In the matter of

CERTAIN ROTARY WHEEL PRINTING SYSTEMS

Investigation No. 337-TA--185

USITC PUBLICATION 1857

MAY 1986

United States International Trade Commission / Washington, DC 20436

UNITED STATES INTERNATIONAL TRADE COMMISSION

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UNITED STATES INTERNATIONAL TRADE COMMI;i[1] TIUSITC
Washington, D.C. 20436

In the Matter of CERTAIN ROTARY WHEEL PRINTING SYSTEMS	Investigation No. 337—TA-185

NOTICE OF TERMINATION OF INVESTIGATION BASED
ON A FINDING OF NO VIOLATION OF SECTION 337,
OF THE TARIFF ACT OF 1930

AGENCY: U.S. International Trade Commission.

ACTION: Termination of investigation upon a finding of no violation of section 337 of the Tariff Act of 1930.

SUMMARY: Notice is given that the U.S. International Trade Commission has determined that there is no violation of section 337 of the Tariff Act of 1930 (19 U.S.C. 1337) in the above—captioned investigation and has terminated the investigation.

FOR FURTHER INFORMATION CONTACT: Charles H. Nails, Esq., Office of the General Counsel, U.S. International Trade Commission, telephone (202) 523-1626.

SUPPLEMENTARY INFORMATION: On February 27, 1984, the Commission instituted the investigation in response to a complaint filed on behalf of Qume Corporation, San Jose, California. The Commission published a notice in the Federal Register of April 18, 1984 (49 F.R. 8502), which instituted an investigation to determine whether there is a violation of section 337 in the unauthorized importation or sale of certain rotary wheel printing systems, by reason of the alleged (1) coverage of such devices by claims¯1 or 8 of U.S. letters Patent 4,118,129, the effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States. On July 19, 1985, the Commission determined that there was no violation of section 337 in the investigation in the importation or sale of the rotary wheel printing systems in question.

Copies of the Commission's Action and Order, the opinions issued in connection therewith, and all other nonconfidential documents filed in connection with this investigation are available for inspection during official business hours (8:45 a.m. to 5:15 p.m.) in the Office of the Secretary, U.S. International Trade Commission, 701 E Street, N.W., Washington, D.C. 20436, telephone 202-523-0161.

By order of the Commission.

eth R. Mason
Sec etary

Issued: August 12, 1985

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CERTIFICATE OF SERVICE

I, Kenneth R. Mason, hereby certify that the attached Commission Decision was served upon the following parties via first class mail and/or air mail where necessary on August 1$, 1985.

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UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C. 20436

In the Matter of

CERTAIN ROTARY WHEEL PRINTING SYSTEMS)

Investigation No. 337—TA-185

COMMISSION ACTION AND ORDER

Introduction

The United States International Trade Commission has concluded its investigation under section 337 of the Tariff Act of 1930 (19 U.S.C. g 1337) of alleged unfair methods of competition and unfair acts in the importation of certain rotary wheel printing systems into the United States, or in their sale, the alleged effect or tendency of which is to destroy or substantially injure an industry, efficiently and economically operated, in the United States.

The complainant is Qume Corporation of San Jose, California, The respondents named in the Commission's notice of investigation were as follows: Nakajima All Co., Ltd. of Tokyo, Japan; Teletex Communication Corp. of Foster City, California; Olympia Werke Aktiengesellschaft of Wilhelmshaven, Federal Republic of Germany; Olympia USA, of Summerville, New Jersey; Matsushita Electric Industrial Co., Ltd. of Kadoma City, Japan; Matsushita Electric Corp. of America of Secaucus, New Jersey; Sharp Corporation of Osaka, Japan; Sharp Electronics Corporation of Paramus, New Jersey; Tokyo Juki Industrial Co., Ltd. of Tokyo, Japan; Juki Industries of America, Inc. of Saddle Brook, New Jersey; Triumph—Adler Aktiengesellschaft of Nuremberg, Federal Republic of Germany; and Adler—Royal Business Machines, Inc. of Union, New Jersey. On July 13, 1984, the following respondents were joined to the investigation: Towa Sankiden Corp. of Tokyo, Japan; Primages, Inc. of Bohemia, New York; and Primages, Inc. of Hsiu Chu, Taiwan.

This Action and Order provides for the final disposition of investigation No. 337—TA-185 by the Commission. It is based upon the Commission's determination made in public session at the Commission meeting of July 19, 1985, that there is no violation of section 337.

Action

Upon review of certain portions of the administrative law judge's (ALJ) initial determination, the Commission has considered: (1) the submissions filed by the parties; (2) the transcript of the evidentiary hearing before the ALJ and the exhibits accepted into evidence; (3) the ALJ's initial determination; and (4) the arguments and presentations made at the Commission's public hearing on May 28, 1985. The Commission, on July 19, 1985, determined that with respect to all respondents in investigation No. 337—TA-185, there is no violation of section 337 of the Tariff Act of 1936 in the importation into and sale in the United States of certain rotary wheel printing systems (Vice Chairman Liebeler dissenting).

Order

Accordingly, it is hereby ORDERED THAT—

1. The portions of Respondent's Motion to Strike (Motion No. 185-91C) (as supplemented) upon which the Commission reserved determination at the public hearing on May 28, 1985, are granted;

2. The Joint Motion to Terminate the Investigation as to Respondent Towa on the Basis of a Settlement Agreement (Motion No. 185-87C) is granted;

Investigation No. 337—TA-185 is terminated as to all issues and all respondents;

4. The Secretary shall serve this Action and Order and the opinions issued in connection therewith upon each party of record in this investigation and upon the U.S. Department of Health and Human Services, the U.S. Department of Justice, the Federal Trade Commission, and the U.S. Customs Service; and

5. The Secretary shall publish notice of this Action and Order in the Federal Register.

By order of the Commission.

Kenneth R Mason

enn= h R. Mason
Secre ary

Issued: August 12, 1985

VIEWS OF CHAIRWOMAN STERN, COMMISSIONER ECKES,
COMMISSIONER LODWICK, AND COMMISSIONER ROHR 1/

On February 15, 1985, the administrative law judge (ALJ) determined that there is a violation of section 337 of the Tariff Act of 1930 2/ in the importation and sale of certain rotary wheel printing systems. Specifically, the ALJ found there are unfair acts in that the accused devices manufactured, imported, and sold by respondents infringe U.S. Letters Patent 4,118,129 (the '129 patent), which he held to be valid and enforceable. He further found that the effect or tendency of respondents' unfair acts is to destroy or to substantially injure an efficiently and economically operated domestic industry. The following opinion reflects the Commission's determination reversing this initial determination (ID). 3/

On April 10, 1985, the Commission determined to review certain issues presented by the ID and, on May 28, 1985, held a public hearing. 4/ Based upon the hearing, the written submissions of the parties, and the entire record in this investigation, the Commission determined on July 19, 1985 that there is no violation of section 337 in the importation and sale of the accused devices in the United States. 5/

1/ The following abbreviations are used in this opinion: ALJ--Administrative Law Judge; ID--ALJ's Initial Determination; FF--Finding of Fact; TR--transcript of evidentiary hearing before ALJ; CTR--transcript of Commission hearing on ALJ's initial determination on violation and also on remedy, public interest, and bonding; RXT--respondents' technical exhibit.

2/ 19 U.S.C. S 1337.

3/ The Commission reviewed the ID pursuant to Rule 210.54(a), 19 C.F.B. S 210.54(a).

4/ See 50 Fed. Reg. 15236 (1985).

5/ Vice Chairman Liebeler determined that there is a violation of section 337.

PROCEDURAL HISTORY

On February 27, 1984, the Commission instituted Investigation No: 337-TA-185 in response to a complaint filed by Qume Corp. of San Jose, California (Qume), to determine whether there is a violation of section 337 in the importation and sale of certain rotary wheel printing systems in the United States. 6/ Qume's complaint alleged that such importation and sale constitute unfair acts by reason of infringement of claims 1 and 8 of the '129 patent. 7/ The complaint further al3ned that the effect or tendency of these unfair acts is to destroy or substantially injure an efficiently and economically operated industry in the United States. Complainant Qume requested that the Commission conduct a full investigation and, thereafter, issue a permanent exclusion order and permanent cease and desist orders.

The Commission's notice of investigation named the following respondents: Nakajima All Co., Ltd. of Tokyo, Japan; Teletex Communication Corp. of Foster City, California; Olympia Werke A.G. of Wilhelmshaven, Federal Republic of Germany; Olympia U.S.A., Inc. of Summerville, New Jersey; Matsushita Electric Industrial Co., Ltd. of Kadoma City, Japan; Matsushita Electric Corp. of America of Secaucus, New Jersey; Sharp Corporation of Osaka, Japan; Sharp Electronics Corp. of Paramus, New Jersey; Tokyo Juki Industrial Co., Ltd. of' Tokyo, Japan; Juki Industries of America, Inc. of Saddle Brook, New Jersey; Triumph-Adler A.G. of Nuremberg, Federal Republic of Germany; and Adler-Royal

6/ Notice of Investigation, 49 Fed. Reg. 8502 (1984).

7/ Complainant alleged infringement of claims 1 through 7 by respondents Sharp and SEC, and of claims 8 through 10 by all respondents. However, complainant stipulated that claim 1 is representative of claims 1 through 7 and that claim.8 is representative of claims 8 through 10. ID at 23-24 (FF 31).

Business Machines, Inc. of Union, New Jersey. On March 5, 1984, Judge Mathias was designated to preside over the investigation. 8/

Between March 28 and April 6, 1984, eleven of the twelve respondents filed responses to the complaint and notice of investigation. 9/ The ALJ held a preliminary conference to discuss discovery matters on April 16, 1984, at which complainant Qume, the IA, and all respondents except Teletex entered appearances.

On June 8, 1984, the ALJ issued an ID granting Qume's motion to amend the complaint and notice of investigation to include three additional respondents. 10/ The Commission decided not to review the ID in a notice issued July 13, 1984, and the following respondents were thereby joined to the investigation: Towa Sankiden Corp. of Tokyo, Japan; Primages, Inc. of Hsin Chu, Taiwan; and Primages, Inc. of Bohemia, New York. 11/ On August 21, 1984, the ALJ denied Qume's motion to amend the complaint to add two more respondents. 12/

Upon the motion of the Primages respondents, the ALJ issued an ID designating the investigation "more complicated" and extending the statutory deadline for completion of the investigation by 61 days. 13/ The Commission issued a notice of its decision not to review that ID on September 5, 1984. 14/

8/ 49 Fed. Reg. 9629 (1984).

9/ ID at 3. Respondent Teletex Communication Corp. (Teletex) neither entered an appearance, nor filed a response to the complaint and notice of investigation.

10/ Order No. 13 (1984).

11/ Decision Not to Review Initial Determination Joining Respondents, 49 Fed. Reg. 29167 (1984). Towa Sankiden Corp. filed a response to the amended complaint and notice of investigation on August 13, 1984, and Primages, Inc. responded on August 14, 1984.

12/ Order No. 28 (1984).

13/ Order No. 29 (1984).

14/ Determination Not to Review Initial Determination Designating Investigation More Complicated and Extending the Deadline for Completion of Investigation by Sixty-One Days, 49 Fed. Reg. 35873 (1984).

On August 23, 1984, the ALJ granted the joint motion by Qume and respondents Olympia Werke A.G. and Olympia U.S.A., Inc. to terminate the investigation as to the Olympia respondents based upon a settlement agreement. 15/ The Commission issued a notice of its decision not to review the ID terminating the Olympia respondents on September 20, 1984. 16/ In an ID dated September 14, 1984, the ALJ granted a joint motion to terminate the investigation as to respondents Matsushita Electric Industrial Co., Ltd. and Matsushita Electric Corp. of America on the basis of a settlement agreement. 17/ The Commission issued a notice on October 18, 1984, advising of its decision not to review the ID terminating the Matsushita respondents. 18/ Both Tokyo Juki Industrial Co., Ltd.- and Juki Industries of America entered into a settlement agreement with Qume that was the basis for the ALJ's ID to terminate the Juki respondents on November 29, 1984. 19/ Again, the Commission decided not to review the ID and issued a notice to that effect on December 31, 1984. 20/

The Primages respondents entered into settlement and consent order agreements with Qume and were terminated as respondents in an ID dated December 11, 1984. 21/ On January 14, 1985, the Commission issued its decision not to review the ID terminating the two Primages respondents. 22/

The ALJ held a prehearing conference on October 29, 1984, and the evidentiary hearing followed immediately thereafter. During the hearing, Qume filed a third motion to amend the complaint and notice of investigation to

15/ Order No. 30 (1984).
if/ 49 Fed. Reg. 37861 (1984).
17/ Order No. 37 (1984).
pi/ 49 Fed. Reg. 42051 (1984).
21/ Order No. 52 (1984).
20/ 50 Fed. Reg. 1138 (1985).
21/ Order No. 54 (1984).
22/ 50 Fed. Reg. 3039 (1985).

dude an allegation that the effect or tendency of the alleged unfair acts and methods of competition was to prevent the establishment of an efficiently and economically operated industry in the United States. 23/ The participating respondents and the IA opposed the motion, which was subsequently denied by the ALJ in the ID. 24/ The evidentiary hearing concluded and the evidentiary record closed on November 9, 1984.

On February 15, 1985, the ALJ issued an ID that there is a violation of section 337 in the importation and sale of the rotary wheel printing systems under investigation. Specifically, the ALJ determined that the '129 patent is valid and enforceable and that the accused devices manufactured, imported, and sold by respondents infringe claims 1 and 8 of the '129 patent. The ALJ further determined that the effect and tendency of respondents' unfair acts is to destroy or substantially injure an efficiently and economically operated domestic industry. Respondents'petitioned for review of the ID. 25/

Also on February 15, 1985, the Commission received a joint motion to terminate the investigation as to respondent Tows on the basis of a settlement agreement. 26/ The notice period elapsed without comment from the public or other government agencies.

23/ Motion No. 185-77.

24/ See ID at 254-59. Qume's petition for review did not seek review of this portion of the ID, and the Commission chose not to review it sua sponte.

25/ Rule 210.54(a)(1), 19 C.F.R. S 210.54(a)(1), provides the following standards for granting such petitions for review:

> (A) A finding or conclusion of material fact [in the ID] is clearly erroneous;
> (B) A legal conclusion is erroneous, without governing precedent, rule or law, or constitutes an abuse of discretion; or,
> (C) The determination is one affecting Commission policy.

26/ Motion No. 185-87C. This motion was directed to the Commission because the ALJ had issued the ID, and, therefore, the investigation was before the full Commission rather than the ALJ. On July 19, 1985, the Commission granted the motion to terminate Towa as a respondent.

On April 10, 1985, the Commission determined to review the following portions of the ID:

1. Whether U.S. Letters Patent 4,118,129 (the '129 patent) is invalid by virtue of anticipation within the meaning of 35 U.S.C. S 102(g).

2. Whether the '129 patent is invalid as obvious within the meaning of 35 U.S.C. S 103.

3. Whether the '129 patent is invalid for failure to disclose 'best mode' as required by 35 U.S.C. S 112.

4. Whether the '129 patent Ls unenforceable by reason of inequitable conduct before the United States Patent and Trademark Office in connection with the patent, applicant's alleged failure to disclose relevant prior art consisting of the HyType I printer and manual and certain optical encoders manufactured by Litton and Disc.

5. Whether the devices manufactured and imported by respondents infringe claim 8 of the '129 patent. The Commission is especially interested in the effect, if any, of prosecution history estoppel on the question of infringement under the doctrine of equivalents.

6. Whether the importation or sale of respondents' devices has the effect or tendency to destroy or substantially injure an 'industry, . . . in the United States.' 27/

At its hearing on May 28, 1985, the Commission disposed of several pending motions by the parties to strike various submissions. 28/ The Commission reserved determination on portions of one of those motions. 29/ The Commission then heard oral argument on all issues from complainant and respondents and upon the economic issues, remedy, the public interest, and bonding from the IA.

27/ 50 Fed. Rec... 15236 (1985).
28/ Motion Nos. 185-89C, 185-91C, and 185-92C.
29/ Motion No. 185-91C. On July 19, 1985, the Commission granted the remaining portions of the motion.

PARTIES

Complainant Qume is incorporated in California with its principal place of business at 2350 Qume Drive, San Jose, California. Qume, which was purchased by International Telephone and Telegraph Corp. (ITT) in 1978, manufactures printers, floppy disk drives, and cathode ray tube (CRT) terminals. Through its Printer Division, Qume manufactures various rotary wheel printers that practice the '129 patent. 30/ Although some printers are still manufactured at the San Jose, California, facility, most of the Printer Division operations were shifted to Qume Caribe, Inc., another wholly-owned subsidiary of ITT, in Las Piedras and Humacao, Puerto Rico, in 1984. 31/ Qume also produces a rotary wheel printer, the Virgo, which practices the claims of the '129 patent, through Qume Taiwan, Inc. 32/ Qume Taiwan, which was incorporated in 1982, began production of the Virgo printer in June 1984.

Six of the originally-named respondents remain as parties to this investigation. These respondents are: (1) Nakajima All Co., Ltd. (Nakajima), a Japanese company that sells rotary wheel typewriters and printers produced by Nakajima All Precision Co., Ltd.; (2) Teletex Communication Corp. (Teletex), a California corporation that imports and sells rotary wheel printers purchased from Nakajima; (3) Sharp Corporation (Sharp), a Japanese manufacturer of rotary wheel printing systems that are exported to the United States; (4) Sharp Electronics Corp. (SEC), a New York corporation that imports into and sells in the United States rotary wheel printers manufactured by Sharp in Japan; (5) Triumph-Adler A.G. (Triumph-Adler), a West German

30/ ID at 142, 144 (FF 259, 263).
31/ Id. at 149-51.
32/ Id. at 160 (FF 313).

corporation that manufactures and exports to the United States rotary wheel typewriters; and (6) Royal Business Machines, Inc. (Adler-Royal), a Delaware corporation that imports and sells rotary wheel typewriters manufactured by Triumph-Adler.

THE PRODUCT AND TECHNOLOGY

The products involved in this investigation are rotary wheel (also known as "daisywheel") printers. Rotary wheel printers are serial impact, "fully formed" character printers. 33/ These printers commonly have been employed as components of a word processing sydtem, in which a printer is connected to a computer supporting several word processing work stations. Recently, the introduction of personal and low-cost professional computers has led to the return of "decentralized configuration" word processing systems, in which one printer serves one word processor. 34/

Rotary wheel technology has also been adapted to various types of electronic typewriters. The more sophisticated of these typewriters may contain all the components of a word processing system, including a small central processor; a thin window, liquid crystal or other type of display to show the material to be printed; a keyboard; and a rotary wheel printer. 35/ any of these typewriters may be interfaced with computers to serve as output printers. 36/

Since 1976, complainant Qume has manufactured several models of rotary - wheel printers, that range in output speed from 20 to 75 characters per second

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33/ ID at 18 (FF 20).
34/ Id. at 18-19 (FF 21).
35/ Id. at 19 (FF 22).
36/ Id. Such interfacing usually requires relatively expensive additional components.

(cps). 37/ Complainant also sells a 20 cps rotary wheel printer manufactured in Japan under license by Tohoku Ricoh Co., Ltd.

Respondent Nakajima manufactures and exports to the United States six models of rotary wheel typewriter and one model of rotary wheel printer, all having an output speed of 13.3 cps. Respondent Sharp manufactures and exports to the United States five models of typewriter, which are sold by respondent SEC. These typewriters all have an output rate of 20 cps. Finally, respondent Triumph-Adler manufactures typewriters for sale in the United States by respondent Adler-Royal. These machines range in output speed from 10 to 17 cps.

THE PATENT

The '129 patent, entitled "Rotary Wheel Printing System," issued to Willy J. Grundherr on October 3, 1978, and was assigned to complainant Qume. 38/ The '129 patent generally relates to an electromechanical printing system in which an electronic control positions a rotary print wheel and activates a hammer to strike a positioned character. The print wheel itself is mounted on a translatable carriage, which moves left and right along a single, horizontal print line. As the carriage/wheel assembly moves from character to character along the line, the print wheel rotates so that the character pad bearing the next character to be printed aligns with a print hammer, also mounted on the carriage. When the carriage stops, the print hammer is activated and strikes the character pad against an inking ribbon and the face of the printing medium (i.e., paper) to print the character. The improvement embodied in the '129 patent consists of an optical intensity adjustment feature, which utilizes

37/ ID at 19-20 (FF 23).
38/ See Appendix ("App.") at 1-18.

precise position control signals to control the position of the carriage and print wheel, and a hammer intensity control feature, which includes a memory device (i.e., the logic control unit) for storing character selection and hammer intensity information and a means for sequentially "reading out" this information. 39/

The origins of the '129 patent are found in the work of its inventor, Mr. Grundherr, who was involved in the early stages of electronic design for rotary wheel printers while employed by Diablo Systems, Inc. as a member of its printer development team. 40/ Between April 1971 and December 1971, Mr. Grundherr designed digital and analog circuitry, and an exerciser and a controller for a rotary wheel printer, a prototype of which was exhibited in December 1971 or January 1972. 41/ The prototypes were designed to have two hammer intensities and employed a servomotor to drive the daisywheel/carriage assembly and a magnetic encoder to feed back print wheel position information.

Diablo then redesigned the printer's circuit boards to improve their performance prior to commencing production. This resulted in a printer known as the HyType I and in the issuance to Mr. Grundherr of U.S. Letters Patent 3,858,509 (the '509 patent) entitled "Control Logic for Print Wheel and Hammer of High Speed Printing Apparatus." 42/ The '509 patent and the HyType I printer employ a read-only-memory (ROM) semiconductor chip that stores binary coded identification "words" corresponding to the location of the print wheel

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39/ Claims 1 and 8 of the '129 patent are representative of these two improvements, respectively. ID at 23-24 (FF 31).

40/ Diablo Systems was purchased by Xerox Corporation in 1972.

41/ The exerciser and the controller permitted the printer to be driven from a Data General Corp. computer. ID at 28 (FF 36). The controller was an interface between an external data source, while the exerciser was a device to enable testing of printer functions without resorting to the external data source. See ID at 32 (FF 46).

42/ The '509 patent, which was assigned to Xerox, issued on Jan. 7, 1975.

type elements and the hammer intensity information. 43/ In the '509 patent, the ROM must be addressed simultaneously for the character location and hammer intensity information. 44/

During his employment with Diablo, Mr. Grundherr also participated in the development of the Mark I printer, a special version of the HyType I for use in a Xerox word processing system. This system was the objective of a Xerox development program called ZODIAC, which was the overall responsibility of ISS, a Xerox subsidiary. The ZODIAC system included the Mark I printer, which was used in conjunction with a separate logic control unit (ISS controller) that directed character position selection and contained information on four hammer intensity levels. 45/ Diablo employees were not involved in the development of the logic control unit, which was the responsibility of ISS. The ZODIAC system, including the Mark I printer, (hereinafter referred to as the ZODIAC/Mark I system) became the subject of U.S. Letters Patent 4,138,719 (the '719 patent), which issued on February 6, 1979. 46/

Mr. Grundherr left Diablo/Xerox in May 1973 for Ancilex (later Qume), where he assumed responsibility for developing the electronics for a new printer, as well as for the exerciser and controller for the computer interface to be used with the new printer. Qume personnel, led by Mr. Grundherr, produced a prototype of the new printer by the end of 1973. Patent Application Serial No. 484,055, which covered the new printer, was filed with the U.S. Patent and Trademark Office (PTO) on July 1, 1974. The

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43/ The ROM in the '509 devices and the HyType I printer has a 256 x 8 bit capacity, with 7 lists accommodating the 96 characters on the print wheel and 1 bit containing hammer intensity information.

44/ "Addressing" involves calling upon the ROM to retrieve hardware control information for execution by that particular piece of hardware.

45/ ID at 31 (FF 44).

46/ App. at 21-72.

application named Willy J. Grundherr as inventor and Qume as assignee. After a protracted prosecution of Application No. 484,055, which involved a'number of rejections and subsequent amendments, the PTO patent examiner allowed the '129 patent to issue on October 3, 1978.

PATENT VALIDITY

Under 35 U.S.C. S 282, patents are presumed to be valid. The burden of proving invalidity falls upon respondents. 47/ The ALI rejected respondents' arguments that the '129 patent was invalid (1) as anticipated within the meaning of 35 U.S.C. S 102(g),¯(2) as obvious within the meaning of 35 U.S.C. S 103, and (3) for failure to disclose "best mode" as required by 35 U.S.C. 112.

1. Validity of Claim 8 of the '129 Patent Under 35 U.S.C. S 102(g)

Respondents argue that the '129 patent is invalid by virtue of anticipation within the meaning of 35 U.S.C. S 102(g). 48/ They assert that claim 8 of the '129 patent was anticipated by the ZODIAC/Mark I system, developed by Xerox prior to the invention of the '129 patent, which became the subject of U.S. Letters Patent 4,138,719, issued to one Swanstrom on February -, 1979.

On the other hand, complainant has contended that there is no clear evidence that the ZODIAC/Mark I system was reduced to practice prior to the

47/ See, 1,11., Certain Limited-Charge Cell Culture Microcarriers, Inv. No. 337-TA-129, USITC Pub. 1486 (1984), Views of the Commission at 11.
48/ 35 U.S.C. S 102(g) provides that a person shall be entitled to a patent unless: "before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other."

filing date of the '719 patent on October 15, 1975. 49/ Further, complainant argues that the ZODIAC/Mark I system does not reveal each and every element of the claimed combination in claim 8. Finally, complainant urges that the ZODIAC/Mark I system was concealed and suppressed, and thus, could not have anticipated claim 8 of the '129 patent.

The ALJ determined that the '129 patent was not invalid as anticipated as provided by 35 U.S.C. S 102(g). 50/ The ALJ based this determination on the finding that the date of the application for the '719 patent (October 15, 1975) is later than the priority date for the '129 patent (July 1, 1974) and on the finding that Mr. Grundherr, the inventor of the '129 patent, had no actual knowledge of the logic control portion of the ZODIAC system. 51/

The fact that the priority date for the '129 patent antedates the filing date for the '719 patent covering the ZODIAC/Mark I system is not dispositive of the anticipation issue. The language of section 102(g) requires only that the prior invention be conceived and reduced to practice prior to the invention of the patent in controversy. 52/ Moreover, the ALJ's finding that Grundherr, the inventor of the '129 patent, lacked knowledge of the ZODIAC/Mark I system was an incorrect legal basis for a conclusion of non-anticipation under 35 U.S.C. S 102(g). For purposes of anticipation under

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49/ See Qume's Post-Hearing Brief at 2.
50/ ID at 211.
51/ Id. (The logic control device is also called the ISS controller.) Priority date is the date of invention (i.e., conception and reduction to practice) as evidenced by the filing of a patent application. However, the priority date may be earlier than the date of filing of a U.S. patent application upon proof of conception and reduction to practice upon the filing of an earlier foreign patent application. See 35 U.S.C. S 119.
52/ See also General Motors v. Toyota Motor Co., Ltd., 205 U.S.P.Q. 158, 177 (S.D. Ohio 1979), rev'd on other grounds, 212 U.S.P.Q. 659 (6th Cir. 1981); cert. denied, 215 U.S.P.Q. 95 (1982).

section 102(g), personal knowledge by the patentee of the prior invention is not necessary. 53/

Three facts must be established to find anticipation. First, the prior invention against which the challenged patent is measured must have been conceived and reduced to practice prior to the date of application for the patented invention. 54/ Evidence of in-house testing may be prima facie evidence of conception. 55/ Actual reduction to practice requires that an invention be sufficiently tested to demonstrate that it will work for its intended purpose. 56/ Second, the prior invention must not have_been abandoned, suppressed, or concealed. 57/ Third, each and every aspect of the claimed invention must be shown to be within the four corners of the asserted prior art reference. 58/

53/ Kimberly-Clark Corporation v. Johnson & Johnson, 745 F.2d 1437, 1445, 223 U.S.P.Q. 603, 607 (Fed. Cir. 1984); see also International Glass Co., Inc. v. United States, 159 U.S.P.Q. 434 (Commissioner's Opinion, 1968), aff'd 408 F.2d 395, 161 U.S.P.Q. 116 (Ct. Cl. 1969).

54/ Kimberly Clark, 745 F.2d at 1445.

55/ Id.

56/ Id. Reduction to practice requires "sufficient success" of the invention in the purpose for which it is intended. Kimberly-Clark, 745 F.2d at 1445 (unsuccessful experiments with adhesive not reduction to practice); Bermes Barme-Maschinenfabrick AG v. Murata Mach., Ltd., 731 F.2d 831, 838-39 (Fed. Cir. 1984) (successful test run of yarnmaking machine constituted reduction to practice, even though improvements were necessary to reach stage of commercial marketability); Shurie v. Richmond, 699 F.2d 1156, 1159-60 (Fed. Cir. 1983) (production of crushed metal oxide reduction to practice, despite fact that oxide was of poor quality and not commercially marketable).

57/ International Glass Co., Inc. v. United States, 159 U.S.P.Q. 434, 440 (Ct. Cl. 1968).

58/ Leinoff v. Lewis Milona & Sons, Inc., 726 F.2d 734, 738 (Fed. Cir. 1984). The date of the application is the constructive reduction to practice of an invention. Of course, a patentee can establish that his invention was conceived and reduced to practice by "swearing back" to the date of actual conception and reduction to practice. See 37 C.F.R. S 1.131. However, in this case there is no evidence of reduction to practice of the '129 patent prior to the date of application.

In this investigation, this legal analysis requires a determination of: (1) whether the ZODIAC/Mark I system was conceived and reduced to practice prior to the invention claimed for the '129 patent; (2) whether the device was concealed, abandoned, or suppressed; and (3) whether every aspect of claim 8 of the '129 patent was disclosed by the ZODIAC/Mark I system. 59/ Based on this analysis we conclude that claim 8 of the '129 patent was anticipated.

First, evidence shows that the ZODIAC/Mark I system was conceived and reduced to practice prior to the invention claimed in the '129 patent. While the date of the patent application is the latest date on which an invention can be deemed to have been reduced to practice, in this case, there is evidence that actual reduction to practice took place at an earlier date. Prototypes of the ZODIAC/Mark I system were built and were operating in purchaer establishments before May 1973. 60/ The record further reflects that the commercial production of the ZODIAC/Mark I system began in January or February 1973. 61/ The record establishes that this included both the printer unit and the controller. Thus, the ZODIAC/Mark I system was conceived and reduced to practice prior to the filing of the application for the '129 patent on July 1, 1974.

The second prong of the test for anticipation under section 102(g) asks. whether the prior invention was concealed, suppressed, or abandoned. 62/ Complainant argues that the ZODIAC/Mark I system invention was concealed and suppressed because it was hidden in a "secretive" development laboratory and because application for the '719 patent was not made until sometime between 2

59/ See id.
60/ TR at 1897-98, 2018, 2040, 2062; RXT 98C, 102-03C, 108C.
61/ TR at 1878; 1883-85, 1897-98, 1905, 2918, 2040, 2062.
62/ See International Glass, 159 U.S.P.Q. at 440.

and 3 years after the reduction of the invention to practice. 63/ Although the ID did not make specific findings on concealment and suppression vis-a-vis the issue of anticipation, the record, as discussed below, contains evidence showing that the ZODIAC/Mark I system was neither concealed nor suppressed.

Actual sales as well as initial production of the ZODIAC/Mark I system took place in early 1973. 64/ Further, a foreign patent was sought in Great Britain for the ZODIAC/Mark I system at the earliest possible time to avoid delays in the United States PTO. 65/ Moreover, the delay in filing the U.S. patent application for the ZODIAC/Mark I system appears to have resulted from the sheer length of the application, rather than from intentional concealment or dilatory patent prosecution. 66/ Consequently, the evidence shows that the prior invention was not suppressed or concealed. Complainant has failed to meet its affirmative burden to prove suppression or concealment. 67/

As to the third prong of the test for anticipation, viz., whether the ;rior invention discloses each and every aspect of the claimed invention, the ID speaks only to the fact that the memory portion (the logic control unit) of the ZODIAC/Mark I system was located apart from the printer. 68/ (The ALJ did not find that this prevented the prior invention from including all aspects of claim 8 of the '129 patent.) This is the only "difference" between the ZODIAC/Mark I system and the system disclosed in the improvement embodied in claim 8 of the '129 patent.

We agree with the ALI that control functions in the ZODIAC/Mark I system were carried out by a "controller" unit separate from the printer unit. We

63/ Qume's Post-Hearing Brief at 2-3; CTR at 45-46.
64/ TR at 1897-98, 2062; RXT 98C, 102-03C, 108C.
65/ TR at 2038-39.
66/ Id. at 2036-37.
67/ See Gallagher v. Smith, 99 U.S.P.Q. 132, 138 (C.C.P.A. 1953).
68/ ID at 89-91 (FF 150-52).

also note that existing devices embodying the teachings of the '129 patent have this feature located within the printer unit itself. 69/ Howevei ', nothing in claim 8 of the '129 patent requires that the logic control unit embodied in the claim be located within the printer. Given this fact, a side-by-side comparison of the ZODIAC/Hark I system with claim 8 of the '129 patent reveals that the ZODIAC/Hark I system includes each and every aspect of claim 8. 70/ Accordingly, we find claim 8 of the '129 patent invalid by reason of anticipation under 35 U.S.C. 5 102(g).

2. Validity of the '129 Patent Under 35 U.S.C. S 103. 71/

Respondents argue that claims 1 and 8 of the '129 patent are invalid because they are obvious extensions of existing printer technology. 72/ As a preliminary matter, respondents contend that the ALJ improperly narrowed the scope of the relevant prior art to the subject matter of the patent or the intended use of that subject matter, and that he consequently failed to accord proper weight to evidence of pertinent prior art. Further, respondents contend that the ALJ did not properly define the person of "ordinary skill in the art." Respondents argue that when the relevant field of art is defined to include the broad field of logic design and optical sensor art, the inventions

69/ See id. at 88-92 (FF 149-52).
70/ See comparison chart, App. at 19-20.
71/ Commissioner Lodwick does not join the majority as to this issue and concurs with Vice Chairman Liebeler's dissent.
72/ 35 U.S.C. S 103 provides:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

of the '129 patent would have been obvious to a person of ordinary skill in those broader arts.

Specifically, with regard to claim 1, the Sharp respondents contend that the ALJ erred by failing to consider the prior art references (i.e., the Dubauskas, Molter, and Kocher patents) in combination. 73/ According to Sharp, the references taken as a whole reveal each and every element of claim 1 of the '129 patent. 74/ Moreover, the Sharp respondents contend that the combinations are obvious to the properly-defined person of ordinary skill in the relevant art. Thus, Sharp argues, claim 1 is invalid as obvious under section 103.

With respect to claim 8, all respondents contend that when the relevant art and the level of skill are more broadly defined to include the design of control logic, the improvement embodied in claim 8 would have been obvious. 75/ Respondents argue that the HyType I printer (which became the subject of the '509 patent) employed a ROM for the same purpose as the '129 patent, differing only in the manner in which the ROM was addressed to obtain character location and hammer intensity information. 76/ The HyType I printer, as evidenced by its maintenance manual and various publications in the field of logic design, demonstrated that the sequential addressing and ' reading out of ROM "words" described in claim 8 would have been obvious to one of ordinary skill in the field of logic design. Respondents maintain that all of the foregoing prior art, when taken together with two patents in the area

73/ Brief of Sharp on Review at 41, 43-47; CTR at 82-83.
74/ Brief of Sharp on Review at 49-51.
75/ See Brief of Triumph-Adler on Review at 29; Brief of Sharp on Review at 52.
76/ See Brief of Sharp on Review at 59-61.

of rotary wheel printing system design (the Beery patents), render each and every element of claim 8 invalid as obvious under section 103.

Complainant maintains that the ALJ properly defined the relevant field of art in light of the problems confronted by Mr. Grundherr in inventing the subject matter of the '129 patent (i.e., design and implementation of control logic for printing systems). 77/ In addition, complainant urges that the ALJ correctly determined the proper level of ordinary skill in the art in light of the relevant art and the expert testimony adduced at the hearing. 78/ Complainant then argues that the ALJ properly evaluated the evidence on the question of obviousness under section 103.

As to claim 1, complainant argues that none of the prior art references cited by respondents disclose an optical encoder with a feedback loop or a feedback compensation system as claimed in the '129 patent. 79/ Complainant contends that the problems faced by the inventor in designing the optical encoder device specified in claim 1 were not recognized by or anticipated in the prior art cited by respondents. 80/ Thus, the subject matter of claim 1 would not have been obvious to a person of ordinary skill in the art.

Concerning claim 8, complainant contends that the invention represented therein, taken as a whole, was not rendered obvious by the prior art cited by respondents. 81/ Complainant points out that the problems solved by claim 8 are mechanical, electromechanical, and electronic, "all combined." 82/ Contrary to respondents' assertions, complainant believes that the general field of "logic design" cannot address the interrelated electromechanical and

77/ Reply Brief of Qume on Patent Issues at 39-57; CTR at 46-48.
78/ Id.
79/ Reply Brief of Qume on Patent Issues at 39.
80/ Id. at 40.
81/ Id. at 46.
82/ Id. at 58; CTR at 46-47.

mechanical problems with which claim 8 is concerned. 83/ Therefore, complainant asserts that the prior art references cited by respondents, which fall only in the broad category of "logic design," are irrelevant to the issue of obviousness under section 103.

The ALJ rejected respondents' arguments that claims 1 and 8 of the '129 patent are invalid as obvious under 35 U.S.C. S 103. Claims 1 and 8 of the '129 patent relate to the optical sensor art and the logic design art, respectively. Claim 1 recites an improvement over the prior art through a particular arrangement of a light source, feedback means, optical sensors, and other components associated with an encoder disc. Claim 8 recites an improvement in a particular control logic means for sequentially accessing certain information to control the movement of the print wheel and the hammer intensity.

In considering the obviousness or nonobviousness of claims 1 and 8, the ALJ first sought to establish the scope and content of the prior art. He limited the relevant prior art for both claims to the "design and implementation of control logic for certain types of printing systems, particularly rotary wheel printing systems." 84/ The ALJ then defined the person of ordinary skill in the relevant art as an "electronics engineer with six to nine months hands-on experience in the design and implementation of control logic for printing systems, either the golf-ball type printing system, or a rotary wheel printing system, or a technician with at least five years

83/ See Reply Brief of Qume on Patent Issues at 58; CTR at 46-47.

84/ ID at 214; see also FF's 89-102. The ALJ's definition of the relevant prior art does not take into account the optical sensor art considered to be relevant by the patent examiner. ID at 36 (FF 54).

experience in the design and implementation of control logic for such a system." 85/

The ALJ found claim 1 nonobvious based upon what he determined were the relevant prior art patents and upon the testimony adduced at the hearing. Specifically, the ALJ found that patents which disclose feedback control of light intensity in optical encoders (the Dubauskas and Holter patents) and an optical incremental rotary position encoder (the Kocher patent) do not render claim 1 obvious. 86/ The ALJ also found the testimony of complainant's witness, whom he defined as a person of at least ordinary skill in the art, to be more persuasive than respondents' witness on the question of obviousness. 87/

With regard to claim 8, the ALJ found that, during the relevant time period (1972-74), the use of the ROM in the '129 patent would not have been obvious to a person of ordinary skill in the art. 88/ In addition, the ALJ found that neither the HyType I printer, nor the '509 patent covering that printer, renders claim 8 obvious.

In Graham v. John Deere Co., 383 U.S. 1 (1966), the Supreme Court set forth the analytical framework for determining obviousness or nonobviousness under 35 U.S.C. S 103, stating that:

> [T]he scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized

85/ Id. at 57 (FF 102), 214.
86/ Id. at 215 (FF 109-12, 116-18).
87/ Id. at 215 (FF 117).
88/ Id. at 214-15.

> to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries may have relevancy. 89/

The Court of Appeals for the Federal Circuit (CAFC) has held that the section 103 determination is a legal conclusion based on factual evidence, 90/ and the factual considerations on which that conclusion is based are those broadly defined in Graham. 91/

The CAFC has defined relevant prior art to be that "reasonably pertinent to the particular problem with which the inventor was involved." 92/ More precisely, relevant prior art is defined in terms of the problem confronting the inventor. 93/ The test is similarity between the elements, problems, and purposes of that problem and the asserted prior art reference. 94/

In inquiries into the level of ordinary skill in an art, the CAFC has observed that:

> The important consideration lies in the need to adhere to the statute, i.e., to hold that an invention would or would not have been obvious, as a whole, when it was made, to a person of 'ordinary skill in the art' - -not to the judge, or to a layman, or to those skilled in remote arts, or to geniuses in the art at hand. 95/

89/ 383 U.S. at 17-18.
90/ See Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1535, 218 U.S.P.Q. 871, 876 (Fed. Cir. 1983); Stevenson v. Int'l Trade Comm'n, 612 F.2d 546, 549, 204 U.S.P.Q. 276, 279 (C.C.P.A. 1979).
91/ See Environmental Designs, Ltd. v. Union Oil Co. of Cal., 713 F.2d 693, 695, 218 U.S.P.Q. 865, 867 (Fed. Cir. 1983); Orthopedic Equipment Co. v. All - Orthopedic Appliances, 707 F.2d 1376, 1379, 217 U.S.P.Q. 1281, 1283 (Fed. Cir. 1983).
92/ Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 1535, 218 U.S.P.Q. 871, 876 (Fed Cir. 1983).
93/ Orthopedic Equipment Co., Inc. v. United States, 702 F.2d 1005, 1009 (Fed. Cir. 1983), cilia Weather Engineering Corp. of America v. United States, 614 F.2d. 281, 287 (Ct. Cl. 1980).
94/ Weather Engineering Corp. of America, 614 F.2d at 287.
95/ Environmental Designs, Ltd. v. Union Oil Co. of Cal., 713 F.2d 693, 697, 216 U.S.P.Q. 865, 868-69 (Fed. Cir. 1983).

The CAFC has listed six factors which are relevant to a determination of the level of ordinary skill in the art: "(1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) the prior art solutions to those problems; (4) the rapidity with which innovations are made; (5) the sophistication of the technology; and, (6) the educational level of active workers in the field." 96/ The person of ordinary skill, a hypothetical construct, is charged with knowledge of all that the prior art disclosed at the time of the invention. 97/

a. Pertinent prior art and person of ordinary skill

Claims 1 and 8 of the '129 patent relate to optical sensor art and logic design art, respectively. Claim 1 recites an improvement over the prior art through a particular arrangement of a light source, feedback means, optical sensors, and other components associated with an optical encoder disc. 98/ Claim 8 recites an improvement in a particular control logic means for sequentially accessing certain information to control the movement of a print wheel and hammer intensity. As noted above, the ALJ defined the relevant

96/ Id. at 696, 218 U.S.P.Q. at 868. See also Orthopedic Equipment, Co. v. United States, 702 F.2d 1005, 1011, 217 U.S.P.Q. 193, 198 (Fed. Cir. 1983).

97/ See, e.g., In re Grout, 153 U.S.P.Q. 742, 744 (C.C.P.A. 1967). We further note that one of the CAFC's predecessor courts, the U.S. Court of Claims, observed: "The days when inventions relating to locks are only made by locksmiths are past us. In today's world, technological breakthroughs which result from the cross-fertilization of minds trained in different disciplines is common." Weather Engineering Corp. of America, 614 F.2d at 286-87. The court went on to state that human knowledge cannot be compartmentalized; rather, prior art must be defined in terms of the nature of the problem facing the inventor. Id. at 287.

98/ An optical encoder disc is a disc formulated from preferably opaque material which is perforated with a number of openings called timing track slots. A beam of light is passed through these slots, altered, and picked up by photoreceptors. The beam of light is then converted into wheel position signals, which are transmitted to a memory device.

field of art for both claims to be "the design and implementation of control logic for printing systems, especially rotary wheel printing systems." 99/

As a preliminary matter, we do not believe that the ALJ improperly narrowed the scope of the relevant prior art as to claim 8 by excluding the - broad field of logic design. 100/ However, we find that the ALJ improperly defined the scope of the relevant prior art as to claim 1. Relevant prior art is that which is "reasonably pertinent" to the problem facing the inventor, and the test is similarity between the elements and purposes of that problem and the asserted prior art reference. 101/ The ALJ•s definition of the relevant art does not meet that standard in that it ignores one of the key problems faced by the inventor with respect to claim 1, i.e., optical sensing and encoding, and is therefore erroneous as a matter of law. 102/ Therefore, we find claim 1 prior art should have been extended to include optical sensor and encoder art.

Consequently, the ALJ also improperly defined a person of ordinary skill in the art for purpose of the section 103 obviousness determinations as to claim 1. We have noted that the ALJ defined the person of ordinary skill in the relevant art as an "electronics engineer with six to nine months hands-on experience in the design and implementation of control logic for printing systems, either the golf-ball type printing system, or a rotary wheel printing

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99/ ID at 50 (FF 87).

100/ In the work upon which claim 8 of the '129 patent is based, Mr. Grundherr was faced with problems unique to printing systems applications. He had to consider logic design for identification of print wheel location and retrieval of hammer intensity signals, which encompassed a variety of electronic and electromechanical problems endemic to printer design. A consideration of the logic design art alone would not address such problems, as the record amply demonstrates. See ID 50-56 (FF 87-101).

101/ See Stratoflex, 713 F.2d at 1535; Weather Engineering Corp. of America, 614 F.2d at 287.

102/ The patent examiner considered a number of references concerning the optical encoder and sensor art. ID at 36 (FF 54); 221; 226-27.

system, or a technician with at least five years experience in the design and implementation of control logic for such a system." 103/

Were the invention claimed under the '129 patent solely concerned with printer control logic, the ALJ•s definition of a person of ordinary skill in the art would be satisfactory under the six element test set forth in Environmental Designs, Ltd. v. Union Oil Co. of California. 104/ However, as the invention embodied in claim 1 involved solving problems of optical encoder design, the person of ordinary skill must be defined to include knowledge of/and experience in this field of art.

b. Validity of Claim 8

Having established the relevant field of art and a person of ordinary skill in the art, we now must determine the obviousness or nonobviousness of the subject matter of the '129 patent. 105/ As to claim 8, our "redefinition" of the relevant art and the person of ordinary skill in that art does not cause us to alter the ALJ•s validity analysis under section 103. The ALJ considered evidence and testimony relevant to control logic design for printing systems, and we defer to his evaluation of that evidence. Accordingly, we adopt the ALJ•s conclusions upholding the validity of claim 8 under 35 U.S.C. 103. 106/

c. Validity of Claim 1

Claim 1 of the '129 patent presents a different analytical problem under section 103. In analyzing the validity of claim 1, the ALJ committed, in our view, three errors and reversal of his conclusion of nonobviousness is

103/ ID at 57 (FF 102); ID at 214.
104/ See note 95 and accompanying text.
105/ See Graham v. Deere, 383 U.S. at 17-18.
106/ ID at 212-15.

required. First, his failure properly to define the relevant prior art and the person of ordinary skill in the art taints his validity determinations. Second, the ALJ did not consider the prior art references (particularly the Molter, Kocher, and Dubauskas patents) in combination. The CAFC has stated that "(c]laims may be obvious in view of a combination of references, even if the features of one reference cannot be substituted physically into the structure of the other reference." 107/ The ALJ only compared the cited prior art references individually with claim 1 of the '129 patent in making his validity determination. 108/ Third, the ALJ ignored probative evidence on the issue of the obviousness of claim 1. Before the ALJ, respondents introduced confidential documentary evidence calling into question the validity of claim 1. 109/ The ALJ should have addressed this evidence in the ID.

In applying the correct legal standards to the validity analysis, the relevant prior art includes optical sensor art. This art includes a number of sensor and encoder patents, particularly the Bolter, Kocher, and Dubauskas patents which were thoroughly analyzed on an individual basis by the ALJ. 110/ While these references taken individually do not show every element of claim 1, taken together the three patents reveal every aspect of claim 1. 111/

The crucial inquiry is then, whether a person of ordinary skill in the art could have arrived at the combination. 112/ The inventor of the '129 patent, Mr. Grundherr, testified that his sole contribution to the optical

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107/ See Orthopedic Equipment, 212 U.S.P.Q. at 533 (emphasis supplied).
108/ ID at 69-70 (FF 117).
109/ RXT 175C.
110/ ID at 63-67 (FF 109-12).
111/ See App. at 73-75.
112/ Orthopedic Equipment, 212 U.S.P.Q. at 528.

encoder in claim 1 was the addition of a feedback loop. 113/ Moreover, Mr. Grundherr merely combined standard components with a standard feedback loop and optical encoder to arrive at his invention. 114/ While combining standard elements in a unique fashion may be patentable, 115/ we are of the opinion that the prior art references, the testimony of Mr. Grundherr as to the standard nature of the invention's elements, and the documentary evidence submitted by respondents show that the claimed combination would have been obvious to the person of ordinary skill in the optical encoder art. Therefore, we conclude that claim 1 of the '129 patent is invalid as obvious under 35 U.S.C. S 103. 116/

3. Validity of the '129 Patent Under 35 U.S.C. S 112

The ALJ's findings and conclusions also address the question of whether Claim 1 of the '129 patent was invalid for failure to disclose the "best mode" contemplated by the inventor for carrying out his invention as required by 35 U.S.C. S 112. Respondents contend that the failure of claim land the specification of the '129 patent to disclose a mask between the encoder disk and the photosensors should result in a finding of invalidity. On the other hand, complainant argues that the use of the mask was non-critical to the '129

113/ TR at 791; ID at 70-71 (FF 118).
114/ TR at 791-92; ID at 70-71 (FF 118).
115/ Environmental Designs, 218 U.S.P.Q. at 870.
116/ The ALJ also found that "secondary considerations" were further indicia of nonobviousness, based upon the commercial success of printers covered by the '129 patent. ID at 96 (FF 159-60). However, there appears to be insufficient evidence on the record to draw the requisite nexus between that commercial success and the improvements claimed in the invention. See Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530 (Fed. Cir., 1983). Moreover, there is a similar lack of evidence concerning other recognized secondary considerations such as unexpected results and long felt need in the industry to compel a finding of nonobviousness. See, e.g., W. L. Gore Associates, Inc. v. Garlock, Inc. 721 F.2d 1540 (Fed. Cir. 1983).

patent and was well understood by persons skilled in the art. Therefore, complainant maintains that there was no duty to disclose the mask. The ALJ determined that there was no failure to disclose "best mode" on the grounds that (1) the device will work without the mask, (2) the mask does not relate to the claimed invention, and (3) the inventor did not act in bad faith by attempting to conceal what he felt was the best mode of implementing the invention. 117/

Under 35 U.S.C. S 112, the patent specification "shall set forth the best mode contemplated by the inventor of carrying out his invention." There is no objective standard by which to measure the adequacy of a best mode disclosure. 118/ Instead, only evidence of concealment, either accidental or intentional, is to be considered. 119/ There is, however, no duty to disclose that which may be readily understood and applied by those skilled in the relevant art. 120/

In light of the foregoing standards, we reach the same result as the ALJ, albeit for different reasons. The intent or "bad faith" requirement imposed by the ALJ is improper because the courts have ruled that accidental concealment of the best mode contemplated by an inventor would be sufficient to invalidate a patent under 35 U.S.C. S 112. 121/ The question in this instance is whether Mr. Grundherr did, in fact, conceal the best mode of implementing his invention, i.e., including a mask between the encoder disc - and the photosensors.

117/ ID at 217-18; see also ID at 93 (FF 154).
118/ In re Sherwood, 204 U.S.P.Q. 537, 544 (C.C.P.A. 1980).
119/ Id.
120/ Id.
121/ Id.

The issue is somewhat confused. The inventor testified that he employed the mask "just to improve the performance" of his invention. 122/ However, he was unable to recall how much the mask improved encoder operation or whether the mask was required for proper operation of the optical encoder. 123/ The testimony does reveal only that the optical encoder would work without the mask and that the mask was commercially available. 124/

The record on the best mode issue does not provide clear and convincing evidence mandating invalidation of claim 1 under section 112. The only undisputed evidence is the inventor's testimony that the mask was commercially available in optical encoders. 125/ Both the CAFC and the Commission have held that there is no duty to disclose that which may readily be understood and applied by those skilled in the relevant art. 126/ Accordingly, we determine that claim 1 of the '129 patent is not invalid under 35 U.S.C. S 112, because the use of a mask appears to have been understood and applied by those skilled in the relevant art.

4. Conclusions Concerning Validity of the '129 Patent

To summarize, with respect to the validity of the '129 patent we determine:

1. That claim 8 and its dependent claims are invalid by virtue of anticipation as set forth in 35 U.S.C. S 102(g);

2. That claim 1 and its dependent claims are invalid as obvious within the meaning of 35 U.S.C. S 103;

122/ TR at 789.
123/ Id.
124/ Id. at 789-90.
125/ TR at 790.
126/ In re Sherwood, 204 U.S.P.Q. at 544; Spring Assemblies and Components Thereof, and Methods for Their Manufacture, Inv. No. 337-TA-88, USITC Pub. 1172 (1981) at 26.

3. That claim 8 and its dependent claims are not invalid as obvious within the meaning of 35 U.S.C. S 113; and,

4. That claim 1 is not invalid under 35 U.S.C. S 112.

ENFORCEABILITY OF THE '129 PATENT

The Commission also determined to review the issue of the enforceability of the '129 patent. 127/ The findings of Chairwoman Stern and Commissioner Rohr on this issue are contained in their additional views. Commissioner Eckes takes no position with respect to the issue of enforceability. Commissioner Lodwick concurs in the dissenting views of Vice Chairman Liebeler on this issue.

INFRINGEMENT OF THE PATENT

1. Introduction

Our discussion of the alleged infringement of the '129 patent by respondents' accused devices presupposes the validity and enforceability of the patent. Of course, we have determined that both claims 1 and 8 are invalid under S 102(g) or S 103 respectively and are unenforceable as a result of inequitable conduct by the patentee and his attorney before the PTO. Accordingly, there can be no infringement of the '129 patent by rotary wheel printing systems manufactured or imported by respondents. However, in that the question of infringement has been before the Commission throughout the investigation, we discuss it in this opinion for the sake of completeness.

2. Infringement of Claim 1 of the '129 Patent

The Commission did not review the ALJ's findings with respect to the infringement of claim 1 as they do not appear to be clearly erroneous as

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127/ 50 Fed. Reg. 15236 (1985).

contemplated by Rule 210.54(a)(1)(II)(A). 128/ We concur in the AL.I's determination that the devices manufactured by the only remaining respondent, Sharp, alleged to infringe the patent as to this claim, include each and every element of claim 1 of the '129 patent. However, in view of our determination that claim 1 is invalid and unenforceable, there can be no finding of infringement.

3. <u>Infringement of Claim 8 of the '129 Patent</u>

The ALJ determined that respondents' accused devices contain each and every element of claim 8 of the '129 patent or were the substantial equivalent of such elements. However, he did not discuss separately the questions of literal infringement and infringement under the doctrine of equivalents.

Claim 8 includes the following elements:

> (e) means for impressing said print characters against a print medium;
>
> (f) first position indicating means for generating signals representative of the instantaneous position of said print Wheel;
>
> (g) means adapted to be coupled to an external data source for receiving a multi-bit character representative of a character to be printed;
>
> (h) means responsive to said print wheel position signals and the character stored in said receiving means for actuating said impressing means;
>
> (i) a memory device having--
>
> > (i) a first portion for storing a plurality of multi-bit characters each representative of the location on said print wheel of a different one of said print characters, and,

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128/ 19 C.F.R. S 210.54(a)(1)(II)(A); see also United States v. United States Gypsum Co. 333 U.S. 364, 395 (1948).

(ii) a second portion for storing a plurality of individual hammer intensity characters each representative of the intensity with which the associated print character in said first portion is to be impressed against said print medium, different ones of said hammer intensity characters representing different hammer intensities,

(j) means for sequentially fetching (or reading out) the multi-bit location character and the associated hammer intensity character specified by the character stored in said receiving means, and

(k) means coupled to said memory means for converting the individual fetched hammer intensity characters to corresponding actuation signals for *said* impressing means having a magnitude dependent upon the intensity assigned to the corresponding hammer intensity character. 129/

The major point of contention concerning infringement involved the effect of prosecution history estoppel on claim 8 for the purpose of determining infringement under the doctrine of equivalents. 130/ This issue focused on whether claim 8 is limited to devices having only a single chip memory with two portions from which print wheel location information and hammer intensity information are sequentially read out.

The ALJ rejected respondents' contentions concerning the effect of prosecution history estoppel in limiting the range of equivalents for claim 8. 131/ He found, inter alia,.that Qume amended claim 8 to specify that it defines "the means for actuating the impressing means as including a memory device having a <u>first portion</u> for storing a plurality of individual location characters and a <u>second portion</u> for storing a plurality of individual hammer intensity characters, and a means for <u>sequentially</u> reading out" print wheel

129/ App. at 10.
130/ Under the doctrine of equivalents a device may be held to infringe a patent if it performs substantially the same function in substantially the same way to accomplish the same result. Graver Tank & Mfg. Co. v. Linde Air Products Co., 339 U.S. 605, 608 (1958).
<u>131</u>/ ID at 231-36.

location and hemmer intensity information. 132/ The ALT went on to determine that the arguments submitted by Qume to the PTO neither limited the memory device to a single ROM having two portions, nor mandated that the print wheel be imposition before the hammer intensity information is fetched.

The ALT apparently based his conclusions concerning sequential read out on the fact that claim 8 was allowed by the patent examiner without specific amendments incorporating Qume's arguments concerning the term "sequential." 133/ He further grounded his determination on the finding that the limitations expressed in Qume's remarks to the PTO did not relate to claim 8, despite the fact that the apparent limitations were considered with respect to claims 8 through 14. 134/ The ALT found that the remarks related only to claims 11 to 14, which were amended in the fashion ascribed by respondents to claim 8. Finally, as to the alleged limitation of the claimed memory device to a single ROM, the ALT found nothing in the prosecution history outside of the preferred embodiment to limit the claim to a single ROM. 111/

Literal infringement of a properly interpreted claim is a question of fact. 136/ To ascertain whether an accused device infringes a valid patent, the asserted claims must be compared with that device. 137/ If the accused product or process falls squarely within the words of the claim, then

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132/ Id. at 234-35 (emphasis in original).
133/ Id. at 144 (FF 215).
134/ Id.
135/ Id. at 142-43 (FF 161).
136/ Amstar Corp. v. Envirotech Corp., 730 F.2d 1476, 1481, 221 U.S.P.Q. 649, 653 (Fed. Cir. 1984); Carman Industries, Inc. v. Wahl, 724 F.2d 932, 941 (Fed. Cir. 1983).
137/ Graver Tank, 339 U.S. at 607; Amstar Corp., 730 F.2d at 1481, 221 U.S.P.Q. at 653.

infringement is established. 138/ Otherwise, a device may still be found to infringe under the doctrine of equivalents. 139/

In "reading" a claim on an allegedly infringing device, one may not compare parts of the description in the patent to the accused product, nor is comparison to be made between the commercial embodiment of the claimed invention and the accused product. 140/ Rather, after establishing the scope of the patent, the claims are read on the accused structures. 141/

Where, as is the case in this investigation, a claim is expressed as a means or step for performing a specified function (a so-called "means plus function" claim) without recital of structure, material, or acts in support thereof, the claim will be construed to cover the corresponding structure, material or acts described in the specification and equivalents thereof. 142/ Of course, claims are always interpreted in light of the patent specification and the prosecution history of the application that led to the patent. 143/ However, it is error to read a "means plus function" claim as limited to a particular means set forth in the specification. 144/ However, the question of whether an accused device performs the equivalent of the function described in the patent may be analyzed using concepts traditionally employed under the doctrine of equivalents. 145/

138/ Graver Tank, 339 U.S. at 607.
139/ Id. at 608.
140/ Amstar Corp., 730 F.2d 1481, 221 U.S.P.Q. 649, 653; ACS Hospital Systems, Inc. v. Hontefiore Hospital, 732 F.2d 1572, 1578 (Fed. Cir. 1984).
141/ Astra-Sjuco, A.B. v. United States International Trade Commission, 629 F.2d 682, 686, 207 U.S.P.Q. 1, 5 (C.C.P.A. 1980); Coleco Industries, Inc. v. United States International Trade Commission, 573 F.2d 1247, 1253, 197 U.S.P.Q. 472, 476 (C.C.P.A. 1978).
142/ 35 U.S.C. S 112; D.H.I. Inc. v. Deere & Co., 755 F.2d at 1574.
143/ Palumbo v. Don-Joy Co., Appeal No. 84-1691, slip op. at 9-10 (Fed. Cir. May 20, 1985).
144/ D.M.I., 755 F.2d at 1574.
145/ Palumbo, Appeal No. 84-1691, slip op. at 11 n.4.

Closely tied to the foregoing discussion of literal infringement, construction of the claim language, and the doctrine of equivalents is the applicability of the doctrine of prosecution history estoppel. Prosecution history estoppel prevents a patent owner from obtaining the benefit of a claim construction that would revive subject matter surrendered during the prosecution of the patent application. 146/ The estoppel applies both to amendments to claims made to overcome rejections based upon prior art and to arguments submitted to the PTO to obtain the patent. 147/

One effect of prosecution history estoppel is to limit the doctrine of equivalents. 148/ A patent that has been severely limited during its prosecution before the PTO will have only a narrow range between it and the point beyond which prosecution history estoppel applies. 149/ In other words, the doctrine of prosecution history estoppel may preclude a patentee from contending in an infringement action that his claims should-be-interpreted-as if limitations added by amendment or by argument before the PTO were not present or as if abandoned claims, or portions thereof, were still present. 150/

Based upon the applicable legal standards and the evidence of record, we find that the ALJ erred in his determination that the accused devices read of

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146/ Thomas & Betts Corp. v. Litton Systems, Inc. 720 F.2d 1572, 1579 (Fed. Cir. 1983); Hughes Aircraft Co. v. United States, 717 F.2d 1351, 1362, 219 U.S.P.Q. 473, 481 (Fed. Cir. 1983).
147/ Hughes Aircraft Co., 717 F.2d at 1362, 219 U.S.P.Q. at 481. See also Coleco Industries, Inc., v. U.S.I.T.C., 573 F.2d at 1257, 197 U.S.P.Q. at 480; Dwyer v. United States, 357 F.2d 978, 984, 149 U.S.P.Q. 133, 138 (Ct. Cl. 1966).
148/ Hughes Aircraft Co., 717 F.2d at 1363, 219 U.S.P.Q. at 482; Autogiro Co. of America, 384 F.2d at 400-01; 155 U.S.P.Q. at 705.
149/ Hughes Aircraft Co., 717 F.2d at 1363, 219 U.S.P.Q. at 482.
150/ Thomas & Betts Corp., 720 F.2d at 1579; Hughes Aircraft Co., 717 F.2d at 1362.

or are equivalent to claim 8 of the '129 patent and determine that, were the '129 patent valid and enforceable, the accused devices do not infringe claim 8. The invention set forth in claim 8 describes a "means for actuating the impressing means as including a memory device having a first portion for storing a plurality of individual location characters and a second portion for storing a plurality of individual hammer intensity characters, and a means for sequentially reading out" print wheel location and hammer intensity information. 151/ This language was included in claim 8 by amendment to distinguish the claim over the prior art. 152/

The structure for carrying out the means specified in claim 8 is recited in the specification to the '129 patent as a ROM from which the wheel position and hammer intensity information are sequentially retrieved or "fetched." 153/ A device would infringe claim 8 if it copied this means and function or if it were the equivalent thereof. In D.M.I.. Inc. v. Deere & Co., 154/ the CAFC stated that the establishment of a range of equivalents to evaluate literal infringement of means plus function claims differs from the infringement analysis under the doctrine of equivalents. However, the CAFC did not provide further guidance on this point. 155/ On May 20, 1985, the CAFC resolved this ambiguity by holding that the underlying principles of . equivalence enunciated in Graver Tank are relevant to the literal infringement analysis of a means plus function claim. 156/ Therefore, one may look to any

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151/ ID at 234 (emphasis in original).
152/ Id.
153/ This is described in the specification as ROM 91.
154/ 755 F.2d 1570 (Fed. Cir. 1985).
155/ Indeed, the parties differed in their assessment of the effect of D.M.I. See, IA., CTR at 80-82; 115.
156/ Palumbo, slip op. at 11.

form of proof to establish the range of equivalent structures, including evidence which would narrow that range.

In this instance, Qume presented arguments before the PTO which clearly were intended to distinguish claims 8-14 of the '129 patent from another patent. Those remarks clearly state not only that wheel location and hammer intensity information are sequentially fetched but also that the print wheel must be in position before the hammer intensity information is accessed. 157/ Contrary to the ALJ's findings, this argument was made prior to discussion of independent claim 11, and the portion of later remarks concerning claim 11 clearly point to the applicability of the limitation to claim 8. 158/ These arguments were made to obtain approval of the application, and they limit equivalent structures to those having a memory device from which wheel position and then hammer intensity are sequentially read out, with hammer intensity being fetched after the print wheel is in position.

In view of this limitation, the claim does not read on the Sharp devices, and those devices would not infringe under the doctrine of equivalents. The substantial evidence of record supports the ALJ's finding that there is sequential read-out in the Sharp devices. 159/ The flaw in the ALJ's findings, and the basis for our conclusion of noninfringement, lies in the fact that the Sharp devices read out wheel position and hammer intensity information prior to any positioning of the print wheel. 160/ Accordingly, the Sharp machines are neither "equivalent" for purposes of literal infringement of a means plus function patent, nor do they perform the same

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157/ ID at 117-18 (FF 215).
158/ Amendment of November 3, 1977 at 12-13.
159/ ID at 115-16 (FF 212).
160/ Id. at 116-17 (FF 213-14).

function in the same way as the claimed invention, which would be necessary in order to find infringement under the doctrine of equivalents.

Similarly, the devices manufactured by Triumph-Adler do not infringe claim 8. In the Triumph-Adler machines, a spoke location code is first addressed in a RAM (random access memory) or ROM, followed by a hammer impact intensity code, which are then stored in a RAM. 161/ This information is then transferred to the circuitry for print wheel positioning and hammer firing. The system for obtaining the positioning and intensity information in the Triumph machines is not the particular sequential method to which the '129 patent, was limited. 162/ Therefore, these devices would neither literally infringe claim 8, nor would they infringe under the doctrine of equivalents.

The devices manufactured by respondent Nakajima present a somewhat different problem with respect to infringement of claim 8. Nakajima has not pointed to evidence of record as to why its devices are neither the functional equivalent of claim 8 nor perform the same function in the same manner to achieve a similar result. In fact, even with the narrowing of the range of equivalent structures mandated by the prosecution history, the Nakajima devices sequentially access wheel location and hammer intensity information in the required order, as well as including the other elements of claim 8 or their equivalents. 163/ Accordingly, we agree with the ALJ that the Nakajima devices would infringe claim 8 were that claim valid or the patent enforceable.

161/ Id. at 129-30 (FF 233-34).
162/ Id.
163/ Id. 137-41 (FF 245-56).

DOMESTIC INDUSTRY 164/

The submissions of the parties and the IA on review raised a number of questions relating to the definition of the domestic industry and of imports. These issues include the propriety of joining the Rotary Wheels I investigation with this investigation, and the aggregation of imports of settled respondents from both investigations.

The ALJ defined the domestic industry as Qume's domestic operations in California and Puerto Rico devoted to the manufacture of the Q series and Sprint series rotary wheel printers which exploit the '129 patent. 165/ Although the ALJ found that Qume manufactures two printers, the Virgo and Letter Pro, in Taiwan and Japan, respectively, he concluded that these operations either did not exploit the '129 patent or were not domestic operations for purposes of defining the industry. 166/ This portion of the ID has not been challenged, and we concur in this analysis and definition.of_the— industry.

1. The binder of the Rotary Wheels I and Rotary Wheels I/ Investigations

The ALJ determined that the "circumstances of the present case compel the conclusion that the date of filing of the complaint has less significance thfn in most section 337 investigations." 167/ He found that considering only that part of the domestic industry which actually exploited the patent and which was adversely affected by importation at the time of the filing of the

164/ The existence of a domestic industry and enforceable patent, which we ar:::=2 - 11;u:;!:::11:; the a valid discussion.
165/ Id. at 238-39. This aspect of the ID is consistent with prior Commission decision. See Certain Molded-In Sandwich Panel Inserts and Methods for Their Manufacture, Inv. No. 337-TA-99, USITC Pub. 1246 (1982).
166/ ID at 239.
167/ Id. at 243.

complaint in this investigation would not be appropriate in light of complainant's allegations that all segments of the domestic industry (including the low end of the industry) have been injured. 168/ In order to reach the question of injury to all segments of the printer market, the AL.1 appears to have relied on the fact that the two investigations involved the same patent and, seemingly, the same imported products, to combine the first and second investigations. 169/

We determine that joinder of the Rotary Wheels I investigation with the Rotary Wheels II investigation is inappropriate. The CAFC has addressed the question of the proper date for determining the scope of the domestic industry's activities in a section 337 investigation. The CAFC established the date of the filing of the complaint as the date for determining the existence Of a domestic industry. In so doing, the CAFC was attempting to take account of the situation in wilich an industry_is.destroyed the course of a Commission investigation. However, by reaching back beyond that date, as As been suggested here, the Commission would be attempting to provide redress complainants who were not timely in seeking relief or who, perhaps, had ceased to exploit their patent rights by the time of filing the complaint. 170/

We note that the statute, which envisions a prospective remedy, accounts' for the "market realities" of destruction of a domestic industry prior to the filing of a complaint by allowing for a claim of prevention of establishment where a complainant is attempting to reenter the previously destroyed

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168/ Id. at 242.
169/ Id. Certain Rotary Wheel Printers, Inv. No. 337-TA-145 (Rotary Wheels I) (settled as to all respondents). The Rotary Wheels I investigation was instituted in March 1983.
170/ Bally/Midway Mfg. Co. v. United States International Trade Comm'n, 714 F.2d 1117, 1121 (Fed. Cir. 1983).

industry. 171/ Significantly, complainant sought to amend the complaint to include such a claim, albeit in an untimely and prejudicial manner on the day evidentiary hearing commenced. 172/ In light of the above, we determine not to join the two Rotary Wheels investigations. 173/

3. Aggregation of imports from Rotary Wheels I with Rotary Wheels II

In reaching his conclusion that the effect or tendency of respondents' unfair acts is to destroy or substantially injure the domestic industry, the ALJ considered the question of aggregating the imports of respondents in the first investigation with those in this investigation. 174/ The ALJ determined that "a finding that the activities of respondents in Rotary Wheels I are irrelevant to Rotary Wheels II would distort the analysis of the rather complex market environment involved in this case and artificially ignore the realities of the marketplace." 175/ He found that the present investigation is essentially a continuation of Rotary Wheels I inasmuch as he found that the same patent, type of imported product, and domestic industry are involved, and the periods of investigation overlap. 176/ Further, the ALJ noted that the respondents from Rotary Wheels I continue to be a significant force in the marketplace and to compete with Qume. For the same reasons that joinder of the two investigations is inappropriate, aggregation of the imports is also inappropriate.

171/ 19 U.S.C. S 1337(a).
172/ Motion No. 185-77.
173/ We provide additional reasons for non-joinder infra.
174/ ID at 253.
175/ Id. at 262.
176/ Id.

4. Inclusion of imports from settled respondents

On two recent occasions the Commission has expressly stated that there must be a finding of an unfair act with respect to the imports of a settled respondent in order to consider the impact of those imports in assessing injury. 177/ As to the respondents from Rotary Wheels I, all respondents in that investigation settled without admitting the commission of an unfair act and no probative evidence was received as to the activities of those respondents. The ALJ found that the Rotary Wheels II settlement agreements imply the commission of unfair acts, thus making consideration of the imports of those settling respondents. The notion that a settlement agreement somehow implies violation is untenable in light of the common knowledge that respondents often settle for reasons other than an awareness that their products are in violation of section 337.

In this investigation, of the 13 settling respondents, only Tohoku-Ricoh has admitted infringement, and the ALJ determined that its imports do not infringe the '129 patent. 178/ Accordingly, we determine that consideration of the imports of settled respondents from either investigation is inappropriate. 179/

177/ See Certain Foam Earplugs, Inv. No. 337-TA-184, Notice of Commission Decision Not to Review Initial Determination, Deadline for Filing Written Submissions on Remedy, the Public Interest and Bonding, Supplementary Information, 50 Fed. Reg. 4277 (1985); Certain Bag Closure Clips, Inv. No. 337-TA-170, Notice of Commission Decision Not to Review Initial Determination; Deadline for Filing Written Submissions on Remedy, the Public Interest, and Bonding, 49 Fed. Reg. 35872 (1984).

178/ ID at 250.

179/ Commissioners Eckes and Rohr note that in this investigation the issues concerning the '129 patent are dispositive as to whether there is a violation of section 337. We have joined in the discussion of the issues concerning domestic industry and importation because it is appropriate for the Commission, when it decides to review issues, to decide as many of those issues as it can without engaging in speculation. To proceed further to a consideration of injury and tendency to injure would be speculative in light of the dispositive issues already discussed.

ADDITIONAL VIEWS OF CHAIRWOMAN STERN AND COMMISSIONER ROHR ON ENFORCEABILITY OF THE 129' PATENT

The ALJ considered a number of allegations of inequitable conduct by complainant before the PTO. The Commission chose not to review the ALJ's findings and conclusions concerning several of these allegations and specifically adopts them by reference. 1/ However, the Commission elected to review the ALJ's determinations concerning two of the allegations of inequitable conduct. Because of the importance of these issues, we believe it is necessary and appropriate for the Commission to decide them. These determinations subject to review involve:

a. The patent applicant's alleged failure to bring to the attention of the PTO relevant prior art consisting of the HyType I printer and the maintenance manual therefor; and,

b. The patent applicant's alleged failure to advise the PTO of certain optical encoders manufactured by Litton and Disc. 2/

As to these two issues, the ALJ found that no inequitable conduct had taken place based upon the lack of clear and convincing evidence of a "threshold materiality" of the nondisclosed information and/or the lack of a "threshold intent" on the part of complainant regarding the withholding of the information. 3/ The ALJ defined "materiality" as the substantial likelihood that the PTO examiner would have considered the information in question important to the allowance of the patent. 4/ He defined "threshold intent" as knowledge on the part of the applicant or his attorney that the

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1/ By deciding not to review them the Commission has adopted the findings and conclusions of the ALI in the ID relating to the inequitable conduct counts numbered 2, 3, 4, and 5. ID at 218.

2/ ID at 218.

3/ See J.P. Stevens & Co., Inc. v. Lex Tex Ltd., Inc., 747 F.2d 1553, 1559-60 (Fed. Cir. 1984).

4/ ID at 223.

nondisclosed prior art in question was a more material reference than that before the examiner. 5/ Although the ALJ found that the prosecution leading up to the patent was "far from error free," he nevertheless determined that these errors did not involve the level of materiality or intent requisite to a finding of inequitable conduct. 6/

Specifically, the ALJ found that there was no reason for the applicant or his patent attorney to have called the HyType I printer and the printer manual to the PTO's attention unless they actually knew that the '509 patent was not a valid prior art reference or that the HyType I and manual were a more material reference. 7/ The ALJ found that the applicant and his attorney were unaware that the examiner had found that the '509 patent was not a valid prior art reference. 8/ Based on his finding that complainant was unaware of the PTO's "unannounced determination of the nonapplicability of the '509 patent," the ALJ determined that the nondisclosure of the HyType I printer/manual was merely an oversight or a good faith error in judgment on the part of the applicant or his attorney. 9/

As to the question of the encoder discs manufactured by Litton and Disc, the ALJ stated that the inventor had purchased nonstandard discs from the aforementioned companies. 10/ However, the ALJ did not provide an explanation in the ID of why the failure to disclose these discs to the PTO was not inequitable conduct.

5/ Id. at 220-21.

6/ Id. at 219.

7/ Id. at 220-21. The ALJ determined that the '509 patent revealed all of the elements of the HyType I printer, as disclosed in the manual, which are material to a determination of the patentability of the "invention" disclosed in the '129 patent.

8/ ID at 220.

9/ Id. at 221-22.

10/ Id. at 228.

In considering the two charges of inequitable conduct on review, we have followed the guidance of the CAFC and of its predecessor the Court of Customs and Patent Appeals. Under the standards applied by the CAFC, the first element of the test for inequitable conduct, which must be proven by clear and convincing conduct, is a threshold degree of materiality of the omitted or false information. 11/ Courts have used at least three standards of materiality. 12/ However, the CAFC has approved, and we adopt, the test established in PTO rule 1.56(a) (i.e., whether there is a substantial likelihood that a reasonable examiner would have considered the omitted reference or false information important in deciding whether to allow the issuance of the patent) as the appropriate starting point for discussing threshold materiality. 13/

The second element requisite to a finding of inequitable conduct is the "threshold intent." The. CAFC has stated -that intent- and materiality- are often interrelated and intertwined. 14/ A lesser showing of the materiality of the withheld information may suffice when an intentional schema to defraud is established, while a greater showing of the materiality of withheld information necessarily creates an inference that its non-disclosure was "wrongful." 15/

The CAFC has stated:

> That intent need not be proven with direct evidence . . .
> It may be proven by showing acts the natural consequences

11/ J.P. Stevens, 747 F.2d 1559.
12/ American Hoist & Derrick Co. v. Sowa & Sons, Inc., 220 U.S.P.Q. 763, 772-73 (Fed. Cir. 1984). The standards of materiality include: (1) an objective "but for" standard; (2) a subjective "but for" standard; and, (3) a "but it may have" standard. Id.; see also J.P. Stevens, 747 F.2d 1559.
13/ J.P. Stevens, 747 F.2d at 1559; American Hoist, 220 U.S.P.Q. 763, 773.
14/ Digital Equipment Corp. v. Diamond, 653 F.2d 701, 716 (1st Cir. 1981) cited in American Hoist, 220 U.S.P.Q. at 773.
15/ Id.

> of which are presumably intended by the actor . . . Proof of deliberate scheming is not needed; gross negligence is sufficient . . . Gross negligence is present when the actor, judged as a reasonable person in his position, should have known of the materiality of a withheld reference. 16/

Simple negligence, oversight, or a good faith error of judgment are insufficient proof of intent. 17/

Once the elements of threshold materiality and threshold intent are established, the next step of the test for inequitable conduct is to weigh them to determine whether the balance tilts toward a conclusion that inequitable conduct occurred. 18/ If, after weighing the two elements, inequitable conduct is found, then all of the claims of the patent, not just those claims to which the inequitable conduct is directly connected, are unenforceable. 19/

Concerning the question of inequitable conduct in the alleged failure of complainant to make the PTO aware of the Litton and Disc encoders, counsel for respondent Sharp stated at the hearing before the Commission, "I do not believe that there are sufficient facts of record to demonstrate that (inequitable conduct]." 20/ No further argument was made on this issue at the hearing or in respondents' briefs. After a review of the record, we agree that there is insufficient evidence to show either the requisite level of

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16/ Id. (citations omitted).

17/ Id. Although gross negligence in withholding a reference may serve as a basis for a finding of the requisite intent, this presupposes that an applicant has the reference before him. An applicant is under no duty to conduct a prior art search. American Hoist, 220 U.S.P.Q. 772.

18/ American Hoist, 220 U.S.P.Q. 774.

19/ See In re Clark, 552 F.2d 623, 626 (C.C.P.A. 1975).

20/ CTR at 80.

materiality or a threshold level of intent. Accordingly, we determine that the nondisclosure of those discs by the applicant does not render the '129 patent unenforceable by reason of inequitable conduct.

With regard to the failure of the applicant for the '129 patent to disclose the HyType I printer and printer manual, we believe that a determination of inequitable conduct is warranted. The first prong of the test for inequitable conduct, the "threshold materiality" of the nondisclosed information, is satisfied on the face of the ID. The ALJ concluded that the '509 patent revealed all elements of the HyType I printer and.printer manual which are material to a determination of the patentability of the invention disclosed in the '129 patent. 21/ According to the ALJ, the HyType I printer and printer manual was not more material art, if the '509 patent were a valid reference. 22/ Therefore, in the absence of the '509 patent, the HyType I printer and printer manual would necessarily-be the-most-materiel-prior-art --- for purposes of prosecution of the '129 patent.

The '509 patent was not a valid prior art reference to the application for the '129 patent because, as a matter of law, an applicant's own invention cannot be prior art to him, absent a statutory bar under 35 U.S.C. 5 102(b), (c), or (d). 23/ In fact, the patent examiner in charge of•the '129 patent application decided that the '509 patent was not a permissible reference and substituted another patent in its place in an office action. 24/ The prosecution of the '129 patent then continued to issuance and the applicant

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21/ ID at 221.
22/ Id.
23/ In re Fout, 675 F.2d at 300 n.2.
24/ ID at 221.

never informed the PTO of the existence of the HyType I printer and printer manual. 25/ Thus, the examiner was deprived of subject matter that was material to the issuance of the '129 patent.

We now turn to the question of whether there is "threshold intent." Contrary to the ALJ's conclusions on this point, proof of deliberate scheming is not necessary; gross negligence is sufficient. 26/ Gross negligence can be found where the reasonable person in the place of an applicant or his counsel knew or should have known that the withheld information was material. 27/ For example, in a recent decision the CAFC rejected patent counsel's arguments that one in his position would not have disclosed certain material information on the basis of a "good faith" misunderstanding of the law. 28/ The Court determined that the nondisclosed information, which presented a bar to the approval of the patent application under 35 U.S.C. S 102b, was clearly material and should have been recognized as material by patent counsel. 29/

We believe that the situation presented in this investigation is analogous to that before the CAFC in Argus. While deliberate scheming on the part of the '129 patent applicarit or his attorney has not been proven, we are convinced that gross negligence on their part has been established.

25/ Id. at 50 (FF 86).
26/ J.P. Stevens, 747 F.2d at 1560.
27/ Argus Chemical Corp. v. Fibre Glass-Evercoat Company, Inc., Appeal No. 84-1418, slip op. at 8 (Fed. Cir. Apr. 4, 1985).
28/ Id. at 8-9.
29/ Id. at 9. Similarly, the Court found gross negligence where an applicant failed to disclose a material reference to a Canadian patent rejecting, inter alia, the argument that nondisclosure was based on the subjective good faith belief that the Canadian patent was inoperable. Driscall v. Cebalo, 731 F.2d 878, 885 (Fed. Cir. 1984). On the other hand, the CAFC declined to find gross negligence where the applicant above was both unaware of the materiality of the withheld reference and was not trained and experienced in the evaluation of what is or is not prior art. See Kansas Jack v. Kuhn, 719 F.2d 1144, 1151-52 (Fed. Cir. 1983).

We note that the attorney employed by the applicant for '129 patent had ten years experience in patent law and had served as a patent examiner at the PTO for three years. 30/ An experienced patent counsel should have been aware that an applicant's own invention (i.e., the '509 patent) could not be prior art to him absent statutory bar by 35 U.S.C. S 102(b), (c), or (d). Moreover, the applicant, who is a sophisticated participant in the patent area and who held the patent which arose from the HyType I printer and printer manual, was well-aware of their materiality. 31/ Quite simply, the reasonable person in the place of applicant and his counsel should have known that the HyType I printer/manual were highly material.

Although the ALJ also recognized the materiality of the printer and manual, he appears to have relied on the patent examiner's citation of the '509 patent on two occasions as the basis for a conclusion that the applicant and his attorney acted. in good faith---The fact that the patent-examiner twice -- cited the '509 patent as prior art in rejecting the application for the '129 patent is not dispositive. Neither is "good faith" reliance. 32/ As has been discussed, applicant and patent counsel should have been aware that the'509 patent was not good prior art. Moreover, the record shows that the examiner recognized in the course of the prosecution that the '509 patent was not a good reference and supplanted the '509 with a new reference (Lundquist). 33/ Although patent counsel was not directly made aware of the examiner's opinion as to why the '509 patent was not a good reference, he clearly was cognizant

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30/ Kujawa Witness Statement 1-3 (adopted by witness TR at 1045); TR at 1068-70.

31/ In general knowledge of facts by the applicant will also be imputed to his counsel, absent the special situation in which the applicant is not knowledgeable about the patent process. See Kansas Jack, 719 F.2d at 1151-52. This special situation is not applicable to the present situation.

32/ See Argus, slip op. at 8-9.

33/ Id. at 44 (FF 74).

that the '509 patent had been supplanted as a prior art reference. 34/ At that point, a reasonable person would have provided the examiner with the HyType I printer/manual, a reference that he should have recognized to be more material in the event of the unavailability of the '509 patent. 35/

In this instance, we determine that the balance tips toward inequitable conduct as a result of the gross negligence of patent counsel. Consequently, we find the '129 patent unenforceable by reason of inequitable conduct before the PTO.

35/ Id. at 221.
34/ Id. at 44-45 (FF 75).

ADDITIONAL VIEWS OF CHAIRWOMAN STERN
AND COMMISSIONER LODWICK -

INJURY TO THE DOMESTIC INDUSTRY

Market Segmentation

In assessing the nature of the domestic industry for purposes of determining injury, the ALJ found that "market realities" had resulted in a segmented market. 1/ The ALJ found, based upon function or end use, that there are four market segments:

> I. (Low-end) - -Machines characterized by portability and compactness; low cost, lower speed printers and typewriters;
>
> II. Office grade machines for small business use; capable of sustaining heavy use, but having limited display and limited memory;
>
> III. Machines covering medium size business uses including full function word processing and small business computers; characterized by greater memory and text editing ability than category II;
>
> IV. (Upper-end)--Higher cost, full function, large business machines utilizing dedicated or cluster type word processing. 2/

The ALJ determined that the accused imported rotary wheel typewriters and printers are competitive in the low and middle segments of the market, i.e., those segments having machines with speeds ranging up to 30 characters per second (cps). 3/ Although complainant produces printers having a rated speed It Isteet eye% thttt printer§ tit0 either of foreign manufacture or do not practice the '129 patent. Qume manufactured a low-speed, low-cost printer (the Sprint 8/20) in fulfillment of a contract with Raytheon. However, Raytheon left the word processing business, and complainant ceased manufacture of the printer. This was complainant's only exploitation of the patent in

1/ ID at 272.
2/ Id. at 271.
3/ Id. at 276.

this market segment. Nevertheless, the ALJ found that competition existed between respondent's typewriters and printers and complainant Qume in 1983.

Complainant then developed another low-speed printer called the Virgo in November 1983, but in January 1984 it moved the manufacture of that printer to Puerto Rico in response to the lower cost of production offshore. 4/ On this basis the ALJ concluded that complainant was unable to set its prices for low-speed printers produced in the United States at a profitable level and still compete effectively. 5/

The *ALJ* also found that the effect of respondents' unfair acts has been to destroy the relevant domestic industry. The ALJ based this finding on the belief that this investigation was analagous to Bally/Midway. In that investigation, the relevant domestic industry was found to have been destroyed during the period following the filing of the complaint. In this investigation, the ALJ determined that the low speed printer market,-and hence the low speed printer industry, ceased to exist when Raytheon terminated its contract with Qume in 1983. As noted previously, such an interpretation of the domestic industry, which defines the domestic industry before the filing of the complaint, goes beyond the bounds set out by Bally/Midway.

The ALJ also determined that the effect of respondents' imports was to substantially injure or destroy the domestic industry in the middle and high end of the domestic market. However, the ALJ found that respondents do not compete in the upper end of the market, and that complainant has no market share in the newly emerging low-end rotary wheel printer market. 6/ Moreover,

4/ Id. at 278.
5/ Id. at 280.
6/ Id. at 283.

the ALJ found that there has been no direct proof that the respondents remaining in this investigation have been the cause of lost sales or customers to Qume. 7/ In the ALJ's opinion, the evidence of injury to complainant lies in price erosion, declining profit margins, and excess capacity in Qume's middle range printer operations as a result of the availability of low-cost, low-speed printers and intense import competition in the middle range of the market. 8/

In this investigation, we cannot agree with the ALJ's conclusions with respect to injury to or destruction of the domestic industry._ While there is no precise or all-inclusive definition of injury under section 337, 9/ the domestic industry must normally establish that the infringer holds, or threatens to hold, a significant amount of the domestic market for the product in question or has made significant sales of that product. 10/

Other factors that-the-Commission has-frequently considered-in-337-injury - analysis include: (1) the existence of underselling of the imported product;- (2) trends in domestic production; (3) employment, profits, and pricing; and (4) opportunities to license or to increase royalties. Neither the presence or absence of any single criterion, nor the specific level of a particular factor is dispositive of substantial injury. 11/ The Commission also considers the special characteristics of each industry in assessing the condition of a particular domestic industry. 12/

7/ Id. at 282.
8/ Id. at 284.
9/ See Textron Inc. v. United States International Trade Commission, 753 F.2d 1019, 1029 (Fed. Cir. 1985).
10/ Id.
11/ See, IA., Certain Limited-Charge Cell Culture Microcarriers, Inv. No. 337-TA-129, USITC Pub. 1486 at 41-43 (1984).
12/ 753 F.2d at 1029.

We find that even if there were unfair acts or methods of competition, the requisite injury had not been proven in this investigation. As the ALJ held, the market for rotary wheel printing systems is segmented into four categories based upon function or end use. 13/ Respondents do not compete in the upper range of the market, and the domestic industry has no market share in the low-end of the market, which includes devices in the under 30 cps range. 14/ Moreover, there is no independent evidence to show that the domestic industry intends to produce for this market segment. 15/ Accordingly, the domestic industry has not established that the accused products hold a significant amount of its domestic market (i.e., the middle and upper end) for rotary wheel printing systems.

We further note that the single low-speed printer manufactured by complainant, the Sprint 8/20, was a slowed-down version of a higher speed Sprint manufactured to fulfill _a contract with-Raytheon.--16/ The number of printers called for under this contract was not produced because Raytheon left the word processing business in 1983 rather than as a consequenceof imports of rotary wheel printing systems. 17/ Then prior to the filing of its complaint, complainant moved its sourcing for low-end printers offshore. In light of complainant's departure from the low-end of the market, and its ' non-involvement in that market segment during the period relevant to this investigation, complainant's attempt to link imports of the accused products

13/ ID at 269-71.
14/ Id. at 283.
15/ Id. at 258.
16/ Id. at 152 (FF 287).
17/ Id. at 277.

to the alleged destruction of its low-end printer manufacturing operations is untenable. 18/

Complainant has argued, and the ALJ held, that respondents' sales of the accused devices have caused injury to complainant's middle-range and upper-end market. The evidence of record does not support that finding. Respondents do not hold a share of the market in which complainant competes. There is no direct evidence that the respondents who remain in the investigation have caused lost sales or lost customers to the domestic industry. 19/ Moreover, with the exception of a small decline in the price of complainant's sprint model 11/50, prices for the domestic industry's products have generally remained stable from November 1982 to February 1984. 20/ As for domestic production, the evidence shows that complainant's total printer production has increased steadily from 1980-83 as have total printer sales and revenue from those sales. 21/ Finally, the profit.margin_figures_given_by_complainant are .-- unsubstantiated by the evidence of record and, therefore,_nat_sufficiently:_;:___. reliable and probative. 22/

The evidence shows, therefore, neither injury to the domestic industry, nor a causal nexus between respondents' alleged unfair acts and injury to the domestic industry. 23/ As a result, we determine that an industry in the.

18/ We further note, having found joinder to be inappropriate, the destruction of the industry involved in the Rotary Wheels I investigation is irrelevant.

19/ Id. at 282.

20/ Id. at 201 (FF's 437-38).

21/ Id. at 200 (FF 436). Based upon the participation in different market segments by respondents and complainant, its unreasonable to assume that the absence of imports would have increased the domestic industry's production. Rather, it appears that the end result would have been an increase in the production of foreign sourced low-speed printers which are imported by complainant.

22/ See, e.g., ID at 284 n.14.

23/ See Spring Assemblies at 42.

United States has not been substantially injured or destroyed by the subject imports.

Tendency to substantially injure

The ALJ determined that a tendency to substantially injure the domestic industry has been shown vis-a-vis certain models of respondents' printers and typewriters which are interfaceable with computers. 24/ The ALJ based his conclusion on his findings that: (1) these devices enjoy a significant cost advantage in foreign manufacture; (2) respondents have the capacity to manufacture additional quantities of the accused products; and (3) respondents have demonstrated an intent to penetrate the domestic market. 25/ In analyzing tendency to substantially injure, the ALJ found that the existing injury by virtue of price erosion, in combination with the foregoing factors, was sufficient cause to believe that future substantial injury would occur.

If the domestic industry can show that an infringer threatens to hold a significant share of the domestic market in the subject articles or threatens to make a significant amount of sales of those articles, a finding of tendency to substantially injure may be warranted. 26/ Moreover, the injury contemplated must constitute a substantive and clearly foreseen threat to the future of the industry not based on allegation, conjecture, or mere possibility. 27/

Assuming arguendo that the '129 patent is valid, enforceable and infringed, a finding of tendency to substantially injure is not warranted.

24/ These devices are listed in the ID at 288. The ALJ determined that other models of respondents' printers and typewriters are noncompetitive and noninjurious. ID at 287. We concur in these findings.
25/ ID at 286-87.
26/ See Certain Combination Locks, Inv. No. 337-TA-45, 50 U.S.P.Q. 1124.
27/ Textron, Inc. v. United States Int'l Trade Comm., 753 F.2d 1019 (Fed. Cir. 1985).

The accused devices do not hold a share of the segments of the market in which the domestic industry competes, nor is there any indication that respondents will attempt to enter those segments. Foreign cost advantage and foreign capacity are therefore not relevant. Further, the price erosion argument is not persuasive for reasons discussed above. Therefore, we determine that there is no tendency of the subject imports to substantially injure the domestic industry.

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Views of Vice Chairman Liebeler

On February 15, 1985, the Administrative Law Judge (ALJ) issued an initial determination (ID) that there is a violation of section 337 in the importation and sale of the rotary wheel printing systems under investigation in Certain Rotary Wheel Printing Systems, Inv. No. 337-TA-185. I would affirm this determination.

The patent in this case, entitled Rotary Wheel Printing System, was issued to Complainant Qume, as assignee, on October 3, 1978. The two independent claims in the patent cover a feedback compensation system for an optical encoder (claim 1) and a hammer intensity control (claim 8), both for use in a daisywheel printing system. [1]

Before addressing the substantive patent issues, I will first consider the proper role for review of Initial Determinations. According to Commission rules, review of the ID can only be granted if (1) a finding or conclusion of material fact is clearly

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[1] To avoid unnecessary repetition. I will only restate the procedural history of this case and the technical aspects of the patent where absolutely necessary. The background is well-documented in the ID.

erroneous; (2) a conclusion of law is erroneous, without governing precedent, rule or law, or constitutes an abuse of discretion; or (3) the determination is one affecting Commission policy.[2] Once review is granted, however, all aspects of the case are reviewed de novo by the Commissioners.[3] The Commission examines the record to decide whether it agrees with the substantive patent determinations by the ALJ, and the ALJ's determinations with respect to the "economic issues" (i.e.. domestic industry, injury).

The statute does not preclude the Commissioners from being the original factfinders in Section 337 cases. However, in view of the complex technical and legal questions arising when patent validity and infringement are at issue. this authority has been delegated to an Administrative Law Judge, and properly so. The ALJ can intensely study the patent issues peculiar to a particular case and render a well-reasoned decision. Because of both statutory

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[2]Rule § 210.54. 19 C.F.R. Chap. II. (1984). Review is granted at the request of one Commissioner.

[3]The Commission can "make any finding or conclusions which in its judgment are proper based on the record in the proceeding." Rule § 210.56, 19 C.F.R. Chap. II (1984).

time constraints and lack of expertise, it would seem appropriate to defer to the ALJ's determinations on patent matters. Review under a clearly erroneous or substantial evidence standard would also remove one level of bureaucracy from the appellate process. The Commission could enact such a standard by rulemaking.[4]

This case presents a good example of a complex case.[5] The ALJ.studied the technology and the applicable law for a considerable period of time and then made his findings. The Commission then threw out all but the factual record in determining to review. Nonetheless, given the present state of the Commission rules, I must join the majority in reviewing this 'case de novo.

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[4]The adjudicative provisions of the Administrative Procedure Act (APA) govern Section 337. The APA provides: "On appeal from or review of the initial decision, the agency has all the powers which it would have in making the initial decision except as it may limit the issues on notice or by rule." U.S.C. S 557(b) (1980).

[5]At the oral hearing before the Commission, the attorney representing the ITC's Office of Unfair Import Investiga-tions stated:

> In this particular case, the patent is a pretty complex electronic patent which certainly this staff member and the staff as a whole did not have the capability to master that technology in order to do the job that would have to be done if we were to take a position in this investigation.

Transcript at 106, Oral Argument In re Certain Rotary Wheel Printing Systems, Inv. No. 337-TA-185 (May 28, 1985). The staff attorney will typically spend as much time investigating the case as the ALJ.

1. <u>Whether U.S. Letters Patent 4,118,129 (the '129 patent) is invalid by virtue of anticipation within the meaning of 35 U.S.C. S 102(e) (1980).</u>

Section 102(g) provides in relevant part that a patent shall be issued "unless before the applicant's invention . . . the invention was made *in* this country by another who had not abandoned, suppressed, or concealed it."[6] Respondents argue that the invention of claim 8 of the '129 patent was anticipated by the Zodiac word processing system and the Mark I printer developed by Xerox. They assert that the Zodiac/Mark I system was conceived and reduced to practice as early as 1972 and that the Zodiac system corresponds to each element of claim 8 of the '129 patent.

The ALJ incorrectly stated that the patent applicant must have had knowledge of the anticipatory art before section 102(g) could operate as a bar to the issuance of a valid patent.[7] No such

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[6] For purposes of the discussion of reduction to practice, I assume <u>arquendo</u> that the Zodiac system shows every element of claim 8 and the Zodiac was not abandoned, suppressed, or concealed within the meaning of section 102(g). I make no determination on these issues.

[7] ID at 211.

requirement exists.[8] Because the ALJ found that the lack of knowledge of the applicant was sufficient to bar a section 102 argument, the ALJ did not make certain necessary t adings of fact. Thus, there is no finding on whether the ISS controller was reduced to practice prior to the Complainant's invention. After reviewing the record, I find that there is no clear and convincing evidence that this reduction to practice occurred.

Zodiac was the name given to the word processing system under development by Xerox. Diablo Corporation was in charge of building a printer that could handle proportional spacing and multiple hammer intensities. ISS Corporation undertook development of the controller. The controller, or control unit, contained the circuitry that controlled character position selection and hammer intensity. The controller and the Mark I printer were completely separate.[9]

Grundherr, the inventor under the '129 patent, worked at Diablo on the printer. As noted earlier.

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[8] Kimberly-Clark Corp. v. Johnson & Johnson, 745 F.2d 1437, 1445-46 (Fed. Cir. 1984); Full Mold Process v. Central Iron Foundry, 489 F. Supp. 893, 899 (E.D. Mich. 1980); I. Kayton, Kayton on Patents 4-23 (2d ed. 1983).

[9] ID at 31.

he lacked knowledge as to the operation of the ISS controller. Just as this lack of knowledge does not bar a section 102(g) objection, neither does it prove that the ISS controller was reduced to practice. Although the ALJ did explicitly find that ten prototypes of the Mark I printer had been built in 1972, he hedged on the issue of the controller,[10] probably because he felt such a finding was unnecessary.

Patents are presumed to be valid.[11] The burden is on the party asserting invalidity to rebut this

[10] The ALJ made several references to the controller that indicate he was not prepared to find that the controllex was reduced to practice. For instance, he states, "Lastly, respondents cite to Xerox's Zodiac system with its ISS controller and Mark 1 printer as being prior art, in that it - - was <u>allegedly</u> conceived and reduced to practice in 1971." ID at 88. The ALJ at one point assumes <u>arguendo</u> that the ISS controller might have been reduced to practice, but goes no farther. ID at 89. The ALJ does indicate that Mr. Grundherr designed a controller as an interface between an external data source and the Mark I printer so that the printer could be tested. This unit bore no resemblance to the ISS controller. The ALJ concludes that "the evidence shows he could check out the functions of the Mark I without having access to the ISS control unit." ID at 32 n.3. This last sentence could be read to presuppose the existence of the ISS controller, but it is ambiguous in light of the ALJ's hesitation to find a reduction to practice.

[11] 35 U.S.C.S 282 (1980); Atlas Powder Co. v. E.I. DuPont De Nemours, 750 F.2d 1563, 1573 (Fed. Cir. 1984).

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presumption by clear and convincing evidence.[12] Because the ALJ failed to make the appropriate findings on the issue of reduction to practice, it is left to the Commission to determine whether the record evidence is clear and convincing on this point. I determine that the Respondents have not met their burden.

In their pre- and posthearing briefs, Respondents cite both to the ID and the transcript to support their contention that the ISS controller had been reduced to practice prior to the invention set forth in claim 8 of the '129 patent. Most of the citations to the ID and the transcript relate to the date when the Mark I printer prototypes were first built and available for testing.[13] The ISS controller was separate from the printer and the subject of different problems. For example, the team at Diablo was concerned with print wheels and stepper

[12] American Hoist & Derrick Co. v. Sons, Inc.. 725 F.2d 1350, 1359-60 (Fed. Cir), cert. den. U.S. 105 S. Ct. 95 (1984); Hycor Corp. v. Schlueter Co.. 740 F.2d 1529, 1536-37 (Fed. Cir. 1984).

[13] See, e.g.,Brief of Respondents Sharp Corp. and Sharp Electronics Corp. for Review of Initial Determination at 25-26, Brief of Respondent Nakajima All Co., Ltd. on the Patent Issues Under Review at 13-15.

motors,[14] mechanical problems unassociated with the control logic.

Some excerpts from the transcript do lend support to the Respondents' position. [During one in camera session, Mr. Kenneth Campbell, listed as co-inventor of the control logic for the Mark I, testified as follows:

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A.
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Q.
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***********?

A. ***.15

Mr. Campbell was subsequently subjected to cross-examination:

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[14] Transcript at 1899, 1902.

[15] Transcript at 2040 (emphasis added).

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*?

A.
***** **** ********** **** ********** **** *********
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4. ***** **** ********* ****?

A.
********** **** ************ *** ************* *** *
************ ***** *****

Although sales or commercial success are not necessary to prove a reduction to practice, evidence of the commercial success of the ISS controller prior to the actual reduction to practice of the '129 patent certainly would be sufficient to show anticipation. The '129 patent application was filed on July 1, 1974.[16] Mr. Campbell is uncertain as to when sales actually began, and there is scant other evidence on this subject. We must therefore look for testing. Mr. Campbell's testimony <u>suggests</u> that the controller may have been reduced to practice as early as 1972. However, it is unclear whether the "use" with the Mark I printer in 1972 constituted a reduction to practice. Mr. Campbell, whose recollection of events was shaky, was named as - co-inventor of the Zodiac patent. Even this

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[16] This was the date of constructive reduction to practice for the '129 patent. Complainant argued that the actual reduction to practice occurred earlier. I need not reach this issue.

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ambiguous testimony must be discarded unless it is independently corroborated.[17]

There is no documentation in the record concerning when the controller operated in a manner that achieved its intended purpose. There seems to be persuasive evidence that Mark I printers were being delivered for testing of the Zodiac system *in*

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[17] In Ralston Purina Co. v. Far-Mar-Co., Inc., 586 F. Supp. 1176 (D. Kan. 1984), the court held that an actual prior reduction to practice must- be independently vorraVatated 111 ¯ani situations and by evidence other than by the testimony of the alleged inventor or by documents originating from him. Thus, the alleged inventor's notebooks unsigned by witnesses and weekly progress reports by inventors to their superiors do not provide independent corroboration of prior reduction to practice because they axe merely self-iervi6g¯ declarations. Moreover, the court found that even a statement by a witness with general knowledge about the products being used as starting materials and the thrust of the experimentation, and who was present at the-time ct-the testing, is insufficient corroboration of prior reduction of a process for making protein product. The court noted that this independent corroboration test, while generally required to obtain priority in an interference proceeding, is also required to establish a reduction to practice of prior art to invalidate a patent. See also Reese v. Hurst, 661 F.2d 1222, 1225 (CCPA 1981); Velsicol Chemical Corp. v. Monsanto Co., 579 F.2d 1038, 1048 (7th Cir. 1978) (facts of case required greater corroborative evidence than that supplied by inventor's testimony and notebook pages and by testimony and reports of his supervisor based entirely on information received from the inventor); In re Reuter, 670 F.2d 1015, 1022 (CCPA 1981) ("we agree with appellant that Poynter's [the inventor] uncorroborated statements regarding his alleged prior invention are entitled to no weight"). It is interesting to note that In re Reuter was cited by Respondent Sharp as support for the proposition that independent corroboration was unnecessary. Reply Brief of Respondent Sharp, at 4 (May 10, 1985).

1973.[18] Apparently at least one of the printers was to be sent to ISS for testing.[19] Mr. Koenig, who was Director of Engineering for Diablo, testified that u**
*********************************.un Testing and some type of "use" began in 1972/73, while commercial success occurred in 1976. Thus, sometime between 1972 and 1976, according to Respondents' witnesses, the ISS controller was reduced to practice.

Some cases have determined that where a research and development program is highly routinized, an actual witnessing of the reduction to practice is not necessary.[21] But independent verification is still required.[22] Despite a voluminous amount of testimony concerning memoranda and letters being sent back and forth, none of it deals directly with the

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[18]Transcript at 1878, Exhibit 126C.

[19]Transcript at 1883 (**********).

[20]Transcript at 1898.

21E.q., Berges v. Gottstein. 618 F.2d 771, 774-75 (C.C.P.A. 1980).

221d.: Donohue v. Baudry, 223 U.S.P.Q. 823. 826-27 (PTO Bd. Pat. Int'f 1984) (inventor's notebook was periodically witnessed by co-workers who were familiar with the inventor's work).

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status of the ISS controller.[23]

Thus, the evidence on this point is at best inconclusive. In a recent case, the Court of Appeals for the Federal Circuit (CAFC) held that in an interference case, an administrative proceeding, only a preponderance of the evidence was necessary to establish an actual reduction to practice.[24]

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[23] One memorandum of record indicates ***
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(***************************). Because the Zodiac/Mark I system was still in testing as of January 1973 (prototypes of the Mark I were still being built (See Exh. Rxt-103C), it is unclear how a customer could already own the Zodiac system. Moreover, the term controller seems to have had several different meanings in this investigation. The control logic embodied in claim 8 does not deal with "******** *************." Thus; this controller may not be the one at issue in this case; - Finally, in this Same memorandum, two paragraphs later, the author notes. u***
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*** [sic]." Although reduction to practice does not require perfection, proof pf reduction to practice does require clear and convincing evidence. The memoranda presented to the ALJ fall short.

[24] In Lacotte v. Thomas, 758 F.2d 611 (Fed. Cir. 1985), the junior party provided independent evidence to the Board of Patent Interferences to corroborate the inventor's testimony and notebook entries with respect to the process invented for replicating video discs. This evidence, in part, consisted of testimony by one of the inventor's research associates that he supplied the inventor with materials necessary to practice the invention. Another research associate testified that he examined replicate media that had been contact printed by the
(Footnote continued to page 13)

Although the instant case is an administrative proceeding, it is more closely analogous to a district court case than to a proceeding before the Board of Patent Interferences. The proper evidentiary burden in district court, and hence upon Respondents, is one of clear and convincing evidence.[25] Even under the lower preponderance of the evidence standard, however, Respondents have failed to present sufficient evidence to overcome their burden of proof concerning the reduction to practice of the ISS controller. Neither the testimony of the inventor nor the corroborative testimony of Respondents' other witnesses was persuasive on this matter.

I do not find even a preponderance of the evidence indicating that the ISS controller was reduced to practice prior to the constructive reduction to practice of the '129 patent. Thus, I

(Footnote continued from page 12)
process. Id. at 612. The CAFC stated that "the combination of such corroborating testimony and independent circumstantial evidence within an organized research program was more than adequate . . ." to sustain the Board. Id. at 613. Contra In re Reuter, 670 F.2d 1015, 1021 n.9 (CCPA 1981) (clear and convincing evidence of prior invention required in interference case); Suitzer v. Etzel, 531 F.2d 1062, 1065 (CCPA 1976).

[25] 586 F. Supp. at 1212.

cannot sustain Respondents' contention that claim 8 was anticipated by the ISS controller.

2. <u>Whether the '129 patent is invalid as obvious within the meaning of 35 U.S.C. S 103 (1980).</u>

Respondents contend that under section 103 both claims 1 and 8 are rendered invalid because the claimed inventions would have been obvious. They assert that the ALJ improperly narrowed the scope of the relevant prior art causing him to misdefine the person of ordinary skill in the art. I will consider each claim separately.

a. Claim 1[26]

Claim 1 deals with that part of the invention relating to the optical encoder. Respondent Sharp argues that the ALJ failed to consider the relevant prior art references-in combination.[27] Sharp asserts that the relevant prior art for claim 1 was optical sensor and encoder art. The ALJ defined the person of ordinary skill as one having knowledge of control logic design for

[26]Commissioner Lodwick concurs with Vice Chairman Liebeler regarding this issue.

[27]Brief of Sharp on Review at 41, 43-47.

printing systems.[28] Sharp contends that this person of ordinary skill should also have knowledge of optical encoder design and that a person with such knowledge would have found the invention of claim 1 obvious over the three relevant prior art patents in combination.

After carefully considering the ID, I have concluded that the ALJ implicitly defined the person of ordinary skill in the art in the manner suggested by Sharp. The fact that the ALJ did not do so explicitly is unfortunate but it is harmless error.[29]

The ALJ examined the prior art dealing with feedback loops and optical encoders. He considered the prior art both separately and in combination. The ALJ stated,

> It is alleged that one of ordinary skill in the art could easily have constructed the electro-optical encoder device of claim 1 of the '129 patent, at the time the '129 device was made, by <u>combining</u> the concepts from the Dubauskas patent and/or the Holter patent with an optical encoder such as that of the Kocher

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[28] ID at 57 (FF 102), 214.

[28] It would have been better to remand this issue to the ALJ but due to statutory time constraints, this option was unavailable.

patent.[30]

The ALJ proceeded to evaluate each of the patents separately and then in combination.[31] The ALJ concluded that the combination of the relevant prior art did not indicate that the claimed invention would have been obvious:

> Even assuming that the use of a feedback loop on a rotary optical position sensor was known during the relevant time period and that the need for compensating light sources, particularly LED light sources, for aging was known at the time of Grundherr's work on the '129 device, the <u>Dubauskas and Bolter patents, in view of the Kocher patent</u> still have not been shown to render the '129 claim 1 device obvious-to- a-person of-ordinary skill in the art. . . . The principal evidence concerning the <u>relationship between these patents and the Grundherr optical encoder disc with feedback loop</u> is the testimony of Dr. Bernstein. Dr. Bernstein is self-professedly one of "superior-u--tkill in the- art. On the other hand, a person-of ordinary skill in the art. Mr. Beery, characterized Mr. GrundherCe - encoder with the -feedback cloop at 41 super creative."[32]

In view of these findings by the ALJ, I conclude that he considered these patents in combination and found Mr. Grundherr's work a nonobvious improvement over them. The fact that the ALJ considered these patents

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[30] ID at 63 (FF 109) (emphasis added).

[31] ID at 63-70.

[32] ID at 69 (FF 117) (emphasis added).

in such depth indicates that he determined that knowledge of these fields would have been possessed by a person of ordinary skill in the art. The fact that he did not explicitly state this conclusion is harmless error.

Sharp contends that when these three patents are read in combination, it is evident that they reveal every element of claim 1. However, the courts have recognized that virtually all inventions are some combination of previously known elements.[33] Mr. Beery testified that the invention embodied in claim 1 was "super creative."[34] The ALJ found this testimony persuasive.[35] Moreover, the ALJ found

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[33] See, e.g., Environmental Designs Ltd. v. Union Oil Co., 713 F.2d 696, 698 (Fed. Cir. 1983), cert. den., U.S. 104 S. Ct. 709 (1984).

[34] The ALJ noted that Mr. Beery, an employee of ITT, the parent corporation of Qume, and Mr. Grundherr, the inventor of the '129 device, were both interested parties. The ALJ found their testimony credible in view of corroborating testimony from one of Respondents' witnesses. ID at 56 n.6.

[35] Mr. Grundherr was questioned by Sharp on this subject at the hearing:

> Q So you took standard components and combined them in a standard way with a standard feedback loop to add to a standard optical encoder? Isn't that correct?
>
> A Yes, but it was never done before with an optical encoder as far as I know.

(Footnote continued to page 18)

"[t]he optical encoder design contributed to a smaller, faster, more reliable printer with fewer moving parts . . ." and thus contributed to the commercial success of the printer. Commercial success is an important secondary consideration on the question of obviousness.[36] This success, in conjunction with Mr. Beery's testimony and the thorough analysis of the prior art by the ALJ, provides sufficient support to uphold the ALJ.

It should be noted that the three patents discussed above were not considered in combination by the patent office. In fact, two of the patents apparently were not cited as prior art at all. In a recent district court case, however, it was once again reiterated that "all evidence, whether considered by the examiner or not, must be olear•cand -- convincing to prove facts capable of overcoming the presumption."[37] Respondent Sharp has not met this burden.

(Footnote continued from page 17)

Transcript at 792.

"Graham v. John Deere Co., 383 U.S. 1 (1966).

[37]Ralston Purina Co. v. Far-Mar-Co. Inc., 586 F. Supp. 1176, 1212 (D. Kan. 1984) (citing American Hoist & Derrick Co. v. Sowa & Sons, 725 F.2d 1350, 1360 (Fed. Cir. 1984) and Connell v. Sears, Roebuck & Co., 722 F.2d 1542, 1549 (Fed. Cir. 1983)).

b. Claim 8

I adopt the ALJ's findings in upholding the validity of claim 8 under 35 U.S.C. S 103 (1980).

3. Whether the '129 patent is invalid for failure to disclose "best mode" as required by 35 U.S.C. S 112 (1980).

I concur with the majority in affirming the ALJ's decision to reject Respondents' argument that the '129 patent failed to disclose the best mode contemplated by the inventor.

4. Whether the '129 patent is unenforceable by reason of inequitable conduct before the United States Patent and Trademark Office in connection with the patent applicant's alleged failure to disclose relevant prior art consisting of the Hy Type I printer and manual and certain optical encoders manufactured by Litton Disc.[38]

a. Inequitable Conduct

The Patent Act of 1952 provides that unenforceability is a defense to a patent infringement suit.[39] Inequitable conduct before

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[38] Commissioner Lodwick concurs with Vice Chairman Liebeler regarding this issue.

[39] 35 U.S.C. S 282 (1980).

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the Patent and Tradeiark Office renders a patent unenforceable in its entirety.[40]

In the parent patent application for the '129 patent, the patent examiner twice cited as prior art a patent (the '509 patent) that had been issued to Grundherr. Without any explanation to the patent attorney, however, the examiner made no reference to the '509 patent in the continuation application that resulted in the '129 patent. Apparently, the omission of the reference by the examiner was because the '509 patent had an issuance date of January 7, 1975, which was after the filing date of the parent application, and the '509 patent and the '129 application had the same inventive entity (Grundherr). Respondents allege that the failu-re of the patent attorney to bring-the coameccial-embodiment of the patent to- the attention of the patent examiner constituted inequitable conduct. The ALJ found the alleged inequitable conduct in the instant case to be perhaps an "oversight or an erroneous judgment made in good faith."[41]

In J.P. Stevens & Co., Inc. v. Lex Tex Ltd.,

40see J.P. Stevens & Co., Inc. v. Lex Tex Ltd., Inc., 747 F.2d 1553, 1561 (Fed. Cir. 1984).

[41] ID at 222 (quoting Orthopedic Equipment Co. v. All Orthopedic Appliances, 707 F.2d 1376, 1383 (Fed. Cir. 1983)).

Inc.,[42] the CAFC held that to establish inequitable conduct, both "threshold materiality" and "threshold intent" must be shown. There, the applicants failed to disclose two patents. Weiss and DaGasso, that were "clearly important." After this finding of materiality, the court considered whether the requisite intent was present. The court noted that proof of "deliberate scheming" was not necessary; gross negligence was enough.[43] The court found that "[a]pplicants clearly should have known of the materiality of Weiss and DaGasso, especially after they took licenses under Weiss and its counterparts. had their foreign applications rejected on Weiss, and had similar claims in their virtually identical [earlier patent] application rejected on DaGasso."[44] The court found that even if this were not deliberate scheming, "there was clearly reckless or grossly negligent activity."[45]

In order to find inequitable conduct, there must be clear and convincing evidence that the two

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[42] 747 F.2d 1553 (Fed. Cir. 1984).

[43] Id. at 1560.

[44] Id. at 1567.

[45] Id. at 1567.

thresholds have been•met.[46] The evidence before me is insufficient to justify overruling the ALJ's determination with respect to intent. There seems to be little doubt that if the '509 patent was not a proper reference, then the Hy Type printer and manual were the most material prior art.[47] However, the ALJ found, and I agree, that arguably section 304 of the Manual of Patent Examining Procedure could be read to indicate that the prior application of the same inventor may become a prior art reference to a second application, if the first one has been assigned. This rule only applies when the applications are copending, as was the case here for the period between July 1, 1974 and January 7, 1975. This rule raises the question as to whether the printer and manual were material prior art.

I have two other concerns. First, there is some evidence on the record that the patent attorney did not know of the commercial embodiment of the '509 patent (the Hy Type I printer and/or maintenance

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[46] 747 F.2d at 1559, 1564.

[47] ID at 221.

manual) during prosecution of the '129 patent.[48] An attorney will not be held to the knowledge of the inventor where the inventor is not knowledgeable about patent law.[49] Second, the examiner cited the '509 patent twice. Was the examiner grossly negligent in these acts? Does reliance on the examiner constitute gross negligence? I am not prepared to answer either of these questions in the affirmative. The line between gross negligence and negligence is far from clear.[50] The ALJ had the parties before him and believed the patent attorney, concluding that the error may have been simple negligence or oversight. I concur with the ALJ and therefore am unable to find clear and convincing evidence of inequitable conduct by the patent attorney prosecuting the '129 patent.

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[48] Transcript at 1135.

[49] Kansas Jack. Inc.. v. Kuhn, 719 F.2d 1144, 1152 (Fed. Cir. 1983); In re Kubicek, 200 USPQ 545 (Comm'r Pat. & Tm. 1978).

[50] In J.P. Stevens. the court stated that "gross negligence is present when the actor, judged as a reasonable person in his position, should have known of the materiality of a withheld reference." 747 F.2d at 1560. Although the court says that it is defining gross negligence, its definition corresponds with that of negligence. The court however goes on to conclude that simple negligence, oversight, or a good faith error of judgment are insufficient proof of intent. This seems to be inconsistent. See also Argus Chemical Corp. v. Fibre Glass-Evercoat Co., Inc.. Appeal No. 84-1418 (Fed. Cir. Apr. 4. 1985).

b. I join the majority in its determination not to reverse the ALJ's decision concerning the purchase of the optical discs from Litton and Disc.

5. Whether the devices manufactured and imported by Respondents infringe claim 8 of the '129 patent?[51]

I would affirm the ALJ's determination that file wrapper estoppel does not limit the range of equivalents for independent claim 8.[52] At issue are remarks directed toward claims 8-14, made by the patent attorney during prosecution of the '129 patent. Respondents contend that the remarks should be read to apply to claim 8, thereby limiting coverage of the claim to situations where the print wheel is in position before the hammer intensity information is fetched.

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[51]The Commission was especially interested in the effect, if any, of prosecution history estoppel on the question of infringement under the doctrine of equivalents.

[52]The doctrine of equivalents provides that infringement will not be avoided if the device "performs substantially the same function in substantially the same way to obtain the same result." Graver Tank & Mfg. Co., Inc. v. Linde Air Products Co., 339 U.S. 605, 608 (1958). A means plus function claim, such as claim 8, is construed to cover the corresponding structure, material or acts described in the specification and equivalents thereof. 35 U.S.C. 112 (1980). File wrapper estoppel is used to limit the range of equivalents. Hughes Aircraft Corp. Co. v. United States, 717 F.2d 1351, 1362 (Fed. Cir. 1983); Palumbo v. Don-Joy Co., Appeal No. 84-1691 (Fed. Cir. May 20, 1985).

In view of the language of claim 11 that provides specifically for this limitation, I would affirm the ALJ's finding that these remarks did not apply to claim 8. I do not base this conclusion on the ALJ's finding that it was "unnecessary" for the patent attorney to restrict claim 8. Courts do not speculate whether a particular claim limitation is necessary to overcome a prior art rejection by the examiner.[53] Rather, I refuse to assume that the particular remark in question was directed toward claim 8 when no amendment to claim 8 was made and the limiting language is in fact found in claim 11.[54] In D.M.I.. Inc., v. Deere & Co.,[55] the alleged infringer argued that a restriction present in a dependent claim also applied to the independent claim. The CAFC reiterated, "Where some claims are broad and others narrow, the narrow claim limitations cannot be read into the broad whether to avoid

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[53] See Prodyne Enterprises. Inc. v. Julie Pomerantz. Inc.. 743 F.2d 1581, 1583 (Fed. Cir. 1984); Kinzenbaw v. Deere & Co., 741 F.2d 383, 389 (Fed. Cir. 1984).

[54] ID at 118 (FF 215), 235.

[55] 755 F.2d 1570.

invalidity or to escape infringement."[56] The court noted that the prosecution history of the application should be used to interpret the patent, but that there was nothing in the file wrapper to suggest the limitation argued by the alleged infringer.[57]

Claim 8 of the '129 patent was amended to overcome a specific prior art objection. The amendment explicitly stated that the improvement in claim 8 was a memory device with a first portion and a second portion and a means for sequentially accessing these portions. Nothing In claim 8 refees to whether the printer must be stationary befofe the hammer intensity is fetched. The remarks by the patent attorney are ambiguous as to whethef the limitation applies to claim 8. This limrfation is present in the narrow claim. Following D.M.I., I decline to read this limitation into claim 8 on the basis of the record before me. Complainant is not attempting to regain subject matter surrendered during the prosecution of the patent application.

The purpose behind the doctrine of file wrapper estoppel is to provide knowledge to the public.

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[56] Id. at 1574 (quoting Deere & Co. v. Int'l Harvester Co., 658 F.2d 1137, 1141 (7th Cir.), cert. den., 454 U.S. 969 (1981).

[57] Id. at 1574 n.2. See also Palumbo v. Don-Joy Co., Appeal No. 84-1691 at 15 (Fed. Cir. May 20. 1985).

Files are open to the public. By looking at the file, a potential competitor can determine whether his product would be covered by the claims. Patent language is sometimes ambiguous, so it is often necessary to explore the rationale behind changes that are made to understand fully the nature of the improvements embodied in the claims.[58]

In Kinzenbaw v. Deere & Co.,[59] the applicant added a limitation to his claim in response to a rejection by the patent examiner based on a cited reference. Although the claim might have been allowed with a narrower limitation, nevertheless the broad limitation was made. Thus, the court found Deere offered "no convincing reason why a competing manufacturer was not justified in assuming that if he built a planter in which the radius of the wheels was greater than that of the disc, *he* would not infringe the Pust patent."

Conversely, in the instant case, in reading the patent, a competing manufacturer would have no reason to believe that claim 8 only applied to devices in which the rotary wheel was in position before the

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[58] Kinzenbaw v. Deere & Co., 741 F.2d 383 (Fed. Cir. 1984).

[59] Id at 389.

hammer intensity infOrmation was fetched. The remarks found in the file clearly relate to the subject matter in claim 11.[60] Thus, this case is one in which the principles Used in finding equivalence are properly invoked "to protect inventors from unscrupulous copyists and unanticipated equivalents."[61]

"Complainant argues that the ambiguity in the patent attorney's remarks is removed if one views them as merely descriptive of one embodiment of-the '129 patent. In Vulcan, Inc. v. Fordees Corp., 211 USPQ 852, 860 (6th Cir. 1981), the court stated, "Although the file history does contain certain remarks that stress base support means, we need not infer an intention that the remarks are exclusive. Those statements were made in an effort to describe the device and to distinguish the prior art generally. 'father than to distinguish the prior art in terms of patentability." There is some reason to believe that the remarks in the instant case were- – – descriptive both because they were unnecessary to achieve patentability over prior art and because the limitation is present in claim 11.

[61] 741 F.2d at 389 (citations omitted). Complainant correctly points out that Builders Concrete. Inc., v. Bremerton Concrete Products Co.. Appeal No. 84-1292 (Fed. Cir. Mar. 4, 1985), is not to the contrary. In Builders, the applicant amended his claim 1 to overcome prior art objections, but made no amendment to claim 10, the claim in suit. The court held:

> The fact that the "passage" clause of patent claim 10 was not itself amended during prosecution does not mean that it can be extended by the doctrine of equivalents to cover the precise subject matter that was relinquished in order to obtain allowance of claim 1. It is clear from the prosecution history that the allowance of claim 1, the broadest claim with respect to the other elements of the float, depended on the amendment narrowing its "passage" definition to that of claim 10.

Id. at 10. In the instant case, no limiting amendment was made to the broad claim and hence Builders is inapposite.

I would also affirm the ALJ's determination that claim 8 does not limit the memory device to a single-chip device having only two portions for storing data. The memory device in the Triumph-Adler typewriters are the equivalent of that called for under the '129 patent.

I, therefore, would affirm the ALJ's determination that Respondents Sharp, Nakajima and Triumph-Adler all infringe the '129 patent.

6. Whether the importation or sale of Respondents' devices has the effect or tendency to destroy or substantially injure an "industry. . . . in the United States."

a. Joinder of--the Rotary Wheels I ala RotarY Wheels II Investigations and Segmentation of the Market

The ALJ determined that the domestic industry consisted of Complainant's operations in San Jose, California and Puerto Rico "devoted to the

[62] Qume was also Complainant in an earlier investigation involving exploitation of the same patent. Certain Rotary Wheel Printers, Inv. No. 337-TA-145. There were different respondents in that case. The petition for that investigation was filed in March 1983. For purposes of this section. the first investigation will be referred to as Rotary Wheels I and the instant investigation as Rotary Wheels II.

exploitation of the patent."[63] Some manufacturing, engineering and marketing takes place in the San Jose facility. Most domestic manufacturing occurs in Puerto Rico.[64] Since the filing date of the petition in the instant case, there has been no manufacturing by Complainant of low speed printers utilizing the '129 patent. In 1983, during the pendency of Rotary Wheels I, a low speed printer was produced in Puerto Rico. The ALJ determined that Rotary Wheels II was essentially an extension of Rotary Wheels I and that the manufacturing of the low speed printer should be recognized as part of the domestic activity affected by the imports subject to this investigation. In addition, the ALJ aggregated the imports of the Respondents that settled in both Rotary Wheels I and Rotary Wheels II together with the imports of the nonsettling Respondents in Rotary Wheels II.

I do not reach the issue of the relevant time frame, nor the issue of aggregation, in this case. The statute directs the Commission to remedy unfair

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[63] ID at 239.

[64] In addition, Complainant has a licensing agreement with a Japanese firm and a Taiwanese firm. ID at 153-64.

acts "the effect or tendency of which is to destroy or substantially injure an industry . . . in the United States . . .."[65] The legislative history to the Trade Reform Act of 1974 states that "Commission precedent, approved by the CCPA, establishes that the importation or domestic sale without license from the patent owner of articles manufactured abroad in accordance with the invention disclosed in an unexpired U.S. patent constitutes an unfair method of competition or unfair act within the meaning of section 337."[66] Nowhere in the statute or the legislative history is there any indication that the Commission should engage in the same like product/domestic industry arfallisis thiiis required by statute in Title VII and escape clause cases.- In dumping and subsidy cases, the Commission must determine the producers of the like product, defined as the domestic product that is "like, Oe in the absence of like, most similar in characteristics and uses with the article . . ." subject to investigation.[67]

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[65] Section 337, Tariff Act of 1930, 19 U.S.C. S 1337(a) (1980).

[66] Trade Reform Act of 1973, H.R. 571, 93d Cong. 1st Sess. 78 (1973).

[67] Tariff Act of 1930, 19 U.S.C. 1677(10). See also Section 201(b)(1), 19 U.S.C. 2251(b)(1) (1980) (Escape Clause).

.The anti-dumping and subsidy laws go into great detail as to what to look for in terms of injury. For example, decreased production or capacity utilization, price suppression, lost profits, and reduced employment are among the factors to be considered. In order to evaluate any of these criteria, it is necessary to define a domestic industry. As noted above, the statute provides such a definition.

Section 337 enumerates no such laundry list. There is no need for such a precise definition of domestic industry. As the CAFC noted in Bally/Midway Mfa. Co. v. USITC,[68] Congress "enacted section 337 to 'prevent evety type and form of unfair practice' and to provide 'a more adequate protecticid to American industry than any anti-dumping statute the country has ever had . .

Viewed in opposition to Title VII, there is an implicit recognition within the statutory framework of Section 337 that patents can be exploited in many ways. Such exploitation would quickly test the bounds of like product within Title VII. This is

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[68] 714 F.2d 1117, 1124 (Fed. Cir. 1983) (quoting S. Rep. No. 595, 67th Cong. 2d Sess. 3 (1922).

precisely why no such limitation exists in Section 337.

A Section 337 analysis need not address the issue of competitive products. To the extent that the products are directly competitive, the substantial injury may appear in the form of lost sales or depressed prices. If the products are not directly competitive, the tendency to injure appears in the form of lost royalties and the loss of the choice as to how one will exploit one's own property right. From a policy standpoint, neither of these considerations should be neglected. Inventiveness, and hence progress, depends on the protection of property rights. Moreover, a strict construction of the statute indicates that -Congress, at the very least, does not want an analysis similar to that found in Title VII. I suggest that the appropriate definition of a domestic industry would include all forms of exploitation of a domestic patent.

For instance, in the present case the patent can be exploited in word processing systems or typewriters, in fast machines or slow machines. The inquiry in Title VII would commence with a discussion of the domestic products that are "like" the imports. Such an inquiry is required by Title VII, but not by Section 337. Complainant argues that the printers and typewriters do not constitute independent economic product markets, but rather, the market consists of a continuum, with its products in the middle to high range of the market. I agree with Complainant that its domestic product does indeed compete with the imports. I believe, however, that this finding is unnecessary because the exploitation of the '129 patent need not occur in the same market segment as the imports.[69] Therefore, I do not reach the issue of the appropriate time frame for this investigation.

b. Aggregation of Imports of Settled Respondents

The ALJ included imports from settled Respondents in Rotary Wheels I and-II in reaching his conclusion that the effect or tendency of Respondents' unfair acts is to destroy or substantially injure the domestic industry. Because I find that the imports of infringing printers and typewriters by remaining Respondents are sufficient to justify the finding of

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"The ALJ excluded certain of Respondents' typewriter models from his finding of violation because they were not interfaceable with word processing systems. This determination is not presently before the Commission for review.

a violation of Section 337.[70] I do not reach this issue.

c. Substantial Injury and Tendency to Substantially Injure

Complainant is the owner of the patent rights under the '129 patent and is, therefore, entitled to sell, license to sell, or prevent sales of devices that exploit the patent. Respondents have made substantial sales of devices that infringe the '129 patent. I would, therefore, affirm the result reached by the ALJ in finding that the imports by Respondents cause substantial injury and a tendency to injure the domestic industry.

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[70] See my discussion of tendency to injure in Certain Optical Wavequide Fibers, Inv. No. 337-TA-189, USITC Pub. No. (1985) (Vice Chairman Liebeler dissenting).

APPENDIX

U. S DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

January 25, 1984
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IIIS IS TO CERTIFY that the annexed is a true copy from the records of this otTice

f **the printed Specification and Drawings of U.S. Patent 4,118,129.**

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COMMISSIONER OF PATENTS AN1) TRADEMARKS

C. L. SiZe
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tjnited States Patent [193 ..1111 4,118,129
Grundber? 1451 Oct. 3, 1978

is tj ROTARY WHEEL PRZTLNC SYSTE1

1753 Inventor: Willy J. Grundberr, Sunnyvale, Calif.

1731 Assignee Qum Corporation, Hayward, Calif:

1211 Apt. No.: 700,654

1221 Ffied: Jan. 23, 1976

Related US. Application Data

1633 Conti:sus:ion of S. No. 445.65. Id. 1.197x,, abandoned.

151] 1st. C.: 8413 1/30
1521 US. C. 400/144.2; 403/61; 403/154.4; 403/157.3; 403/3=4 250/203'
[sgl Field of Saudi 197/1 R., II, 49.53. 197/46; 101113.03. 93.13, 93.14, 93.19.93.19; 250/201, 570; 311/696 6-1 t32

1561 Rderenue Cited

U.S. PATENT DOCUNCENTS

3...n740a 1/1966 Jon; ---- 19709
Lit4.r5 6/1971 kteekkasiLeral. ' 313160
3.771161 11/1973 Bolsi 197/13 X
3.7:9.971 2/1974 Deyeno et al. 197/1S
3.139.539 1/1975 Alruirtall 230i X
40,1304 1/1977 Lundquist 101/93.03

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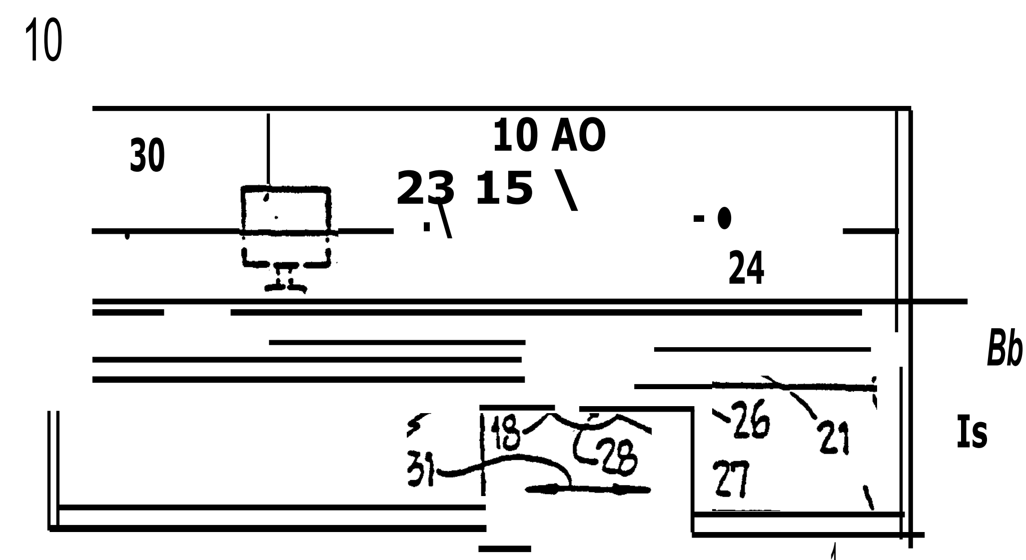
ABSTRACT

The prbst wised and carriage position control signal generators rah employ an LE:3 fight soup far Ultra. sating light sensitive defeats associated with the timing track of an =case disc mutably 'notated on the print wheel or carriage motor shalt The detectors are arranged to g=teraze a pair of signal trains having a, consent phase displacement in response to f011tiCi32 of the asso...:••ei disc. Thee signal trains are shaped and processed to provide position reference signals used to control an associated position counter trait and an electronic servo control system' for driving the assocated motor. the servo control system having both a position and a rate mode of operation. A separate fight see= is arranged to *be* constantly illuntineted by the T.= source to provide intensity monitoring signals which are cot spared with a reference voltage in a feedback so that any variation in the light intensity is autatiall-=11y carrecteL The elect:rook ,corral system **Provides** variable hactuner *striking* intensity taBored to the nidividna-chasetem or symbols coespsiiing the print wheel font. A memory stares ha:livid:al address thanes= each corresponding to Efferent on= of the print wheel symbols and individual lsentree intensity **chine=** associated with clifferent ones of the address eistricters;•Whess the print wheel is rotated to the proper•osition, the corresponding *hammer* intensity character is fetched from memory and used to spe&y the 'intensity with which the symbol is isnpretsed spins the print median by a solasoid banter drive =it.

14 Clams, 16 Drawing Fire=



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01)000 02

' ROTARY *i; *TLNG* SYSTEM

reis is a comitiostiott oral:piked= Sc. No. *425.033.* pd July I. 1974 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to electromechanical priming devices of the type employing a rotary print whml. More parriculariy. this invention reams to printing systems *at* the type noted. wherein the rotary print to wit= is both rotated and translated by a pair of motors ender control of an ele=ronic control system.

Rotary printing systems* are known in which the ratary print wheel is manned on a carriage for treadsties across the width of the print throat area during printing. The carriage is typically mandated from left to right through a series of cables *and* pulleys driven inurementally by a D.C. motor controlled by a suitable elec. =tic central :ye= As the carriage-wheel assembly • is translated from print pesixion to print position along a line. the print wheel is rotated so that the character pad besting the nest character to be printed is aligaed with the striking end of a print Lamm= also mounted on the carriage. when the carriage is enermestertly capped. Whet the carriage stops. the print hammer is =axed to impress the charm= borne by the pad against an Wing nbbon and the face of the printing =edit to print that clura==. After the print hammer rebounds. the carriage is translated to the next character locadoz, the print wheel is rotated so that the proper character pad is aligned with the print hast=e, and the nett charamer is printed. This preens =Mims cas=k a complete line has be= so prnted, eta which the carriage is =creed to the starting posidion hs preparation far priming.the nest line of char ems

Proper cape aticre of rotary printing systems depends on a mutt=of factors. Festly,, accurate posidaning esm.haetis= must be employed for bath the carriage amslation mmlatims and the print win= zota=g_ _ =barb= to insure that the chas=e= *are* printed ,at =may the right location -with the proper orientation. Both optical and magnetic =cod= have been ens- played in the past for this purpose, and wi=le smith:. tory for some applications particularly low speed sp. plienicres • have not proven altagethor satisfactory in applications requiring a wide variety of character spec. kg or feints having diiTciag total numb=s of chars:. um.

Anothc factor critically affeng paforitan= of chaise-a =my prating systems is the manner in which the print hammer is opens= during the actual printing of a char- am; In the past, ha--sorer drive =in have been de- tied to provide a consist= hamster crating force • regodless of the c..rar-c being printed in an effort to obtain uniform print density from thane= tp.chiree... W and line to line. However;not all chara=mr Oven font =eat *an* identical swain for= in order to prat with uniform deity. In far. difre-at font char- have beta fond to require different mim ag for= in *order* to achieve uniform density along an entire line of dliTc=tt chars==. On the other: hind, in some applications it is desirable Id print sel=ed chaser ten or words or phrases with a different density from the remaining priced trattmial is order to improve the intortnationsl content of the document bang print, =•f.. to provide italics; a particular emphasis for a given %IT:bal. word or phase or the Is. Similarly, a hammer drive unit having the capanty to provide variable ham- met striking force is highly desirable when the monated printing system is =ployed to prod= sevens.' copies of the donna= being printed in applications where the total numb= of copies required varies from documett to doeummt. Conventional hannner drive units providing only a constant hammer railingforce are totally unsuited for three applications having one or more of the above requirements.

SUMMARY OF THE INVE'rn°241

The invention camprises a rotary prinskag system *which* is extremely inexpensive to fabricate. which provides extremely flexible and precise print wheel and carriage positioning at high speeds. and which provides a variable print b=a=ser =sling force capable of being adjusted over a wide range of nageitudes. In the pre- Armed embodiment. the print wheel and carriage stepping motors are each provided with an apto•electronie •position sensing circuit far gen:ming precise position can=al signals for the S310C.22/115 electronic coat= systems, the poiticat sensing =it having an apto.elec. monk feedback cir=it for providing precise self-regal:- ion of the magetitude of the output signals thee:from. The electronic control gyms= includes a character register for stating data representative of a character to be printed supplied from an associated source a men. cry device for staring bed: character selection informi. don and also *hammer* intensity information asseadated with the individual dame= on the print wheel fano print wheel paid= counter far gettessing signals in. diescive of the in angular position of the . print wheel; an arithmetic unit for gresaating signals representative of the angular position of the desired character an the print wheel relative to the character printing peeition, and the initial aptinsuct direction of rotation. of the whee I a =Sage position comma for indicating the instantannom position of the print wheel character relative to the nest charactc print position along a Eng sndst.timingend controL=it responsive to . the sepals generated by the afarementicoed =iss far generating coutrol signals for a hammer *lye ma, & print wheel drive unit and a carriage drive mit. as well' as timing signals far docking the print wheel and car- siege position coan=s and select signals for specifyieg read out of the character sale:don or the *hammerinteo*- slay information from the sensory.

The ebaraceer Went= information pardon o rtEr nteeseey spettlies the address on the priest wheel of a to be printed and is used to control the posi- ti=ng of the print wheel prior to the printing of a specided chance:. The h=earse it:I=21:y information portion of the memory sp=lies the intensity with which the print harmer is to stale the corresponding &anima-. on the print wheel and is *used* to control the alarmetc staling_iptensity during printing of the sped. cha.-e The forma is used -to control the posi- . toning of the print wheel prim to printing of a sp=ified chessmen the la= is used to control the hanmer iag inuarity during printing of the sp=.:Bed character. The ,:-rint wheel drive =it and the etrriage drive unit tech =erria servo control system operable m both a positiaa node and a ram mode, the fern= being =played when the print wheel or the carriage is rd wkly positioned for prim:mg. the latter being employed during =don of the print wheel or the carriage. In position=de. a refmence signal indicating devia6cm of the print wheel or carriage from a null position is used to gene=ts a =rr=tion signal to reposition then e n o o 3

Amber to the null minion. In rate =ode, , le=ce signals from the 11130dilasi opto- positics =set; -s:=It -are shaped sad 1a ;reside a pl=ality of sequ=tally *sa=pled* o:::: i*pals* ind1=--ir.; instzettneous velcdty of S I us»„r1:.-e, =ovw.ble ==.1=, while the position 6 = the ossocht. petition co=ter are con- a ===r:on stir-alre*sestative of a prede- Steel =mot veiodry. The instantaneous veloc. lipais zed the ideal velodry sir-als are cos:hived to Oeide an opt !==t =or corr=:= voltage for driv ; the =dated =our so that the motor is driven in dt a sea== as to each the optional acceleration- td--sdcz carve of the servo systc= in order to pod- ki the assochted moveable =e=ber to the proper Won without poshiceal overshoot.

Fa a full= =dm-standing of the =tare *and* Eaof the investinn. sedate should be bad to the kneg deailed des=ption taken in conjunction with k seco=pLaying drawings.

HDESC7C17TION OF TEE DRAWINGS

FIG. 1 is a top plan view of a rotary *hater embody- I the iovesrion;

FIG. 2 is a partialse=i0nal view take= along En= 1.2 of FIG. 1 illustrating the print wheel _optical en- de;

MG. :A is a front devational view of the pike assembly 14. _ „

FIG. 3 is a front elevadasal view of the optical en- deal= ——

FIG. 4 h a partial =Soul view taker along lines • of 1-4 of PIG. 2 showing the ispdcal encoder light hr:;

c 4 is a partial se=ianal view takes along lines 35 7IG. 2 illustradng the light recq=ors of the-- ...seed=

FIG. 6 is a pardal se=i0=1 view taken along lines l-Cof FIG. 2 1utrating the positional relatiouship-- the light scums and the encoder disc ti=ing AO

FIG. 7 is a partial sch=atie daps= of the optoclec.-- — W.: es=d= swim;

FIG. $ iis block discs= of the ele=rostic central- — -- m., a dap= of.!,he print whet position eineesee - lit *eparc 8;*

ItG. 10 is a diagram of the arithasede. =it of FIG. 1;

171G. 21 is a block dime= of the ti=ring and =trot I= of *FIG.* I;

GS. 17. and 13 are wave for= cliogranss Elustrazing pr=sdcz elite FIG. .3 system , —

FIG. 14 it a sch==lic block &Fs= of the, print hr.! drive nit; and

iFIG. LS is a ==it disgrz= of the h

1 r'ssc71.1716?4.°F •I PRE4r-Itipp_ -- .„ EStionzmN-7

,Turj..:g tow to the drawings, FIG. 1 is a top plan hw of a rotary prize-- =bodying the inveetion. jinr 10 has a psir of =d walls 11. 12 and a base 13 *for* Cam:; the el=mical and ne=ihnical co=pone=s of T,s=-femed =bodi=est. A carriage ass=ably 14 is suppor.ed on a pair of support rods IS, 16 .g lamrally betw= r:de walls 11. 32. Carriage Sly 14 includes a hose plate 12 which provides }art for a rotary priet wheel drive assembly 23 ic ,m in FIG. 1 a print bar=er solenoid assembly 21, an ink :fob= =midge 2, sad_ a ==idge drive :n em tos (not shown), and a pair of Y.= ribbon ;hid= 33, 24„ lit=t *ha*=== sol=eid ass=biy 21 =eludes a truss: lauble hare== IS, 1 solenoid 26, a pivotable h a swag sr= 2,7 =d a ht2.:-,.= reb=nd stop 23.

: Ink abort cartridge 22 is pref=ably a cartthige efe ta type di:eh:net in e===only =signed co-p=ding Liz. Patent application S. No. 449.131, Bled MILL 7,197{., The cartridge drive appestats for =midge 22 is puler. ably the apples= disclosed in commonly assigned eopending U.S. Paten application. S=. No. 442,1,4% filet Mar. 7, 1974.

A conventional plea 30 is mutably si=ted to =.:5 walls 11,12 renrwsrdly of carriage assembly 14 and j a preferably provided with a netnual-a=santic feed ___ mechanism of the type disclosed in ca=stattly assigned co-pending U.S. Pas= application Sec No. 441470. filed *Ms:.* 7,974.

Carriage assembly *14* is translatei is the opposite 4:Erections ineli=ted by mow 32 by teems of a mem- gge ac motet 32 senzed to base 13 ad iltv ag a sheave 33 motosted act the drive shaft thereof, Rota- tional motion of sheave 33 is COSIVerted to transla.deend movement of strange assembly 14 by =ears of a drive — cable 34 witicl: is wrapped about sheave 33 received about a pair of pulleys 35, 36 se=redie end walls 2,2r respe=ively, and se=red to base plate LI of eaniage

In epee ion. it:trade= af'DC motor 32 with sigrals of a fast polarity or phase causes-settadon-of-alsessie-33 in a feu direevion which in turn results in the trasslasion perriage asse=bly_14-in-a-feet-dieeethen-byeshie 34.- Application of signals of an opposite polarity or *phase* to DC motor 32 cans= rotaticen of sheave 33 in the owes= dire=on resulting in transits:ion of an=iage assembly 14 in oberepposhe-aeenien, bye ew 8g,: -

'The various ==poneetreoerprisig ereettere•- control-system-sleschted-beiew..eie,metinneenentir - FIG. 1, but prde-ably are macnststet on coevericinsl -plug-inissistscieirectitboardviceasadinnprkezr-lett warily of plates 31L

FIG. -2-is a- prifrial *side eleratenar-vitorl* *irs"* the eanftgurztion of rosary print wheal drive :sac:Ably -.a4-exsztvesticsal revastlale- DC:usator411,-Itas output shaft 39 on one and of which a rotary print _asibed40-iaraelessably-saaarad-br4Inipprk•Whisordeso-a *-see* to FIG. 2A, story print what 40 has a plurality of radially eetentlin spokes 43 equiangularly dim motel about the ash the eat Each spoke 43 ==instes in *se* =larged eh= pad portion 44 as which a raised eh:tact= is =bossed. In the pref=red =bodice= rotary print whesi--404.provieled-withltspoket0"94'0 1" which ter=inate in character pads and the re=ar--'g two having an cedes pad which series to indicate the ate: drive =it. 33 posidon along a r=e of the next chat= to be printed . . .: 'Wilt ,tae. optical =pod= disc and counter logic dr scribe. below, 'Tour" print wheels having diffew numb=s of spokes up to a =a=== of 192 may be ertsploy as desired, to menthe requineserntts of a parr:color appli=tion.

Scared to the other end of DC =tor drive shaft 39 is an optical ant=i= disc 44 shown in FIG. 3. Disc .66 is preferably fabricated from an opaque mat=ial and is provided with a ===fe=tially arrangeek_5==p =sok cons sting of a plurality of transpor=t slots 47 for=d there Disc 46 is additionally provided with= index slot 43 fox=ed the: radially inwardly of the b=ier; track- As will be anon= to those skilled in the sr„ disc 46 may be fabricated in a compl==tary fish-ioe. if desired. of a transparent znate-isl in which case slots 47, 48 - would comprise opaque marks pia. thereon. In the preferred embodiment. the print wh=1 cooder disc has 192 timing track slots.

s-ureei to the encoder disc ad of D.C. motor 38 is s housing 50 having a downwardly opening dot 51 in which a portion of the encoder disc 46 is received. With rdercece to FIG. 4, a pair of light =lain; diodes 52.53 err other equival=t light source are s=urd in outer wall S4 of housing 50. With reference to FIG. 5, a pie-rZlitY of light sensitive elements 56-59 are secured in attract wall 54, elements 56 being positioned to receive light from source 53 and elements *57-S3* being posit dotted to receive light from source 52.

FIG. 6 illustrates the positional relationships between receptors 56-69 and timing slots 47, 48 of disc 46. As shown in this Fig., receptor 56 is positioned in housing so its alignment with the path of index, slot 48 in such a manner as to re....ve light from source 53 once per revolution when index slot 44 unblocks the fight path theretweeitt. Lightreeeptors *57,58* are mounted in the path of timing slots 47 so that the =touts of light tad-dent thereto from source 52 is c=trolledby timing slots 47„ In addition. light receptom 57, 58 are spaced along the timing track by a distance reined to theapacing of tinting slots 47 in such a =an= that the output signals from this pair of elements will alwaysleK degrees oat of phase Itt=eptor 9 is located above the upper edge of disc 4.6 so that light fro lossPeA-j.§.ceMihgoitsi betide= thereto whenever sources 52, 53 are energised.

With rearm= to FIG. 7, receptor 56 _comprises phototradsistor having a coll=or coupled to a source of reference voltage V and an emitter coupled to the input of a Schmitt trigs= circuit 60 or the De. The output of Schmitt trigger circuit -60 0. which is positive-icing pulse-u=eed INDEX-- occurring-ancet-pea--- revolution of print wheel 40, is coupled .tp tge.OOOrsit,..-4011141Z.Ottatilleichis =mind 61.

Light receptors. 57-59 are.tenov=ticnekplueomilsn403linnAlskt.theptrtfr=rsk=ehorSizteen each having s =bode coupled to came= ground, together with the cathode of light -emitting diode 32.-,114 The anode of photeeell 57 is coupled directly, and reedy by an lave= 62, Po the haptg-ef.44141 49etlit-boning unit 63. Simaluiy, the anode of photo:4 *St* is -coupled both directly sod its..tlitrZ37..in i4.1;310=042.......gP to signal conditioning unit 63. Signal conditioning =it 63 is a =nye:do:al device which independently amp-lies the individual signals V_I, V_I, V2, and V2, =Wes the =piratic of the amplified signals to levels syrnmet-ri=l about =re voltage. and adjusts the individual rig-ads for a peak-to-pesk amplitude of 20 volts._rho thus-conditioned =put signals from signal conditioning =it 63, designated V'_1 and V'2 are individually coupled to the hadividual inputs of a plurality of Schmitt trigger units 65, 66 *and* 67, each of which. &enemas a positive gttg pulse designeted X. Y and Z. respectively, when-eve: the input voltage thereto e=eds a predammMeel threshold level described below. Schmitt nigger ca-=its 65, 66 are configured to produ= a pulse output when the ma.gnitude of the voltage input thereto risen to 0:707 times the maximum amplitude of the input wave form. Schmitt tugger circuit 67 is configured to gmer-ate a positive pulse output whenever the input voltage thereto *wen=ds :=1:* volts in the positive direction. The X. Y and Z position signal pulse trains thus gmerned. which are illustrates! in FIG. 12, are applied to a print wheel position counts shown in FIG. 10 and *are* used to derive control signals for the purpose dnr.r.ih= be-low.

Output signals V's V'K V's and V'3 are also =pied to a print wh=1 drive unit shown in FIG. 14 for a pur-pose to be des=ibe..

An important feature of the preferred embodiment is the self-regulated control of the intensity of the r emitted by source 52, 53. Tile *acids* of int=sity photocell 59 is coupled to a first input of a diff=m--/ amplifier 68, the remaining input to which is a re==ce voltage derived from ground by a == diode 69. The output of amplifier 68 is coupled through a load irape: dance 70 to the ca element at's trarsistar71 used to regulate the tnagnitucle of the volage applied from a ref==ce voltage V to the anode of source M. In opera. don, as the light output of sources 52 or 53 mks, this cchange in intensity is seesed by photocell 59, thereby , altering the voltage =ass this denier.. This change in potential is se=ed by differential amplifier 63 so that the bias on _the ceetrol dement of =resistor 71 is ch=gesi, This changed bias causes the mignimide of the voltage applied to the anode of sour= 53 to be changed second. ingly to maintain the light output substantially ecessont.

A similar e=odadise and_self-regniaseeLopto-elec-tonic position saner is provided for carriage D.C. motor 32 to g=erste position *self= ide=ifying the instantaneous position of carrisge assembly 14 along the pri= *stri„Since th•* •¹•-.Pk•-tts areasibstantially_ideetsict.L_ to those already desmthed with rder=ce to FIGS. 2, 3 _and 44, *fordictskvas sze_nrairsed_truivsisd* prazity.

FIG. 8 shows the decoy:tic control system in the pre .=lacelins=t. Charam=aedzactiage dui gene rated by a conventional data source. such ss the output buffer register 80 of a digital computer, is coupled by a first and second data bus *1,12 to --seterregister gg-sed-aeositionvo==esairgiri -ter- Teeter S3 seonvettelead -device -capable- , ta-e-Landaming.s= response to the application:eta strobe 6puiseArkatlem, ehorSizteen seven bit ASCII code charamms. Pesidon caten= =it isseoeveecioosicooettenseepahlevf=eveser000hi., bit information specifying the numbs: of =mine ...betWeset edizonst-priuted, charay.gesha_respouseicuka_. application of a strobe pulse oa =obe 86. Position reibossolepla,ta.sititichalexa=age.pesi•—• don s=sor signals are applied from =Lap position sensor =it *El* for the purpose of eteppieg position count= unit 84. The esrriage podti= sensor signals 30 also coupled to *a* carriage drive =it &screed below via a bus EL The output of position counter unit U. =ad AC. is coupled to =inputel timing and eon-col =it 89 and also to the =rage drive =it via a bus 90.

The output of chzraeser *rrert=* 83 is coupled In the rr.-- data input of i read only memory, or ROM. 91 along with a control signal from timing and control unit &V ==ed SELECT. ROM 91 is a o=v=tional 256 by 8 bit unit which is functionally divided Use two halves GO schematically portrayed by the broke= line. The fur. half is used to stare the two's armpl==t of the posi-tion on the psi= wheel 40 of the charm.-= comprisag the print wheel font. The second half is used • sere: har=er Intensity characters which speey ek-6 U intensity with which the print 1 ==w is to be for the individual charact=s in the font. The SELEC.7 signal species the portion of Ghe ROM. *first c* second =don, from which a eharact= is to be me.

The chars= position characters are couplral by a / .data bus 92 to a lint input of an arit...eic =it 93 illus• trued in de•1 in FIG. 10. The harm= intensity char- so= are coupled by a data bus *94* to a hams= drive =it 95 shown in detail is FIG. 15 along with a control epal desigsated STRIXE from Bung and control unit 89. The output of hammer drive unit *95* controls the =onion of print hammer solenoid 96. •

The =seining input to arithmetic =it 93 is obtained via a data bus 97 from a position coo= =it 98 thus- =tad in detail in FIG. 9. Position count= unit SI sped- flea the instantaneous position of print wheel .40 during operation in =pause to the application of the X. Y. Z position pulses from wheel position sector 99, described above, and clock signals from timing and control unit •

Arithmetic unit 93 initially Ci3132paret the output of- position counter mit 98, specifying the initial position of print wheel 40, with the character =rpm from ROM 90 to determine the direction of rotation providing the- shortest angular travel path required to align the char- am.= pad bearing the desired character to be printed - with the trail=ing end of the solenoid 1 '•''•-•t•-• A signal spedfying the optimum rotational dire:don is coupled visit a condom= 100 to tinning and control unit 89. Asith-• mesa unit 93 also continuously con:pates the state of position count= unit 98 with the character from the' • first half of ROM 91 and grammes a multi-bit adgaal -- representative thrazot which is coupled via a data bus ' 101 to tarring and cattool unit 88 and via data bus 102 to a prat wheel drive =it 103. '

In addition to the SELECT and STR3XE signals noted above, timing and control =it 89 generates a- D1:R.F.CTION ca=rol signal and a MOVE PRINT signal. which *are* coupled to print wheel drive emit 203 used to control the rotation of print wheel DC motor 33.

Timing and control unit 89 also generates CLOCX sifsalrfat clocking positive counter units 24.93 and a _ control signal =mad MOVE CARRIAGE which is coupled to the input of a carriage drive =it 105 =en- daily similar to print wheel drive =it 103. Toe output ;- of carriage drive =it 105 isused to coma' the inert- mental rotation of carriage DC motor 32.

PIG. 9 ill=tratcs position ccranter 98. This =it in- eludes first and sezond.ptirs of control flip-flops 2471. 1= and 1=, r=pe=ivily. The first pair of control flip-flops 120. 121 control the operation of an up-pulse generator comprising a pair of ftip-flops 126. 177 and also enable a first conditioning flp-flop 130. The second • pair of coeval flip-flaps 2=, 13 shisilary =able the operation e a down-pulse generator 222, 179 and en- able the operation of a mooed conditioning flip-flop 131. Bath the up-pulse generator and the down-pulse generator are clocked by an ==nal clock g=ersted by il:rang and control unit 89, which in die preferred era- • • ..-ndim=t is a 503 XI-Etrelock· ignal tiara as shtiwn in --- FIG. 13. The up-pulse and down-pulse generators re-' sp=ively ino-e==t and d=entient a position co=t= 136. In the preferred thbocliment, position count= 136 is a stale of 236 ==t= modified *ss* shown to operate as a scale of 192 counter which is either el rd to zero aft= re=hing the ==t of 191 when Mo-e==ted by the up-pulse generator or is preset to a co=t of 1.91 *aft=* passing through zero when d=cm=ted by the down- pulse generator.

When reference to FIG.12, in operation in response to the re=ipt X. Y. and Z control signals from the print whet position sensor 99 (which it all be resne ebe are g==-4 whenever grant why is in=leomta, sowed) *one* of the two pairs of c=trol flip-flops 7.:14. 123 =shl= the associated pulse generator. depe 1dizt on the dire:ion of rotation of prMt wheel *40.* Wbc:i rotated in a first direction. 120 is set by the con=r=ce of Z true and positive Y =dim &fuze whiff a positive =tuition of X cause; flip-flop 122 be set thereby releasing flip-flops ='6.127. for checkl et by the inco--iog clock signal. In addition. the rec cirarap is r=oved from conditioning lip** 130 by tLe set condition of flip-flops 120,121

Thereafter, the next four clock pulses cycle the op. pulse rescues through four stum=ive binary st ates. resoling in the g=eation of an up-pulse on lead 1st which is applied to the incraneming input of come' 136. Member, *when* HOME us:Ishii:es true at the output of AND gate 116, flip-flops 1=1, 121 are una which disables up-pulse gem= flip-flops 226, 137 23 and err. ring flip-flop 130 until the net purge sego= of Z, Y. and X sigmas tc=m.

If counter 136 held a count of 191 before flip-flop was sra. a condition indicated by de:can pea 137-139, conditioning flip-flop 130 is set by the fliptep 23.126 Q true oat:diem and count= 136 is *dewed* to Imo • by the resoling output signal from OR gate 135. • Count= 136 is also cleared to zero by the dyed g=er- eased by OR. gate 135 in response to the generation of an output signal from AND gate 134 when HOME and 1247DM:_siguals are both true: ——

Opcssion of the position count= =it 98 in the down. mode is subramtially similar to that described above, with flip-Cops 122 . 123 er =meg the emetics of dawn- pulse generator flip-flops 1=, 129 and conditioning the operation of flip-flop 131. In this case, however, flip. ,Bop 2= is set by Z true and a subsore=mansition ofX - true, we flip-flop 123 is set by *'I* true oc=raing after op-flop 122 is sm. The resulting Teleaseof da%Va-pulsi .1'==ator flip-flaps 128. *129* canteralra generarke of _eagle • down-pube•on- lair 241' INLifich =ma= 136. In addition, if count= 136 holds a count of '2= sie rsed by decuic•pte 140 witraillip-frcip 122 medic= true count= 236 is pre= by conditioning flip-flop 331 to hold-a cot= of 191: Mt= =canes 134 has been d===ited, flip-Cops I=. 123 and 13k:re_ tes=lest-the•-appearanceoft 1107tirt-reirgiS1.

Position counter unit 98 also includes fourinvcthsg AND pus 105-112 far gee&-erbsg the 6.3i and 64 =mool sir...als also shown in FIG. 12 which are coupled to print wheel drive unit 103 far a purpete to be dm=sbe..

The IsMnt wheel petition-coma= 136 outputs. viz PC1-PC223 are each =opted to a first input of a dire:- ent one of a plurality of individual comparator in 142-149 of air.: melt unit 93 shown is FIG. 10, to- • :-To.he:-V'fith:the-dred print wheel petition chars.= Li= ROM 91 from the fun portion thereof. The re- ipe=ive amp= from individual comparators 142-149 we sampled is the following =an=

Initially the four most significant: bits output fro= ==paretors V.4-445 are sampled in a four-bit binary add= 150 to der--r=ine whether the &Trace= tom= the position of the character desired to be printed se:ti- fth by ROM 91 and the instantaneous wheel position s g-stm• the the number 96. If so, =oval gate 151 gen- raves an output pulse. trained REVTZSP-. irhi h c=" d:-..ions a plurality of esciusive OR gates 1W-1.19 to =able add= 160 to generate the two's consp1==t of

0006i;u1

the dif7=== signal tram comparators 142-149 noted With SE -ECT flip-flop above. In addition. the REVERSE signal is coupled to timing and =sta-ol =it $9 to condition this unit to g=- *=ate* a revue DIRECTION signal which. as noted above. is coupled to the print wheel drive unit 103.

If the diffc'ence signal is not gnaw than 96. the differert= =Arse= is simply *tr zIsietTed* through adder 160.

The differ=oe cleram= tamed A NV at the output of adder 160 is coupled to *a* zero dam.= 162 in timing and control =it 19 shown in FIG. 11. Zero detector 162 is a convention unit for gel===8 a signal of predeter- mined level whenever the input thereto is zero. The output of zero detector 162 is coupled to a first input of as *AND* gate 163. the rernairthog input to which is HOME signal from position counter unit 98. The output of *AND* gate 163 is coupled to the data input of a !We flip-flop 164 having a deck input coupled to the output of a clock generator 165.

The output of clock 163 *is* also coupled through a delay device 166 to a f= input of an *AND* gate 16, the reeeelleng inputs to which er th output of zee deewt 1 output " leveled by a conventional iavetta and the CI comprises a * The *AND* gaze 167 which delayed signal hldl. 25 =du that A NW equals zero, is coupled to the clock input res le D4rPe aphavi=g thc dall iliPt"Cap =Voltage V. The reset ioput to zi;flop obtained from the =vat of 2e= det=r 161 which causes flip-Clop 170 to reset when A I/transitions false. The output of flip-flop 170 is the clastrol signal MOVE PRDZI• which is noted shove, is coupled to an input of piistt-wh=.1 drive unit 103.

The output of delay unit 166 is also coupled to the dock input flip-flop 172 having s data input 23 coupled to the REVERSE control signal fro= arid:sae- tic =it 93. Flip-flop 172 it set whentifer REVERM • is true to gesause the DERECTION signal 112 this FIG. which is *abo* coupled to print wheel trivrunit 1113 -ttr control the direction of ?outlaw of priarwheel 43k The of flip-flop 164, which is 4 hi-level LF-CT signal used to designate the reading of *a charac.* ter from ebb= the first or second portion of ROM 90, is also coupled to the input of a conventional one shot 173 which provides a settling time for the m=hanical ear 45 menu e.g. print wheel 40, prior to-the impressien of a print symbol against the print radium. The output of *So./* L.= *one* shot 173 is coupled to the input of a HAMMER one shot 174 which g==ates STRUM control signal far triggs.-.ing open-ation of the hammer drive unit 95. The output of hammer one shot 174 is coupled to the input of a CARRIAGE one shot 175 whose output is coupled to the clock input of a D-type flip-flop 176 used to enable the =triage DC motor. The reset input to flip-flop 176 is obtained from the output of a zero det=or 179, sinsfizr to zero det=tor 162, whietr-..f generates an output signal wbent''er the carriage posi- bort counter unit IS; has be= inmuniented to the =3 state, indicting that the carriage is in the nest prop= print position. The output of =nap one shot 175 it also coupled via an invert= 177 to the input of a re= one shot 271 which g=catm a ram pulse to ruse~ flops 164 and 172 *after* one shot 173 times out

In opmation. with the carriage in the print position, in response to the mansion of a strobe pulse on strobe fine 35 (FIG. 8) the neat desired char= to be printed is caupl= via data bus SI to char:etc register 83 where it remains =o1 the appearance of the nest strobe pulse

164 initially reset (FIG. 11). The two's compl=t=t of this desired then= is read cut fro= ROM 91 and coupled to comparators 142-149 in aritimedc unit 93, together with the output of prim wheel position counter 136 in position =miter unit 98. A comparison of the two characters is made and flip-flop 172 of doting and control =it 39 is *sea* to the binary configuration corresponding to the optimum dir=on of rotation of print wheel 40. Substantially sbnuita. 170 is set by A W :=0 via zero dv=gar 162, inverter *168.* and Alm sue 167. th=eby enabling =us= of print wheel 44.111e output of adder 160 of aritl=edc =it 93 is sampled by z.--o detector 162 and print wheel is permitted to continue to rotate until A W equals zero, huficating that the print wheel is in the ready position.

VII= A Ver equals *zero,* VO is sorer to slate rotation of prim wheel 40 sad the stem HOME pulse pamits flip-tlop 164 to be set by deck 165 to change the level of the SE2= thereby spec- fyiog ohanoter resa.00t from the lower portion of ROM 91 and blceking AND gate 167. The hammer intality chuact= is thereafter coupled to ha== • drive unit 95 after which hammer one shot 174 g=er- ales a STRIRZ end signal, which =dm in the lomation of the print ha=mer solenoid 96. Aft= 1=3- ffiet tree., 174,timen cut carriage one shot 175, rer CARRIAGE flip- the e a tlt gen to S 7 tam1=1 tilthe 7 -:; - P eet1°26 "eettege is traasiatd p=on, the poem= counter unit is to marded the carriage position sensor =n1 A C equals sum. When A C egtulla 2="°. zero'-ecnr 179 resets flip-flop 176 to t==nale further carriage navel. Furth= op=adon =lc: already dense d. As Pmeeede e4 tuttenutesPe'ret fietl= drive UM of sew rtua- ,211x284 ate a Plerarg7 eletent=deltunteer"yi=hes--" Premidede eta having trausfer input ter•-- acr =real couPledleaPer!oivelrrolefer,=sigelr 07 sE. V', V'a respes=ively and a coottol input teremsal coo- Pled to re===e airah 401, 402, 43.44j =Pe:liven signals the fewer= bthtg suPPaad by Peet wheel 99 and Paid= ccertt= 91 The =fa output. 1 =tetinnla of switches 201-214 Ice coupled erthe *lutes =to versional diff==tiater =remit 217. The output.cf f=entiator 217 is coupled to a fast network re a ===g =3, the output of which is coupled to a at= So input of a differential anoPria= 209. A W signals are coupled via data bus 102 to the input velocity =cud= =1 having act aenhr=8 *rat coupled tag to the move print wheel =enrol signal from and control unit 89. Velocity decoder sn is a conventional eta--sit having a plurality of deader: gat= ftsperusive to the 7 .bit binary code *A.N1 chars= far* generating control signals reprtioniative of i d=ined motor velocity. These =Vol signals are coupled via data bus 212 to the input of a velocity select unit. 214. velocity select =it 214 has *an* =Mint input coupled to the DIRECTION control signal from ti and control =it 89. Velocity sel= unit 214 is a e=ven- tianal ciresit which g=erm= a voltage Laving a level representative of the desired motor velocity inregponse to the control signals input thereto from veleey de- cad= 211. The output of velocity isel= =it 214 is' coupled to the re=ining input of the su==ing junction =I.

...tovE PRINT Niel= . =sal siptal frog t=ang Led col unit 89 is Lisa coupled to the c=trol :roe.: of m electronic =sneer switch =6 having *a* t.-..=fc Lam-: =upled to V'$_t$ refc-mce dgais supplied by whe- position sensor 99. Tter.sfc switch 216 is S atic. Wh c„-mould is such a rn=nc that the V'$_t$ position si8=1 is couple- to the tra=fc output tc=iml thereof when-eve the MOVE PR-14T control signal is false *(Le.* whm the print wheel is in a statioaary =ode). The transfer otc of switch 226, designated POSITION ROR. is =upled to the first input of diffcmial att.plifier =3. The =+• :in input to diffc-mtial s=pra-fie 209 is co cold to po=d refaces potemial

The output of the dificentisl =plific 209 is coupled back by *a* reistance 218 to the *fiat* input of drive *ant-*plific =. The output of driver =Mc = is cou=ld the to paint wheel =our 38 and is used to control the acute-on thceof. The =oust driving circuit is ==pleted by a mica= =1 coupled to fond referee potentha 170, and feedback loop = coupled to the r= drivc. amplifier =.

Print whcl drive unit 103 coesprises an electronic servo cereal thmit for c=trolI=g the operation of print wheel motor 38 in two modes a position =ode and a rase =ode_ In the position mode, the =lie position of prior wheel 40 is =Qatar= by photor..11 57 to =zinnia the mid= of the wheel ecincid=t with the negative going =0 cessing point of voltage level V$_1$ (F10. 12). For this purpese, V) position signals coupled via trais-fc switch =6 to crifcemisl a=plifier 209, which got-eats a ===ion voltage of proper polarity and teag.. nit=le whenever print wheel 40 =rays from this posi-don. The resulting error voltage is :simplified by driver amplifier = and applied to motor 38 to reposition print wheel 40.

In the rue mode, sified by MOVE PRINT . co=c1 signal roc transfer switch 216 *ii* velodty =tar 38 is =coned by the , diffcc.= be the instautceenn motor velocity =d the sage= distance the wheel mast travel in order to reach the ;Tom print position. signified by AW. Ibis insures that the velocity of the motor 33 in any given instant tracks closely the opts al aceselcation decrier-atian curve of the servo :yr.= so that the wheel =at ire quickly pcdtiened to the prom print position with-out positicnal overshoot.

The instaataneous velocity of the print wheel 40 is =onitored by phomas 57.58 'odd represe=ted by . refer r.= ipals V's V's 12). These ipals see se ten =pled by =sic switches =1-204 ==olled by signals 6$_1$-4, so that dining the =tmval free 315' to 45' V*$_1$ is coupled through such-=ing ocwore =6 to the input of diffcentiamr =7; V'$_s$ is coupled e..=-=3 during the interval from 45' to 135'; V'$_t$ is coupled thereto during the interval fro= 135' to coupled thereto during the interval frocrs. 323* to I IS". Diffc=tiztor 27 in response to the input applied thereto g ates a reference output sign =I which is =izuous over the =ire 360' interval be:we= sti,!.adt---t =11 points and which is re-re ta-ewe of the ====ecus ve1c:Cry of print wheel 44.

At the same =e AW signals are dc.oded by velocity lend- 211 v.-hies cables erne of nine velocity sele= lines which are coupled to velocity selc: unit 214. Velocity =I= unit 214 in rcpome thereto g=c-ites a voltage rectote signal which is proportional to the =$_5$-slar position error. The resulting refers:et= simal is =upled to the sat= ling network 248.

Toe two rette=e sigrals from difIC—:=tor 207 mt vel=7 select =it 214 *Ere* contained in s•=•g a$_e$„ week and used to ==rol the spa= of *sector* zg =I the two *.s -mac* sipals cantc-bal=ce ca..1$_1$ *tie net* output of stuccoing network 208 k scr., the velocity of actor 38 is constant.

As actor 33 turns, the sisr-lc Position ctor Cu*,. ash= and at W changes a=ordingly, tic:by selcdng a &ice= *one* of the nine velocity select Bus in bus 2:22. In re=pose thereto, velocity select =it 214 g,encanet a retool voltage signal having a diffcent =agneitzd$_e$ corresp=d=g to the altered angular posidon cror, with the result that the velocity of motor 38 is the ac=rdiegly. The velocity and position error are thus coesinnously monitored until print wheel 40 is whieh$_t$ boundary of the appropriate =It position.

With reference to FIG. 12. =en= of this pa$_s$hi$_{ce}$ is signifed by it 17 equals zoo which resets fIrp-tlop thceby tenating the rate mode and re-=ion. sizing hop= of lag tam positian =ode. Final pa:biotin; of print whe$_a$l 44 in the =II position is ca=rolled by ref=== sigma V'$_t$ whida is eranchitted by a tr$_a$nsf$_e$r s$_w$it$_c$h 216 an . abled by MOVE PRINT ' l=s false to the input of differ =pad. 209.

In order to permit the er=1 wheel 44 to settle to this nuIl ;odd= settle one shot 113 provides an approi. =scaly two reuriseeond delay before *hammer* one shot 74 is accosted.-As noted aboveraconrion of *hanteiii* one shot 74 onuses the g=erazion of a =he pulse fat barer= drive =it 95.

Welt =fag= to *FIG.* 73, bacces$_c$r d$_r$i$_{ve}$ $_{tsar}$ 9g comprises a vicar/ of parallel branches of Invert g AND ler-es =1238 and resistances 241-24 elide bras= having an iaput tett=inal coupled to a differ one of the condemars in but 94 and an output terusizal coupled toil come= conductor 254-cattp1Cd through a *ance=* to a source of reference voltage. Can.-mon tam=s1 250 is *Ltd Coupled to = R-C network connar=ing a reds= 252 and a capeniter 29, the week bCng coupled-us the ii=e-constost inpard a convestiocal one shot einmit 253. The STAMM signal from threitsg and =col unit 89 is =pled to thitriggss input of one shot 253, which g=crates an output pulse whose le mirth in.:propordattal-to-theldifratiialiaige sp-plied at the time ==tant =put thereto after the sneer; an of the S.P..1= signal. The output of one shot 255 is peeled by an AND gate 257 enabled' by ST .13a =ncol si.a.1 to the control input of a control tranistor 258. Control transinar 258 is coupled to a power nan-icor .7^{4}9 having the er=ittcooll-or *cis= coupled in series with hammer solcsoid coil 260 of pea= Isti=ieer solenoid 96 by a resistor 261. The free terminal of mil 260 is =srpled to a high voltage retc.c= sour= *+Vet:* the cds:tc of =ad:tor =9 is coupled to a second high voltage recta= sac= -V$_N$.

In the operation. the gm:ration of a particular ham-a= i==ity chars= on but 94 by the mplication of a SELZ= signsakl to the =put of ROM 91 causes the se!. = of predr—=ited ones of the heri=etal branches having invc-Mg AND vacs =1438 and rod=== :41-24. The value of resistances 241-248 are pr--el.=.= to establish a preeletc=ned voltage level at $_a$tunedon 163 for corn's particular horivezti branch thus selectee' Capadtor 153 charges up this voltage level through resistance 152 and one shaft-5* triggered by the appsaa= of the STRIKE control signal applied to the trigger input thereto. The output of one shot 253 is coupled through AND 82:2001,6tro

IX- :antral signal ared causes control transistor swi•ch on power transistor 259, thereby causing ;•nt harnm= solenoid 96 to be strzat... Solenoid ;; ..es accused unite one shot 235 times out, which .3 site a variable intevsl detemined by the hem- intzosity them:tee input. In the prefered ecebocli- rzt. this Le,teval is variable from about 1.3 to about 3.0 hands. As wfil be apparent *to* those skilled in the or.. the ..,.erval may be legthmed or shortened by }• the values of resistors 141-1.43 to meet the seeuir=em of a particular application.

Reary pin= control *syst=s* constructed in never gze= with the teachings of the invention provide et- rely flexible control over the hammer %treating listen- sty. by virtue of the fact that each character in the first .,,,rooti of ROM 90 can have a unique harm= intensity slurs=m assoc.:sled them-with. In the preferred em- thediet=t. e.g., each of L.t1 print characters in the first rordoo of ROM Se has a certesponding individual Le c• litessir• thane= in the second portion dived. The gyve- may be readily expanded to =cm- reed= applications repenting more than 123 characters tr. r,•ely repladng the ROM with another having a F storage capacity.

A forth= advantage of the invention resides in the =piety to accommedate e.sracte fonts having differ' sit numbes of characees. As disclosed. the preferred co00dimeet is capable oflesndraig character foots hay- tog up to a =win= of 192 individual print characters. To expand the system beyond tins =parity, the decd- mg logic for print wheel position counter 136 is rod's- feed to provide the CLEAR and PRESET f=tgions at impeptiate =nest inturals and the arithmetic unit logic den=ts 131.152 which peter= the optimum angular drecion test *are* simfiarly modified to generate the Rt"V S-- signal whenever the difference been= the chars-ter to be *mod and the starting address of the print wheel is greater than NCI. where N is the total amber of font charactes.

A forth= advantage of tram= constroeed in accor- deice with the teachings af the invention resides in the • print wheel senor unit and the carriage pea:berms= unit which are bath• immune to variations in the light intensity output of the light sourm, so that the print whcl and carriage positiem recce= signals are always pe=ely defined.

Lastly, rotary printer control systems construed in scoordan= with the teach=gs of the invention provide estraely premise positioning of the prim wheel and carriage in the position mode, whale at the same time controlling movement of the print wheel and carriage suc=sive print positions in the rate mode in an opti- real ranee so that the motor follows the optimal seen!- eration•decics.tion =rve of the servo system and comes to rest without positional overshoot

While the above provides a full and complete disci=- lure of the invention, various modifications. alternate c.onstra=ns and enivalcits may be employed with- out from the true spirit and scope of the in- vetti=. Therefore, the above description and Must:a- mons should not be construed as limiting the scope of the invention. which is defined by the appended class.

What is claimed is:

1. For use in a rotary wheel printing system having a trans:at:lie carriaget rei=s for translating said carriage slang a prat line, a rotary print wheel mounted on said earnage,, said rotary print wheel having a plurality of endevezel print chaser.= distributed about the radial e=tc the zzli means for rotating said print whmb me= for lie-retie; said priet chaesmors wins; a print m=bertr efts: position ir.dient=g ==-s for genes. sting sipais repre.enadve of the bestmeteseous positive of mid print wh_eeL mid fest position indiett.eg beckding an ==4.= disc mounted for rotetion with said print wheel and having plurality of eltemately arreged =qua zed trazsbacent pardons arranged in a subasedally erculir meek about the radial con- te. of said and =ens responsive to said is-Mt wheel position ipals for , swag said impring me= the improvemeet wheeliasaid first posidan indicating me= includes a first light source snotmted adjacent a fest surface of said disc, a plurality of Ugh se hive devices mouatd adjacent the opposite serf= of said disc and responsive to the angular lac.- tat of said opaque and trans1=et timing track panic= when said print wheel is =wed for generating a pair of position • trains having a subssandally constant phase diffeenee, and first feedback me= for maintaining the inmmity of said light sauce substantially constant, said first feedback means including power :mem for apply- ing cle=rical poe= to said light soarer, first light semi- tive cleans disposed adjacent said opposite side of said disc at a petition to continuously intercept light =lie- tics =timed by said first light soarer for gestating sir elemrieal signal represeerive of the intensity of said light radiation adjacent said Ugh sensitive 'device compuison metes for competing said in:emirs ape! with x, aszdard representative of a preestab- Tubed desired rigrs amenity; :means far gene ating a eorr-ces signal when said tui=sky signal differ fro= said standard siprl; and means for coupling said ear• =ion signal to said power means to very the reapi- trade of said light intensity to re-establish said desird light intensity. •

2. The sync= of chain 1 wherein said light sour= comprises a light emin=g eliode and said compson meets comprises a differential-amplifier having a fee ierpet coupled to said aandarei signal and a se=nd input - coupled to the output of said line:airy sigeal g==ing means

3. The cyst= of &site 1 when= said phase Met- eeme is snhaantially 90%

4. The sync= of claim 1 wherein said =lisp vans- lacing mesas inc odes a mentor having a rotatable shaft and means for converting the motion of said =able shaft to trauslazimal maven:est of said eir.'.amems1 • turtles including seemed positive indicating means far gesteeting signals repreccuarive of the inst=taneaus peation of said carriage, and =cans responsive to said carriage position signals for controlling the aemation of said carriage =sluing toes= said second pc con icedi=ting means 'inducing an optical encoder disc se- cured to said rotatable shaft and having a plurality of alt=--ately arraaged opaque and translucent portions disposed about the radial =user of said disc to form a substantially *circulsr* timing track; a second light sot= mounted adjazmt a *first* surface of said optical eaccdc disc. at lest one light se Ave device mounted adja- eat the opposite surface of said optical =code disc and responsive to the angular displacement of said opaque and translucent track pardons of said optical =code disc when said disc is rotated for gene:- adz; a position signal train. and second f eedback ==s for maintaining the =leaky of said light-sidisrm sub- =daily carsliett. said seated feedback mesas ineud- beg power e== for applying electrical powe to said

BilAtiltAh4

/light source s=and light sensitive =cans dis- adjaccat said opposite surface of said optical -,coder disc U a position to con=uoualy intmccpt light radiation =itted by said light sour= for g==ating an electrical signal represcuative of the into: miry of said light radiation adja=t said at 1=st one light se sitive device, comparison sac= for co=paring said intensity signal with a standard signal repracitative of a pre- established desired light intensity; me= for g=matieg a correction afrad said when intensity signal differs from said standard signal; and means for coupling said e4.,„.__ on signal to said power =van to vary the tug- • nitude of said light intensity to re-arshlish said desired light intensity.

5. The rye= of adze 4 wherein said right source comprises a light =sitting diode and said(=caparison moans co=prisen a diffenantial =path= having a Feat input coupled to the output of said imoosity signal geo- cuing =on.

6. The systo= of claim 1 whet= said first light source comprises first and second light-gencrating ar=ts coupled in series to said power =cans, and wherein said first light sensitive metais disposed in a position to cominuously inutocept light radiation =nit- led by at least one of said first sod se=nd light gt==st- ing el=u=rs.

7. The syr.e= of clahat 4 wh== said semond light sour= comprises third and fourth fight g==sting ale- mean coupled bl mien to said power means, and wh&-sita said se=nd light set:skive === is aposed a position to coothtuously int=expt light radiation =it- tad by at 1=st one of said third and fourth light gen=st- bag el=u=ts

L For use in a rotary wheel printing :rut= having a =sk•lk carriage, assns for tresslasing said curiage along a print Er..= & rotary print whi=1 mounted on said =eine. said rotary print wheel having a plurality of individual print characters distributed about the radial e=tort-1=f; =um for rousing said print whet.- mess for i=prtssing said print &am == against a print medium first position indimuing =emu for g==- Ling signals represe=xive of the itssuouneous position of said print when means adapted to be coupled to an data scar= for =giving a multi-bit character representative of a charamor to be prime; and means =passive to said print wh=1 position sigmals and the chars= stored to said removing =um= for a=uattiog said i=pr=dog =sung the improvement wha-Mii said last-gamed mews includes a ==ory device having a *first* portion far storing a plurality of individual bit chaise.= each roprmastative of thro location on said print wheel of a different one of said print ClaraC- t= and a se portion =ring a plurality of indi- vidual ==== intensitychusct= each representative of the hit=nty with which the svvv-I ’t-: print charac- t= in said *Ern* porch= is to be i=nress against said ;:not differ=t ones of said ==== inter airy chars.= rer.reseating diff==t === for s u lly fetching =tad-bit location chariot= and the assoMated imi=ery chariot= sp=aled ry the Murairaor star in said r ving ===. and === =cried to said ==ory === for =ovc.--'r•g the =divide...1 fetched haro.== ==siry chaise.= to corresponding actuation signals for said itepreosing ES -ens having a magnitude depend= upon the intensity to the ===ponding intensity charac•

9. The system of elzhn 8 wherein said impressi et means comprises a sol=oid =sated ha===. and converang =ea= (=prises a hammer drive first fo r supplying said ammition signals to said solenoid aid ha===.

10. The ar•= of dal= 9 where= said ha=-m tusit inalud=1 Illata= for generating &a:nation tiguis each baying a period of duration deter iced by the caagaitude of a cononl signal coupled thereto, and memos coupled to the output of said memory device for Valentin said =tral signal having a magnitude dem. mined by the value of given ha=== intensity Mum.

it Aele=ronic control sysu= fame with a rotary wh=1 primer having a truislauble curing rat= for taladagtsaid =in t: al ong a print li on a rotary print 7.7.1 having alcruTted plurality said =Tins, said rotary Pthlt wheel a of individual print symbols dismna- tad about the radial =at= thereof mesas for rotadog said print wheel; means for =pressing said print sm. bolt against print =edit position mesas a = first Isdicntalt of the gsiPtalsrepresentative fc't io• of said pr=at when; and sexed F• an =„1:1= g =f= for g=elatinsignalsrepro,. :S stmtative of the instantaneous position of said earriage. said syste= =mprisinip first storage =eons ationt. to be coupled to asio=a- nil data sons= for storing a multi-bit char=== ropres=tative of a symbol to be pins a print wh=1 positionco== unit adapted to I:4- -- coupled to said fast position indicator ==s far converting said position signals to a =ulti-bit char- acter representative of the irstantaneotts position of said print whom a memo=ry devin couplad to said first storage oats= and having a fast pardon for storing a plurality of charz== ragrres=tative of the *ad*= -' on said print who of each of said symbols, atm- end pardon for storing a emrespontroag plurality of --- ha=== intensitytharam= each asscdsind td &fen= one of said plmality of address chums= in said first pardon, and means respemsive to no a con=1 signal far sequentially reading a multi-bit address Musa= and the itssoalss ham- men is sty ei.sram= sp=fied by a dun= svored = said first =rap meaez lat grit. ado trait coupled to the output of said print wheel position ==• =it and said am:tory nail for gone ntdog a =ulti-bit differ al-signal repre- s=tative of the difference wean said symbol adder chat= and said instantaniecies pe=t wheel position: chaise.= and a reference signal indicating the c pti==i di- on of rout= of said print wheel drive =cans coupled to the output of said ci=ory means for generating variable magnitude si=als for said impressing We in ac=rcianon with the value of said hammer intensity chars= s4I-oc•”-1 • to said address clime= corresponding to said multi-bit character in said first storage === and =ins and control === coupled to the output of said pri= position count= unit and said arith=edr. unit for generating control signals for sp=fying the desired dir=don of rotation of tai: print when!, for =carolling said s=uF1till roadie; out :se= and for enabling the amiitihn of said =emu for rotating said print wheel, said =ping and control =cans including first means for grne-asszt.

W LO MAO 'tilA

Awl u-bit address character and subsequent read-out of said associated *hammer* intensity character when said differential signal indica= that said print wheel is correlly aligned for printing a symbol represented by said character stored in said first storage means. stand mesas for enabling said =pressing means when said differmtial signal indicates that said print wheel is correct ly aligned for prating a symbol represcated by said character stored in said first storage =emu, and third signals for enabling said carriage translating means after said impressing means has been enabled and a symbol has been printed to translate said carriage wheel said print line to a succeeding locadoe.

LI The combination of claim 11 wherein said print wheel rotating means includes a bidirecdonally rotatable motor said first position indicating etc= includes means for generating a first pair of cyclic print wheel position ignais having substantially coextensive periods and s phase displacement of substautially 90', means for driving a second pair of cyclic print whel position signals comprising the inverses of said first pair, and mews far deriving from one of said pairs of print wheel pmnon signals four mutually exclusive phase control signals each defining a different quadrant of the period of one of said signals of said pairg

and wherein said system furthc includes a servo mntrol system adapted to be operated in a position *mode* and a rate mode and having an output conpled to said molar, said servo control system including:

m=ss coupled to said scvo control sysumt output for generating an error signal,

means having a phirality of inputs each coupled to a different one of said first and second pairs of print wheel position signals and said four phase control signals for generating a first referent= signal representative of the instamancous velocity ot said print

=cuss having a plurally of input tcminalscoupled to said arithmetic =it and said dining and control *mess for* gmcating a second refcesM signal having a magnitude specifying a predetermined desired velocity in amordance with the value of said multi-bit differential signal generated by said arithmetic unit and a predetermined polarity in acceirdarice with said control sips' sp=lying the dcired dirmdon of rotation generated by said timing and curzol

means coupled to said first and =end reference signal generating means for generating a first crier signal generating mesas input signal for controlling error signal mead= during the rue mode of . operation, and mesas having a first input coupled to said timing and control *and a* scond input easy pled to said first position indicating means for generating a semnad error signal rzeetating means input signal for controlling error signal generation during the position mode of operation.

13. The combieation of claim 12 wherein said first Warren= signal generating means comprises a plurality of transfer switches each having a transfer input coupled to a different ape of said first and second pairs of print whael position signals, a tretsiC output, and a control input coupled to a different one of said four phase control signals,

a siumming mesas having a plurality of inputs each coupled to a diffcmt one of said transfer outputs and an output terminal. and

a diffe-mr:stor means having an input coupled to the output of said summing metes.

14. The conthMation of claim 12 wherein said semrsd recent= signal signal gemming menns comprises a velocity decade having a plurality of input tworinals each coupled to a cliffermt cue of said bits of said =tid-bit cliffermr:al signal, a control input coupled to said enabling signal for said print wheel generated by said timing and control meam, and a plurality of output teminalg *and*

a velocity select it having a plursity of input =missals each cogsktd to a different one of said plurality of output terminals of said velocity deader and a =carol input Imminal coupled losaid control signal specifying the desired dirmtion of rotation g=cated by said...h21; and •emen1 maws.

Ail2

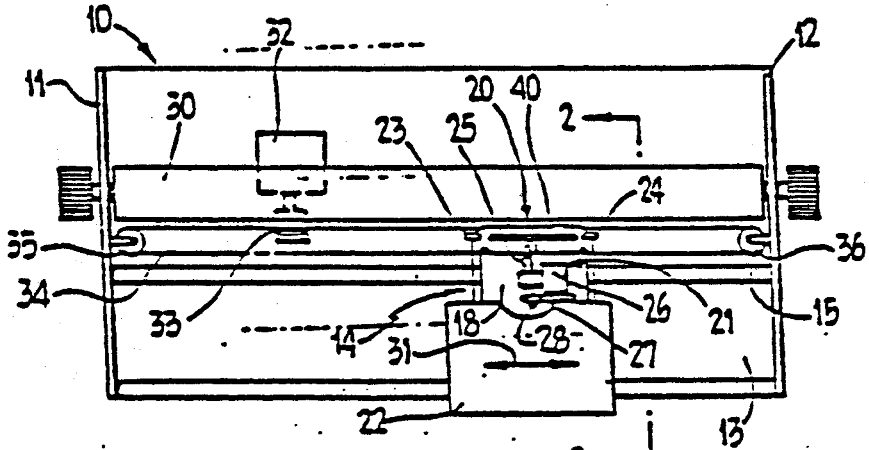


Fig_1

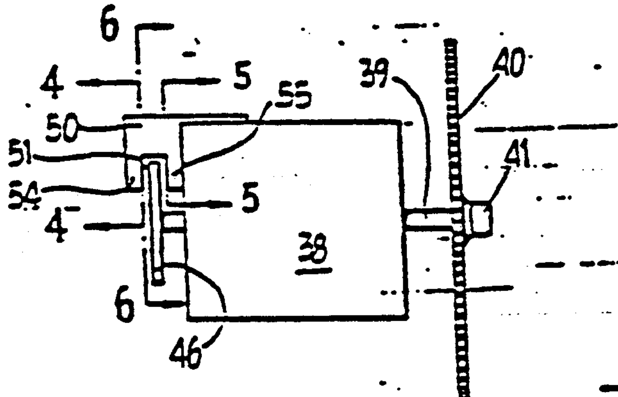


Fig_2

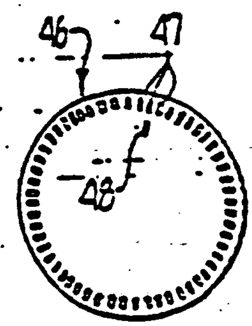


Fig_3

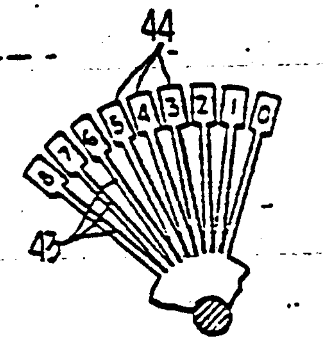


Fig_2a

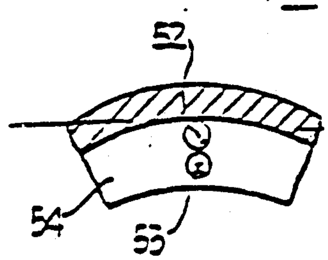


Fig_4

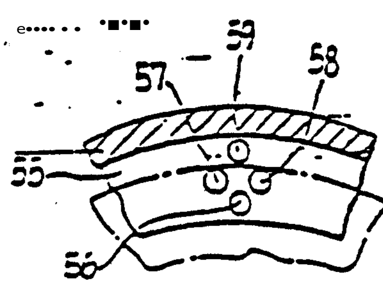


Fig_5

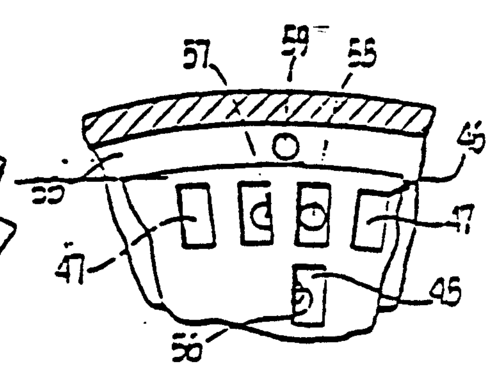
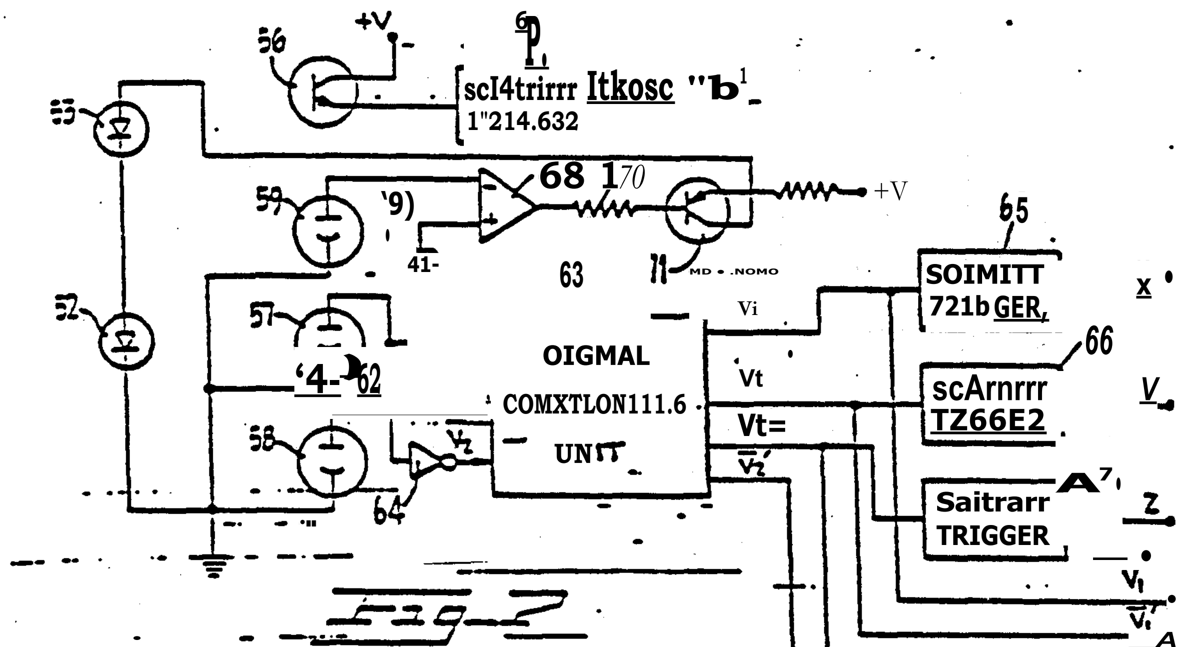
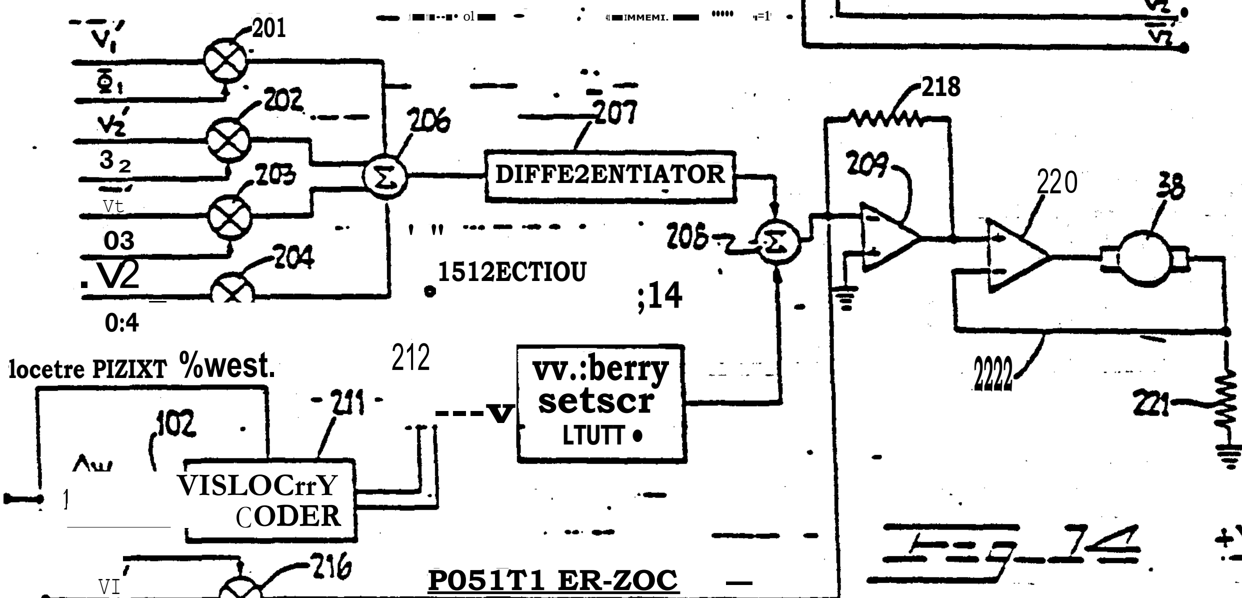
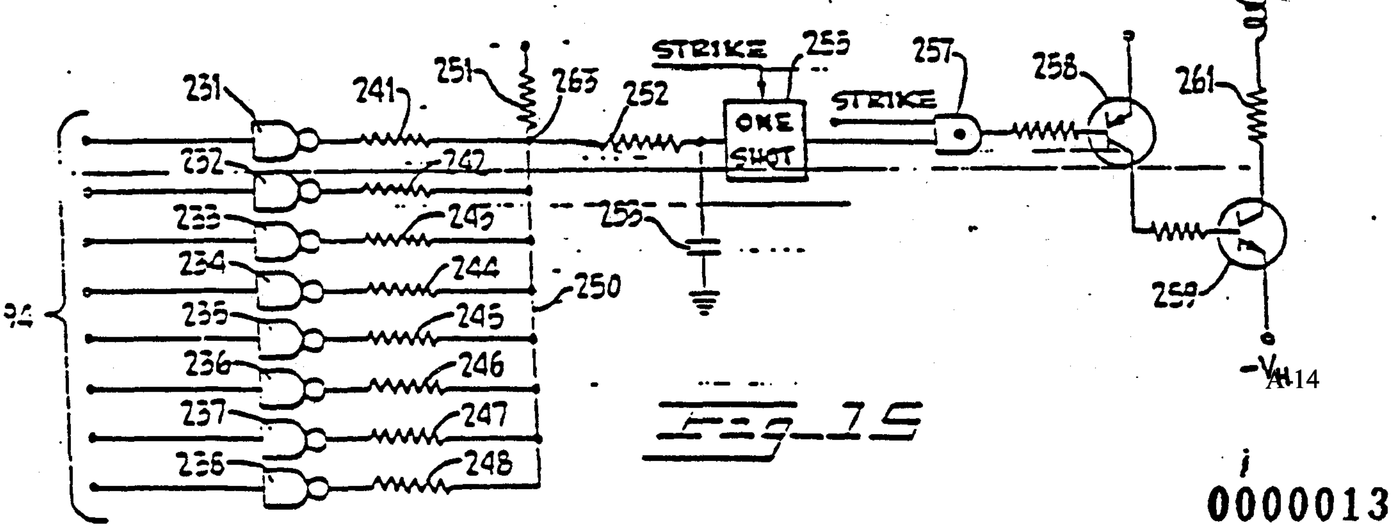
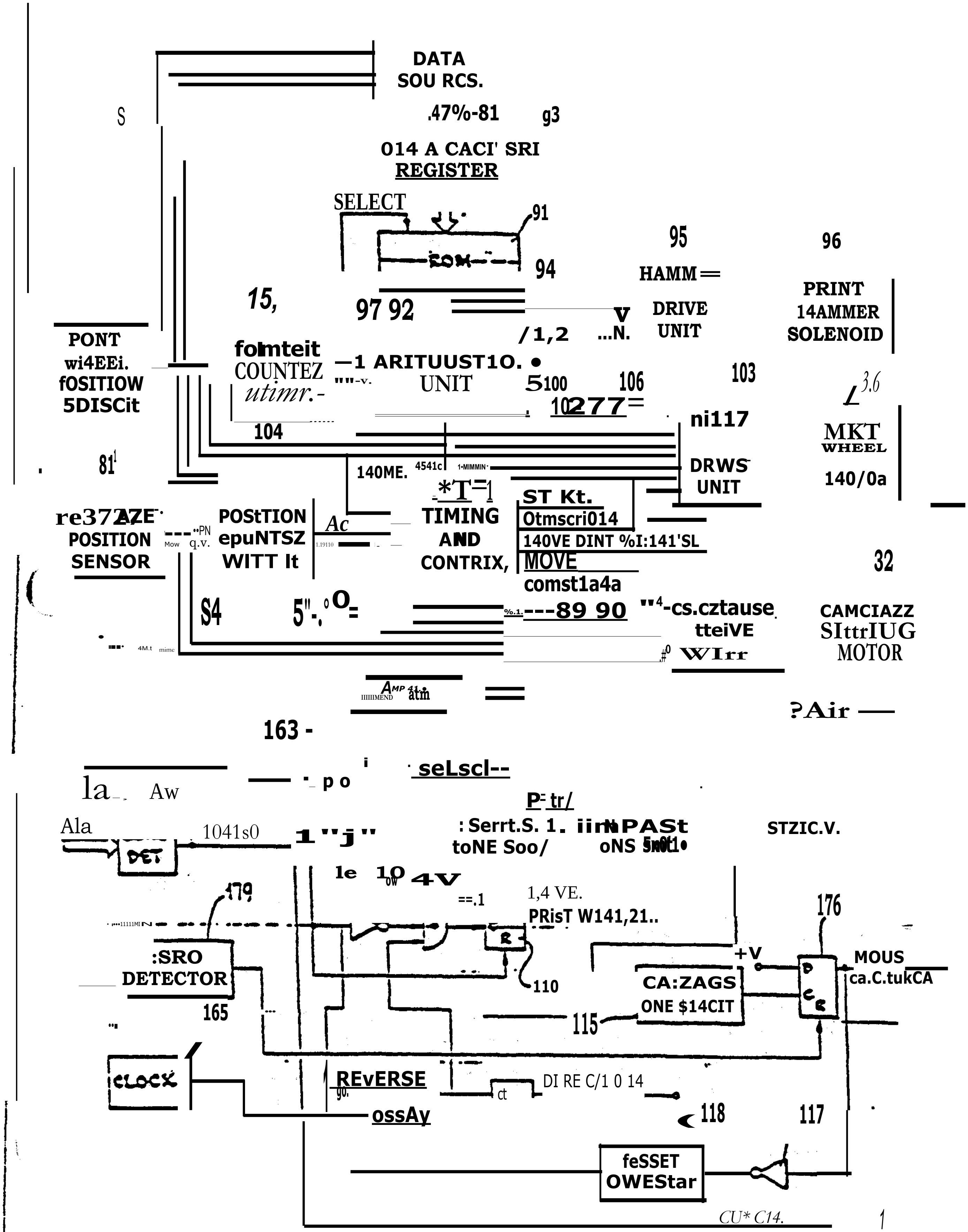


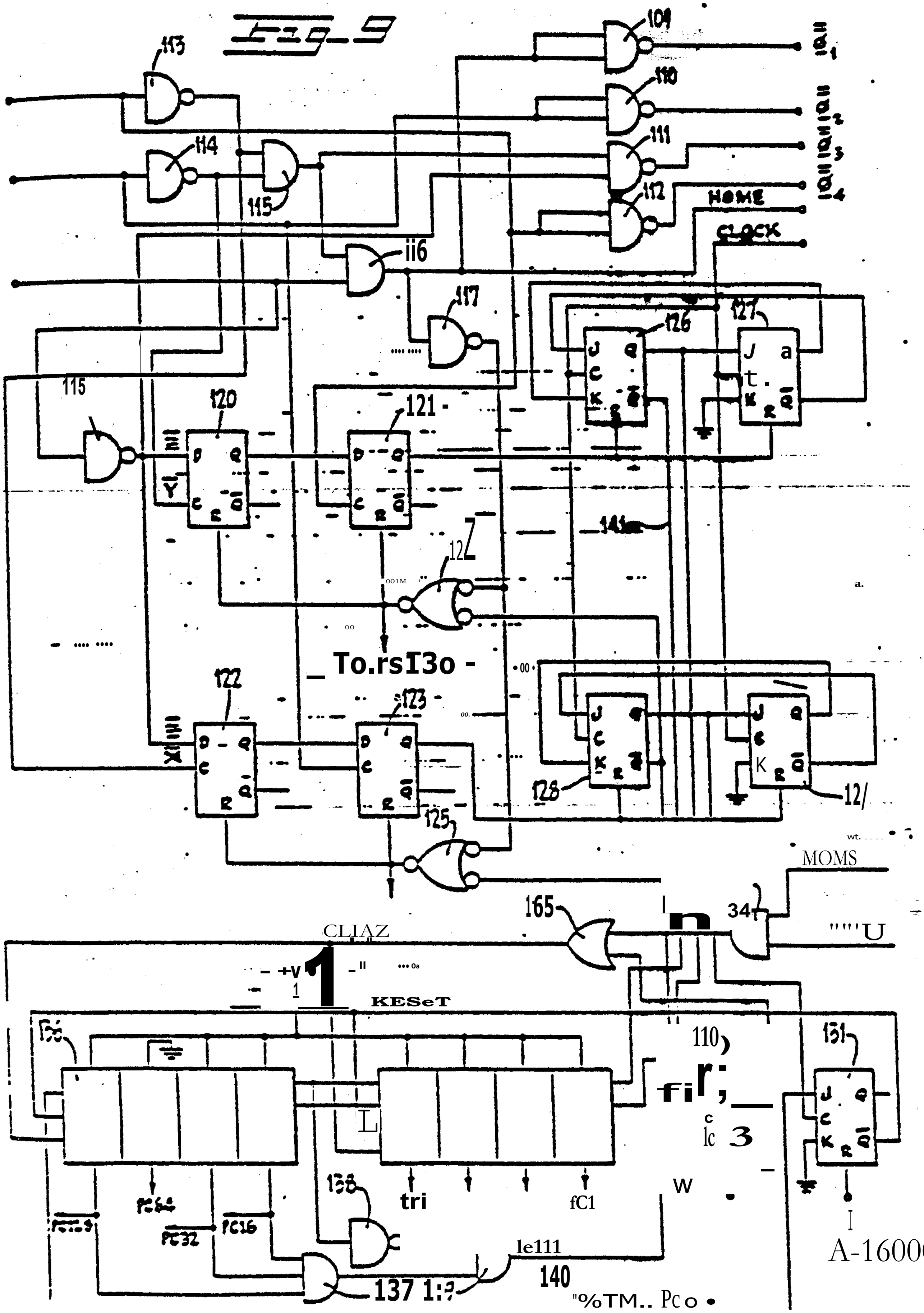
Fig_6


+V
+V
SOIMITT
OIGMAL
UNIT
TRIGGER


DIFFE2ENTIATOR
218
220
38
221
212
211
102
216


STRIKE
STRIKE
ONE SHOT
+VH
-VH


DATA
SOU RCS.
REGISTER
SELECT
91
94
95
96
HAMM
DRIVE
UNIT
PRINT
14AMMER
SOLENOID
97 92
COUNTEZ
UNIT
103
106
104
MKT
WHEEL
DRWS
UNIT
TIMING
AND
CONTRIX,
MOVE
POSITION
SENSOR
32
S4
MOTOR
163
DETECTOR
165
110
115
176
CLOCK
REvERSE
118
117
feSSET
OWEStar


113
114
115
116
117
109
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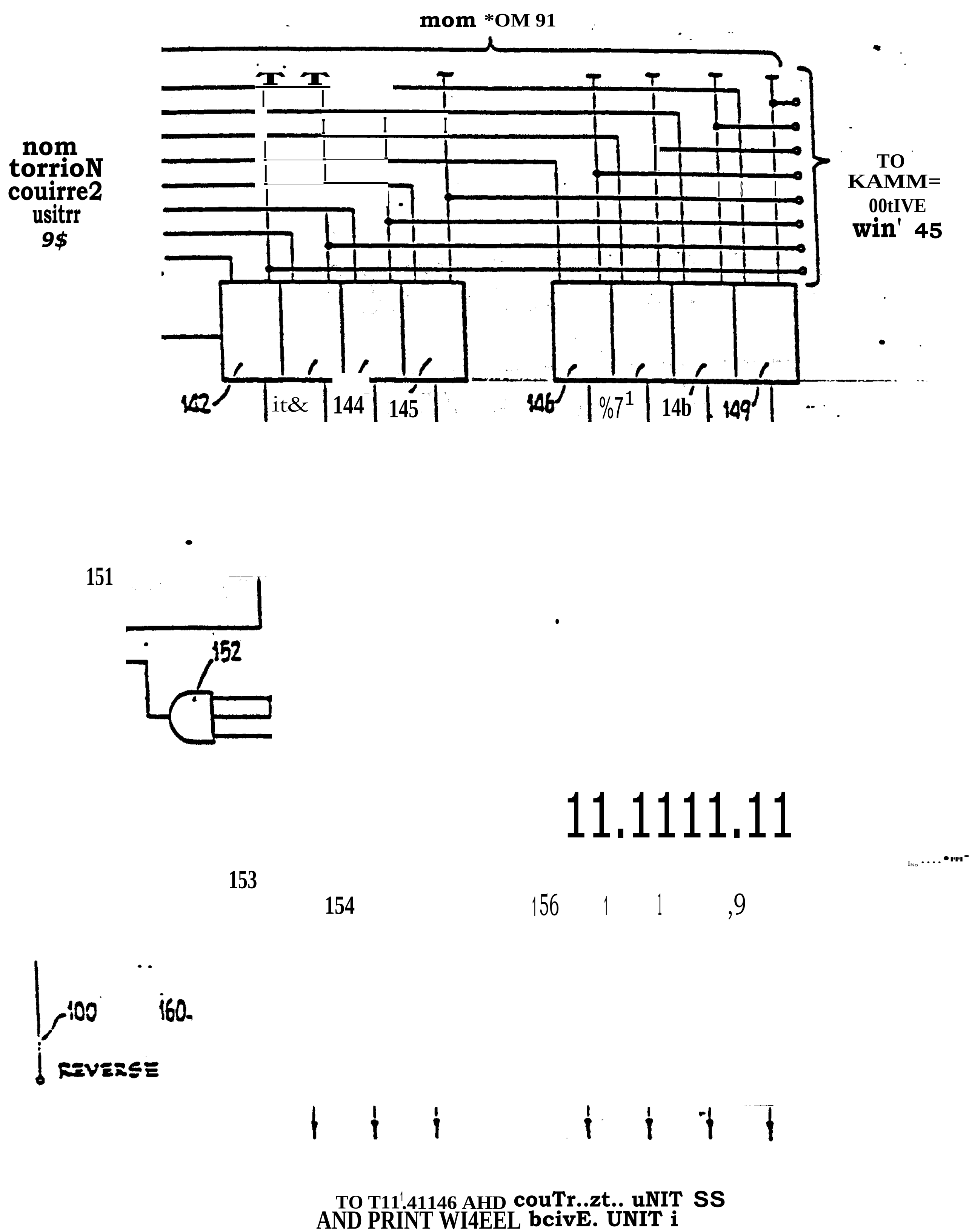
111
112
HOME
CLOCK
120
121
122
123
125
126
127
128
165
RESET
131
137
140


mom *OM 91
nom
torrioN
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TO
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00tIVE
win' 45
142
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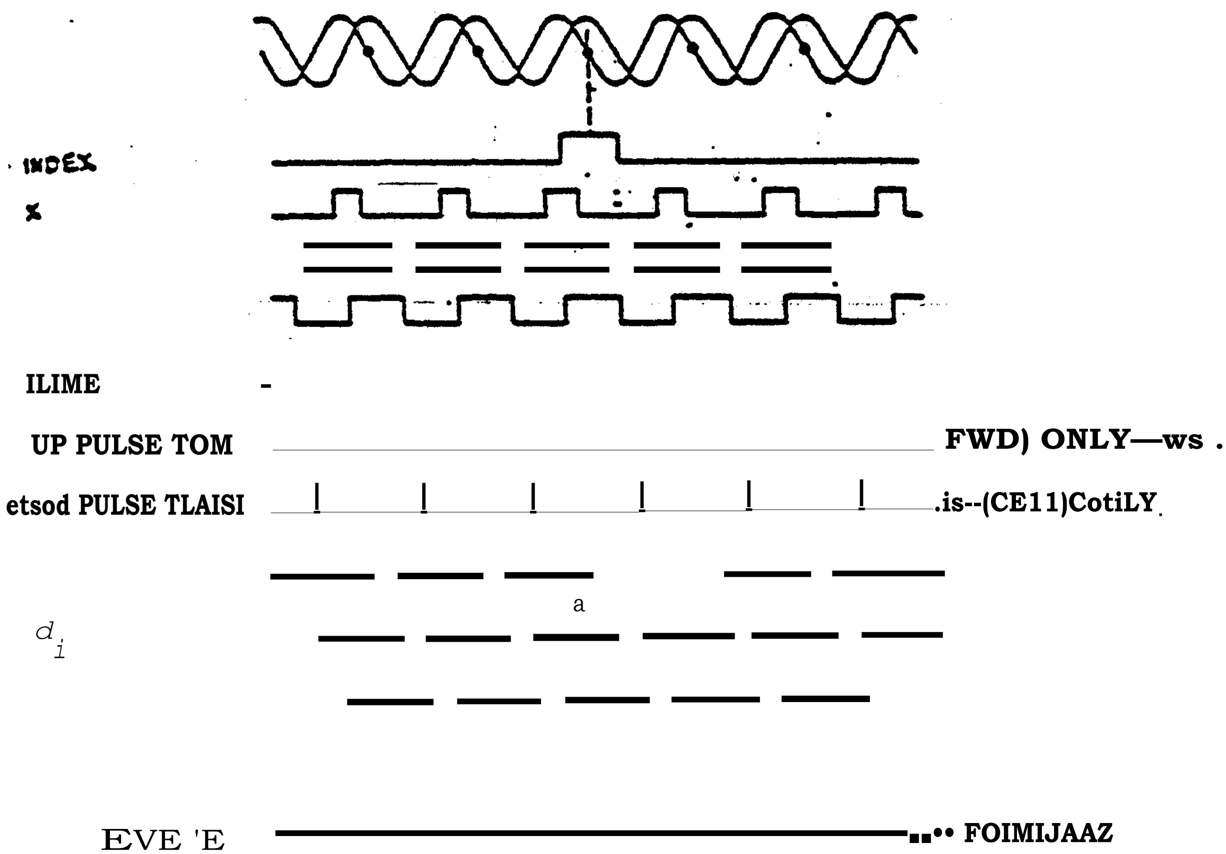
144
145
146
%7
14b
149
151
152
11.1111.11
153
154
156
,9
100
160
REVERSE
TO T11.41146 AHD couTr..zt.. uNIT SS
AND PRINT WI4EEL bcivE. UNIT i

A-17

FIG. 10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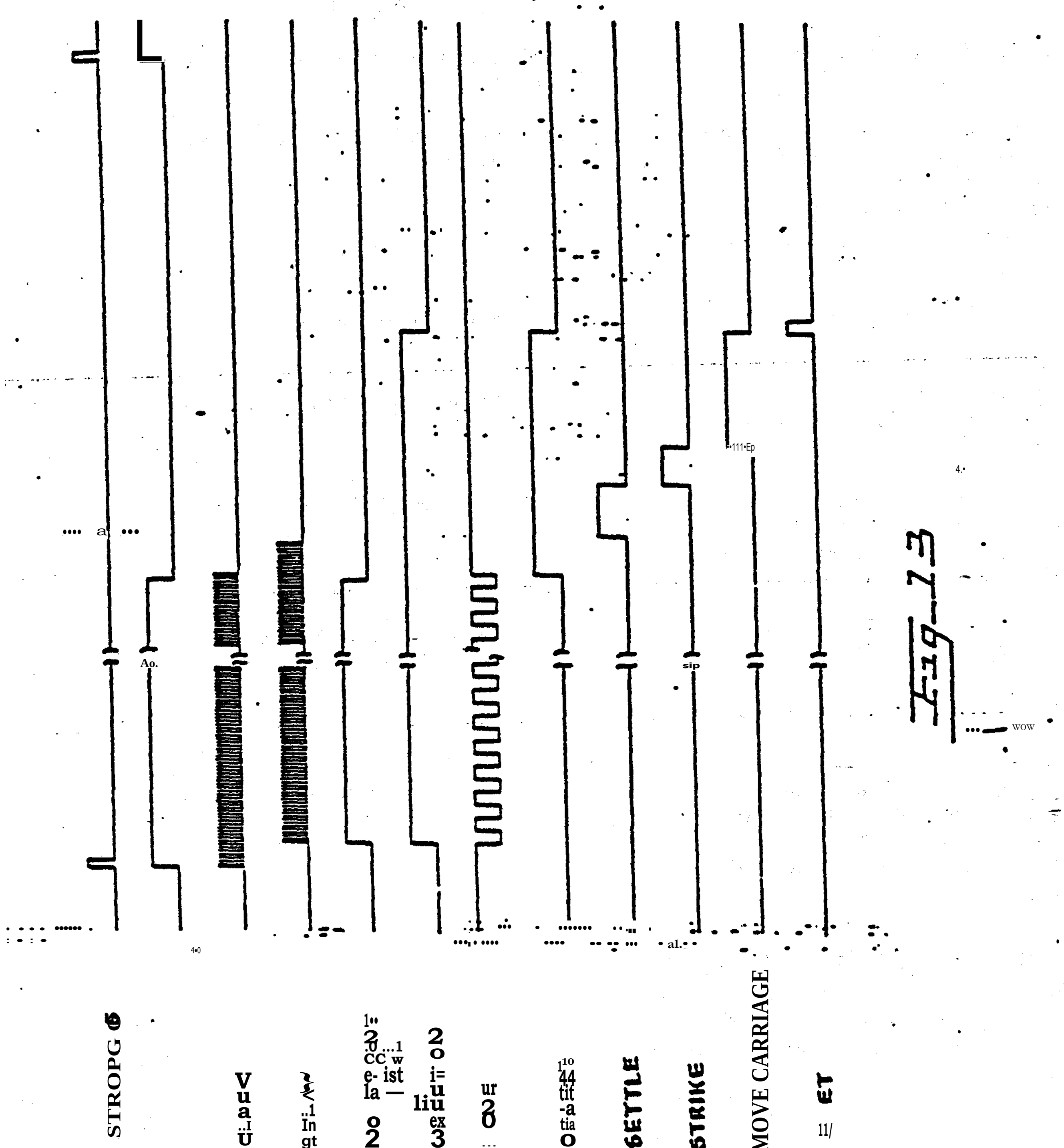

Fig. 13

cl0000ts

Mari wOf the '129 Patent and the '719 Patent Compared

Claim 8 From-Finding of Fact 34	Corresponding elements of the '719 Patent (Swanstrom)
34. Claim 8 provides that what is claimed is for use in a rotary wheel printing system having:	HyType I* or
(a) a translatable carriage;	(a) See carriage controls 317 318, 351 in Fig. 6
(b) means for translating said carriage along a print line;	(b) carriage motor driver 351 in Fig. 6
(c) a rotary print wheel mounted on said carriage, said rotary print wheel having a plurality of individual print characters distributed about the radial center thereof;	(c) text in col. 13 and block diagram of Fig. 6
(d) means for rotating said print wheel;	(d) print wheel driver 341, Fig. 6
(e) means for impressing said print characters against a print medium;	(e) hammer coil driver 340, Fig. 6
(f) first position indicating means for generating signals representative of the instantaneous position of said print wheel;	(f) print wheel logic 334 in Fig. 6
(g) means adapted to be coupled to an external data source for receiving a multibit character representative of a character to be printed; and	(g) 8-bit address latch 440 of Fig. 8 receives ASCII code
(h) means responsive to said print wheel position signals and the character stored in said recetvinglmedns for actuating said impiissing means;	(h) printer status MPX 381 of Fig. 7

1V tioanstrom incarborpal by reference inrC01. 13 the Model 1200 HyType I Serial printer with amcdifietinterfaci. It has been admitted throughout this investigation ihairthe HyType I drsciciiii all elements of the Claim 8 preamble. These elf:Wants are•lino disclosed in Figs. 6 and 7 of Swanstrom as noted above.

THE IMPROVEMENT WHEREIN SAID LAST-NAMED MEANS INCLUDES

(i) a memory device having

(i) a first portion for storing a plurality of multibit characters each representative of the location on said print wheel of a different one of said print characters and

(i) ROM 441 in Fig. • is a 256 x 8 bit ROM which stores print wheel spoke locations for each character in a first 8-bit word. Col. 19, lines 11, 12 and 47 to 51 and Col. 141.

(ii) a second portion for storing a plurality of individual hammer intensity characters each representative of the intensity with which the associated print character is said first portion is to be impressed against said print medium, different oriel of said hammer intensity characters representing different hammer intensities,

(ii) a second 8-bit word for each character is stored in a second portion of ROM 441 and 2 bits are used to provide four possible levels of hammer intensity. Col. 19, lines 14-16, 48, 49

(j) means for sequentially fetching (or reading out) the multi-bit location character and the associated hammer intensity character specified by the character stored in said receiving means, and

(j) the two 8-bit words read out in "two passes", 19, lines 5-10, Col. 19 Col, 141. See also claim 16.

(k) means coupled to said memory means for converting'the.individual fetched hammer intensity characters to corresponding actuation signals for said impressing means. having a magnitude dependent upon the intensity assigned to the corresponding hammer intensity character.

(k) hammer level encode and hammer coil driver in Fig. 6.

0000020

United States Patent 1191

Swanstrom et al. •

(11) 4,138,719

pssi Feb. 6, 1979

(St) AUTOMATIC WRITING SYSTEM•AND METHODS OF WORD PROCESSING

1721 IltratOr1;,. :1-ï41P1.1Wrac; – Swaastrom; UsedC Werner Scheer, all of Dallas, TeL

(73) Assignee: Xerox Corporadoe, Stamford. Conn.

[21] Appl. No.: 622,7110

(22) Oct. 15, 1975

(30) Foreign Applicadca Priority Data

Nov. H, 1974 (OH) United Kingdom 44626/74

(51) Int. CV GO6F 3/12

(52) US. O. . ... -....-- ——......... 364/200

(511) Field of Search 444/1; 364/200 MS File, 300, 200

(561 References Cited

U.S. PATENT DOCUMENTS

1853.696	9/1956	Mendelson	340/172.5
3,470,542	9/1969	Tmmanella	364/200 X
3,533,076	10/1970	Perkins et al.	340/172.5
3,533,076	10/1970	Perkins et al.	340/172.5
3,760,376	9/1973	Tanner	340/172.5
--:--1,1105,249	4/4974	•	
3,815,104	6/1974	Goldman ...	364/700
3,973,244	5/1976	Lovercheck at al.	364/200

Primary Examines—P.3We B. Zache

[57] AssrgAcr

Automatic writing systems and methods of word m-ousing therefor are provided in accordance with the teachings of the present invention wherein a central processor and a plurality of peripherals including at least keyboard means, printer means, buffer means and means for recording data on a record media are each connected to a common data bus, a common status bus and a common instruction word bus and a prinvv data storage peripheral means is connected to said common data bus and said common instruction word bus. Alphameric character data, format data, and function data may be entered from the keyboard and the presence Of such data is indicated to the central processor on the common status bus. Upon receipt of a data presence condition, program control is initiated by the central processor calculated to achieve the designated fraction or functions with the alphameric or format data presented. The manner as asynchronous operation in data translation between a plurality of peripherals and a central processor enables a multitude of editing. revision. control and manipulation steps to be accomplished in *the* central processor under program control while allowing the overall automatic writing system to be hillblY-Axib14414•OPIMIgOo.and•reediiyotapitodidslo

119 Claims, 39 Drawing Figures

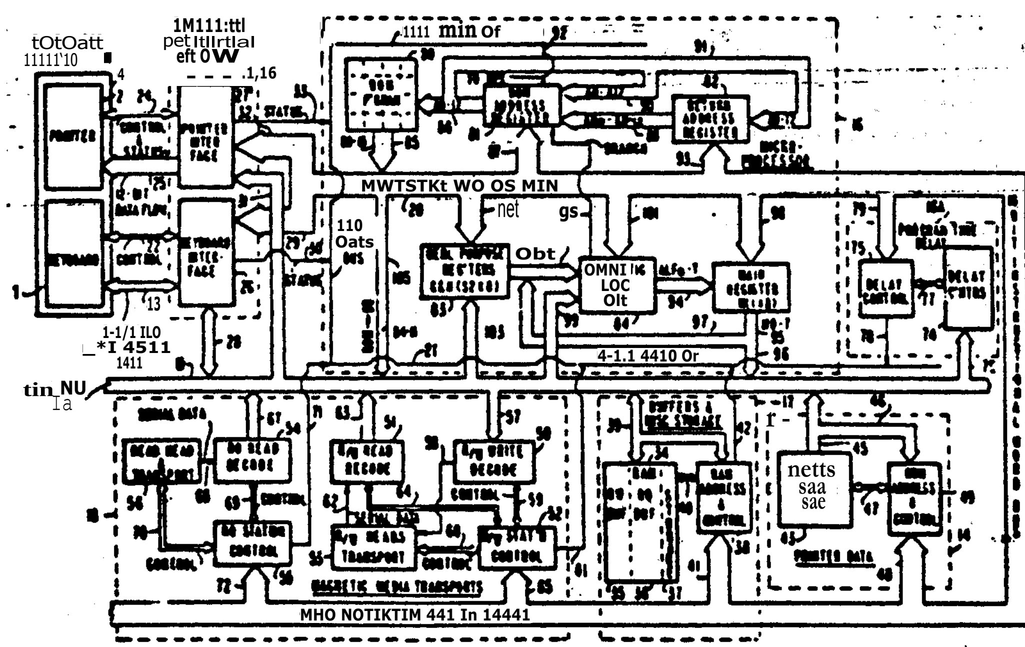

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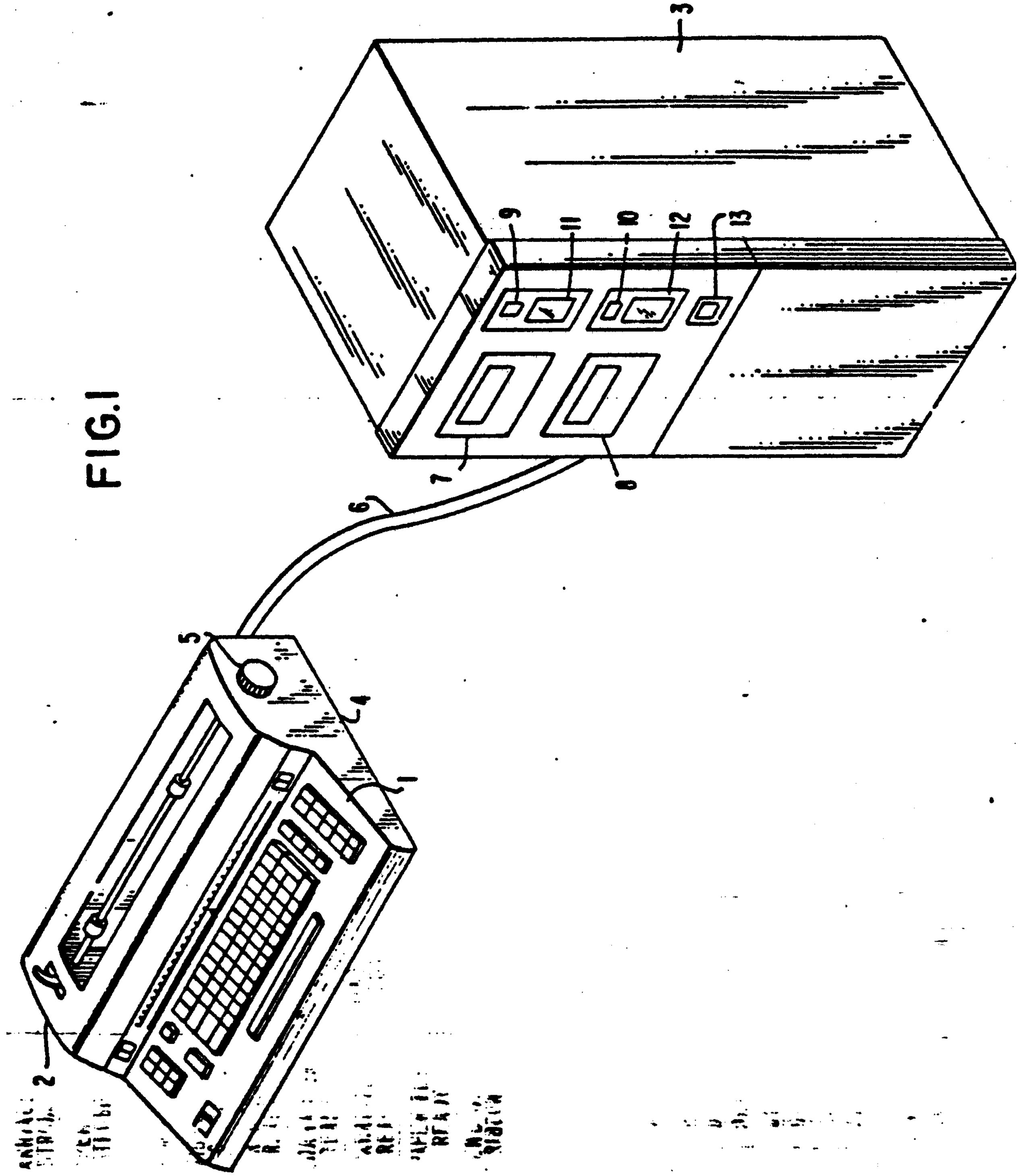
FIG.1



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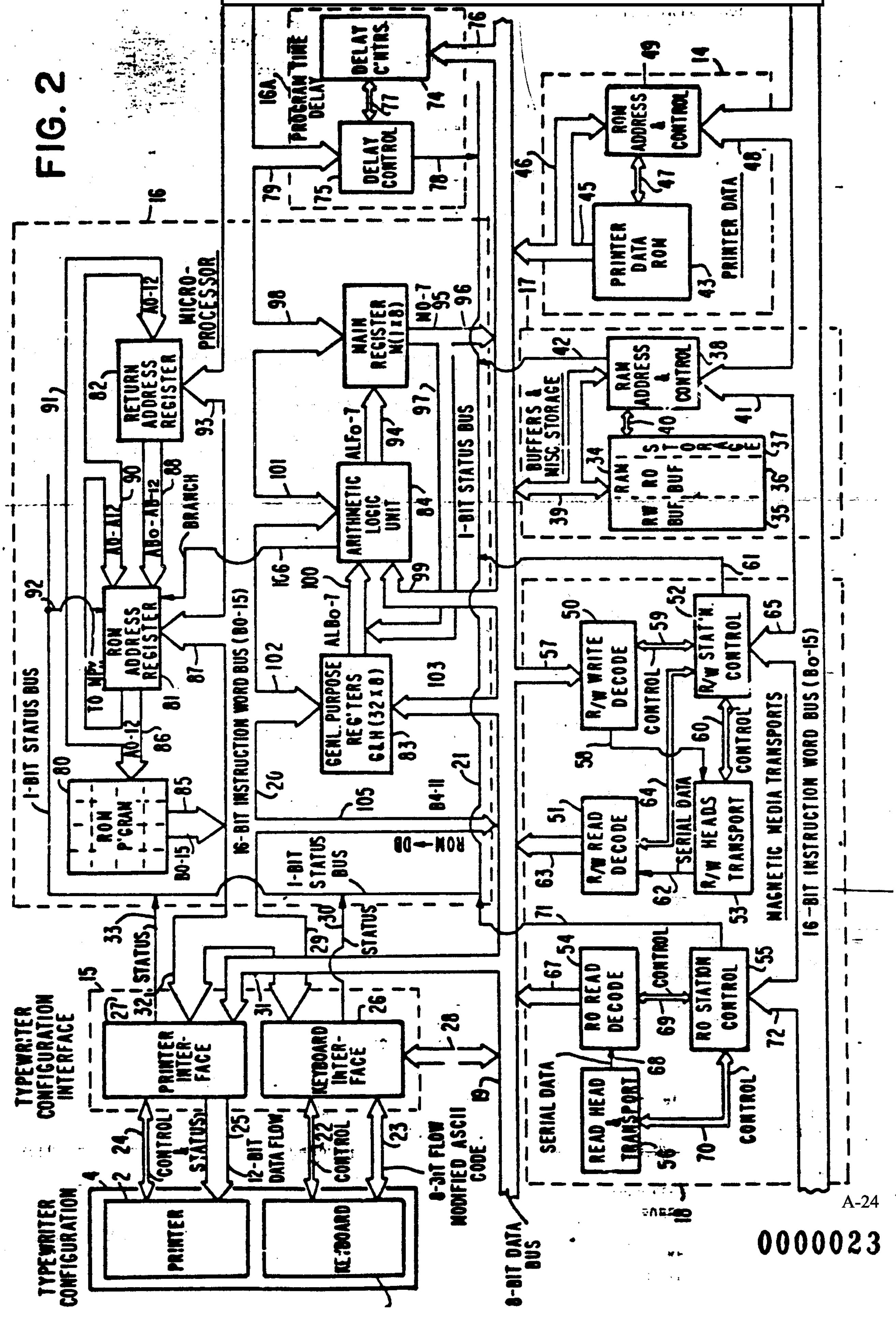

FIG. 2

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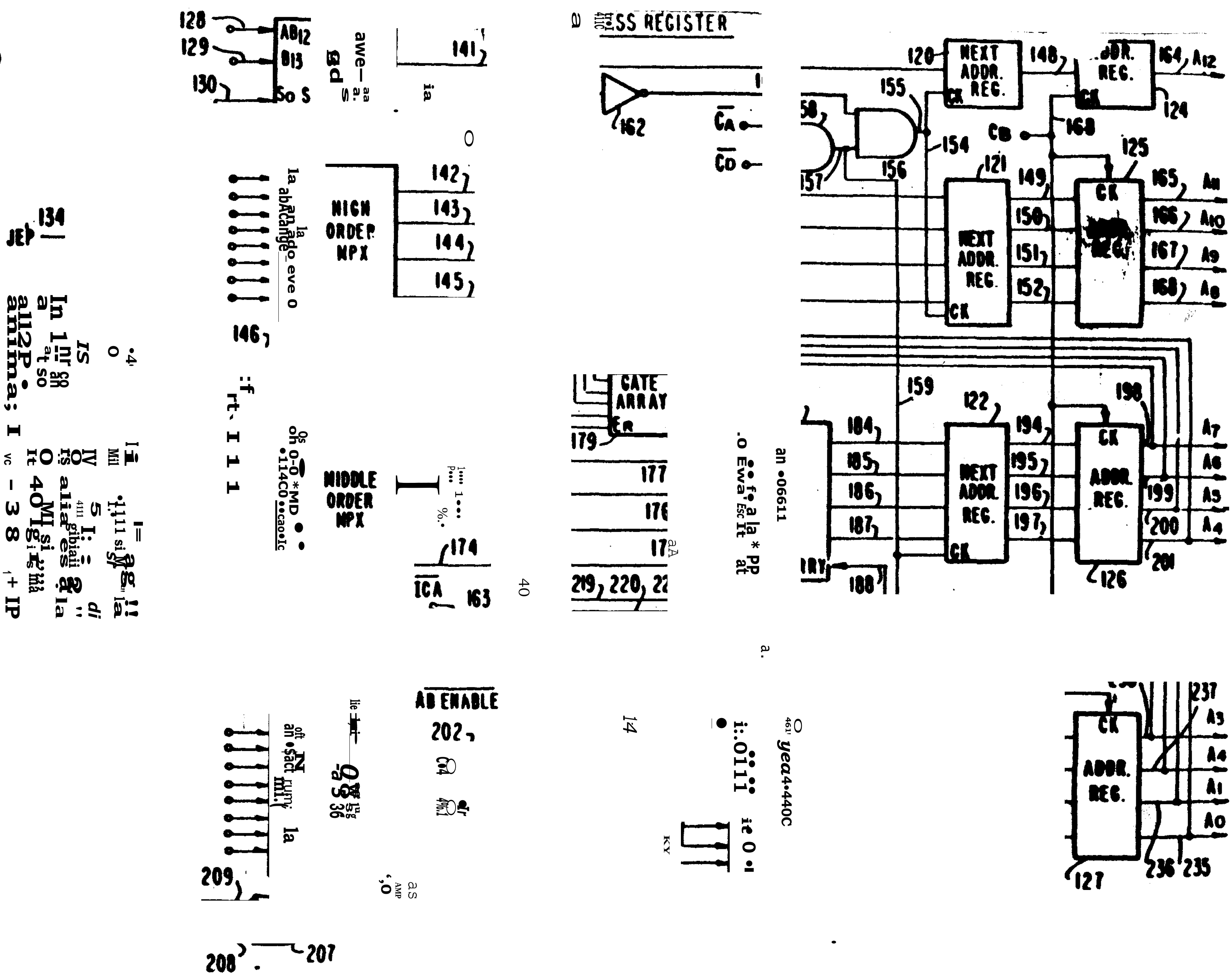
FIG. 3



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RETURN ADDRESS SUCK

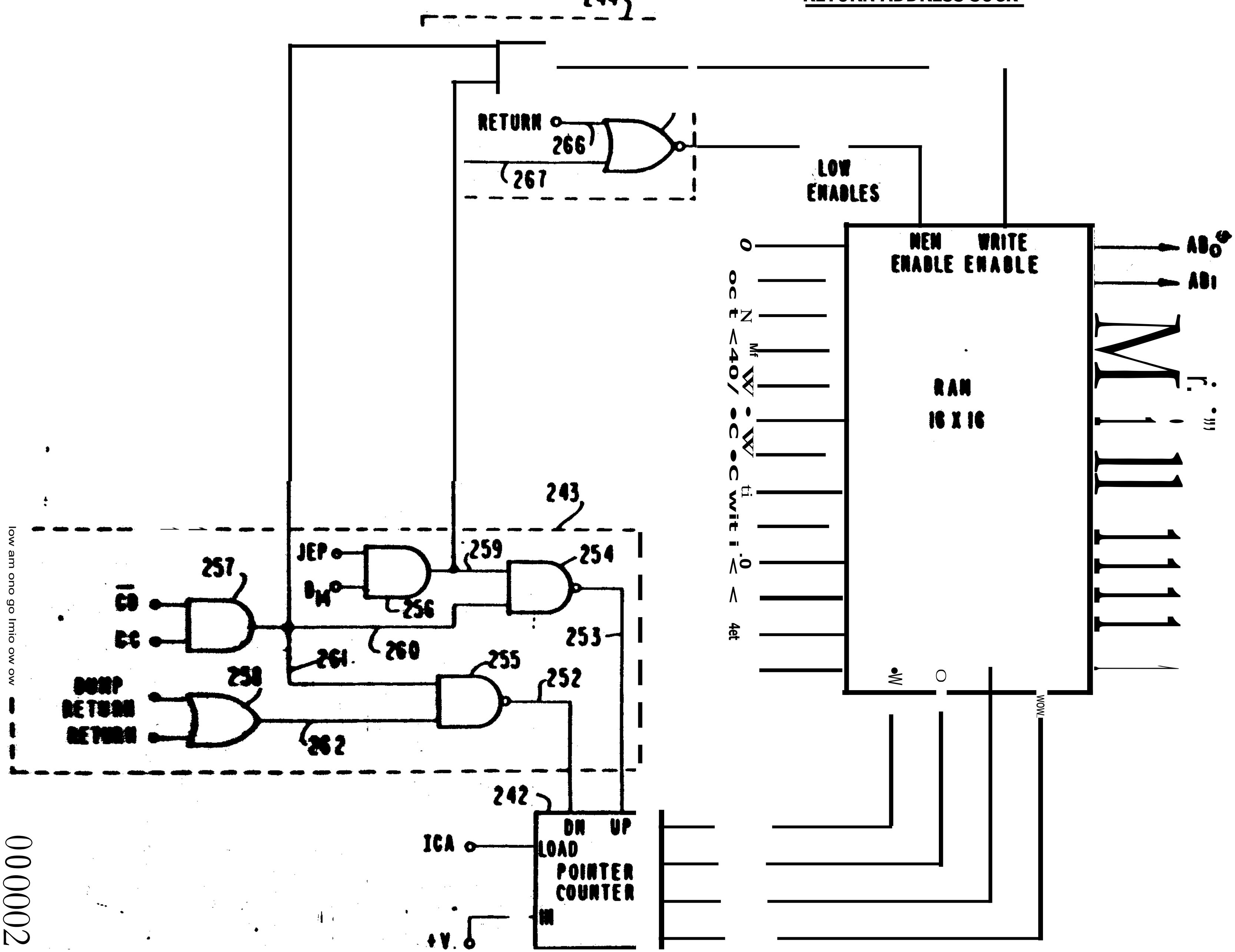

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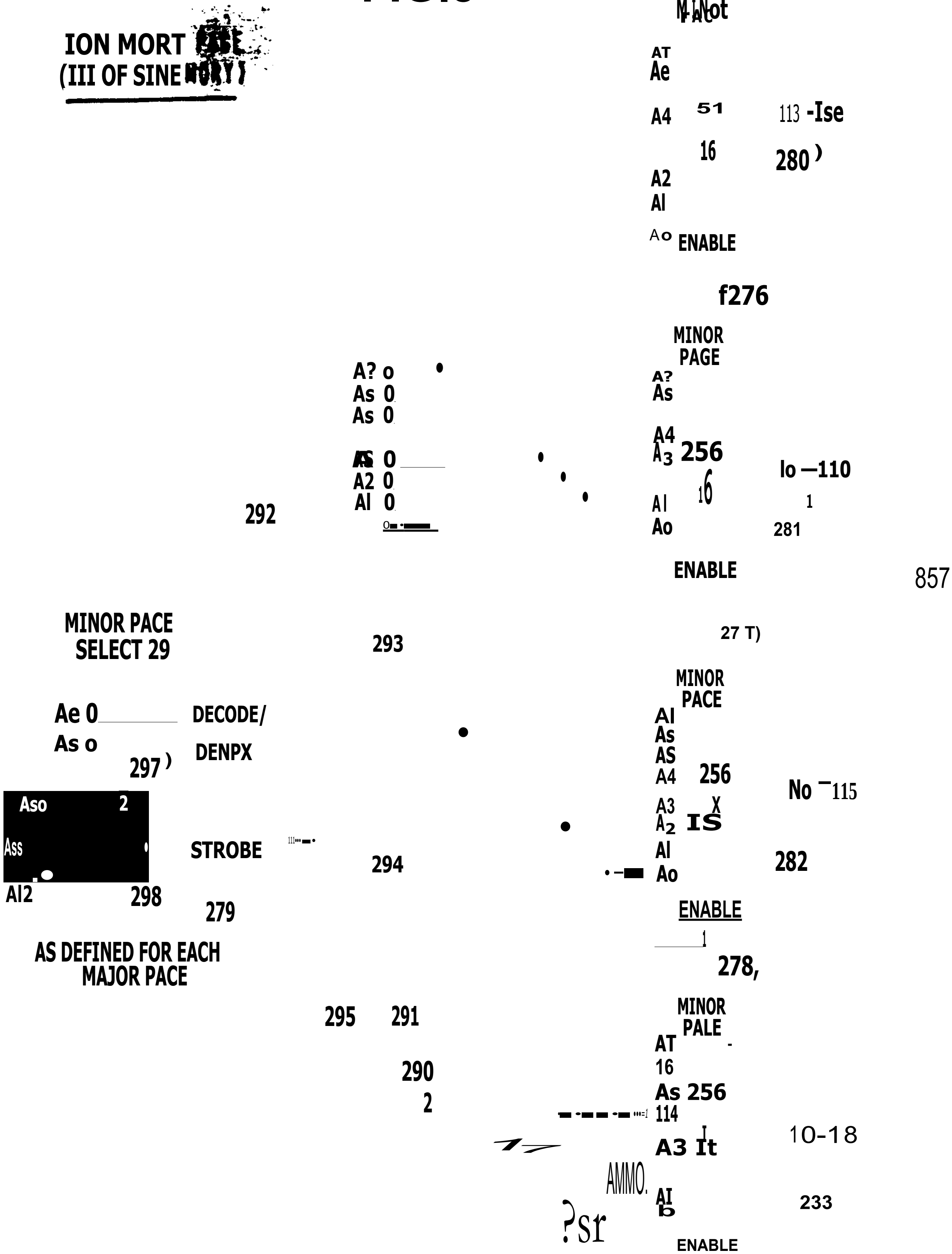
FIG.5



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As
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Aso
2
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STROBE
A3
A2 IS
294
Al
Ao
282
Al2
298
279
ENABLE
278,
AS DEFINED FOR EACH
MAJOR PACE
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MINOR
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ENABLE

PRINTER UNIT

FIG. 6

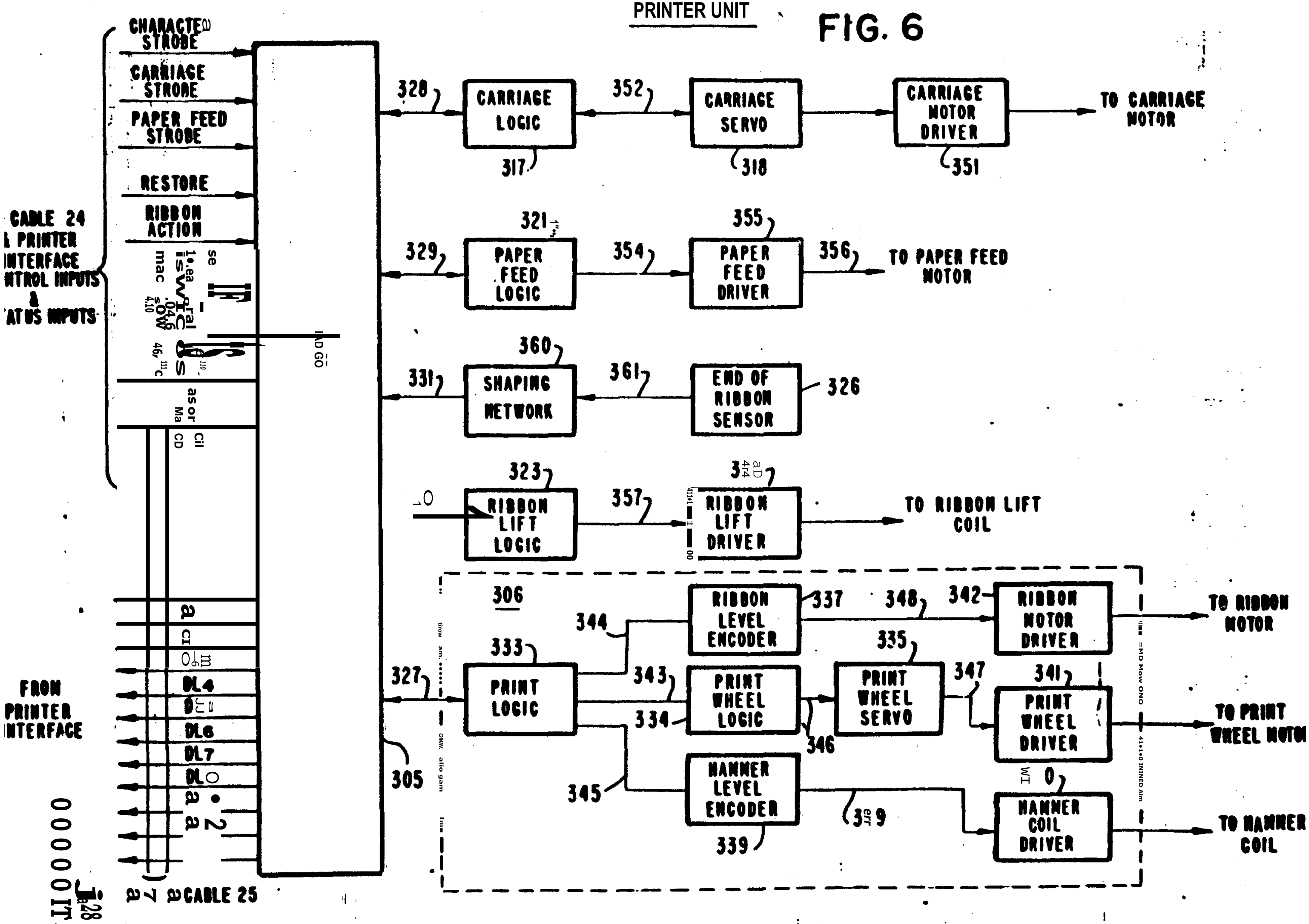
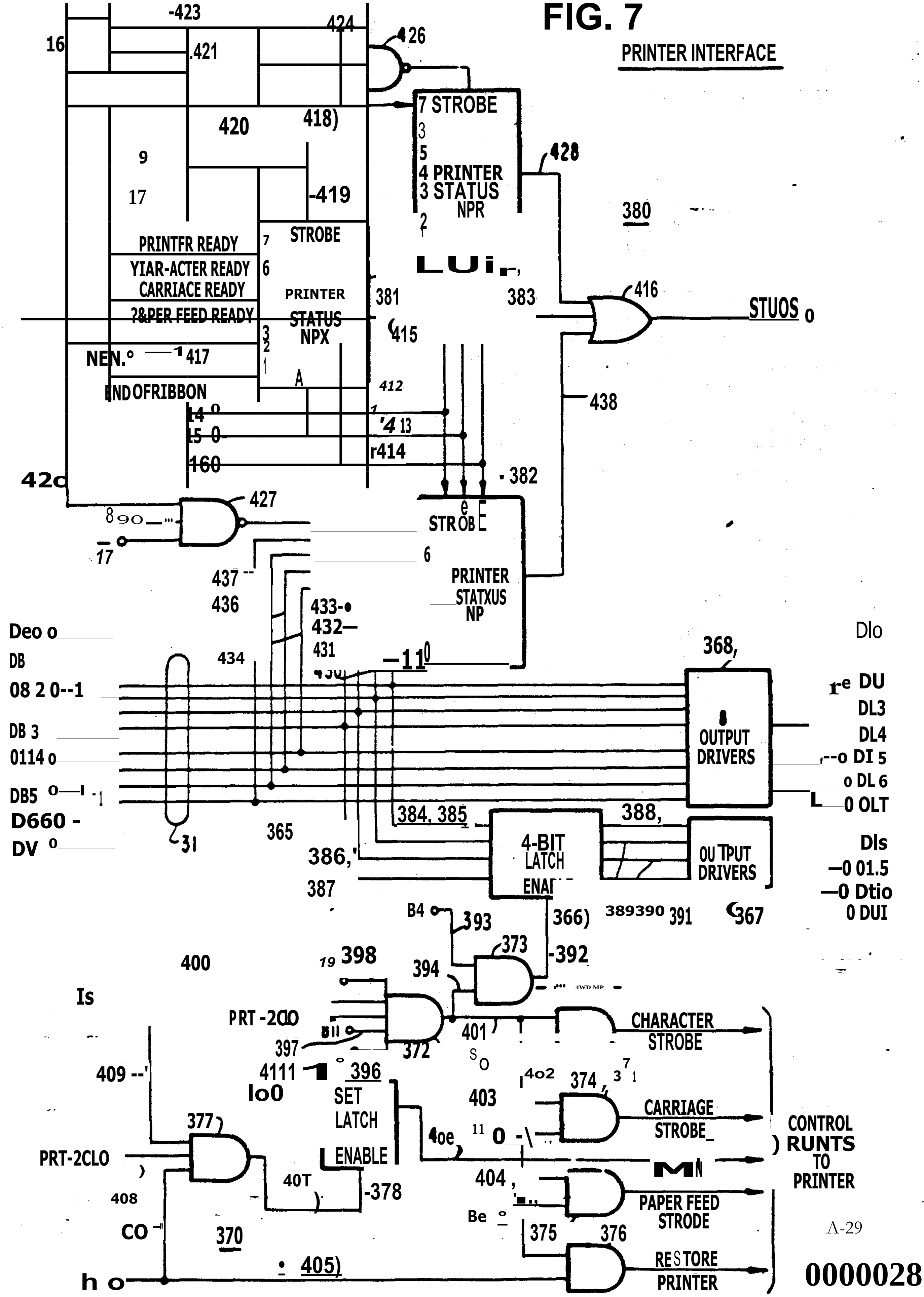


FIG. 7

PRINTER INTERFACE



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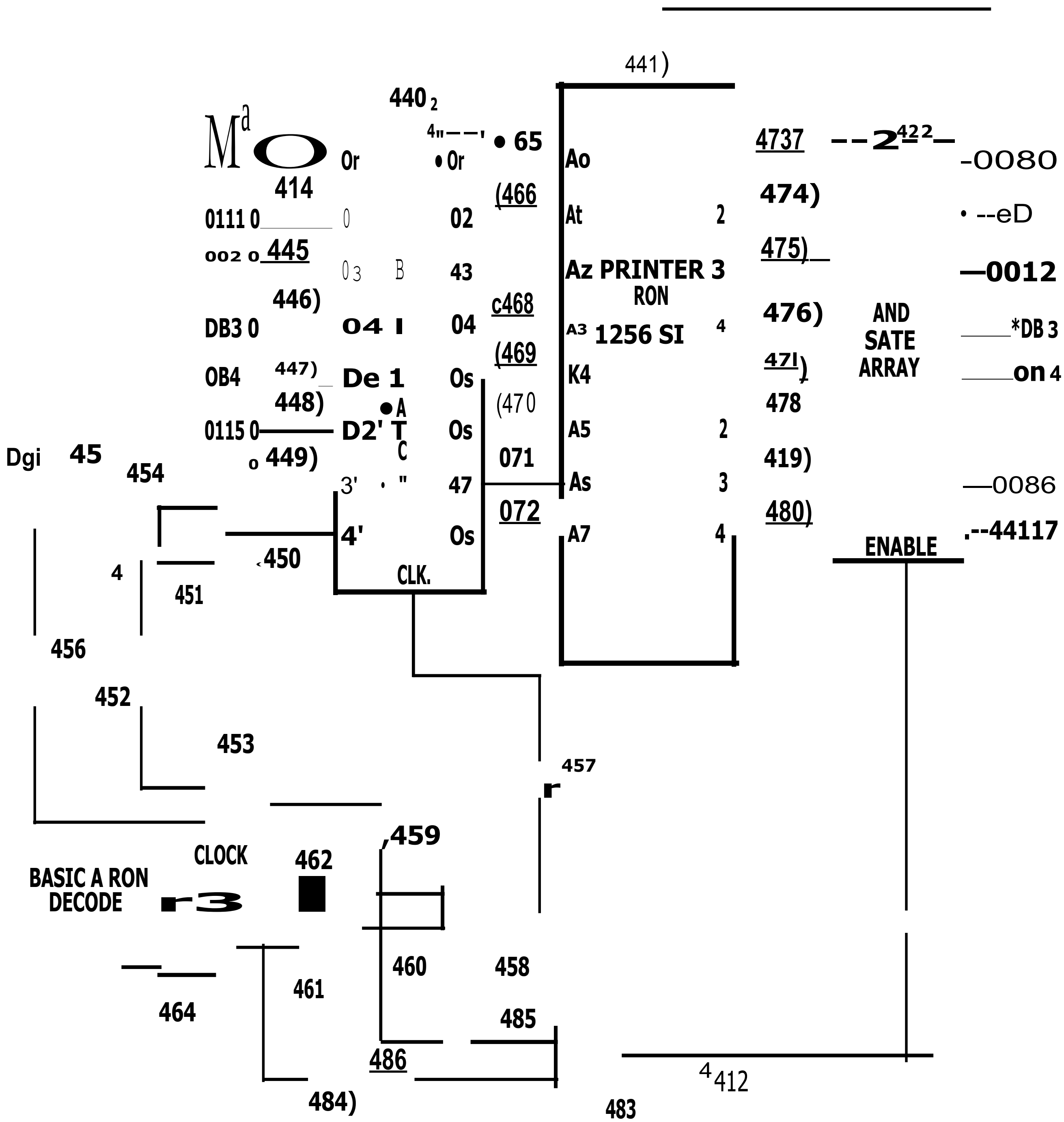

PRINTER DATA ROM

FIG. 8

oopp29

AUTOMATIC WRITING SYSTEMS AND METHODS GP WORD PROCESSING THEREFOR

ImiLe OF CONTENTS •

This invention relates to word processing method, and apparatus employing data processing techoiques and more particularly to improvements in the automatic writing techniques and systems disclosed in U.S. patent application Ser. Nos. 429.479 and 430,130. each application being filed in the names of Harry W. Swanstrom, Werner Schaer and Kenneth C. Campbell, on Ian. 2, 1974 and assigned to the Xerox Corporation.

In U.S. patent application Ser. Not 429,479 'and 430,130 there is disclosed automatic writing systems and techniques therefor wherein, a central Processor and plurality of peripherals cooperate us form a highly flexible and versatile word processing system. According to a preferred embodiment, the plurality of peripherals include at least a keyboard, a printer unit, a buffer and a transport station for recording data on a record media. The central processor and each of the plurality of peripherals are each connected to a common data bus, a common status bus and a common instruction word bus, through which the word processing system as a whole is controlled and data is conveyed and processed among the various peripherals. Automatic system control is exercised pursuant to operator instructiorg by the control processor which is disclosed in specie in U.S. patent application Ser. No. 430,130, supra, while the system as a whole is set forth in U.S. patent application Set. Nn: 429,479, supra, and the disclosures of each of these applications is incorporated herein by reference so that recourse to these applications may be had for appropriate description of common functions and modes of operation to thereby avoid the lengthy recitation thereof in this specification.

Briefly, however, upon the initiati.in of a power up cycle of operation, the central processor begins automatic sequencing through its fixed program, the initial positions of which are devoted to an initializing of the system to prepare it for subsequent word processing operations. During this period, a read only memory within the central processor is sequentially addressed and as each inb.ruction is issued the address is incremented by one to obtain the next sequential instruction. Upon the completion of an initializing of the system, a monitoring loop is entered whereupon the central processor awaits the occurrence of an event at the keyboard and rpon a detection of such an event a branch or jump instruction issues to cause addressing to shift to a program routine calculated to achieve appropriate processing in response to the event which occurred. Alphanumeric character data, format data and function data may be entered from the keyboard *and* the presence of such data is indicated to the central processpr on the common status bus. Upon receipt of a data presence co-•1ition, program control is initiated by the central processor to achieve the designated function of functions with the alphameric or format data presented.. The program control of each peripheral by the central processor is carried out on the common instruction word bus while the degree of completion of the command issued to a peripheral is indicated to the central processor on the common status bus. Data is conveyed among the peripherals and the central processor through the common data bus for example, in a record mode, alphameric data entered at the keyboard is placed on the common data bus and entered on a per character basis into the central processor. Thereafter such data is again placed on the common data bus and applied on a per chancier basis to the printer and buffer wider program control. When a line of characters has been entered into the buffer, the contents of the buffer are recordegain under program control, and each character re-gelded is-first loaded into the central orocessor and is thereafter applied to the traaport station for recording purposes. CattyOn*, it a playback mode, s line of characters h [illegible] the record media and loaded into the buffer, [illegible]er; PA character loadea is applied to the [illegible] Oat, under dram control, wi•lt the transfer otaiiall character taking place through and under the control of the central processor. This manner of asynchronous operation in data translation between a plurality of peripherals and a central processor enables the automatic writing systems disclosed in U.S. patent application Ser. Nos. 429,479 and 430,130 to perform a multitude of editing, revision, control and manipulation steps within-the central processor, under program control, while allowing the overall automatic writing system formed to be highly flexible in operation and readily expandable.

Through the utilization of additional memory and dedicated, special purpose peripherals, the automatic writing systems and techniques disclosed in U.S. patent application Ser. Nos. 429.479 and 430,130 may be improved so that additional word processing futures, enhanced speed and printing characteristics as well as advanced levels of operator convenience and ease of operation, heretofore unavailable in word processing equipments conventionally accessible in the market place may be provided. Thus, since the subject automatic writing system employs an independent printer unit in the form of • peripheral whose printing functions, indexing functions and escapement and other carriage displacement functions are independent of the keyboard, the printer unit may be controlled by the automatic writing system in such manner that both variable pitch and proportionally spaced printing is selectively available at the option of the operator. Similarly where high speed printing from a prerecorded media is required without an attendant requirement for editing, such high speed printing may selectively occur under program control in both a forward and reverse direction wherein alternate lines are printed in opposite directions so that the time required for the printing of prerecorded material is not wasted by unnecessary carriage_ return operations and the like. In like manner, overall print speed characteristics may be enhanced by deferring execution of escapement associated with space code characters and the like until a next alphameric character is entered whereupon the total displacement associated with both the space code character and that required prior to the printing of the alphameric character may be executed at once to avoid repetitive, adjacent escapement operations and the loss of time attending such repetitive operations.

Additional memory may also be relied upon to enhance operator cnivenience as well as the overall utility of the automatic uniting system. For example, automask modes of underscoring may be provided wherein designated groupings of alphameric character information such as one or more words or a line of information are automatically underscored. under prorarn control. Additionally, memory backspace may be provided to not only erase a previously entered character from memory but to also precisely reposition the carriage at the printer to accept corrected character information. This is highly advantageous to an operator where proportional spaced printing is selected as it obvires a need for repetitive, manual carriage positioning operations and similar advantages will alto obtoin where backspacing over a tab entry or the like occurs. Similarly, line information may be entered without special placement during a record mode operation tosethe- with appropriate designator codes and automatically centered, ender program control, upon playback while columnar information may be entered from the left-hand portion of defined columns together with appropriate designator codes without special placeme .t during a record mode operation and upon playback, automatically centered and/or printed in a right-flush manner so that such columnar data is aligned adjacent to the right-hand portions of the columns defined. Further, although margin control functions upon the playback of prerecorded documents has been known in conventional word processing equipment, additional memory capability may be utilized to extend the margin con..al functan to straight typing or recording modes of data entry so that in this mode, an operator need not be concerned with the right hand margin defined but instead may merely enter data on a continuous basis while the automatic writing system acts independently to automatially insert carriage return information and the like at appropriate locations so that the right hand margin will be honored and reflected on the document initially printed. Similarly during the playback of a prerecorded record media, document information may be printed in a justified format so as to exhibit a uniform right hand margin and the manner and extent to which word spaces are modified, under plogramocontrol, to achieve such justified format may be rendered controllable by the operator.

An increase in memory capability over that set forth in U.S. patent application Ser. Nos. 429,479 and 430,130 supra, may also be employed to provide enhanced operator convenience through the provision of specialized functions which add to th■ overall utility and ease of word processing within the automatic writing system. For instance, blocks of format information may be recorded which not only include the usual margin and tab stop information for data to be recorded, but in addition thereto title or other information descriptive of the following document information may be recorded therewith and a mode of operation provided where a reading and printing of only blocks of format information takes place. This would mean that for record media recorded in this manne-, an operator could quickly, easily and automatically obtain a print out or log in the form of a listing of the title or other descriptive information representing the data present on a record media. Similarly, although access to pages of document information on a record media is available in conventional word processing equipment as is the indescriminate accessing of paragraphs, lines, words and characters of information without regard to content within a given page, a mode of operation may be made available wherein an operator may define a precise string of text located within a page of information and th' automatic writing system may locate or search to a point at which that string of text is initiated to thereby provide data accessing capabilities which may descriminste in regard to substance as well as verniers, structure.

Embodiments of automatic writing systems employing magnetic cards as a recording medium may be provided with a capability to search to a given recording track thereon as well as to step tt descrete number of tracks in either direction to more readily facilitate editint operations. Furthermore," in embodiments of automatic Writing systems employing magnetic cards as, a recording medium, during modes of operation whe entered,. non printing codes are being selectively printed, the track which printing is taking place may be Moms at end of the line being entered thereon US matinee the utility of draft copy and to pro ease in the subsequent retrieval of informatIod on a selective hasis.

Automatic processing features *Akin an automatic Writing System may also be enhanced to increase operator efficiency. For instance, switch codes, search codes and switch and search codes are known to permit batched letter operations to be performed. In such batched letter operations a constant letter format recorded on one record media is employed in combinetion with an address list recorded-on a second record media to automatically prepare an individually addressed form letter to each addressee listed on the second record media through conventional word processing techniques. However, the addition of recordable Switch and Skip codes and functions as well as recordable Skip OR codes and functions for terminating an initiated skip operation would also enable the address information recorded on the second record media to be employed in the preparation of printed envelopes for the batched letters prepared to thereby enhance the overall utility of the automatic writing system under consideration.

The-.fore, it is an object of this invention to provide improved automatic writing systems for word processing applications and the like.

It is a further object of this invention to provide an improved automatic writing system exhibiting enhanded speed and printing characteristics as well as advanced levels of operator convenience and ease of operation.

It is an object of this invention to provide an automatic writing system capable of selectively pe:rforming variable pitch and proportionally spaced printing operations.

It is an additional object of this invention to provide an automatic writing system having a selective playback mode for pre' ecorded information wherein alternate lines of information are ordinarily printed in opposite directions to avoid time consuming carrier return operations and the like.

It is a further object of this invention to provide an improved automatic writing system wherein print speed is increased during selected playback modes of operation by deferring the execution of carriage escapement in response to space codes and the like until a next alphameric character is entered whereupon the total displacement associated with both the space code character and that requireel prior to the printing of the alphameric character maybe executed at once to avoid repetWye operations.

another objecf'brthis invention to provide an siintrtnatic writing sYitem capable of perfOrming autotnatfi underscoring operations upon designated groupings of information during a data entry mode of opera4tion.

lih a further object of this invention lb prOvidean infproved automatic writing system having t :memory "bactipace !unction which acts to automatically reposition thrprinter to ui location corresponding to an ipproptiite witty pastafor the next character to be entered upon on enabling Of said memory baCkipace fuiction:

Yt is an additional object of thii invention to provide an automatic writing system capable of automatically CI:Meting during playback; recorded line information entered without special placement.

It ii a further object of this invention to provide an automatic writing sr ten responsive to defined colwins. columnar data and designator codes for autoauititally centering, upon playbici, recorded columnar data S within the associated i..lumns defined.

It is another object of the instant invention to provide an automatic writing system responsive to defined col=as, columnar data entered from the left-band portion of each column defmed and designator codes for automaticaily printing, upon playback, recorded columnar data flush to the right•hand portion of an associated column.

It is an additional object of the present invention to provide an improved automatic writing system exhibit. ing a margin control mode of operation operablt dung data entry which is responsive to data entered from the keyboard to cause such data to be printed and to in:crt carriage return codes where appropriate to achiev. printing of entered data in accordance with estikAishat margins.

It is a further object of the present invention to pmvide an automatic writing system capabhy of printing recorded text in a justified format exhibiting a uniform right-hand margin and permitting an operator to 'elec. Lively control the limits of spaces inserted between words, under program control, to achieve such justified format.

It is another object of the instant invention to provide an improved automatic writing system capable of recording title and other descriptive information within blocks of format information and upon initiation of a special playback mode to cause printing of only infor!nation contained in said blocks of format information and thus provide a log of recorded information.

It is an additional object of the present invention to provide an automatic writing system having a search mode of operation wherein a string of recorded text nay u, : defined at the keyboard and said automatic writing apparatus conducts a search of a page of recorded information to the beginning of the text string defined.

It is a further object of the present invention to provide an improved automatic writing system wherein embodiments thereof relying upon magnetic cards as a recording medium have the capability to search to a given track on said magnetic card as well as the ability to step to adjacent tracks in either direction.

It is another object of the instant invention to provide an automatic writing system having embodiments employing a magnetic card as a recording medium and a mode in which entered non-printing codes are seleclively printed, the mode in which entered non-printing codes are selectively printed in a record mode of operadon additionally causing the track number upon which printing is taking place to be automatically printed at the end of the line being entered thereon.

It is an additional object of the instant invention to provide an improved automatic writing system having "nconlabte switch and skip and skip-off codes and respossive thereto to shift a playback operation from one record media to another and to skip over the informadbn reeorded thereon untie a skip-oft code is read whereupon playback and printing is resumed.

^^" Vkrious other objects and advantages of the instrnt Invention will be cbme clear from the following descriP-33 Wit of several exemplary embodiments thereof, and the novel features wilrbe partic-Arly pointed out in consection with the appended claims.

BRIEF SUMMARY

Lr accordance with a preferred embodiment of this invention an autotnalk writing system is provided wherein a central prOCiiicir and a plurality of peripher- ale including at least teyboard means, printer means, buffer means and means for recording data on a record media are each connected to a common data bus, a coalman status bus and a common instruction word bus and a printer data storage peripheral means is connected to said common data bus and said common instruction word bus; alphameric character data, format data, and 'Unction data may be entered from the keyboard and the presence of such data is indicated to the central processor on the common status bus; upon receipt of a data present: c ':edition, program control is initiated by the central processor calculated to achieve the designated function or functions with the alphameric or format data presented; program control of each peripheral by the central processor is carried out on the common instruction word bus while the degree of completion of the command issued to a peripheral, if required, is indicated to the central processor on the common status bus; data is conveyed among the peripherals and the central processor through the common data bus; in a record mode, for example, alphameric data entered at the keyboard is placed on the data bus and entered on a per character basis in the central processor, thereafter such data is again placed on the data bus and applied on a per character basis to the printer data storage periph. eral means and the buffer means, each character applied to the buffer means is stored therein for accumulation purposes while the printer data storage peripheral means is responsive to such character data to apply character print information appropriate to the variable pitch or proportional spaced printing mode selected to the common data bus for initial application to the central processor and subsequent application through the common data bus to the printer means; when a line of character information has been accumulated in the buffer means, the contents of the buffer means is recorded, -again under program control, wherein each character to be recorded is first loaded into the central processor and thereafter applied to said means for recording; conversely, in a playback mode, a line of char- asters is read from the record media and loaded into the buffer means; thereafter, each character loaded is applied to the printer data storage peripheral means with the transfer of each character taking place ,through and under the control of the central processor; the printer data storage peripheral means is reponsive to each character received to apply corresponding character print information appropriate to the variable pitch or proportional spaced printing mode selected through the common data bus for initial application to the central pro- censor and subsequent application through the common data bus to the printer means under program control with the transfer of each character taking place through and under the control of the central processor, this manner of asynchronous operation in data translation between a plurality of peripherals and a central processor enables a multitude of editing, revision, control and manipulation steps to be accomplished in the central processor under program control while allowing the overall automatic writing system to be highly flexible in operation and readily expandable.

The invention will be more clearly understood by reference to the following detailed description of an

asemplary embodiment thereof in conjunction with the accompanying drawings in which:

FIG. I is a pictorial view of an embodbnent Of an automatic writing system in accordance with the teachings of the present invention;

!FIG. 2 is a block diagram which schematically illustrates the overall apparatus contained in the embodiment of the invention depicted in FIG. L

FIG. 3 is a block diagram schematically Illustrating an exemplary ROM address register suitable for incorporation into the embodiment of the automatic writing system depicted in FIG. 1 and more particularly into the microprocessor portion of the apparatus depicted in FIG. 2;

FIG. 4 is a block diagram schematicalloushowing an exemplary return address register suitable for use as the return address register depicted in FIG. 2;

FIG. S is a block diagram schematically illustrating the structure of a typical page of the eight page read only memory employed fur ROM orogram storage within the microprocessor illustrated in FIG. 2;

FIG. 6 is a block diagram schematically illustrating the logic details of a printer unit suitable for incorporation into the embodiment of the automatic writing system depicted in FIG. 2;

FIG. 7 schematically shows an interface suitable for use with the printer unit illustrated in FJG. 3;

FIG. $ schematically depicts an exemplary printer data storage peripheral suitable for use in the embodiment of the invention depicted in FIGS. 1 and 2;

FIGS. 9a and 9b illustrate keyboard configurations suitable for use in conjunction with the apparatus depicted in FIG. 2 wherein FIG. 9a is a keyboard configuration specially adapted for embodiments of this invention employing record media in the form of a tape or the like and FIG. 9b is a keyboard configuration more suitable for embodiments of this invention employing a magnetic card as the record media;

FIG. 10 illustrates a suitable keyboard interface for keyboard configurations shown in FIGS. Sc and 9b,

FIG. 11 schematically depicts an exemplary RAM peripheral which is suitably configurated to provide the buffer and miscellaneous storage requirements for the apparatus depicted in FIG. 2;

FIG. 12 schematically depicts a program time delay peripheral suitable for use in the apparatus depicted in FIG. 2;

FIG. 13 schematically illustrates record media write apparatus suitable for use in the embodiment of the automatic writing system depicted in FIG. 2;

FIG. 14 depicts record media read apparatus suitable for use in the embodiment of the automatic writing system depicted in FIG. 2;

FIGS. 15a and 1Sb schematically illustrate record media transport control apparatus suitable for use in the embodiment of the automatic writing system shown in FIG. 2, wherein FIG. 15a is record media transport control apparatus specially adapted for embodiments of this invention employing record media hi the form of a tape or the like and FIG. 15b is record media transport control apparatus configured for embodiments of this invention employing a magnetic card as the record media;

FIG. 16 is a flow chart illustrating a simplified system idle loop program;

FIG. 17 is a flow chart illustrating a simplified escapement and character printing program sequence of operation;

A-34

FIG. IS is a Aso chart illustrating the program se-mime of Operatifons for Play, Skip and Duplicate functions;

a low chart illustrating a program se-quest Control Stop Conditions associated with play skip and duplicate operations;

FIGS. 20a awl 206 are flow charts illustrating program sequences of operations for word underscore operations wherein FIG. 20a depicts the processing functions which occur when a word underscore code is entered from the keyboard while FIG. 206 shows the functions occurring during playback;

FIG. 21 is a flow chart depicting normal program sequence operations under a playback mode of margin control;

FIG. 22 is a flow chart illustrating a program sequence of operations under a manual mode of margin control operative upon an entry of data from the keyboard;

FIGS. 23a. 231 and 23c are flow charts illustrating the program sequence of operations relied upon to achieve justification of the right-hand margin of printed document information wherein FIG. 23a depicts the normal justification routine. FIG. 236 illustrates the justification break point analysis subroutine and FIG. 2k depicts the justify help routine employed under cases where justification can not be achieved without operator intervention;

FIG. 24 is a flow chart illustrating the program sequence of operations relied upon in a high speed print mode of playback wherein printing takes place in a forward and reverse direction, the flow chart is combinable with FIG. 23 to achieve this mode of playback with justification;

FIGS. 25a and 2Sb are flow charts illustrating the program sequence of operations associated with line centering operations wherein FIG. 25a depicts the program routine initicted in conjunction with the entry of a line centering code from the keyboard and FIG. 2Sb shows the program routine for implementing line a-tering upon playback.

FIG. 26 is a flow chart depicting a program sequence of operations for "Column Centering" data and presenting the same in a "Right Flush" manner during playback;

FIG. 27 is a flow chart depicting a program sequence of operations for an "Auto Log" printout mode of operation wherein format information and descriptive information recorded in format blocks is selectively printed; and

FIGS. Zia - 20d are flow charts depicting the program cycle of operations wherein data is entered from the keyboard and the record media is searched therefor, FIG. 211.411ustrating the initial portion of this routine and FIGS. 211! and 2k illussrating forward and reverse portions. : the searching routines and FIG. 2Sd showing :4%...parison routine per se.

tii.NERAL DESCRIPTION

. . Referring now to the drawings and more particularly to HO. 1 thereof, there is shown a pictorial view of one embodiment- of an automatic writing system in accordance with the teachings of the present invention. The ezemplary embodiment of the automatic writing system depicted in FIG. 1 comprises keyboard means 1, printer means 2 and a record media and processor control console 3. The keyboard means 1 and the printer means 2 are enckeed within a common housing and Imaged to give the appearance of an input/output typewriter configuration 4. This arrangement is desirable because it presents an operator with a familiar typewriter configuration while placing, as shall be seen below, substandolly all elements of the automatic writing system which require manipulation at the operator's fingertips. Although, as shall be appreciated by those of ordinary skill in the art, any input/output typewriter apparatus could be utilized with the instant invention, independent keyboard matins and printer mesas are here preferred. The keyboard means 1 may take the form of a conventional electrmic keyboard such as those manufactured by The Microswitcl. Division of Honeywell Corporation or The Keytronics Corporation of Spokane Washington and conventionally available. Physical characteristics of the keyboard such is touch and feel should preferably approach those of conventional •ectric typewriters so that input operations carried out at the keyboard will not adversely affect the operator or convey the impression that alien equipment is being employed. The keyboard means 1, as further described hereinafter, includes all the standard 44 alphanumeric charset.r keys found on conventional typewriters. In additiun, as better illustrated in FIGS. Ila and 9b a plutalky of specialized function keys have been added to the conventional keyboard and a plurality of additional functions have been addorto certain selected ones of the conventional alphameric keys.

The printer means 2, as further described in conjunction with FIG. 6, may take the form of a serial electronic printer wherein a servo controlled daisy wheel mounted on a servo controlled carriage effects printing while paper indexing and the like is controlleJ by a servo associated with the roll S. Although any conventional serial printer may be employed, this type of serial printer it preferred as it allows printing to be accomplished at essentially twice the rate available with conventional input/output modified Selectric typewriters when the printer is being driven in an ordinary manner from the record medium. The keyboard means 1 and printer means 2 arranged in a typewriter configuration 4 is connected through a multiconductor cable 6 ti the record media and processor control console 3.

The record media and processor control console 3 depicted in FIG. 1 includes first and second cassette mounting chambers 7 and i, rewind/eject buttons 9 and 10 associated with each of the cassette chambers 7 and as well as digital displays 11 and 12; which also may serve as read/record function indicators; in addition, a power switch 13, for energizing the automatic writing system depicted in :71'1. 1 is also provided on the record media and pro. -stop weird console 3. Althcaigh the embodiment of the filltellitiC writing system depicted in FIG. 1 has been illustrated as employing multiple record media in the form of magnetic tape cassettes, it will be appreciated by those of ordinary skill in the art that any suitable recording media such as magnetic cards, magnetic tapes, magnetic belts or even paper pwscued tape could be substituted therefor. In addition as shall be apparent to those or ordinary skill in the art as the disclosure of the present invention preceeds, although a two (2) station recording and playback system has been depicted in FIG. 1 and will be described below, the common bus operation of the instant invendon allows more or fewer recording and playback stations to be employed without deviating a whit from the concepts. of the instant invention. AccordiAgt6 if it "litAtre dais I to provide an automatic writing system having more limited capabilities thin that of the embodiment disclosed herein; a single recording and playback station could be while if it were desired to add further capabilit (3) or more recording or playback stations could anted.

Similarly, cassettes, preferably of the conventional Phillips type have been illustrated in FIG. 1, because they are highly desireable r•ons the standpoint of operator handling and filing while allowing substantial amounts of information to be recorded on a single media. However, should a limited system be desired such as a system wherein a single letter provided per record media, magnetic cards or belts could be readily substituted for the cassettes depicted in the FIU. 1 embodiment of the present invention. The structure and function of the cassette chambers 7 and * and rewind-/eject buttons 9 and 10 therefor are entirely conventional. Thus, in the well known manner, the depression of one of the eject buttons 9 and 10 results in the rewinding of the record media and the opening of the cassette chamber associated therewith, whereupon a cassette may be loaded or removed. As shall be seen below, the condition of the cassette chambers 7 and 11 are monitored so that the status of each system is continuously available to a central processor. The digital displays 11 and 12 associated with each record station act in the conventional manner to indicate, by their illumination and the provision of read and record indicia means therein, which of the stations is active in a.given role and additionally provide in a manner to he detailed hereinafter, a digital display indicative of the portion of the record media then being utilized. Although not illustrated in FIG. 1, the record media and processor control console 3 houses the majority of the logic and processing equipments employed in the automatic writing system illustrated. Thus, as shall become apparent in connection with the description of FIG. 2, the record media and processing control console 3, houses the central processor, the buffers. the control and transport equipment associated with the record media stations and interface equipment for the printer means and keyboard means 1 and 2.

Accordingly, the embodiment of the automatic write lag system illustr:tcd in FIG. 1 comprises a typewriter configuration which provides all control, format and alphanumeric input elements at the operator's fingertips and a record media and processor control console which houses the logic associated with the instant automatic writing system and the record media stations as well as the power switch 13 which acts to energize and deenergize the entire system.

DETAILED DESCRIPTION OF AN EXEMPLARY EMBODIMENT

Referring now to FIG. a there is shown a block dia.. gram schematically representing the embodiment of the automatic writing system depicted in FIG. I. The embodiment of the automatic writin; system schematically illustrated in FIG. 2 comprises a keyboard mem: 1 and printer means 2 arranged in a typewriter configuration 4, as briefly described in conjunction with FIG. 1, and the electronic structure contained in the record media and processor control console 3 which comprises a printer data ROM peripheral indicated by the dashed block 14, a typewriter figuration interface indicated by the dished block 15, a central processor which takes the form of a microprocessor indicated by the dashed block IS and a program time delay peripheral indicated by the dashed block 16A. buffer and micellaneoue storage apparatus indicated by the dashed block 17, record media control write and read apparatus indicated by the dashed block 1$, a common data bus It a "VIM= instruction word bus 20, and a common status ..es 21.

THE TYPEWRITER CONFIGURATION

The keyboard means 1. as mentioned above, may take the form of a conventional electronic keyboard such as that manufactured by the Microswitch Division of Honeywell Corporation or the Keytronics Corporation and should exhibit touch and feel characteristics similar to those of a conventions! electric typewriter. The keyboard means 1 includes a standard 44 character set of keys which are each capable of three fbnctions, to whit, lower case, upper case, and an encoded function As each key on the keyboard means 1 is Jepresaed an eight (1) bit ASCII code associated with the character is produced in parallel by the keyboard in the conventional manner. In addition, certain of the keys within the standard forty-four (44) character set are typamatic or repeatable as is also conventional in electric typewriters and/or electronic keyboards. Such typamatic or repeatable keys should include at least the underscore key, the hyphen key, the space key and the a-key and act in the conventional manner to enable a repeat line so that the character code associated with the key depressed is automatically repeated whenever such typamatic key is held depressed for longer than a predetermined interval of time such as five hundred milliseconds (500 ms) in a manner to be further described below. In addition to the forty-four (44) conventional alphanumeric character keys, the keyboard means I should also include conventional input keys or levers such as space bar. shift, shift lock, carrier return. tab set, tab clear and tab as will be further described below. Typical configurations for the keyboard employed in the instant invention are shown in FIG. Sc for tape versions and 9b for card versions. In addition to the conventional keys found on the majority of electric typewriters, the keyboard means I. as shown in FIGS. Sc and 9b also includes a plurality of specialized function keys such as record, revise, alternate reader, code print, search or track step, code, line correct, margin control, duplicate, skip, play. auto, paragraph, line, word, character stop, paper index, space expand and justify keys, as shall be more fully discussed below. Furthermore, as an independent printer is here employed, levers are provided on m keyboard to control the margin settings, print pitch selected including proportional spacing and the intermediate line spacing. These levers, as slot: be seen below are neceuary because the electronic printer which is preferably employed in this embodiment of the instant invention does not utilize physical stops for margin setdap, but instead maintains margin settings and printer position information in memory and selectively controls the limits at which the single element printer carriage may move. Therefore, margin i:ttinp are electronically set and stored and paper spacing intermediate lines is controlled by an indexing operation.

The keyboard means 1 is connected to the typewriter configuration interface indicated by the dashed block 15 through a multiconductor control cable 23 and an eight (I) bit data cable 23. The multiounductor control cable 22 comprises a plurality of individual confittamprs through which coqtroL information is interchanged between the keyboard mesas 1 and other apparatus present in the record media and processor control eon. sole 3. Although the control signals supplied to the conductors in the muliii:ondbcteor cable 22 will be described in detail in SAM the description of FlO. 10, h-should, :,00ted hi essence control signals indicative is at the keyboard' are supplied to the appeal is within word media and processor control console 3 and command signals indicative of the type of data to be gated onto the eight (1) bit data cable are supplied to the keyboard from the record media and processor control console 3 through the multiconducto- cable 22 The eight (8) bit data cable 23 comprises eight (d) parallel conductors which are each hi-directionally gated tc form a full duplex conductor. The eight (8) bit data cable 23 is employed to supply each eight (8) bit ASCII code sequence generated at the keyboard upon the depression of a key thereat in parallel to the apparatus within record media and processor control console 3, while information employed to produce a status indication such as by the illumination of-a key or the sounding of an alar.n at the keyboard is supplied throubh the eight (8) bit data cable 23 to the keyboard toms 1 from apparatus in the record media and proceewr control console 3.

The printer means 2, as aforesaid, •-kes the form of an electronic serial printer. Although any conventional serial printer or for that matter any input/output typewriter may be employed in the instant embodiment of the automatic writing system in accordance with the teachings of the present invention, a modified version of The Diablo Model 1200 Type I serial printer, available from Diablo Systems Incorporated of Haywood, California is here preferred. The printer means 2 will be more fully described in conjunction with FIGS. 6 and 7 below; however, it should be noted that the Diablo 1200 High Type I serial printer is viewed as highly desirable for applications such as those present in automatic writing systems of the type here being described because a single element pnnt carriage employing a rotating daisy wheel is utilized and results in a serial printer which operates at twice the rate of conventional input/outv • devices while such serial printing is accomplished without the hie ambient noise attendant in both normal line printers and input/output typewriters. In addition, print element positioning, carriage displacement and paper movement or indexing are all accomplished electronically and hence the unit exhibits exceptionally Ligh reliability characteristics due to the avoidance of the majority of mechanical parts normally employed to accomplish these, functions in both input/output typewriter devices and line printers. Furthermore, as a plurality of the so-called daisy wheel print fonts are available, type styles and format may be rapidly and easily ganged by an inexperienced operator. The printer miels1 is connected to the typewriter configuration inteffaee indicated by the dashed block tS through i inultiCOnductor control and status cable 24 and a twelve (12) bit data cable 25. The multiconductor control and status cable 24 will be described in greater detail in conjunction with FIG. 7. However, it may be noted that the multiconductor control and status cable 24 it employed to supply status information as to the various conditions monitored at the printer to the apparatus Contained' in the retard media and processor control console 3 and to supply strobe information for chatactir dint, carriage movement and data and paper incluing or movement data from the apparatus in the record media and processor control console 3 to the printer means 2. The twelve (12) bit data cable comprises twelve (12) parallel conductors employed to convey the character data. carriage displacernae data and paper indexing information between the printer means 2 and apparatus in the record media and processor control' console 3. When character data is being supplied from apparatus in the record media and processor control console 3 to the printer means 2 twelve (12) bit wide character data is supplied from a readinp of the printer data ROM peripheral 14. Only seven ('7) bits of this character data are employed to define the ASCII code utilized for the character information perse while the remaining five (5) bits are employed at the printer means 2 to define hammer force and nbbon width to be used in printing. However, for carriage displacement information or paper indexing tam nation, one bit is employ-. to define direction while only the necessary c..mber of the remaining eleven (I I) bits as are required to define the given displacement within the twelve (12) bit data cable 25 are utilized. The twelve (12) bit data cable 25 is indicated as only providing an input to the primer means 2 because once such an input is supplied, the printer means 2 has sufficient logic to carry out the designated function and provide an indication of its status, i.e. ready, busy or the like, on the multiconductor control and status cable 24.

THE TYPEWRITER CONFIGURATION INTERFACE

The typewriter corifigurition interface indicated by the dashed block IS comprises a keyboard interface 26 and a printer interface 27. Each of the interfaces 26 und 27 is described in greate- detail below in conjunction with FIGS. 10 and 7 respectively. Therefore, at this juncture in the description of the present embodiment of the instant invention, it is only necessary to note that the keyboard interface 26 and the printer interface 27 perform a plurality of common functions with respect to the printer means 2 or keyboard mums 1 with which they are associated and the remaining apparatus in the record media and processor control console 3 and in addition thereto receives control and command information from the apparatus present in the record media and processor control console 3, supplies and receives command and status information from the keyboard means I and supplies status information on a command basis to the remaining apparatus in the record media and processor control console 3. Similarly, the printer interface 27 receives twelve (12) bit and multiple bit data representing character information, carriage displacement information or paper movement information from the remaining apparatus within the record media and processor control console 3 and supplies the same as an input to the printer means 2. In addition, the printer interface 27 receives control and command information from the remaining apparatus within the record media and processor control console 3, supplies control information to and receives the same from the printer means 2 and provides a -talus indication on a command basis as to a selected status condition of the printer to the remaining apparatus within the record media anu processof control console 3. Both the keyboard interface 26 and the printer interface 27, additionally act in the traditional role of clStiventional int-dice* at providing for the raising of the vas ions forms of data conveyed - appropriate logic levels for translation to the logic atvice at the designated destination as well as inAheacal gating roles. The keyboard interface 26 is connected to actor control cable 22 and the eight (II) bit le 23, both are associated with the d mein 1. and Patio information ed. be Xeyboard means 1 and the d interface the'asuldconductor con- 22 whale ike the form of eight (8) bit rs, wherein each bit of a character is conveyed 10, is exchanged between the keyboard means 1 V keyboard interface 26.

- -Tbeleyboard interface 26 is connected to the remain- Aug apparatus within the record media and processor nomad console 3 through an eight (8) bit data cable 2$, Watteten (16) bit instruction word cable 29 and a single /tams conductor 30. As shall become more apparent as-the disclosure of the instant invention proceeds, the automatic writing system disclosed herein is organized as a single address data processing system whe rein all data is conveyed in parallel along the common data bus, 0, all instructions are *conveyed* along the common instruction word bus 20, while all status information as to the various conditions of *the* peripherals is conveyed along the common status bus 21. Furthermore, *the*-addressing technique employed is such that the microprocessor indicated by the dashed block 16 initially goes through an idle program in which it selectively samples a plurality of status conditions at each of the peripheals in sequence. Thus, in this idle program the microprocessor indicated by the dashed block 16 essentially waits for a designated event of one type or another to occur at one of the peripherals. When such an event occurs as indicated by a flag on the status bus, the program shifts as a function of the event at the peripheral for which the flag appeared on the common status bus 21 th:reby accomplish appropriate processing for the condition at the peripheral indicated. Accordingly, to achieve this mode of organization, the eight (8) data cable 23 is connected from the keyboard interface 26 to the common data bus 19, the sixteen (16) bit instruction word cable 29 is connected intermediate the keyboard interface 26 and the common instruction word bus 20 while the single bit status conductor 30 is connected between the keyhnard interface 26 and the common status bus 21. Thus, eight (8) bit character data is conveyed between the common data bus 19 and the keyboard interface 26 through the eight (8) bit data cable 28, instruclion words in the form of command and control information is supplied to the keyboard interface 26 through the sixteen (16) bit instruction word cable 29 from the common instruction word bus 20 and status information. representing a condition on the keyboard which the microprocessor seeks to monitor is supplied from the keyboard interface 36 to the common status bus 21 throuEcdtwsingle bit conductor 30. Therefore, as more t in connection with the in PIO. keyboard interface 26 acts to accept commands issued by the microprocesated by the dashed block 16 on the common word bus 20, to indicate the status of various to be monitored at the keyboard and to logite eight (II) bit character data to and from the data bus 19 so that characters are *maintaineV* ate boob on the common data bus 19.

ranter interface 27 is oonneeed to the printed 2 through mukiconductor control and status and through a twelve (12) bit data cable 23. In U , in a similar manner to-the keyboard Interface prioter interface 27 is connected to the remainrann in the record media and processor control console 3 through an eight (S) bit data cable 31. a sixteen (U) bit instruction word cable 32 and a single bit status conductor 33. The eight (8) bit data cable 31 Is con-meted to the common data bus 0 and may take the name form and provide the same function as the eight (g) bit data cable 20 connected intermediate the common data bus 19 and the keyboard interface 23. The eight (8) bit data able 31,_as indicated in F10. 2, thus acts to convey characters in the form of eight (8) of less parallel bits from the common data bus 19 to the printer interface 27 for subsequent application through cable 2$ to the printer means 2, however, as shall be seen in conjun-tion with FIG. 7, no data is conveyed from t1.4 printer interface 27 to the common data bus 19 and acconiingly a single direction of data flow is indicated for the eight (8) bit data cable 31. As will be fully apparent to those of ordinary skill in the art, the eight (8) bit data cable 31 need not be gated half duplex cable in that the gating function is here achieved by output apparatus located at the printer interface 27 which responds to instructions issued by the microprocessor indicated by the dashed block 16 while the printer meant2 is capable of independently acting upon instructions ani placing an instruction completed flag, as shall be more fully described below, on the single bit status conductor 33. The single bit status conductor 33 is connected to the common status bus 21 and may take the same form and provide the same function as the single bit status conductor 30 connected intermediate the keyboard interface 26 and the common status bus 21. Thus, as shall also be seen hereinafter, the single bit status conductor 33 serves to provide status indications on the common status bus 21 as to the condition of any bit on the common data bus 19 and of the printer and more particularly, as to the ready, busy or instruction completed condition of the various aspects of the printer means 1 which are being selectively monitored.

Although both the keyboard interface 26 and the printer interface 27 will be separate' v discussed and described in connection with FIGS. 7 and 10 respectively, it should now be apparent that the typewriter configuration interface indicated by the dabbed block 15 provides an independent interface for the printer means and the keyboard means and that each interface so provided carries out three separate and distinct functions in addition to the normal logic functions of raising inputs to and outputs from a destination device to appropriate logic levels. The first of these functions is to provide a status indication to the common status-bus 21 as to the status of the condition within the printer means 2 or the keyboard means 1 which is then being monitored. For instance, if operation is being initiated and the microprocessor indicated by the dashed block 16 is in an idle program and is thus waiting for some action to occur at one of the peripherals, when a flag goes up on the single bit status conductor 30 and a data presence condition is being monitored, the microprocessor will branch into A Data Presented From The Keyboard program and run through the approimiate program steps to insure that the data character presented from the keyboard is appropriately processed. Similarly, the single bit status conduc*tot* 331.vas the printer interface 27 is employed to indict& the status of the printer means 2. Thus,for example, if a print step has been issued to the printer, through the combined action of the microprocessOr and data supplied from the common data bus 19, the status condition supplied to the common status bus 21 through cable 33 will indicate, in a manner to be more fully explained below, that the print instruction has successfully been completed, that It !WI in process. or that further instructions may i provided to the printer means 2.

The second • n of the typewriter configuration interface ibdleited by the dashed block 15 *is* to selectively gate alphameric character data or other selected form: of data from the common data bus 19 to the keyboard means I or the printer means 2 and to assure that data on the common data bus 19 is appropriately gated at the proper interval to these peripherals or that data from the peripherals is pled at appropriate intervals to the common data bus 19. For example, in a recording operation each eight (8) bit data character presented by an operator el the keyboard means 1 will be selectively gated from the keyboard interface 26 to the common data bus 19 through the eight (8) bit data cable 28 and such gating, which occurs under program control, will ensure that cal,. one eight (8) bit character is supplied to the common data bus 19 in a given processing interval. Similarly, in a printing operation, the printer interface 27 functions to ensure that twelve (12) bit character information is gated from the common data bus 19 to the printer at intervals in which the printer means 2 is ready to receive such information and that no subsequent character information is supplied to the printer before a previous printing operation has been completed

The third distinct function of the typewriter configuration interface indicated by the dashed block 1$ is to selectively receive address and instruction data from the common instruction word bus 20 to thereby enable the peripheral which has been addressed and to cause such peripheral to acquire the appropriate data from the common data bus 19 and further to perform the appropriate command upon receipt of such data. F Jr instance, when data has been inserted by an operator at the keyboard means 1, a Gate Data To The Data Bus command will be presented on the common instruction word bus 20 and in a manner to be fully described below, the eight (8) bit ASCII code or a modification thereof supplied by the keyboard means 1 is gated through the eight (s) bit data cable 28 to the common data bus 19. Similarly, when a character is to be printed an Acquire Data From The Data Bus command will be presented on the common instruction word bus 20 and supplied to the printer interface 27 through the sixteen (16) bit instruction word cable 32, assuming a proper status indication on the common status bus 21 had previously been received. In response to this command, the printer interface 27 will cause the printer means 2 to acquire the data present on the common data bus 19 and respond to an appropriate manner thereto. From the foregoing description of the keyboard means 1. the printer means 2, the keyboard interface 26 and the printer interface 27. it will be apparent that no direct connection of any type is established between the keyboard means 1 and the printer means 2. Therefore, unless appropriate commands for printing are received from the common instruction word bus 20 and appropriate character information is supplied to the printer means 2 from the common data bus 19. the depression of a key at the keyboard means 1 will not automatically result in the printing of a character representing the key depressed at the printer means 2.

THE PRINTER DATA ROM'

The present embodiment of the instant invention is capable of selectively printing information. as shall bet Noe more apparent below. is ten pitch. twelve pitch and proportionally spaced print modes. The selection of a desired pitch for printing is accomplished by the placement of the pitch lever at the keyboard. as may be seen in FIGS. 94 *and* 9b. in the appropriate position for the pitch selected and the mounting of a daisy wheel print element having a corresponding pitch to that selected within the printer. Although seven (7) bits of the eight (8) bit codes generated at the keyboard are sufficient to uniquely designate each of the alphameric printing characters employed within the instant invention, in proportionally spaced printing modes, the width of each character printed, together with appropriate portions of intercharacter spacing therefor, may vary depending upon the character lion three (3) to eight (8) units wherein a unit corresponds to one-sixtieth (1/60th) of an inch while in ten (10) pitch and twelve (12) pitch, printing character widths together with portions of intercharacter spacing therefor are six (6) units and five (5) units, respectively. Furthermore, high quality printing requires that a variable impact or hammer force be employed so that a uniform character impression in printing is achieved regardless of the actual width or other physical parameters of the alphameric character struck. For this reason, the printer data ROM peripheral indicated by the dashed block)4 is employed to provide twelve (12) bit character information to the printer unit 2. Seven (7) of these bits are employed to uniquely define a character to be printed in terms of the spoke on the daisy wheel print element upon which said character is located, three (3) of the bits are relied upon to define charw:ter width and are used in proportional spaced modes of printing to control ribbon displacement and :he escapement information forwarded while the remaining two (2) bits are employed to define hammer force in four (4) levels.

The printer data ROM peripheral indicated by the dashed block 14 comprises a printer data ROM 43 and a ROM address and control -leans 44. Although the details of the printer data ROM peripheral indicated by the dashed block 14 are set forth in great detail in conjunction with FIG. 8, it may be here noted that the printer data ROM 43 may take the form of a conventional read only memory containing two hundred fifty-six (256), eight bit words bolded therein and is addressable by eight bits in parallel which are sufficient to uniquely define each eight (8) bit word. The printer data ROM 43 is connected through an eight (8) bit data cable 45 to common data bus 19 to which it supplies addressed eight (8) bit words stored therein and through a multi conductor cable 47 to the ROM address and control means 44 from which address information is received. Both the cables 47 and 45 may be viewed as comprising eight (8) parallel conductors and the mitput of the printer data ROM 43 is gated.

The ROM address and control means 44 may take the form of an address register and a decoding arrangement for commands received from the common instruction word bus 20.1 gin ROM address and control means 44 is connected through an eight (8) bit data cable 46 to the common data bus 19 and through-a sixteen (16) bit instruction cable 48 to the common instruction word bus 20. The eight (a) bit data cable 46 may comprise eight (8) conductors which are *connected* in parallel to the eight (8) bit data cable 45, as shown, while the sixteen (16) bit instruction cable 48 may comprise sixteetT 4) conductors connected in parallel to the common instruction word bus 20. The printer data ROM periph-

„: oral indicated by *the* dashed block 14 is not connected 7 to the COMMIS steins bus 21 as only ROM addressing and output openithins_ are conducted therein and hence a no monitoringritions need be conducted.

In essence, printer data ROM peripheral indicated by the dashed block 14 fu:. tions each time an alphameric character is to be painted to supply twelve bit character information read from the printer ROM 43 in two passes to the *co:*gluon data bus 19 for subsequent application to the printer unit 2. Of this twelve (12) bits of character information, the first seven (7) bits define the spoke position of the character to be printed, the next three (3) bits define character width to be employed whenel.a proportional spaced printing has been selected and the remaining two bits define the hammer force with which printing is to take place. A character to be printed as initially introduced at the keyboard, or one of the other peripherals, as will become more apparent below, is applied to the common data bus 19 in the form of an eight (8) *bit* character wherein only the first seven (7) bits thereof are definitive of the character while the eighth bit designates the underscored or nonunderscored nature thereof. This convention for character designation is available because only seven *(7)* bits are required to define alphameric character information while an eight (8) bit code is rNuired to define all of the function and processing information which may be 'introduced into the system together with alphameric information. At any rate, whenever a character is to be presented, the eighth *bit* thereof is masked off. a command is applied to the common instruction word bus 20 to cause the ROM address and control means 44 to latch at least the first seven (7) bits of data on the common data bus 19 to thereby serve as the first seven *(7)* bits of an address for the printer data ROM 43. Whether the eighth bit on the common data bus 19 is latched or a *bit* from the command instruction is latched as part of the address will turn upon the specific command issued. The command and data to serve as the address is applied to the ROM address and control means 44 through the cables 46 and 48 and tie latched address is applied through the multi-conductor cable 47 to the printer data ROM 43. In response to this address, an eight (8) *bit* word is read from the printer data ROM 43 am: applied to the common data bus 19 for subsequent assembly into twelve (12) bit character information and application to the printer. Thus it will be seen that the address for the initial eight (8) *bit* word of character information read from the printer data ROM 43, is provided essentially by the character information on the common data bus 19 which defines the character per se.

The address initially latched in the ROM address and control means 44 and employed to obtain the first eight (8) bits of the desired twelve (12) bits of character information is also inipected under program control and depending upon the condition of one of the bits therein, data bit 6, one of two fixed quantities are added to the address and a new address is formed. This new address, as formed in the microprocessor, is next latched under program control into the ROM address and control means 44 and applied through multi-conductor cable 47 to the printer data ROM 43. This causes a second eight (8) bit word to be addressed, read therefrom and applied to the common data bus. If one of the two filed quantities were employed to obtain the new address, the four (4) most significant bits of the eight (11) bit word read from the printer data ROM 43 are employed in the assembly of the twelve (12) bit character information while if a second of the two fixed quantities was employed, the four (4) least significant bits of the second eight (8) bit word are relied upon in the assembly of the twelve (12) bits *of* character information. Thus, by reliance upon the information defining the character to be printed per se and rued variations thereof, twelve (12) bits of character information are developed under program control for controlling the operation of the printer unit 2 and these twelve (12) bits of character informstion define the character to be printed, its width if a proportionally spaced mode of printing has been selected and the hammer force with which it is to be printed.

THE BUFFER AND MISCELLANEOUS STORAGE APPARATUS

The buffer ano miscellaneous storage apparatus indicated by the dashed block 17 comprises a random access memory (RAM) 34 and RAM address and control means 38. The actual construction of both the random access memory 34 and the RAM address and control means 38 is developed in great detail in conjunction *with* FIG. 11. Therefore it is here sufficient to appreciate that the random access memory 34 may comprise a conventional 1024 x 8 non-destructive read, random *access* memory requiring a ten (10) bit address for uniquely defining a given eight (8) bit storage location for reading or writing purposes. More particularly for functionally understanding the operation of random access memory 34, it should be noted that the available storage locations within the RAM 34 are divided into quarters to form a read/write buffer 3$ laving two hundred fifty-six (256), eight (8) bit words of available storage, a read only buffer 36 having a like number of storage locations and the remaining half of the RAM 34 is allocated for general storage purposes, as set forth in an attached listing, to thereby accommodate five hundred twelve (512) words of information which require selective storage and retrieval during normal processing operations. Here, however, principal focus should be placed upon the read/write and read only buffers 35 and 36 formed *within* the RAM 34 as they act, under program control, as independent peripherals within the instant invention. Both buffers 3$ and 36 defined *within* the RAM 34 act, in essence, to accumulate line information to be processed either as the same is entered from the keyboard 1, read from another buffer and/or a record media so that such information as is accumulated as a line may be further processed at highly efficient rates and in a manner to suitably accommodate both the forwarding and receiving peripherals involved in a given operation. Thus, for example data entered at the keyboard for recording purposes is typically accumulated in the read/write buffer 3$ until an end of a line is indicated by a carriagr return character. Thereafter, the record media is enabled and brought to speed and the entire line of eight (8) bit characters accumulated in the teed/write buffer 35 is recorded. Conversely when a record enema is being played back, a line of information is typically read therefrom and accumulated in the read only buffer 36. Thereafter it is handled on a per character basis as the same is read out and transformed into character informatiol suitable for application to the printer unit 2. When the line of information in the read only buffer 36 has been proceeseu, the record media may again be enabled to cause the reading of a new *line* of information therefrom and the insertion of this line of information into the read only buffer 36.

he RAM 34 is connected through the eight (8) bit cable 39 to the common !hut ,bus 19. The eight (I) late cable 39 may takethe rag eight (8) conduc- which are connected in to irSividscol con- geton within the common, dab bus 19 so that any 411111ressed location within the RAM 34 may be read out ago the common data bus 19 or alternatively an eight lilt bit word present on the common data bus 19 may be written in parallel into an addressed storage location within the RAM 34.

The RAM 34 is connected through a multi-conductor cable 40 to the RAM address and control means 38. As the RAM 34 requires a ten (10) bit address as aforesaid plus an additional bit for enabling either a write or read Ainctícm, the RAM address and control means 34, as -shall be seen in greater detail in conjunction with FIG. 111, comprise essentially an eight (8) bit up/down counter for addressing a given quarter of the RAM 34 in sequence, a multiplexor for selectively applying eithe; the output of the up/down counter or the RAM 34 to a gated output to the common data bus 19 and logic for decoding commands issued to the buffer and miscella- mous storage apparatus indicated by the dashed block 17 and enabling appropriate functions therein in re- sponse thereto.

The RAM address and control means 38 is connected to the common data bus 19 through the eight (8) bit data cable 39 through which it receives eight (8) bit addrest information for the up/down counter and to which it selectively supplies the current address of the up/down counter. Thc up/oown counter provides eight (8) of the .• (10) bits of the address required for the RAM 34 and (fore serves to address individual words therein .in a quarter through the multi-conductor cable 40. Similarly, the RAM address and control means 38 is connected to the common instruction word btu 20 through a sixteen (16) bit instruction cable 41. The six- teen (16) bit instruction cable 41 may comprise sixteen (16) conductors which are connected in parallel to indi- vidual conductors within the common instruction word bus 20. The decoding of instructions issued to the buffer and miscellaneous storage apparatus indi •sled by the dashed block 17 controls the operations thereof and it should also be noted that two bits within such instruc- tions are employed to complete the address applied to the RAM 34 through the multiconductor cable 40 end serve in the role of uniquely defining one of the quarters therein. The RAM address and control means 38 is also shown as connected through connector 42 to the cont- Awn status bus 21 so as to selectively provide status ""'cations thereto. Such status indications may be pro- , for example, to indicate nn end of stored line rmation in one of the buffers 35 and 36.

us, in the same manner u any other peripheral toyed within the instant invention, the buffer and llaneous storage apparatus indicated by the ed block 17, receives commands from the common ction word bus 20, conveys eight (8) bit data be- n itself and the common data bus 19 and indicates opriate status conditions on a command basis to the mon status bus 21. However, due to the functional nn by' quarters of the RAM 34. effectively three mdent peripherals are here provided in the form read/write buffer 35. a read only buffer 36 and ral storage locations 37.

THE RECORD MEDIA TRANSPORT APPARATUS

The remaining alphameric data handling peripheral employed in the instant embodiment of the automatic writing system according to the present invention le the record media control write and read apparatus iodi- cited by the dashed block 18. In similar manner to the buffer and miscellaneous storage apparatus indicated by the dashed block 17, the record media control write and read apparatus indicated by the dashed block 18 com- prises two record media stations wherein one of said record media stations is employed for both writing data on and playing data from a record media while the other station is employed solely to read data from a record media which has previously been recorded. This mode of organization, though arbitrary, has here been employed so that recording will always take place at the same record station to avoid possible °pastor confu- Non; however, it will be apparent from the portions of this disclosure that follow that both record stations could be supplied with a writing capability without any deviation from the concepts of the invention here being disclosed. The record media control write and read apparatus indicated by the dashed block 18 includes a read/write station comprising a write decoder means 50, a read decoder means 51. a read/write station con- trol circuit 52 and a read/write record media transport 53 which includes recording/playback heads; *and* a read only station comprising a read decoder means 54, a read only station control circuit 55 and a read only record transport 56 which includes a playback head.

The read/write record station acts to either receive data in parallel on a per line basis from the common data bus 19 and to cause such data to be serially recorded on a record media or to read data in a series on a per line basis from a record media and apply such data in paral- lel to the common data bus 19. Accordingly, although the write decoder means 50 will be further described in connection with FIG. 13, the write decoder means 50 may here be considered to take the form of a conven- tional parallel to series converter which acts in the well known manner to convert an eight (8) bit data character received in parallel to a serial format and present the converted character oil a single output conductor. The write decoder means 50 is connected through an eight (8) bit data input cable 57 to the common data bus 19, through a single output conductor 58 to the read/write record media transport 53 and through a multi-bit con- trot cable 59 to the read/write station control circuit 52. The eight (8) bit data input cable 57 may take the form of eight (8) parallel conductors each of which is con- nected to one of the eight (8) data bit conductors in the common data bus 19. Thus, the eight (8) bit data input cable 57 may take precisely the same form as the other data cables employed to convey data between one of the peripherals utilized in the instant invention and the common eight (8) bit data bus 19. The eight (II) bit data input cable 57 acts as will ut apparent to those of ordi- nary skill in the art, to apply eight (8) bit character data to the write. decoder means SO from the common data ..bus 19. The.thgle bit output conductor 5$ is connected intermediate the write decoder SO and the reed/write record media transport 56 and more particularly, as shall be seen below, to the recording had therein. tatpt cord ugly, Use single bit output conductor U acts to supply each data character applied to the write decoder means 50 to the write had within the read/write record are high while providing a high or disabling output kinder any other set of input conuitions. The three inputs 4° the NAND gate 299, as shown in FIG. 5, are con- to the annotated Alp - Al: which, a cooed, ire the hits °reach address employed to efine 'one Of 'The emaplarVannotations ' mployed for Tenninah in FIG. $ would indicate t the page of memory illustrated therein is selected when each of address bits A10 - Al2 are high; however, -It will be appreciated by those of ordinary skill in the art 'That through the use of the various permutations of the One (1) and Zero (0) states of address bits Ala- Al2 and their complements eight individual combinations to selectively address one of the eight (1) pages will be provided.

Thus when the address bits A10 - Al2 as defined for each major page of memory are present in an address. the output of NANi..) gate 299 associated with that page will go low to provide a strobe input to the decoder/-demultiplexer means 279. In the presence of such • strobe input, address bits AI and A9 are decoded and one of the enable lines 292 -295 has a high level applied thereto to enable one of the minor page memory means 275 - 278 on the selected page. Upon si.ch enabling, the section within the enabled minor page memory means 275 - 278 defined by address bits A4 - *A,* is addressed and the instruction therein defined by address bits A0 - A3 is read out on one of the multiconductor cables 280 - 283 and applied through the multiconductor instruction word cable $5 to the common instruction word bus 20. Accordingly, it will be seen that each time an address is read from the ROM address register means 81 and applied through the multiconductor cable $6 to the read only memory $0, one of eight pages of memory therein are selected through a decoding of address bits A10 An and on the selected page of memory one of four minor pages is selected through a decoding of address bits As and A9 to cause the enabling of a minor page memory means 275 - 27$ selected by that address. Thereafter, one of sixteen sections within that minor page is selected through a direct addressing by address bits A4 - A, and an instruction therein is addressed through address bits Ac - A3 whereupon a selected sixteen (16) bit instruction word is applied to the common instruction word bus for each instruction cycle.

The discussion of FIGS. 3 - 5 set forth above sobstandaily completes the treatment of the microprocessor indicated by the dashed block 16 because both the arithmetic logic unit $4 and the general purpose registers $3 have retained the same structure and ,operation described in U.S. Ser. No. 430,130, supra, which is incorporated herein by reference and hence a detailed discussion thereof is not set forth to avoid undue repetition. It should be notedWoivever, that several of the storage ,ju siviments modified with the general purpose registers CI and Whave been modified witLn the instant invention as temporary storage is also available within ::the random access memory means 34. To provide a reader with a complete disclosure however, all of the storage assignments presently employed for each of the sixteen, eight bit storage locations within the *G* and H registerrare listed in Appendices D and E attached thereto in a listing where the eight bits of each word are het forth aloni the abscesses while the sixteen, eight bit :reinter location are specified along the ordinate. Thus, "the microprocessor indicated by the dashed block 16, when provided with the microprogram: listed in either Appendfx A or B provide a sophisticated, versatile, resident control within the instant invention which pet min the microprocessor to monitor each of the input/output devices for arynchronous °eminences, ana- any action detected and take appropriate steps to bninch. jump or generate control signals in order to process in an appropriate manner the uyoheonous oo. currence indicated.

The instructions issued by the read only memory $0 in accordance with the operction of the microclocessor also perform a similar function within the microprocessor itself. Thus, when these instructions are connected together the system acts to process raw data into a finished output form whereupon the entire automatic writing system according to the instant invention functions under microprogram control.

THE PRINTER UNIT

The automatic writing system according to the instant invention herein being disclosed, preferably employs an independent serial printer *which* acts as the output device for the system. This serial printer exhibits operational speeds exceeding those generally available in conventional input/output typewriter apparatus while printing a single character at a time through the utilization of impact printing techniques. In preferred emLudimenu of the instant invention, the printer unit may take the form of a Model 1200 High Type I serial .printer available from Diablo System. Incorporated of Haywood. California. This printer unit has been slightly modified to accommodate the proportionally spaced printing requirements of the instant invention through what is tantamont to a bypassing of certain of the logic therein, as shall be described below, so that the printer unit effectively accepts print position data from the system in a form directly useful thereby rather than employing its own read only memory to develop print position data from a standardized code such as ASCII. However, in all other respects, the Model 1200 High Type I serial printer available from Diablo Systems Inc. effectively functions as an off-the-shelf item within the instant invention and hence, the detailed structure thereof will not be set forth as the same is readily available to those of ordinary skill in the art. It should be noted, however, that the High Type I serial printer is described in detail in the Model 1200 High Type I training course published by Diablo Systems Inc., 1973. and in addition, the same is described in U.S. application Ser. Nos. 229,314, 229,397 and 229,396 each of which was filed on Feb. 25, 1972 and are entitled respectively, "High Speed Printer with Intermittent Print Wheel and Carriage Movement", "High Speed Printer with Drift Compensation Cable for Carriage", and "Ribbon Carriage", wherein the first two applications were fad in the name of A. Gabor while the last application is filed in the names of S. L. Lee and E. T. Hess. Furthermore, the logic of the printer unit in a nonmodified form is dislcosed in U.S. Ser. No. 429,479. Each of these applications are incorporated specifically by reference herein and therefor the details of the printer unit shall only be briefly described where the same has been previously set forth in one of the application, referred to above, to reduce the length of the instant disclosure; however, additional detail is readily available to a -reader upon inspection of any of the aforesaid applieslions.

The printer unit is a serial printer which functiOns in response to Ideal inputs provided thereto to *lave serial printing at a rite which exceeds 30 characters per

0 ill

word with a 90 character set being available and arranged about a so-called daisy wheel print element. biotin; it thieved by the positioning. in response to apprw*logic signals, of a designated spoke on a daisy print element opposite a print position. Depeuding. upon the daisy wheel print element in place and the mode of printing selected in the system, characters may be printed according to 12 pitch, 10 pitch or proportionally sps.ad printing tect•niques. Once the apprορtiate spoke of the daisy wheel print element is positioned orposite a print position, an electrically fired impact holm is driven into the spoke to rause a carbon or cloth ribbon to impact the document being prepared with the appropriate character. As no mechanical drives or nii-viuuncally driven print hammers are employ,x1, the operation of the printer unit is extremely quiet. Similarly, carnage displacement and paper indexing operations are achieved by the printer unit in response to displacement information, specifying both distance and direction, provided to the printer unit from the automatic writing system according to the instant invention. Thus, the printer unit employed within the automatic writing system according to the instant invention acts in receipt of control signals on the common instruction word Ins 20 to implement the print, carriage displacement or paper indexing functions specified on the common data bus 19 and p vides appropriate indications on the common status bus 21 when these functions have been appropriately completed.

Although the detailed operation of the printer unit is best left to the aforementioned applications, three principle functions of the printer unit should be noted for an appropriate appreciation of the operation of the printer means 2, its function and interconnection within the remaining apparatus disclosed in the present embodiment of the automatic writing system according to the instant invention. In essence, each of these three principle functions ere independently controlled by logical inputs provided to the serial printer and may be generally described in terms of three basic printer motions, to wit, print wheel displacement associated with character printing, carriage displacement associated with character escapement. carriage return operations and the like and paper feed motions associated with line spacing, and other indexing functions. The control signals to implement each motion are supplied through 12 data lines to the serial printer wherein the data lines either transmit the seven bit, two's complement of the absolute pr at.on number for a desired spoke on the print wheel for the next character to be printed, a twelve (12) bit word specifying the direction and displacement to be moved by the carriage in multiples of 120th of an inch, or a twelve bit word which specifies the direction and number of vertical line space indices that the paper is to be displictid through paper feed functions in multiples of 1/45th of an inch. In addition, whenever spoke position information is furnished through_ 7 of the 12 data lines present, a three (3) bit word which specifies the length of the ribbon movement, i.e. character width.. and a two (2) bit word defining the level of print hammer intensity for the next character to be printed are also forwarded so that a full twelve (1p bits of Wormstion is always proyided to the printer unit. Strobe livela to initiate the apropriate action at the printer unit are decoded from the common instruction word bus 20 at the printer interface 27 and forwarded to the winter unit while command convicted signals are provided by the printer unit to the status bus 21 to apprise the avtom. tic writing system that a commanded motion his been completed.

The function or printing character information occurs in a serial manner and is accomplished by causing $ a daisy wheel print element to rotate until the designated character is is an appropriate printing position and thereafter impacting the pedal of the daisy element upon which the designated character resides to cause the character information thereon to be impacted against a carbon tibbon and the document on the carnage roller 5 (FIG. 1) of the printer unit. Any conventional daisy wheel print element having an appropriately spaced print font for the mode of printing selected may be employed; however, due to the repidity with which printing occurs with the instant invention, daisy wheel pnnt elements of the type disclosed in U.S. application Ser. No. 509,195 as filed in &A, names of R. J. Lahr and Frank M. Weller, Jr. and entitled Proportional-Space Character Print Wheel on Sept. 25, 1974 and U.S. Scr. No. 509,193, as filed in the names of G. Sohl, 1). L. Bogert, R. G. Crystal and M. C. Weisberg entitled Composite Print %..eel on Sept. 25, 1974 are preferred.

The daisy wheel print element, as mill be appreciated by those of ordinary skill in the art, is a flat disc like member having one spoke or pedal for each character representation thereon. The pedals are impacted in such manner that they are driven jrrnsversely to the plane of the disc to impact a ribbon and thereafter the document being prepared. The daisy wheel print element is mounted for rotation on a print carriage which is displaceable along the longitudinal axis of the carriage roller S (FIG. 1), and hence, the positioning of the carriage determines the location at which the character to be printed is placed on the document being prepared. Such displacement of the carriage in response to a command strobe and a predetermined increment defined on the twelve (12) data lines forms the second basic motion of-the printer unit and, as well known, it is preferable to displace a print element carriage rather than the carrinse roller S per se due to the lower relative mass thereof. The carriage roller 5 would ordinarily take the form of a fifteen inch roller, although thirty inch rollers and/or pin wheel feed rollers for automatic paper feeding operations are also available.

The third basic function of the printer unit, which is also an independent function enabled by separate control inputs to the printer means 2, is the index or paper movement function which accomplishes the `vertical spacing of each character line printed on the document as well as subscripting, superscripting and tile like. Thus it will be appreciated that control inputs to the printer means 2 which control the rotation and ultimate positioning of the daisy wheel print element determine what character is printed upon command, the control inputs which control positioning of the print element carriage determine wherein a vertical column of character spaces that character is printed while the control inputs on the printer unit which control the paper indexing or movement functions thereof determine the position of the document at which information such as lines appear as well as super and subscripting which may occur in any given line.

The control inputs which act to initiate each displacement command or basic motion concerning the positislating of the daisy wheel print element, the carriage position and paper indexing are independent 9f one another and hence in the absence of approgteilia cornmantis, automatic escapement does not occur upon the

.completion of militias of each character nor does autotic paper Work at the completion of each TWK feat - AO be seen below, are utilized the irtt in - : • to achieve more efficient print- operations whes the printer is being controlled by a becord media. It should further be noted that although a firthrred format for the serial printer employed within the instant invention has been set forth, any serial printer or input/output modified typewriting configuration could be substituted therefor without • substantial modification of the instant invention as the same merely repreatent• a preferred form of output peripheral. Additionally. CRT displays with or without o1 off line printing functions could be.readily substituted for the printer peripheral disclosed.

Although reference to the aforesaid U.S. applications and/or manuals directed to the printer unit per se are relied upon here- s thorough disclosure thereof, the logical lope*. and outputs of the printer means 2 are depicted in FIG. 6 so that the interconnection of the printer means to the lc:ical inputs of its interface and the automatic writing system as a whole may be full/ appreciated. Therefore, turning now to FIG. 6, there is shown a block diagram schematically illustrating the logical details of a printer unit suitable for incorporation into the embodiment of the automatic writing system depicted in FIG. 2. The printer unit Mustn't' d in FIG. 6 comprises interface logic for the printer unit indicated by the block 305. print logic circuitry indicated by the dashed block 306, carriage logic means 317, carriage servo system means 21$. paper feed logic means 321, ribbon lift logic means 323 and end of ribbon sensor means 326. The printer unit interface logic indicated by the block 305 includes appropriate logic and gating circuitry, well known to those of ordinary skill in the art, for raising inputs and outputs applied thereto to appropriate levels and for thereafter distributing such input signals in an appropriate manner corresponding to the nature of such input signals to either the print logic circuitry indicated by the dashed block 306, the carriage logic means 317, the paper feed logic means 321 or the ribbon lift logic means 323. In addition, as described in U.S. Ser. No. 429.479, the interface logic indicated by the block 305 may include means responsive to system clock inputs for gating information in a bi-directional manner therethrough in appropriately timed sequences.

The interface logic indicated by the block 305 is connected along the left-hand portion thereof to a plurality of input and output connectors, which, as indicated in FIG. 6 connected through the twelve bit data cable 25 and the multiconductor control and status cable 24 to the printer interface 27 shown generally in FIG. 2 and more specificallyAn PIG. 7. More particularly, data z7 lines DLO - DLI ikt connected through the twelve bit e. data cable 25 to the printer interface 27 and, as shall become more apparent below, receive either twelve (12) bit print information, twelve (12) bit carriage db-placement information or twelve (12) bit paper indexing information from the common data bus 19 through the printer interface 27. At the onset, it should be noted that —_ although the Common data bus 19 comprises an eight bif wide bus, twelve (12) bit data for applicatioi to data lines at the printer unit are assembled at the printer interface 27 by what is in effect, a latching of four bits from a first eight bit word on the common data t bus and combining such latched four bits with the next • eight (I) bits supplied to the printer interface rf on the common data bus 19 to effectively form a twelve (12) bit data word for use in the printer unit through a direct application of such 12 bits of information to data lines DLe - DLit.

'the nature of the 12 bits of data supplied to the printer unit through lines 1D0 - D11 will vary depending upon which of the three printer unit motions are being defined. Thus, if a print command is specified, 7 bits of character information defusing, in a two's coefplement format, the absolute position number of a selected chu- b) octet on the daisy wheel print element will be supplied on data lines DL0 - DI.4 from the common data bus 19 while 3 bits of information. defining *the* character width for ribbon advance purposes will be supplied on data lines DL, - DL, and the hammer force with which printing is to be implemented is supplied as two bits of information on data lines DLI0 and DLit. Therefore, when character print information is specified, the twelve bits of information supplied to the interface logic on data lines DL0 - DLI1 in effect is a combination of three words wherein the first seven (7) bit word supplied on data lines DL0 - D1.4 defines the characters to be printed, the three bit word supplied on data lines DLL - DL, defines the width of the character to be printed for the purposes of advancing the ribbon while the two bit word supplied on data lines DL10 and DLi defines the impact or hammer force wjth which character printing is to be achieved. As stated above, each daisy wheel employed in the exemplary printer unit being discussed may include up to 96 spokes wherein each spoke has a character representation suitable for printing thereon. In actuality, in an English language system, only SI of such spokes are utilized; however, the seven *(7)* bit twos complement code supplied on data lines DLO- DI.4 is more than sufficient to uniquely define each of sue:. spokes with reference to s Zero (0) position on the wheel.

It should be noted that the High Type I printer as supplied by Diablo Systems is equipped with a read only memory which accepts a seven (7) bit ASCI! code and transforms this code into a seven (7) bit two's complement code which specifies the absolute position number of a spoke on the daisy wheel. Therefore. as the automatic writing system according to the instiot invention supplies a seven *(7)* bit, two's complement absolute position code directly to data lines DL0 - DL4, this read only memory within the printer unit is effectively by-passed as the same is unnecessary. Furthermore, as the automatic writing system according to the instant invention may print in either a 12 pitch. 10 pitch or proportionally spaced mode wherein character representations have different widths, a three (3) bit word,is married to each character representation defining the width associated therewith. This three bit word is employed within the microprocessor indicatd by the dashed block 16, in a manner to be more fully described below, in furnishing escapement information to the printer unit and is used directly by the printer unit to cause ribbon advancement so that an appropriate new width unit is stationed at the print position prior to character printing. For purposes of the unseat invention, units of width for ribbon advance end escapement purples are defined in terms of 1/60th of an inch and seven definitions-of character width varying from two units to eight units are employed depending upon the Mode of printing selected. Thus, in a twelve pitch TOR of printing, all clipacter representations are printed having a five unit width. in ten (10) pitch all characters are printed using is units of width, while in proportionally spaced modes of operation, character width may vary two to eight units. Therefore, the three bits of width specified on conductors DL, – D1..9 may vary from two VIIII, defined by a 000 code to eight units defined by al tAide 110 in binary.

Similarly. 10 achieve nigh quality printing, the hamwet Impact level must vary in accordance with the l:attire of the character representation being printed. Thus, even in twelve pitch or ten pitch, if an "i" and an "M" character representation were pi rated with LEI. same force, the '1.1" might be faintly represented while the same intensity applied to an "1" alphameric chaiseier representation might puncture the document being prepared. Therefore. ir there are widely varying character representations in uniform pitch print modes and IS this mode of variation is compounded in proportional spaced printing, four levels of hammer force are employed for printing within the instant invention and supplied to the printer unit on data lines D1.10 and DLit.

When a carriage movement commanded is supplied from the printer interface 27 to the interface logic 305, s twelve bit word which specifies the direction and number of printing spaces or columns through which the carriage s to be displaced, in multiples of an incremerit equal tc 1/120th of an inch are provided through data lines D1.4,- DL11. For carriage displacement information, data lines DI.0 - DL10 are employed for the portion of the word actually defining the displacement under such circumstances where only so much character information as is required to define the actual displacement in absolute terms is supplied while the character information supplied on data line DL11 reps amts motion to the right or left wherein a One (I) level residing on data line Mt i in association with a carriage displacement command represents motion to the left while a Zero (0) level under these circumstances repreBents motion to the right.

Similarly, data representing a paper feed or indexing command is alio applied as a twelve (12) bit word to data lines DI..0 - DLI i under conditions wherein the information present on data lines D1.0- DLio represents the indexing displacement commanded while the data present on data line D1-11 represents the direction through which indexing is to occur under such conditions that a One (1) level on data line DLi t represents a reverse index operation, i.e. paper down, while a Zero (0) level on conductor DLI I represents paper indexing in the normal dirt:::on implemented upon a carriage return operatics' or the likt For paper indexing operations, only so much bit info...Anon is necessary to specify the actual displaceme • .'. -,plied to data lines D1.4 - DL10 and for the purposes of paper indexing, increments of •iglacement equal to 1/48th of an inch are employ .4 tglepresent the increment of displacement. Thus, regardless of which of the three basic motions are being commanded, all data greeted to the printer as present on the common data bus 19, is assembled at the printer interface 27 into twelve (12) bits of word information and is applied through the twelve (12) bit data cable 25 on data lines D1.0 - DLit to the interface logic indicated by the block 305 for further distribution to the various subsystons within the printer unit.

The various control inputs applied to the printer unit from the printer interface 27 and the various states ..outputs supplied thereby to the printer interface are conveyed through the multiconductor cable 24. More particularly, as shown in FIG. 6, the interface logic indicated by the block 305 receives five input ekmducson from the printer interface 27 and supplies five output indications thereto. The input conductors present within the multiconductor cable 34, es indicated in PIG. 6, are annotated character strobe, carriase strobe, paper feed strobe, ribbon action and restore. These input conductors serve to provide the printer unit with the foitowing information:

Character strobe — A signal used to sample the print information provided on data lines DI-0 - DL i t. The print information supplied comprises a seven (7) bit word on data lines DL-0 - DL, defining in a two's cornplement format, the absolute spoke position number ou th■ eleiev wheel print element of the next character to be wy nt·d. a three (3) bit word, presented on data lines • sl..7 - DLL, which specifies the width of the character tor use in defining the length of ribbon movement and a two (2) bit word presented on data lines DLit:, and DLit which defines the level of print hammer intensity for the next character to be printed.

Carriage Strobe — A signal used to designate and cause sampling of a twelve (12) bit carriage displacemeat command supplied on data lines Dle - DL11 wherein the information contained on data lines DI-e, - DLit:, defines the displacement distance in increments of 1/20th of In inch while the level of data line DLit defines direction. •

Paper Feed Strobe — A signal used to designate and cause the sampling of a twelve (12) bit paper feed cornmend presented on data lines Ma - DLIt wherein the bit content of data lines DLO - DLit:, defines the metes and bounds of the displacement through which indexing is to occur in increments of I/48th of an inch while the level on data line DLit defines the direction in which incrementing is to occur.

Ribbon Action — A signal employed to control the position of a carbon or cloth ribbon between an up print position a.-.d a down position where the ribbon does not have s tendency to obscure the operator's view of the Print location.

Restore — A signal employed to set the daisy wheel Print element, the print element carriage and the various logic registers to initial conditions, such as when a sysrein is initially energized or reset.

Additionally, athough only five control input conductors have been provided to the printer unit in the instant embodiment of the invention being described, it will be appreciated by those of ordinary skill in the art that additional inputs could be supplied if-Additional printer functions were desired. For instance, in a printer having the capability of employing a two or more color ribbon, a ribbon logic input could be supplied to designate the level to which the ribbon is raised to cc.,trol the portion of the multicolor ribbon which is impacted during printing.

The five status outputs provided by the printer unit to the printer interface 27 are indicated in FIG. 6 as including the conductors annotated printer ready, character ready, carriage ready, paper feed ready, and end of n'bbon. These conductors within the multiconductor cable 24 are utilized to perform the following functions:

Printer Ready — A conductor whose level is utilized to indicate that the printer is properly stspeyed with power.

Character Ready — A line whose signal level is utilined to indicate that the Printer is in a ready condition to accept a dharacter command._

Carriage Ready — A conductors whose signal level is utilized to indicate that the printer is ready to accept new carriage displacement commands.

Paper Feed Ready — A conductor whose signal level is relied spat to Whete' this the printer is ready to accept new paper teed commands.

End of Ribbon — A sensor initiated indication utilized to provide the operator with .n indication that the and of ribbon is near. This indication. which may be provided through audible and/or visual indicia means, may occur, for example, when a point at the ribbon is reached where only sufficient ribbon left to permit the printing of approximately 3,000 characters. Thereafter, a second indication may be provided when sufficient ribbon for approximately 1,250 characters remains and this second indication could be continuously provided to the operator so that machine operation could be terminated at a convenient location and the ribbon changed. Additionally, automatic shut down may be provided in response to this indication when the actual end of ribbon is reached.

Although only five status output conductors have been illustrated in FIG. 6, it will be appreciated that additional status conductors may be employed to monitor additional status conditions at the printer. For instance, a microswitch may be employed to indicate whether or not paper has been loaded at the printer unit and the output condition of such microswitch may be taken from the interface logic indicated by the block 305 and placed on a separate status conductor for application to the printer interface 27. Similarly, a check condition output conductor may be employed to indicate whether a previously supplied instruction has been appropriately implemented or a malfunctions has occurred. If such a check status output is utilized, the output thereof would ordinarily only be capable of being superceded by restore printer input which would act to initialize the printer means 2 and hence clear the malfunction. Accordingly, it will be appreciated that the printer unit depicted in FIG. 6 receives all data inputs supplied thereto from the printer interface 27 on data lines DL0- DLit while control inputs are supplied to the printer unit and the status outputs are supplied by the printer unit to the printer interface 27 through individual ones of the conductors within the multiconductor cable 24. The data inputs supplied to the printer unit originate from the common data .bus 19, the control inputs supplied to the printer unit derive from commands present on the common instruction word bus 20 while the status outputs provided by the printer unit 30 result in appropriate status indication on the common status bus 21. The manner in which this data is manipulated through the system, will become more apparent below in connection with the description of the in inter interface 27 as described in detail in conjunction with FIG. 7.

The interface logic indicated by block 305 is connected through multiconductor cables 327 - 331 to the print logic circuitry indicated by the dashed block 306, *the* carriage logic means 317, the paper feed logic 321, GO the ribbon lift logic means 323, and the end of ribbon sensor means 326. The multiconductor cables 327 - 329 are employed, to convey data, control, and status information between the interface logic indicated by the dashed block 305 and the basic printer motion tune- dotal logic blocks 306, 317, and 321; while the multiconductor cables 330 and 331 are relied upon to convey a control or status level intermediate the interface logic Block 305 and the ribbon lift logic 323 or the and of ribbon sensor means 326. For instance, all data present en data lines DL0 - DLI $_t$ is loaded into an appropriate register at one of the logic blocks 306, 317 or 321 only in response to the application of control information to one of the control conductors annotated character strobe, carriage strobe, or paper feed strobe. Thus. if it is assumed that a twelve (12) bit character information node defining a unique character, the width of the character and the hammer force required for a printing of the character is applied through data lines DL0- this twelve (12) bit code will be loaded into register means within the print logic circuitry indicated by the dashed 'triock 306 upon the occurrence of a character strobe. Thereafter, the three basic words within the twelve (12) bit code associated with character information will be divided in such a manner that the seven (7) bit word uniquely defining the character to be printed, as originally forwarded on data lines DI.0- DL4, will be supplied to print wheel :.iic while the three bit word defining appropriate width for the character to be printed will be supplied to ribbon level nervier logic to thus cause, in a manner to be described below, the displacement of the daisy wheel print element to position the appropriate spoke for the character to be printed at the print position while *the* ribbon is displaced to present a sufficient amount of new ribbonto accommodate the printing of this chancier. Both ribbon and print wheel displacements are initiated in a virtually simultaneous manner and after both of such displacements have been successfully completed, the print hammer is fired with force defined by the two bit word, originally conveyed on data lines DL10 and DLt i.

Upon the successful completion of the printing operations specified, a ready signal will be conveyed from the print logic circuitry indicated by the dashed block 306 through the multiconductor cable 327 so tl-tt a character ready indication may be applied to the printer interface 327 through the appropriately annotated status conductor at the interface logic indicated by block 305. Similarly, when a carriage motion instruction is presented to the printer unit, the distance in multiples of 1/120th of an inch are applied from the printer interface 27 to be eleven low order data lines 131. $_0$ DL10 while the direction of the displacement in indicated by the condition of the bit applied to the high order data line DLI 1. This information is loaded in parallel through the multiconductor cable 328 into a register therefor in the carriage logic means 317 upon the occurrence of a car= riage strobe on the appropriately annotated control conductor. After the displacement instruction has been processed by the carriage logic and the carriage displaced a distance equal to that specified by the data character applied to the late lines DL0 • Di..10, in a %unction specified by the condition of data D1.11, an operation completed indication is supplied from the carriage logic means 317 through the multiconductor cable 320 to the interface logic 305 and is applied therefrom to the carriage ready status conductor connected through the control cable 24 to the printer interface means 27. The carriage ready status indication may be subsequently supplied to the common status bus 21 so that the microprocessor indicated by the dished blimilt46 16 1 apprised that the next program may be initiated.

In like manner, when an eleven (11) bit paper displacement increment is applied to the data lines DL.0 - DLioand the direction En which such displacement is to *occur* is indicated on data line DLI 1, this twelve (12) bit Met displacemen data is loaded in parallel into a reg- fitter resent within the paper *teed* logic means 321 upon the lication of paper feed strobe to the interface 305 on the appropriately annotated conductor. Thereafter, tar paper displacement instruction is implemerited by the paper feed logic means 321 and upon the completion of the command, a paper feed ready signal is conveyed through the multiconductor cable 329 to the interface logic 305 for application to the appropriately annotated paper feed ready output conductor so that such status condition is applied to the printer interface 27 and subsequently to Lae common status bus 21. Thus, the operation of the printer unit depicted in FIG. 3 is such that data is conveyed from the common data bit′ 19 to the data line inputs DLe- DLt of the printer unit, and gated to the appropriate circuitry which responds thereto upon the application of a command signal in the form of a strobe pulse issued by the read only memory SO and conveyed through the common instruction word bus 20. Upon use appropriate completion of the corn-mend, a status indication is provided by the printer unit to indicate that such command has been successfully completed whereupon the next step of the program sequence then in process may be initiated. In a typical printing sequence, as shall be seen more in detail below, a displacement command is issued to the printer unit which causes the carriage to displace a distance which is equal to one half (I) the width of a previously printed character plus one half (i) the width of the new character to be printed plus any inter . ening space code character or the like. Thereafter, a print command is issued to cause the newly selected character to be printed and the print *sequence* is terminated. Additionally, as will be appreciated by those of ordinary stall in the art, prior to the issuance of any command to the printer unit. the appropriate status conditions associated with the corn-mand to be issued are tested and the command actually issued by the microprocessor only occurs once the peripheral it this case the printer unit, has indicated on the status bus that it is ready to accept a new command for a. specified function.

Although the printer unit is described in great detail in U.S. appin. Ser. No. 229,314. supra and the additional materials and manuals recited herein, a brief description thereof will be set forth to acquaint the reader with the operation of FIG. 6 as well as the simplified modifies-dons applied to the printer to better accommodate itc insertion within the instant invention. The print wheel logic circuitry indicated by the dashed block 306 con-troh all functions of the printer associated with the basic motion of displacing the daisy wheel print element so that a Wiled character is placed in a print position, and printed. The print logic circuitry indicated by the dashed block 306 is connected to the interface logic 305 through the multiconductor cable 327 and comprises print logic means 333, print wheel logic means 334, print wheel servo means 335, ribbon level encoder means 337, hammer level encoder means 339, and driver means 340 - 342. The print logic means 333 is connected through the multiconductor cable 320 to the interface logic 305 and serves as a buffer and control means between information forwarded from the interface logic 309 to the remaining elements within the gilt logic circuitry indicated by the dashed block 306, to appro. priately sequence the operation of the hammer level encoder means 339 with respect to the print wheel logic 334 and the ribbon level encoder means 337 and additionally serves to convey status information, in the form of a character ready input, to the interface logic 305 upon the appropriate completion of a character print operation.

More particularly. focusing for the moment oo actual data applied to the interface logic indicated by the block 305 on conductors DL0 - DLii, the printer logic means 333 may be viewed as receiving each bit of dara therefrom each time a twelve (12) bit character is presented and hence may be viewed as containing a twelve (12) bit buffer store for loading the bit inform-lion received on conductors DL0 - DLit whenever a character strobe is received. Alternatively, the interface logic per se may contain a buffer store in which case the twelve (12) bits of data applied on conductors DLo - DLit would be appropriately gated through the print logic means 333 upon the receipt of a character strobe at the interface logic indicated by the block 305. An appropriate gating arrangement for this purpose may comprise either twelve (12) AND gates arranged to be commonly enabled by the character strobe and convey the individual bits of data from lines DI.0 - D1.11 therethrough or a multiplexer device similar to those described above. In any event, the print logic means 333 functions with respect to data received on data lines DL.0 - DLii.to receive such data upon the arrival of a character strobe which identifies that data as apPropriate for the print logic circuitry indicated by the dashed block 306 and divide the bits therein in an appropriate manner among the ribbon level encoder means 307, the print wheel logic means 334, and the hammer level encoder means 339. *As* was previously described, each twelve (12) bit character applied on data lines DL4 - DL.›, which conveys character print information effectively comprises three (3) words within a first word as present on data lines M.(- DLa contains a seven (7) bit word actually defining the character to be printed according to a two's complement format. This seven (7) bit word would be applied to the print wheel logic through multiconduc-for cable 343 wl..ch would contain at least one conductor for each of the seven (7) bits of data to be conveyed plus additional conductors which are necessary to provide control information, as shall be seen below.

In a similar manner, data lines DL, - DL, would contain a three (3) bit word defining character width each time a twelve (12) bit character associated with a print command is forwarded. Therefore, upon the arrival of a character strobe, this three (3) bit word would be conveyed through the print logic means 333 through the multiconductor cable 344 to the ribbon level encoder 337 which will function in response thereto= to displace an appropriate amount of ribbon to enable the charac. •:.r defined to be printed. The multiconductor cable 304 would contain at least one conductor for *each* bit of information to be conveyed therethrough plus at least an additional control conductor so that a consolebon of the ribbon displacemeot operation may be indi. cated. Finally, data lines DL10 and DLit, under these conditions, would contain a two (2) bit word defining the lira with which the character defined is to be prii.ted. This information would be conveyed through the print logic means 33: through the multiconductor cable 345 to the hammer level encoder means 339 which would respond thereto to initiate hammer displacement for printing purposes at an appropriate force or ver ity upon receipt of a triggering sigral. A-

The multiconductor cable 345 would thus contain at least one conductor for each of the two bits of inforista-

Lion to be provided to the hammer level encoder means 333 plus at least one _additional control conductor through which Vista! is supplied. Thus, with respect to data for print purposes op the data lines DIo DLitt pied logic mans 313 respond thereto In the fresence of a character strobe input to appropriately distribute the three words therein to the ribbon level encoder means 337, the print wheel logic means 334 and the hammer level encoder means 339 so that the same may be acted upon. Additionally, the print logic memos 333 performs the control function of supplying a triggering level to the hammer level encoder means 339 upon the completion of the print wheel and ribbon displacements, as aforesaid, and thereafter provides a control level through the multiconductor cable 327 to the interface logic block 305 so that a character ready status level may be provided at the output thereof to indicate that new character information may be supplied to the printer unit.

Both the ribbon level encoder means 337 and the print wheel logic 335 will convey through the multiconductor cables 344 and 343 a signal to the print logic means 333 indicative that the displacements associated therewith have be' n completed. These signals may be ANDed at the print logic means 333 according to conventional logic techniques to provide a triggering level to the hammer level encoder means 339 to effectively fire the hammer and cause pr; 'tins to occur. Thereafter, the print logic means 339 ..ouid supply a character ready indication to the interface logic block 305 so that a ready status for character information may be presented thereby on the common status bus assumirg the same is appropriately gated. Although a multitude of logic techniques may be employed to obtain the triggerin3 signal followed by a character ready signal which occurs at a time which is sufficiently removed from that of the triggering signal to assure that the hammer firing operation has been completed, a preferred technique may take the form of the triggering of a monostable multivibrator by an ANDing of the ribbon displacement and print wheel displacement completed signals which act to trigger the hammer and thereafter, upon a termination of the duty cycle of the monostable multivibrator, the changed state of the monostable could be employed as an enabling level to a gate controlling the outputting of the character ready status level from the interface logic.

In the Diablo Model 1200 High Type I printer, as supplied from the factory, there is present an absolute print wheel address read only memory, a present podtion counter, and a logic and cr.:Terence counter for providing an indication of the difference in terms of both magnitude and dir•Aion between the address read from the absolute print wheel address read only memory and the present position counter. Because the insuuit invention directly supplies a seven (7)hit 'chaseter defining the character to be printed in a two's complement format, the absolute print wheel address read only memory may be bypassed and hence. the print wheel logic mesas indicated by block 334 may be viewed as including only the present position counter and a logic and difference counter for providing an indication of the difference in terms of both magnitude and direction between the seven (1) bit address supplied to the print wheel logic means 334 from data lines DLo - DL.i and the print wheel position indicated by the present position counter. Upon the occurrence of a character strobe at the control input to interface logic SW the seven (7) bit, two's complement code designating a particular character is supplied through the multiconductor cable 343 to the print wheel logic means 334 and more particularly is applied in parallel to the logic and difference counter which also receives a seven (7) bit output from the present position counter present within the print wheel logic 334. The present position counter present within the print wheel logic 334 is utilized to maintain a count indicative of the actual pimadon of the daisy wheel print element due to previous rotations therein in previous printing cycles. Thus, assuming a 94 character print wheel, the absolute print wheel address w;11 designate the rotation coordinates of the character to be printed with respect to a home position while the present position counter will provide an output signal designating the present coordinates of the print wheel.

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These two outputs are applied to the logic and difference counter where they are subtracted and an output indicating the shortest rotational movement to place the print wheel in a position where the desired character resides, as specified by the seven (7) bit word presented on data lines DL0 - DL4 is provided at the output thereof. As will be readily appreciated by those of ordinary skill it the art. the shortest rotational distance to achieve appropriate daisy wheel print element positioning may be obtained by 'Akins both the difference and complemented difference between the inputs of the present position character and the characters supplied on data lines DL0 - DL`. Thereafter, the smallest value between the actual difference count and the complemented count is selected to represent the magnitude of the displacement where the actual difference is utilized to represent rotation of the print wheel in one direction, i.e., clockwise, and the complemented difference is utilized to indicate rotational movement in the opposite direction. Thus, the logic and difference counter provides a pair of output signals wherein one such signal is indicative of the magnitude of the rotation through which the print wheel is to be driven while the other such output is indicative of the torection in which rotation is to occur. Furthermore, as the present position counter is continuously incremented as the daisy wheel print element is rotated, it will be appreciated by those of ordinary skill in the art that the magnitude of the output from the logic and difference counter will continuously diminish as the daisy wheel print element is rotated toward a defined position. Due to the manner in which the print wheel logic initially specifies the direction and magnitude of the displacement through which the daisy wheel print element is to be rotated and there-after provides a continuously diminishing signal representing the remaining necessary displacement, the output of the print wheel logic may be utilized to initiate and control the 'displacement of the print wheel driver u well' as providing for an operation completed signal and other necessary housekeeping signals when the designated print position is obtained. For these reasons, the output of the print wheel logic means 334, as well will be more fully appreciated upon a review of U.S. application Ser. No. 229,314 supra and the additional applications and manuals cited herein, may be used to develop a velocity signal indicating various velocities for large displacements and a level control signal for precisely centering the print wheel at a desired locatiot These signals are applied through multiconductor cab 48 346 to the print wheel servo which responds thereinto actually displace the daisy wheel print element in saw-dance with the velocity snd control signals supplied and acts to update the position information maintained within the present position counter of the pint wheel logic meantl34 as the displacement occurs. As will be appreciated W.os? of ordinary skill in the art, when the count of the logic and difference counter present within the print wheel logic means 334 becomes zero, indicating that the daisy wheel print element has been rotated to the defined print position. this zero level may be applied through conductor 343 to the print logic means 333 to indicate that the print wheel displacement operation has been successfully completed and may be employed as an input to an AND gate for developing the triggering level for the hammer firing signal.

Although any suitable servo system may be employed for the print wheel servo means 335, it is preferred that the servo systems disclosed in U.S. pat. apples. Ser. Nos. 137,283 and 71,984 to A. Gabor and referred to in U.S. appin. Ser. No. 229,314, supra, be employed because this form of servo system provides an extremely rapidly responding and positively acting servo system for placing the print wheel in a designated position without any overshoot. The multiconductor cable 346 may comprise a plurality of conductors which are utilized to convey direction and magnitude information in terms of a velocity command and level control to the print wheel servo means 333. In addition, the multiconductor cable 346 includes in additional conductor which conveys displacemen ,formation from the print wheel servo means 335 to the print wheel logic means 334 so that such displacement information may be utilized to increment the present position counter therein whereupon the present position is continuously updated and maintained in a curren tote to reflect the actual position of the daisy wheel print element being rotated.

The outot of the print wheel servo means 335 is connected through a conductor 347 to the print wheel driver means 341. The print wheel driver means 341 may take the form of a conventional motor driver circuit which responds to the magnitude and polarity of an input signal applied thereto to cause a motor to rotate a shaft in a direction indicated by the polarity of the input and at an instantaneous velocity representative of the magnitude of such input. The print wheel, may be axially mounted on the motor shaft and rotates with the motor although gearing arrangements therefor are readily available. Thus, the print wheel logic means 334, the print wheel servo means 335, and the print wheel driver means 341 act in conjoint to appropriately position a daisy wheel print clement at a position so that the character defined by the seven (7) bit code supplied on conductors Dk - DL6 during a print command is placed in an appropriate position for impacting by a hammer and !fence printing.

Tice ribbon level encoder means 337, receives as aforesaid, the three bit word from the multiconductor cable 344 which defines the character width as originally specified on data lines DL7- DL, by the character information specified thereon during a print instruction. The ribbon level encoder means 337 may therefor take any conventional form of level encoder which responds to a three bit input to provide one of up to eight (8) analog levels or alternatively. pulse sequences, depending upon the input level supplied thereto. As well known to those of ordinary skill in the art, the three bit input supplied thereto on the multiconductor cable 344 may define increments varying from 0 to 7 wherein a zero (0) is not employed bait instead is relied upon to

indicate a deenergized condition while input levels I - 7, are responded to by the ribbon level encoder means 337 to provide seven (7) discrete levels of ribbon advance which may be characterized for the purposes of the instant invention as varying from two (2) increments to eight (1) increments of ribbon displaceman. Thus, depending upon the input levels supplied to the ribbon level encoder means 337, an analog output level, a series of pulses, or a decimal output indication varying from 2 to 8 increments through which the ribbon is to be displaced is applied to the multiconductor cable 348 connected to the ribbon motor driver means 342. The ribbon mi.tor driver means 342 may take the form of a conventional amplifier or driver apparatus which acts in the well known manner to apply the level encoder output of the ribbon level encoder means 337 to a stepper motor means after raising the same to a suitable magnitude to drive the stepper motor. The stepper motor may here be viewed as displacing the printer ribbon one increment for each output level. pulse of decimal level provided by the ribbon level encoder means 337 so that the ribbon on the printer is displaced a suitable amount for printing the character defined on data lines DLo - 131.6. In twelve pitch printing operations, five increments of ribbon advance are employed, in ten pitch printing operations, six increments of ribbon displacement are employed "Atilt in proportional spaced printing operations, from two to eight increments of ribbon advance will be employed depending upon the width of the character to be printed. Upon the completion of the incrementing of the ribbon by the ribbon stepping motor, a signal is supplier from the ribbon level encoder means 337 through the multiconductor cable 344 to the printer logic means 333. This ribbon advance completed indication may be provided as a function of the output of the stepper motor per se, or as a function of a suitably timed interval which assures that the ribbon incrementing function has been completed. At any •ate, the print logic means 333 receives an indication from both the ribbon displacement circuitry indicated by the blocks 337 and 342 and a print wheel displacement completed indication from the circuitry indicated by the blocks 334 and 335 indicative that the functions of print wheel displacement and ribbon incrementing for a given character have been completed thereby. Both of these function completed signals are ANDed at the print logic means 333 and employed to develop a hammer fire signal, as aforesaid.

The two (2) bit word initially supplied for each charaster on data lines DLio and DLit associated with the hammer force with which a given character is to be printed are supplied from the print logic means 333 through the multiconductor cable 345 to the hammer level encoder means 339. The hammer level encoder means 339 may take the form of a digital to analog converter, digital to pulse converter or digital to decimal converter of the conventional varieties mentioned anent the ribbon level encoder 337 and its function is to provide one of four levels which act to define the force with which the hammer is to be impacted in the printing operation to be initiated. As will be appreciated by those of ordinary skill in the art, the two bit word defining the hammer force supplied on data lines DLio and DLit may act to define up to four (4) discrete levels and all four of such levels are employed within the instant invention to control the velocity with whicbViLlaimmer in the form of a piston is driven against the spoke on the daisy wheel Mint element which has been positioned for

a given printing operation. The output of hammer level encoder means 339 is applied through the multiconductor cable 349 to the hammer coil driver means 340. The hammer coildebit meant 340 may take the coeven-Waal fbrm of a edity dews which provides an appropriate input to an armature which is arranged to impact a portion of a piston-like print hammer whenever an input signal is applied thereto. The print hammer, as will be appreciated by those of ordinary skill in the art, when impacted by the armature of the relay, will be driven forward to drive the selected daisy element from the plane of the prin. wheel and into engagement with a carbon or cloth ribbon and the doctor...en upon which printing is taking place. The actual application of the output of the hammer coil driver 340 to the solenoid does not occur until a triggering level is supplied to the hammer coil driver means 340 through multiconductor cables 345 and 349 from the print logic means 333. This triggering level is provided as a function of the print wheel positioning and ribbon displacement completed signals provided thereto so thrt the triggering of the hammer does ro: occur until the daisy wheel print element has been appropriately positioned to the desired character location and the ribbon incremented to assurs: appropriate printing will take place. Once triggered, the hammer coil driver means 340 will apply a pulse to the solenoid to cause the same to actuate the piston-like print hammer. The duration of the pulse is controlled by the output of the hammer level encoder 339 which may directly control the dur .ion of the pulse produced by the hammer coil driver 340 or may alternatively act to superimpose a velocity 'eve.; on the back porch of such pulse so that the initial driving force applied to the piston-like print hammer is uniform in each case, however, the velocity signal applied thereto at a moment before impact, will vary as a function of the output of the hammer level encode .cans 339. In this manner, an appropriate hammer for e which is uniquely suited to the particular character to be printed is supplied to the hammer coil driver means 340. Thus, the printing of alphanumeric characters such as ".", "I", "1" and the like, generally require a print stroke of a first duration while the printing of chancier' occupying substantially more area such as "M", "N" and the like require substantially longer print strokes. Thus the instant invention•define% four levels of print strokes and furnishes one of such levels for each character to be printed with the character information furnished to the printer unit.

After the expiration of a suitable interval following the issuance of a hammer trigger, signal by the print logic means 333, a signal is applied through the multiconductor cable 327' which causes the interface logic means 305 to provide a character ready status output on the appropriate conductor for application to the printer interface means and subsequent application to the common status bus 21 on a demand basis. The hammer trigger level--output by the print logic means 333 may be issued as a function of the ANDing of completion signalsfroan the ribbon drive and print wheel servo apparano and .a result of the ANDing of these two levels may be employed to trigger a monostable Rip flop. Upos the termination of the duty *cycle* of the monostable flip flop, the output thereof may also be ANDed with the completion signals from the print wheel servo and the ribbon motor Illiner to assure that each otthe three Nieto= provided by the print logic circuit indicated by the dashed block 306 are in a completed condition prior to the issuance of a character ready status indication by the interface logic block 305 Thus it will be appreciated that when a three word character associated with character printing is applied to data lines DL0 -DLit and a character strobe is applied to the interface logic indicited by the block 305, the print Ionic circuitry indicited by the dashed blocks 306 responds to each of the words therein to cause printing of the character to occur. More particularly, in response to the seven (7) bit word defining the character to be printed the daisy wheel print element is displaced to position the charge - ter defined in an appropriate print position are: a suitable length of ribbon is displaced by the ribbon stepping motor so that an appropriate portion of new ribbon will be made available to the character to be printed. After both of these operations are completed, a piston-like print hammer will be triggered to cause printing and the force or durrtion of the impact will be controlled by the hammer force specified on data lines DL10 and DL, 1 so that an appropriate hammer force for the character defined will be employed during the printing operation. Accordingly, the printer unit illustrated in FIG. 6 responds to character print data and a character strobe to accept the characterinformation, the ribbon displacement incormation and the hammer, force informaton contained therein and thereafter acts to independently cause the printing of the character defined and subsequently acts to apprise the microprocessor through an appropriate indication on the status bus that printing bas been satisfactorily completed.

The carriage logic means 317, the carriage servo means 318 and a carriage motor driver 351 together with the carriage motor corrected thereto may each take the same form as the correspondingolements associated with the daisy print wheel element. This position is taken because a similar logically controlled servo system may be employed to control the rotational displacement of the print wheel may be employed to achieve the lo.agitudinal displacement of the daisy print wheel element carriage. The only exceptions being that the carriage logic may be substantially simplified as it need not perform as many functions nor need it perform as complex a position designating function and the rotational motion of the shaft of the carriage motor must be translated into longitudinal motion through a cable driver or through other conventional techniques well known to those of ordinary skill in the art. More particularly, as the carriage logic means 317 receives a twelve (12) bit input wherein the high order bit designates the direction in which travel is to occur, i.e, right or left,' while the lower eleven order bits designate the distance to be travelled in increments of 1/I20th of an inch. the displacement data applied to the carriage logic means 317 may be directly loaded into a register. Thereafter, the register may be counted down in response to increment of movement pulses supplied by the carriage servo means 318 and hence the present location counter employed in the print wheel logic I II may be avoided. Thus, when twelve (12) bit carriage displacement information is loaded onto data lines DLe - DLt t and a carriage strobe is applied to the appropriately annotated conductor in a multiconductor cable 34, the lower iieven (I I) bits on data lines DL10- DLeare loaded into a register in the clunagelogie means 317 while the directional information contained in the high order bit may be used to set a flop or the like. The carriage servo moms Star may take precisely the same form as the print wheel servo means 335 and hence, when the otoiSilt of the carnage logic mauls 317, which represents a rnagnitilde equal to the setting of the register therein is applied through multiconductor cable 352 to the carriage servo mans 318. the,earriage servo means 318 will cause the tesergization 011ie carriage motor driver 351 and the Carnage motor las that the carnage will be displaced in a direction determined by the setting of the flip flop, at a rate representative of the magnitude of the setting in the register present in the carriage Icgic means 317. As the carriage is displaced, the carnage servo means 311 will apply pulses through the multiconductor cable 352 to the carriage logic meats 317 representing each increment of motion through which the carriage is displaced. These pulses are utilized to count down the register originally set by the displacement magnitude applied to data lines DI-to – DL.0 and the state of the count in eye register continuously represents the remaining distance through which the carriage must be displaced to achieve the displacement originally set on data lines DLio - DLI. When the state of the register in the carriage logic means 317 has been decremented to a zero condition a carriage ready pulse is applied through the multiconductor cable 328 to the interface logic 305 so that a carriage ready status indiertion may be applied to the carriage ready conductor indivsted and subsequently to the common status bus 21. It should be noted however. that as the instant printer means does not employ physical margin detents or other physical stops. circuitry external to the printer must be utilized to keep track of the position of the carriage and prevent the motion thereof when a margin zone setting would be exceeded by a carnage displacement command. This function. however. is provided by the RAM peripheral 34 in combination with the operations of the microprocessor 16.

Thus, it is seen that v.'her twelve (12) hit carnage displacement character is applied to data lines DLII - DL0 and a carriage strobe is applied to the appropriately annotated conductor at the interfa4..e logic 305, the displacement character will be loaded i ai the carriage logic mean: 317 and utilized to control the carriage servo means 318 which energizes the carriage motor driver 351 to thereby cause the displacement of the carnage while each increment of displacement of the carriage while each increment of displacement of the carnage is applied from the carriage sero means 318 to the carnage logic means 317 to decreMent the register therein. Accordingly. when the register within the carriage logic means 317 has been decremented to a zero count and the carriaje has been displaced to the full extent designated. the carriage logic means 317 provides an appropriate carnage ready status indication to the interface logic 305. It should additionally be noted that the input "squired to cause carriage displacement does not in any .z.nner derive from those associated with the positioning of the daisy print wheel element and hence in the absence of appropriate commands, no automatic escapement will operate. In the foregoing manner. the carnage position of the printer may be moved on a continuous basis to any column position in a line with which printing is normally associated and it should be noted that unlike conventional input/output typewriter apparatus, the movement of the carriage from one position to the next is not an incremental unit, but is continuous so that carriage shifting is accomplished at a masimum available speed. Carrisqe escapement, like ribbon advance described in conjunction with a print command will be generally uniform when printing is occurring in either a 10-pitch or 12-pitch mode; however, for proportional spaced modes of operation, the escapement associated with each character will vary depending upon the incremental width assigned to that character. Furthermore, to accommodate proportional spaced modes of printing, the commands issued to the printer unit, as aforesaid, are such that the printer unit is caused to escape a distance equal to one LJf the :iscremental width of the previous character printed plus one-half the incremental width of the next character to be prin• ad and thereafter an actual print command is initiated. At this juncture, no further escapement command is provided until a new print cycle occurs unless a 100ms delay expires prior to the entry of a new character to be printed. At this juncture, the microprocessor assumes something has occurred to interrupt an input operation and therefor. to provide the operator with a synthesized version of the familiar escapement of a typewriter, a displacement of one-half the incremental value employed in 12-pitch operations is added to the incremental value of the previous character printed, and this escapement value is forwarded to the rrinter unit so that it appears to an operator as if the printer unit his' escaped in the familiar typewriter fashion a1iJ has stopped at a location where the entry of new character information may occur. However. in proportional modes of operation, u the next character entered after the interruption does not have an incremental value equal to the uniform incremental value in 12-pitch modes of operation, the microprocessor will effectively subtract one-half the incremental value assigned to that character from the one-half incremental value of a 12-pitch unit previously utilized and cause the daisy wheel print carriage to move either in a forward or reverse Jirection to achieve appropriate positioning prior to the actual printing of character information. Since the varying escapement, ribbon advance motions, and hammer impacting levels employed within a proportional spaced mode of operation ate quite diverse. exemplary values for one typical proportionally spaced print font have been set forth in Appendix F so that the same may be viewed for exemplary purposes by a reader; however, it will be appreciated by those of ordinary skill in the art, that any desired print font may be designed and appropriate hammer force. escapement and ribbon advance functions assigned thereto.

The paper feed logic means 321. like the carriage logic means 317, accepts a twelve (12) bit movement command which in this case represents the upward or downward indexing of the paper. The high order bit supplied on data line DLit represents the direction in which movement is to take place while the data characc - ter presented on data linea DI-so - DLo represents the displacement to be implemented in increments of 1/48th of an inch or ith of a print line advance. This enables superscripts and subscripts to be automatically achieved, as well as the automatic positioning of the document to a first line position which is exceedingly useful when continuous paper forms are employed or when the operator merely loads the document so that the top of the document is indexed with the top of the document carrier and thereafter proper indexing of the paper to a Out line position is automatically achieved. The paper feed logic 321. like the carriage logic 317. includes a register in which the displacement infornia- tion represented by low order bits on data lines DL.' 52 DLO are inserted, upon the appearance of a paper fe strobe at the interface logic block 110. Similarly, the direction input present on data line DLit may be employed to set a flip flop. However, for paper feed ad-Stave no servo system is employed to achieve move-Sent, but rather a gaper feed nritor, as indicated in :PIO. 3, which takes the form of an incremental supping '¬asotor is relied upon. Therefore. the setting of the rein-' ler within the paper feed logic 321 enables clock pulses :10 be applied from the paper feed logic 321 through a conductor 354 to a paper feed driver 355. Each clock pulse so applied to the paper fold driver 355 is raised to an appropriate logic level and is applied through a conductor 356 to the paper feed motor indicated. Each pulse applied to the paper feed motor will cause the paper feed motor to step thereby causing the roller 5 to step and hence index the paper in an upward ur downward direction, an amount equal to such step. As each poise is applied by the per feed logic means 321 to the paper *feed* driver 353 through conductor 354, the pulse is also employed to decrement the register in which the paper indexing displacement has been loaded. Thus, as will be appreciated by those of ordinary skill in the art, clock pulses will be applied to the paper feed driver 355 and to the paper feed motor to continuously cause the stepping thereof and hence the appropriate indexing of the document until the register present in the paper feed logic means 321 is decremented to zero.

When the register present in the paper feed logic means 321 is decremented to zero to thereby indicate that the displacement indicated by the low order bits supplied thereto by data lines DI-10 - DLo 16.3 been achieved, the flip flop indicative of the direction in which the indexing occurred is reset and a paper ready status indication is supplied through the multiconductor cable 329 for application to the paper feed ready conductor present within the multiconductor cable 24. In this manner, an indication to the prnter interface ry for subsequent application to *the* common status bus 21 is supplied to provide an indication to the microprocessor indicated by the dashed block 16 that the next step in the program sequence may *be* initiated The direction in which the motor stepped and hence the paper is indexed may be controlled by the polarity of the pulses applied on conductor 356 to the paper feed motor. This is controlled, as will be appreciated by those of ordinary skill in the art by the setting of the flip flop which responds :o the high order bit present on data line DLit.

The sequence in which instructions associated with a paper movement command are applied 'to the printer unit is as follows, initially a twelve (12) bit data displacement character is applied to the data lines DLII - DI.0, thereafter a paper feed strobe is applied to the appropriately annotated input conductor on the interface logic block 305 whereupon the paper displacement character is loaded into the paper feed logic register 321, paper displacement is then caused in response to pulses applied to the conductor 354 by the paper feed logic means 321 and subsequently a paper feed ready status indications is provided at the status output indicated in FIG. 6 at the interface logic 305.

In the same manner as other peripheral it the automatic writing system &cording to the present invenbon, a data character, which in this case takes the form of a twelve (12) bit character formed at the printer interface means 27 from a pair of entries to the common data bus 19, is conveyed to the printer unit while iastructions applied to the strobe inputs of the interface logic means 305 originate as instruction commands on the common instruction word bus 20. Similarly, the status condition provided at the outputs of the interface logic means 305 connected to the atulticonductor cable 34 are applied through the printer interface 27 to the common status bus 21 to apprise the microprocessor indicated by the dashed block 16 that the next instruction in the program sequence being processed may be issued. It should be noted that the inputs to the interface logic block 305 associated with the paper indexing operation do not derive in any form from carriage displacement character information which may be supplied thereto. There've, in the absence of appropriate instructioa from the read only memory SO, the document being prepared will not be automatically indexed to the next line upon receipt of a carriage return command, which takes the form of a carriage displacement instruction.

Although the ribbon lift logic 323 may be employed to control the printing nosition of a two color eibon, the ribbon lift logic 323 here performs only the simplified function of positioning a black or other single color cloth or carbon ribbon in a first position intemediate the character pedal of the daisy print wheel element and the document to be printed so Lie same is impacted when the print hammer strikes the selected pedal of the daisy wheel print element, or a second position in which the ribbon is in a down position and hence does not tend to obscure the operator's view of the print position on the document being printed. The function is achieved, in essence, by providing a delay interval thrt5ugh the operation of the program time delay means 16A such as a five-hundred millisecond (SCO ms) interval in which a succeeding character input is to be supplied to the printer unit. If this input is not supplied within the given period a high level input is supplied to the input conductor within the multiconductor cable 24 and more specifically, the conductor annotated Ribbon Action in FIG. 6. When the ribbon action input conductor to the interface logic 305 is high, the ribbon is placed in the down position while when the input on the ribbon action is low, the ribbon is placed in a first or up position. For this reason, the ribbon lift logic means 323 need only comprise a flip flop or other suitable logic device which produces an output which follows the input supplied thereto. The input to the ribbon lift logic 323 is supplied through a cable 330 from the interface logic block 305, which essentially acts to apply the level on the ribbon action input thereto, to the ribbon lift logic 323 although the internal structure of the interface logic 305 may be employed to raise the control signal on the ribbon action conductor to an appropriate output level for the *ribbon* lift logic 323. The output of the ribbon lift logic 323 is applied through a conductor 337 to ribbcin lift driver means 358. The ribbon lift driver means 358 may comprise any suitable form of driver stage which raises the output of the ribbon lift logic means 358 to • level which is suitable to drive the ribbon lift coil indicited. The output of the ribbon lift driver 351 is connected, as indicated in FIG. 6, to the ribbon lift coil through a conductor 359. Therefore, as will be appreciated by those of ordinary skill in the art, when a low condition resides on the conductor annotated Ribbon Action within the multiconductor cable 24, this low level will be reflected at the output of the ribbon lift logic means 323 and conveyed to the ribbon lift coil to place the ribbon in an up condition which is the appropriate condition for a printing operation. However. when the levet on the ribbon action input onncluctnr within the multiconductor cable 24 goes high,5inclicating as shall be seen beibw, that sc character input has been provided within a specified interval, this high level is reflected at the output of the ribbon lift logic means 323 wbereuZ lirMon lift coil is de-energized and the carbon rthbon is displaced in its non-print • or low condi**, that the operator may clearly view the portion or tfte 'document at which printing is to occut.

The end of ribbon sensor means 326 is employed within the instant invention to apprise the operator, the microprocessor 16, and hence the system as a whole that the cloth or carbon ribbon employed in the printer unit for print purposes, is approaching exhaustion and upon exhaustion, to shut down the system. The printer unit employed within the instant invention preferably employes a specialized ribbon cartridge containing a cloth or carbor ribbon which is provided with indicator means at locations thereon corresponding to a point where sufficient ribbon is left to print only 3,000 characters., a point where sufficient ribbon is left to print only 1,250 characters and a point corresponding to the actual end of the ribbon Additionally, such ribbon cartridges are available both in cloth ribbon and carbon ribbon versions so that the cloth ribbon may be employed or a reusable basis for draft copy wc..* and the like while carbon ribbon embodiments are utilized in the preparation of final copy. The indicia provided in the ribbon cartridge may optionally take the form of magnetic, metallic or reflective indicia so that the same may be appropriately detected by sensory means present within the end of ribbon sensor means 326. Preferably, the indicia present on the ribbon would take the form of reflective metallic strips of 'oil and hence, the end of ribbon sensor means 326 may comprise means for illuminating the ribbon whenever the automatic writing system according to the instant invention is energized and means for detecting reflected radiation disposed in such relationship to the illuminating means and the typewriter ribbon present at the print position that radiation from the illuminating means is only sensed thereby when a reflective strip is present on said ribbon. Additionally, it is preferred that the automatic writing system according to the instant invention provide an initial warning to the operator when only sufficient typewriter ribbon remains for the printing of 3,000 characters and thereafter this warning is repeated and maintained at a location on the ribbon which is sufficient for printing only 1,250 characters while the system is to be shut down at the actual end of the typewriter ribbon. Therefore, under these cond.,:ons, a reflected strip may be placed on the typewriter ribbon at each of these locations *and* a counter provided within the end of tibbon sensor means 326 which effectively counts the pulses produced by the optical sensor and is reset through conventional means upon a changing of the ribbon. Thus, under these conditions, when the first strip is detected, the microprocessor according to the instant invention may be responsive to an end of ribbon indication from the interface logic 305 to provide an audible beep or the like; however, such end of ribbon level would terminate as soon as the sensed condition terminated. However, upon a detection of the second reflector on the typewriter ribbon, the counter would be set to a count of two (2) and the end of ribbon indication from the interface logic maintained so that the microprocessor could• respond thereto to provide a continuous audible warning to the operator. Upon the actual end of the ribbon, a count 3 state would be registered and this condition weld be employed to actually disable further printing operations in the automatic writing system according to the instant invention until the ribbon was actually changed. Alternatively, the powerful microprocessing techniques employed within the instant invention could be relied upon to maintain a count of the end of ribbon pulses provided at the output of the interface logic means 305 and the same results could be obtained by the microprocessor keeping track of the number of end of ribbon pulses supplied to the common status bus so that upon the first such pulse, an audible beep would be briefly produced, the second • pulse would cause an audible beep to be mutinously produced, while a third pulse causes system shut down. The output of the end of ribbon sensor means 326 is applied to a shaping network 360 through a conductor 361 which applies the outputs of the end of ribbon sensor means 326 to the interface logic 305. The shaping network means 360 acts in the conventional manner to configure the output of the optical sensor means present within the end of ribbon sensor means 326 into a logic compatible format and hence may take any of the well known forms of this conventional class of device. The output of the shaping network 360 as applied to the interface logic 305 may be directly applied to the status output conductor present within the multiconductor cable 24 annotated End of Ribbon and hence acts to apprise the microprocessor If to,the condition of the ribbon loaded.

The output conductor within the multiconductbr cable 24 annotated Printer Ready in FIG. 6 is employed to indicate the status of the printer unit. More particularly, the printer ready conductor is employed to indicate whether or not the printer is properly supplied with power. Therefore, as will be appreciated by those of ordinary skill in the art, the status condition defined by the printer ready conductor apprises the microprocessor indicated by the dashed block 116, when this status condition is gated to the common status bus 21, that the printer peripheral is in the system and that such peripheral is ready to receive operational commands. Accordingly, the program control sequence utilized by the microprocessor indicated by the dashed block 16 will test the status of the printer ready conductor prior to the issuance of any command to the prirter unit depicted in FIG. 6.

The restore input conductor within the multiconductor cable 24 provides a specialized input to the prim, unit which causes the printer unit to be placed in a predetermined initial state. More particularly, an input on the restore input conductor causes a restore operation sequence to occur at the printer unit whereir the-printer unit is placed in an initial condition by returning the carriage to the first character position, rotating the daisy print wheel element to its starting or home position and resetting the internal logic of the printer unit. The restore sequence is introduced to the logic whenever power is turned on or when an operator activates. the restore command input line through a reset operation or the like. Data inputs for achieving the necessary displacements in a restore operation sequence are supplied to *data* lines DLo -DLit from the common data bus 19 in response to commands issued by the read only memory SO. The restore operation, as will be appreciated by those of ordinary skill in the art, is not only utilized to initialize the printer unit each time that system pouter-is turned on, but in addition theretoAtliel initiation of this sequence is mandated each time it is necessary to clear a malftinetion. In the restore se-

Astnce, the print wheel carriage is first displaced to its most position, by causing the carriage logic means 317 to Woe a move to the let command and this command is maintained =atm carriage ans 318 indicatea that the carriage 6 Ito longer moving. As fully .'itied in the above cited applications directed to the *inter unit, no mechanical detente or margin settings .-14 employed in the printer unit, therefore, as the - printer unit will attempt to fully carry out each commend issued thereto, the axis upon which the print *heel carriage traverses is provided with a pair of crash stops located at the extreme limits of permissible carriage movement. When the carriage servo means 318 detects that the carriage is no longer being displaced towards the left, such condition indicates that th. print wheel carriage is against the left crash stop and has been prevented from being further displaced. A failure to further displace is indicated to the carriage servo means 318, which normally senses inductively coupled cross points for each increment of displacement of the print wheel carriage, by a failure to further detect welt cross points. Upon a detection that the print wheel carriage is up against the left crash stop, a move twelve (12) to the tight command is supplied to the printer unit by loading the data lines DL0 - DLit with a magnitude of twelve (12) units (24 increments) ..nd a right direction inpuyt while applying a character strobe to the interface logic 305. This causes the carriage logic means 317 to initiate the movement of the print wheel carriage twelve (12) units to the right and terminate such movement after the carrige *serve* means 318 has appropriately decremented the register in the carriage logic means 317. The twelve (12) unit incrementing of the position of the print wheel carriage to the right of the left crash stop is significant because it aligns the print wheel carriage with a position which corresponds to the zero margin or column positinn of the carriage. Thus. the restore operation effec-,.. 'y acts to place the daisy print wheel element carriers in a zero starting positioi, whereupon the registers employed to keep tree: of the position of the print wheel carriage for margin control monitoring purposes may be placed in a cleared condition as the zeroing of the print wheel carriage is assured.

After the print wheel carriage has been placed in its starting or zero (0) position, the print wheel is placed in a home position. The print wheel takes the form of a flat disc-like member having a plurality of regularly extending spokes on which each character is positioned. Normally, the print wheel element iicludes 96 available character locations and a metal tab is affixed to a character position which has arbitrarily been assigned as the zero character position. Under logic control the print wheel is rotated in a coveter clockwise direction until glie metal tab associated with the zero character position * detected. At this position the rotation of the print eel is stopped. During the rotation of the print , hal, in a restore cycle, the feed back from the print Neheel servo to the present position register in the print V=1 logic means 334 is disabled and when the print eet is stopped at its home position, the present psi- register within the print wheel logic means 334 is Fareel or plsced in its zero condition, it now being tired that the daisy print wheel element is in a home zero position and hence the zeroing of the present 'don mister within the print wheel logic guarantees t a synchronization betwce›. six daisy print wheel ent and the present position counter within the wheel logic means 334 is atablished. In addition, during the restore sequence, the ribbon lift logic means 313 may be sated to place the ribbon in its down posidon while paper feed logic means 321 is inhibited. Accordingly, as will be appreciated by those of o• t'aarY AM in the art, the restore operation initiated b3' a restore input establishes a set of initial conditions in the printer unit so that from this point fonvard synchronization between the various monitoring registers in the printer unit and in the printer interface 27 and the various command displacements issued to the printer will be assured. This is necessary because the use of dynamic registers and the like within the present embodiment of the automatic writing system according to the present invention requires that the microprocessor indicated by the dashed block 16 be assured that each time a power up operation is initiated a predetermined set of starting conditiors are present. However, as dynamic registers lose their storage when the system is deenergized, such set or initial conditions must be reestablished when the syste... first receives power. Similarly, any malfunction which might occur at the printer unit might well cause one of the monitoring registers therein to lose synchroiltation. Therefore. the, restore operation is necessary to clear the malfunction in order that a re-synchronize-:nr. of the system is assured.

From the foregoing description of the printer unit logically set forth in FIG. 6, it will be appreoiate that all operations of the printer are electronically initiated, implemented and controlled. This makes for highly reliable printer structure because the majority of mechanical expedients employed in most printers are completely avoided while the printer may operate at speeds exceeding those available from conventional input/output typewriters. For instance, while conventional input-/output typewriters normally operate at a maximum speed of 15 characters per second, the instant printer unit depicted in FIG. 3 may operate at rates exceeding 30 characters per second when driven by a record media. Furthermore, the printer unit depicted in FIG. 6 is particularly well suited for incorporation into the automatic writing system according to the present invention because, as will be appreciated from the operation thereof set forth above, once a command is issued to the printer, the printer may act in the absence of further program control, to carry out that function and will indicate on an appropriate status output when that function has been appropriately completed. This means that once the microprocessor indicated by the dashed block 16 has issued an instruction to the printer unit, the microprocessor may advance its program sequence to carry out further operations at other peripherals and may later return to the printer unit to monitor if the command failed has been successfully carried out poor to the issuance of a new command thereto.

THE PRINTER INTERFACE .

Referring now to FIG. 7, there is shown the details of the printer interface 27 and more particularly, FIG. 7 schematically illustrates the printer interface 27 for the printer unit illustrated in FIG. 6. The printer interface depicted in FIG. 7, as shall become more apparent below, essentially performs three basic unction 'noelaced with the various operations of the printer unit depicted in FIG. 6 to that the same may functiopss an independent peripheral within the automate II/Ming system as a whole and appropriately implement and comply with instruction§ issued by the microprocessor indicated by the dashed block 16, with which it has primary association. The three basic functions performed by the printer interface illustrated in FIG. 7 ate (1) selectively obtaining data from the common data Ws assenellas such rata into twelve bit characters for application 10 the printer unit and selectively gating such twelve bit characters to the printer unit, (2) decoding printer action ..tstructions issued on the common instruction word bus 20 and selectively appiying such action instructions as are decoded to the printer unit in the form of discrete control levels and (3) responding to status conditions indicated at the printer as well as other locations assigned thereto *and* responding to instructions issued on the common instruction word bus to selectively gate such status conditions to the common status bus L. Thus, in accomplishing these basic *fubc*bons, the printer interface depicted in FIG. 7 complements and controls the functions of the printer unit so that when the printer unit is connected through the printer interface to the common status bus 19, OP common instruction word bus 20 and the common slams bus 21; the printer appears as any other peripheral to the microprocessor indicated by the dashed block 16 and can be selectively enabled or disabled by the issuance of selected sixteen (16) instruction words on the common instruction word bus 20.

The printer interface depicted in FIG. 7 comprises a data section 365 which includes four *(4)* bit latch means 366 and driver means 367 and 368; a command strobe section 370 which includes AND gates 371 - 377 and a single bit latch means 378, and a status section 380 which includes the multiplexer means 381 - 383.

THE DATA SECTION

The function of the data section indicated generally at 363 is to selectively assembled data .onveyed in the form of eight bits in parallel from the common data bus 19 into twelve (12) bit characters suitable for application to the printer unit illustrated in FIG. 6 through the twelve parallel data lineS DL0 - DLit which serve as the data input thereto. As will be appreciated by those of ordinary skill in the an, when the automatic writing system according to the instant invention is operating a processing mode, data of one form or another is normally present on the common data bus 19 and hence, only data destined for the printer unit is to be assembled into a twelve bit format and selectively applied to the printer unit illustrated in FIG. 6. The miserably of eight (8) bit data into a twelve (12) bit format is accomplished by the data section 365 while selective gating to the printer unit is controlled through the generation of a character strobe, carriage strobe, or paper feed strobe input to the printer unit by the demand strobe section 370. The twelve (12) bit character information assembled within the data section 365, may take the form of a twelve (12) bit carriage escapement displacement defined in increments of I/120th of an inch as well as direction. a twelve bit paper indexing displacement defined in terms of 1/48th of an inch as well as direction. or a three word print command wherein oven (7) bits act to define the character to be printed, three (3) bits define the width thereof for the purposes of ribbon displacement and the remaining two bit word acts to define the hammer force with which printing is to occur. Briefly, since data is conveyed through the common data bus 19 in the form of eight bits in parallel, data for application to the printer unit 2 is applied to the printer interface illustrated in FIG. 7 in the form of two eight bit applications of data on the common instruction word bus. During the first eight (8) bit application of data on the commas data bus, significant information is contained only on data lines DB0 - DB3 of the common data bus and such information as is contained therein is latched at the priitter interface. Thereafter, the second eight (8) bits of data applied to the common data bus are directly applied through the printer interface illustrated in FIG. 7 to the printer unit together. with the four (4) bits from the previous pass which were latched thereat. The twelve bits of relevant data thus assembled by the printer interface originate, as shall be seen below, in the case of pent information at the printer data ROM 43 and are applied in two passes to the common data bus, rearranged into an appropriate order by the microprucessor indicated by the dashed block 16 and applied in two eight bit passes to the printer interface illustrated in FIG. 7. Displacement information, whether in the form of escapement information associated with carriage displacement or paper feed displacement informstion is generated by the microprocessor as a function of COnStima read from the read only memory 80, and various stored conditions which result as a function of conditions set by the operator such as line spacing, print pitch and the like as well as previously stored escapement information associated with character information printed during a previous cycle of operation.

Turning specifically to the data section 365, it will be appreciated by those of ordinary skill in the art that the same is directly connected to the individual bit conductors within the common data bus 19 through the multiconductor data cable 31, illustrated in FIGS. 2 and 7. The various data bus bits DB0- DR, associated with the individual conductors of the common data bus 19 have been indicated on the separate conductors illustrated within the multiconductor cable 31 in FIG. 7 and to simplify the description presented hereinafter, the individual bit conductors illustrated in FIG. 7 will be referred to in terms of the data bit DB0 - DB7 associated therewith. Each of the eight bit conductors D130 - DB7 within the multiconductor data cable 31 are directly applied to respective inputs of the driver means 368 while data conductors DB0 - DB3 are connected through conductors 384-387 to individual ones of the inputs to the four bit latch means 366. The four bit latch *means* 366 may take the conventional form of a Model 7475 four bit latch as available from The Texas Instrument Corporation which acts in the well known manner to store the four bits of information applied to the inputs thereof on conductors 384 - 387 in the presence of en enable level and to retain such four bits of information available at the outputs thereof until new information is written therein upon the subsequent generation of in enable level. The four outputs of the four bit latch means 366 are applied through conductors 388 - 391 to respective inputs of the driver means 367. Thus, when enabled, the four bits of information conveyed during a first pass of data on the common data bus 19 will be applied through conductors384 - 387 and loaded into the four bit latch means 366 where the same will be maintained as output levels on conductors 388 - 391. Therefore, during the seat application of data to the common data bus 19, twelve bits of data in parallel will be applied to the driver means 367 and 368. The driver means 367 and 368 may take the form of individual amplifier stages associated with each of the twelve inputs and outputs such as Model 7406 urivers as conventionally available from The Texas Instrument Cofpgalion; however, to simplify the illustration in FIG. 7,

.111ch of the driver means 367 and 368 *has* been shown in „Nock format. In any event. the function of the driver leans 367 and 368 is to raise each of the bit levels ap- led to the inputs thereof.to appropriate logic levels. d after suitable amplification to apply such inputs to outputs thereof connected to terminals DL0- DLit. output lines annotated DL - DLII directly COM- 'Aped to the input data lines on the printer until illus- lated in SO. 6 and it will be appreciated by those of -.11dinary skill in the art that whenever the printer unit =Delves an appropriate command strobe level, the information contained on data lines DL0 - DL_{11} will be accepted thereby and employed to implement the print, carriage displacement or paper indexing function defined by the strobe level associated therewith.

The data actually present on data lines DLit - DL0, it will be recalled, may take one of three forms depending upon *the* nature of the command being implemented. Thus, when a print instruction was forwarded, a three (3) bit word will be defined on data lines DL_{11} - DLo wherein the two bit word defined on data lines D1-10 defines the hammer force in four levels, the three bit word on data lines DL.3- DLL defines the ribbon displacement width while the seven (7) bit word on data lines Ms - D1.0 defines the absolute spoke position of *the* character to be printed. Conversely, when escapement information is being provided, the bit information contained on data line DI-12 will define the direction in which the carriage is to be displaced while the information contained on data lines DL10- DLpwill define the actual displacement in terms of 1/120th of an inch. Similarly, for paper index functions, the information on data line DLit defines the direction with which he paper is to be displaced while the information contained on data lines DL10 - DL0 defines the distance .hrough which displacement is to occur in increments of 1/48th of an inch. Thus, when data is to be appliee • the printer unit 2 for the purpose of printing a character, carriage displacement associated with escapement or the like, or paper indexing functions, the first eight (8) bits of information is applied through the common data bus to the printer interface wherein only the data contained on bit conductors DB0 - DB3 is significant. This data is applied through conductors 382 - 387 to the four bit latch means 366 where it is stored and applied to the outputs thereof on conductors 388 - 391. In a subsequent instruction cycle wherein the second eight (8) bits of data for implementing a printer function are applied to the common data bus, the four (4) bit latch means 366 remains in a disabled condition so that all eight (8) bits of information are applied through conductors DB0 - DB7 to the eight bit output driver 368. Under these conditions, both driver means 367 and 368 will have printer function data applied to the inputs thereof so alit the outputs annotated DL0 - DLI I will have the .mosembled twelve bits of information present thereon 'Am application to the printer unit.

7 The four (4) bit latch means 366 is selectively enabled iii7 that the same may at: x•pt four bits of information c conductors 384 - 317 only during the first applies- on of eight (8) bits of data destined for the printer unit the common data bus 19. The instruction for imple- Openting the enabling of the four bit latch means 366 is triotated Load High Order Data Bits in the operand st associated with printer control which is attached arm as Appendix C. Like all other printer commands this instruction bares a module address, defined by 40M bits Bas - B12 equal to *Hex* 1 and ROM bits B11, Buy and B, are in the binary condition 0, 0, 1 to define a control function so that. in effect, ROM bits B0 - Bs act to actually define the control function which is to occur. In the case of *the* instruction load high **icier* data bits, ROM bit B4 is in a One condition while the remaining ones of ROM bits B0- Bs are in a low condition and hence this form of decode is employed to selectively enable Coe four (4) bit latch means 366. The enable level for the four (4) bit latch means 366 is applied through conductor 392 frnm the output of AND gate 373. The AND gate 373, is within the command strobe section 390, however, as shall become more apparent below, this AND gate acts to decode a load high order bit instruction and to apply an appropriately timed enable level to the four it latch means. 366 so that the same is enabled during an interval when the first eight (8) bit pass of data for application to the printer unit 2 is on the common data bus 19. A first input to the AND gate 373 con' cted through conductor 393 to a terminal annotated y.. and as will be appreciated by those of ordinary skill in the art, receives the condition of ROM bit B4 during each instruction cycle. The second input to AND gate 373 is connected through conductor 394. •This AND gate, as shall become apparent below, serves to decode and time the high output level whenever a printer control function is present wherein RCM bit Bs is in a low condition. Thus, it will be appreciated by those of ordinary skill in the art that The data section indicated generally by the reference numeral 363 serves to assemble a twelve (12) bit data character from two eight (8) bit characters applied to the common data bus whenever such characters are destined for application to the printer unit and holds such twelve bit character in readiness for acceptance by the printer unit whenever a command strobe is applied thereto. The generation of command strobes are governed by the command strobe section 370.

THE COMMAND STROBE SECTION

Regardless of the nature of the data outputs provided on data lines DL0 - DLI I, the printer unit illustrated in FIG. 6 will not respond thereto to accept such data and initiate a print operation, a terrine displacement operation, or a paper feed displacement until a character strobe, carriage strobe, or paper feed strobe is applied thereto to cause this information on data lines DL.0 - DL11 to be taken and appropriately processed by the printer unit depicted in FIG. 6. In addition, as was seen in conjunction with the description of FIG. 6, a restore control lout and a printer action input are also applied to the printer unit to cause the same to establish itself in an initial state of readiness wherein certain specified initial conditions are assumed or to periodically drop the ribbon so as to place the print position in plain view of the operator. Each of these control levels nre generrted at the printer interface illustrated in FIG. 7 and more particularly within the command strobe section 370 thereof whereupon they are applied to respective ones of the conductors within the multiconductor cable 34. This function is achieved by the command strobe section 370 by a decoding of instructions issued by the read only memory on the common instruction bus 20 and the provisiGn of an appropriate output from one of the AND gates 371, 374.376 or the one bit latch means 378 whenever the appropriate instruction is recejtep As was mentioned above, all printer commands bear a module address equal to One (1) i.e. wherein ROM bits B15- Bu are each in a zero-(0) condition while ROM bit

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Du is in a One (I) state. In addition, all control functions have binary 0,9, 1 conditions for ROM bits B11, BIN and 119 while tbecondition of ROM bits Bo - Bs within a control instruetkic specifies the specific control action which is to occur. Additionally, for each of the control functions developed within the command strobe section 370, ROM bit B8 will be in a Zero (0) condition. Therefore, as shall be seen below, the command strobe section 370 initially acts to generate an appropriately timed signal when any of the control instructions for the printer unit are present on the common instruction word bus and thereafter acts to specifically decode individual bits to ascertain whether or not that specific control function is present.

The AND gate 372 within the command strobe section 370 performs the principal function of decoding control functions designated for the printer means. The AND *gate* 372 may take the conventional form of a five input AND gate device which acts in the well know-manner to provide a high at the output thereof only when each of the inputs thereto are high. A first input to the AND gate means 372 on conductor 395 receives an input annotated PRT • 2CL. The annotation (PRT has been adopted herein to indicate the printer address which is a module 1 address, as aforesaid, and hence, the PRT input may be developed through conventional ANDing techniques under conditions wherein ROM bits 1315. B14, and B13 are in a 0 condition while ROM bit B12 is in a One (1) state. In addition, this printer or nodule 1 address, is ANDed with two phases of the four phase clock which in this case comprise clock phases CB and CC which yield clock subphase CL3 as aforesaid. Thus, the input to AND gate 372 on conductor 395 will go high during clock subphase CL3 of any instruction cycle wherein an instruction on the common instruction word bus 20 contains a module 1 address in ROM bit positions 13)5 — B12 to thus define the printer unit. The remaining inputs to AND gate 372 on conductors 396 - 399 act to provide the remainin • ,ecessary inputs for a complete decoding of printer cc :v1 functions wherein the condition of ROM bit Bs is low. Thus, the inputs on conductors 396 and 397 are connected to bit conductors *within the* common instruction word bus to which the condition of ROM bits B10 and B11 are applied and both of these inputs will go high, as indicated by the not conditior. illustrated only when the condition of ROM bits B11 and Bio are low. In simoar manner, conductor 398 is connected to the bit conductor within the common instruction word cable to which ROM bit B9 is applied and hence this input to AND ;,itc 372 will go high only when the condition of ROM bit 89 is high. The last input to *the AND* gate 372 is convected through conductor 399 and at inverter 400 to a terminal annotated Bs and it will be appreciated by those of ordinary skill in the art that this terminal connects to a conductor within the common instruction word employed to convey the condition of ROM bit 115. Therefore, due to action of the inverter 400, line 339 which serves as an input to AND gate 372 will go high only for instructions wherein ROM bit Be is low. Thus; it will be seen that the output of AND gate 372 goes high only during clock subphase CL3 of control fume-tion instructions designated for the printer where ROM bit Bs is in a 0 condition and hence a high output from AND gate 372 may serve as a predicate or enabling level for the development of each of the control levels provided by the command strobe section 370 which are solely as a function of instructions defining printer control functions. The output of AND gate 372 is connected through conductor 401 to an enabling input to each of the AND gates 371. and 374 - 476 while it is additionally applied through conductor 394 as an enabling input to the AND pie 373. The AND gate 373, it will be recalled, provides an enabling level for the four bit latch means 366 for printer cur nand control function instructions having ROM bit Be in a One (I) conditior. Thus, the input thereto on conductor 393 decodes the nigh condition of ROM bit B_4 while the input thereto on conductor 394 is effectively an appropriately timed decode of a printer command control function instruction.

The AND gate 371 acts to define character strobe commands as a function of instructions issued to the printer on the common instruction word bus 20. The AND gate 371 acts in the conventional manner of a two input AND gate to provide a high level output or character strobe only when both of the inputs thereto are high. As shall now be apparent to those or ordinary skill in the art, a character strobe is developed from a printer command control function instruction which has ROM bit Bo in a high condition. Therefore. the condition of ROM bit Bo is applied to AND gate 371 through con-doctor 402 while the overall nature of the printer command control instruction is defined by the output of AND gate 372. Whenever an appropriately timed high output is provided by the AND gate 371, this output, as indicated, is applied through the multiconductor cable 24 to the printer unit illustrated in FIG. 6 and causes a twelve (12) bit character to be accepted thereby on data lines DLo - DLii and processed in a manner appropriate to achieve a print function.

Similarly, AND gate 374 acts to decode instructions including a carnage strobe control level which, as shall be apparent to those of ordinary skill in the art, comprise printer control function instructions having ROM bit II_1 in a One (1) condition. Thus, whenever these conditions are present, as indicated on conductors 401 and 403, the output of AND gate 374 will go high for the clock subphase interval CL3 to thereby produce a carriage strobe output on the appropriately annotated output conductor. This output, will be applied through the multiconductor cable 24 to the printer unit illus-trated in FIG. 6 and cause the same to accept twelve bit data contained on data lines DLO- D1.1 and process the same as a carriage displacement function. In a like man ; ner, the AND gate 375 acts to decode printer command control functions which include a paper feed command. These instructions, as shall be apparent, are printer control functions wherein ROM bit 133 is in a One (1) condition. Therefore, the condition of ROM bit B2 is applied to AND gate 375 through conductor 404 while the printer command control function instruction is decoded generally by the AND gate 372 and applied as an input to the AND gate 375 ttaough conductor 401. Accordingly, when such a paper feed strobe control level is decoded by the AND pie 375, a high level for paper feed strobe will be produced at the output of AND gate 375 and applied through the multiconductor cable 24 to the printer unit where it causes twelve bit data present on data lines DLe - DLit to be accepted and processed as paper feed or paper indexing informs-lion. in like manner, the AND gate 376 acts to decode restore printer instructions and to provide an appropriate strobe level tp the printer unit illustrated kti FIG. 6 whenever such instructions are decoded. Thus h1 dons as shall be apparent, are printer control function instructions wherein ROM bit B3 is in a high condition. ▪refore, the condition of ROM bit B3 is applied as input to the AND gate 376 ihrough a conductor 405 ..file an app. opriately timed antra function decode is applied thereto through conductor 401. When both conditions obtain, the AND gate 376 will apply an enabling or strobe level to the printer unit illustrated in *FIG. 6* through the multiconductor cable 24 to cause the printer unit to automatically initiate a restore function as described above.

The remaining output provided by the command strobe section 370 as indicated on conductor 406 is the ribbon action fiington. As was described in conjunction with *FIG.* 6, the ribbon action function provided at the printer unit is implemented, under program control, to drop the ribbon so that the operator's view of the print position is unimpeded any time the receipt of information to be printed is terminated for a tiled interval which may typically comprise a half second or SOOms interval. Although this particular function may be implemented in a plurality of ways, it is here achieved through program control. More particularly, each time a print function has terminated, an instruction is read which causes a 500ms delay to be set within the prograrn time delay 16A as shown in FIG. 2 and each time new print information is generated, this delay is reset so that under conditions where character information is continuously being printed under operator or media control, the 500ms delay set at the prow ion time delay means 16A will be continuously reset and hence will not time out. However, should the operator stop for coffeer;ons or the flow of character information to be printed trt.trise terminate through editing procedures or the , the 500ms delay set at the program time delay indicated by the dashed block 16A in FIG. 2 will time out. Under these'editions, the timed out condition will be indicated to the microprocessor indicated by the dashed block 16 on the common status bus and will cause an instruction to be issued to the printer interface illustrated in FIG. 7 to drop the ribbon through the production of a ribbon action input for the printer unit. Conversely, any time character information is printed at the printer unit, one of the early steps in the escapement and character printing routine, as illustrated in conjunction with FIG. 17, is to cause the ribbon to be raised through a resetting of the ribbon action input produced at the printer interface. A ribbon action or ribbon down instruction takes the form of Hex 1309, while a ribbon up or Ribbon Action instruction takes the form of i Hex 1308 instruction on the common instruction word bus 20. As will be appreciated by those of ordinary skill in the art, the only difference between a Hex 1308, and a Hex 1309 instruction is that is the latter rue ROM bit Bo is in a One (I) condition while in Lie former case it is in a Zero (0) condition. Furthermore, although each of these instructions will contain a module as printer address, ROM bit Bs will be in a One (1) condition and ROM bit B3 will also be high. Thus, the condition of ROM bit Bs will distinguish these commands from the strobe levels otherwise produced by the command strobe section 370. The presence of a Hex 1308 or 1309 instruction is decoded within the command strobe sec- '-n 370 by the action of AND gate 377 while the condi- ' of ROM bit Bo is relied upon during an apprcpri- Ay timed interval when this command is present to either establish or remove the ribbon action level produced on conductor 406. More particularly, the AND gate 377 comprises a three (3) input AND gate which acts in the well known manner to produce a high or enabling level at the output thereof connected to conductor 407 only when each of the three inputs thereto are high. A first mput to AND gate 377 is applied through conductor 408 from a terminal annotated PRT • 2CL. This input is the was as that applied to conductor 395 of AND gate 372 and *hence* it will be appreciated that this input goes high during clock subphase CL3 when an instruction having a module One address has been issued on the common instruction word bus 20. Similarly, second and third inputs to the AND gate 377 are provided through conductors 409 and 410 to the terminals annorsted 138 and 83, respectively, so that these inputs to the AND gate 377 will go high only in the presence of instructions having RUM bits S_s and B3 in a One (1) condition. Accordingly, the output of AND gate 377 will go high to produce a high level on conductor 407 whenever either a Hex 1308 (ribbon up) or a Hex 1309 (ribbon down) command has been issued on the corm, in instruction word bus 20. The output of the AND gate 377 is connected through conductor 407 to the Enable input of the one bit latch means 378. The one bit latch means 378 may take any conventional form of this well known class of device which acts in well known manner to latch an input only in the presence of an enable level and apply that input to the output thereof until a new input has been loaded there& Tycatty, the one bit latch means 378 may be formed by a R, 3 flip flop and the single data input thereto is applied through a conductor 411 from a terminal annotated So. Thus, the one %I) tut latch means 378 will only be enabled in the presence of a high at the output of AND gate 377 which will occur during the presence of a Hex 1308 or 1309 instruction while the Ito input applied to the one bit latch means 378 on conductor 411 will be high or low depending upon whether a 1309 or 1.108 Hex instruction, respectively, is present. Accordingly, when a Hex 1309 instruction is received, the one bit latch means will be set to a One condition whereupon a One output level wil be aplied to the output thereof connected to conductor 406 to prcvluce a ribbon action level which will cause the printer unit, which receives this command strobe through the multiconductor cable 24, to drop the ribbon so that the print position is not obscured and this One level will reside on conductor 406 until such time as the One (1) bit latch 378 is reset by the issuance of a 1308 instruction in Hex. Conversely, when a 1308 Hex instruction is issued, the _Zero (0) present on input conductor 411 will be loaded into the one (I) bit latch to cause a Zero (0) level to be applied to conductor 406 whereupon the printer unit will respond to the Ribbon Action indication to place the ribbon in an up or print position and such condition will persist until a One (1) is subsequently set into the One (1) bit latch means 378. Accordingly, it will be seen that the command strobe section 370 produces each of the five strobe inputs for the printer unit illustrated in FIG. 6 so that the same may accept and appropriately process displacement data and the like present on data lines DLo - DLI 1, initiate a ribbon action function to clear the print position, or implement a restore the printer hnction in response to the output of AND gate 376.

The status section 380 of the printer interface depicted in FIG. 7 acts to respond to the various status conditions generated at the winter unit illustrate gat FIG. 6 and other status conditions which are here convenient to monitor to apprise the microprocessor indicated by the dashed block 16 as to the status of various aspects of the printer unit or the other conditions monitored so that the same may cause new instructions to be blued thereto tithed in abeyance until the appropriate Status conditiorWlitesent to indicate that the printer 'trait or the like fit a condition to receive and process new instructions. This ftinction of the status section 380 is achieved through the operation of the multiplexer means 381 - 383 which act, on a command basis, to gate a selected one ors plurality of status conditions onto *the* common status bus 21 so that the same may be sampled at the ROM address register means Ill, as aforesaid, to cause appropriate branch operations to occur. More particularly, each of the multiplexer means 381 - 383 may take the conventional form of eight (8) input single output multiplexer means which act in the presence of a strobe input to apply a selected one of the inputs thereto to the single output thereof. In each case, the desired input which is applie4 to the single output of each multiplexer device in the presence of a strobe pulse is definer' by the select inputs to each multiplexer device annotated as terminals A, B and C. Typically, each of the three multiplexer means 381 - 383 illustrated in FIG. 7 may comprise an eight input multiplxer device such as a 74151 MSI multiplexer chip conventionally available from The Texas Instrument Corporation. Each device. has eight data inputs annotated 0 - 7, three select inputs annotated A, B and C, and a strobe input which has been annotated accordingly so that the *device* performs in the well known manner to gate one of the eight inputs thereto 0 - 7, to the output thereof, when the input is defined by the select inputs A - C thereof and a strobe pulse is applied to the multiplexer. Each of the three multiplexer devices illustrated in FIG. 7 has different inputs so that a total of 24 status conditions, to be described below, may be selectively gated onto the common status bus 21. *The* three multiplexer means 381 - 383 are organized in such manner that the select inputs thereto annotated A, B and C are commonly connected through conductors 412 - 414 to terminals annotated 04 - 05 so that for each instruction cycle, a common input 0 - 7 for each multiplexer device 381 - 383 will be selected; however, the strobe inputs to each of the multiplxer means 381- 383 are decoded in such manner that only a selected one of the multiplexer means 381 - 383 will be enabled in a printer branch instruction having ROM bits 85 - 87 in a condition to define the se!xted multiplexer means having the status input condition which is desired to be gated onto the common status bus 21. Thus, as shall be seen more clearly below, a strobe input to one of the multiplexer means 381 - 383 is only available in a printer instruction having ROM bit Bs in a Zero (0) condition while a selected one of the multiplexer means 381 _ 383 will be strobed in accordance with the condition of ROM bits 85 and 87. Thus, when ROM bits B5 and B7 are both high, multiplexer means 383 will be strobed, when ROM bit B, it low, and ROM bit 87 is high, multiplexer means 381 will be strobed and when ROM bit 85 is high and ROM bit B7 is low, multiplexer means 382 will be strobed. Accordingly, of the three multiplexer means 381 - 383 illustrated within the status section 380, a desired input to a given one of the multiplexer means is selected through selection inputs which are commonly supplied to each of the multiplexer means 381 - 383 while a desired multiplexer means having the selected input thereto is defined through the selective strobing thereof and it will be appreciated by those of ordinary skill in the an that this technique readily admits of the addition of more multipeter means should additional sampling at this interface be desired.

The multiplexer means 381 receives the majority of status outputs provided by the printer unit illustrated in *FIG.* 6. Thus, an end of ribbon status indication as plainly indicated in FIG. 7 is provided to the Zero (0) input thereof, a paper feed ready status input is provided at input 4 thereof, the carriage ready input is provided at input 5 thereof, a character ready input is provided at input 6 thereof and a printer ready input is provided at input 7 thereof. t.ach of these status inputs from the printt r unit was described in conjunction with FIG. 6 and it will be appreciated by those of ordinary skill in the art that when one of these inputs is selected by the select inputs to status multiplexer means 381 and a strobe input is supplied thereto this input will be gated oi.to the output of the status multiplexer means 381 connected to conductor 415 and subsequently through an OR gate 416 to the common status bus as generally indicated in FIC. 7. The OR gate 416, it will be appreciated, is conventional and hence *acts* in *the* well known manner to go high when any of the inputs thereto are high. Accordingly, as Zero (0) inputs are obtained from non-selected status multiplexers, the One (1) or Zero (0) condition of the selected status condition at a strobed status multiplexer, as applied to the input of the OR gate 416, will be reflected at the outpurthereof and applied to the common status bus 21 as indicated generally in FIG. 7. An additional input annotated Memory Equals Zero is applied through a conductor 417 to input 3 of the printer status multiplexer means 381. This input, as shall be seen in greater detail in conjunction with FIG. 11, is employed to sample the condition of storage locations within the random *access* memory 34 to ascertain whether or not a location is present wherein no information is stored. Additionally, this input is also applied through conductor 418 to data input 7 of multiple..er means 383 whereat it takes on a different connotation due to the condition of the select bits employed therefor. Thus, this similar input, as shall become more apparent in conjunction with FIG. U takes on the connotation of memory address equal to zero (0) when applied to the seventh input of multiplexer means 383 due to the effect of the changed conditon of ROM bit B4 in the selection input of the instruction which also has a differing gating effect in the random access memory illustrated in FIG. 11. The different nature of the input may be quickly seen by en inspection of the operand list attached hereto as Appendix C and more particularly, a comparison of the operands M AZ asC and MEZ NBC set forth in the list of printer branch instructions. When these instructions are inspected it will be noted that ROM bit 85 is a One (1) or a memory address equal to zero (0) instruction, while it is in a Zero (0) condition for a memory data equals zero instruction and hence these instructions not only cause the address or data to be read from the ROM but the appropriate input to be selected at different ones of the multiplexer means 381 and 383. Inputs 1 and 2 to the multiplexer means WI are not illustrated as employed in FIG. 7; however, it will be appreciated by those of ordinary skill in the art that these inputs are available for additional status functions such as a printer check status indication or a printer out of paper status indication, as described above, should it be desired to employ such status indications at the plater.

The select lapels to the status multiplexer means 381 are connected through conductors 412 - 414 to termiisle annotated 86 .• 86 and it will be appreciated by **me of ordinary skill lo the art that these inputs are led to conductors within the common instruc- n=c rd bus 20 which convey bit information associ- 2 Sid with ROM bits Bs- 8◆ The varying One and Zero .:toles of these three bits are sufficient to select any one nip to eight of the inputs of the printer status multi- *ler for gating to the output thereof connected to conductor 415 in the presence of a strobe input. The strobe input to the multiplexer means 381 is connected through conductor 419 to the tput of NAND gate 420. The NAND gate 420 ny.) comprise any of the conventional forms of this well known class of logic device which acts to provide a low or strobing level for the multiplexer means 381 whenever all of the inputs thereto are high. The lower two inputs to the NAND gate 420 are connected to the terminals annotated 87 and Ig so that these two inputs will go high for instructions wherein bit BI is a Zero (0) and ROM bit B7 is equal to a.One (I). The remaining input to NAND gate 420 is connected through conductor 421 to the output of AND gate 423 which acts in the conventional manner to provide a high level output only when both of the inputs thereto are high. A tint input to AND gate 423 is connected to a terminal annotated PRT which is a decode of the modular one (1) printer address, as described below, while the second input thereto is connected to a terminal annotated K. Accordingly, the output of AND gate 423 goes high whenever the printer is addressed in an instruction with ROM bit B s in a low condition and hence a strobe or low level output will be applied to the printer status multiplexer means 381 on conductor 419 whenever such an instruction is present and additionally, such instruction has ROM bits 86 and B7 in a 0. 1 condition respectively. Thus, the AND gate 423 acts to decode instructions having a modular one printer address and ROM bit Bs in a Zero (0) condition which serves as a predicate for enabling one of the printer status multiplexer means 381 - 383 while NAND gate 420, when properly enabled by the output of AND gate 423, acts to further decode the condition of ROM bits Bp and 87 to ascertain whether the status multiplexer 381 is to be enabled.

The output of AND gate 423 is applied through conductors 424 and 425 to the inputs of NAND gates 426 and 427 which perform a corresponding role to the NAND gate 420 for their multiplexer means 383 and 382 respectivey. Thus. in a manner well known to those of ordinary skill in the an, the NAND gate 426 will apply a low or enabling level to the status multiplexer means 383 whenevzr the output of AND gate 423 goes bgh in instructions having ROM bits 39 and B7 in a 1, 1 condition while the NAND gate 427 will provide a low et -strobe input to the multiplier means V: when the :input of AND gate 423 goes high in ••••• ..sctions having ROM bits Nand B7 in a 1.0 condition r.

Accordingly, it will be appreciated that the selected *robing of one of the multiplier means 381 - 383 is Sehieved by the selective decoding of ROM bits Bs and min instructions defining a module One printer address ere ROM bit Bs is in a Zero (0) condition and with ills technique an additional eight bit multiplexer means **Id be readily added should this be desired.

-The multiplex-.r means 383 is illustrated in FIG. 7 as av in g only a status inp; : supplied through con ctor 418 to input 7 thereof. This input. as was dearibed above. reflects • ROM memory address equal to 43 condition and hence in the presence of a strobe pulse when this input is selected, the One or Zero condition of this status input will be selectively gated through conductor 428 to another input of OR gate 416. Although only a single input to the multiplier means 383 has been S illustrated in FIG. 7, it will be appreciated that the remaining inputs to this multiplexer means are available for diagnostic test status conditions or, for the status condition of a language translator peripheral is disclosed in U.S. Ser. No. S/10114)13 as filed on equal date herewith.

The status multiplexer 382 has its select inputs commonly connected to conductors 412 - 414, its strobe input connected to the output of NAND gate 427. as aforesaid, while each of the eight data inputs thereto are connected through conductors 431 - 437 to individual ones of the bit conductors within multiconductors data ca ile 31 and hence to the individual data bit conductors within the common data bus 19. This means, that "trough the appropriate manipulation of select inputs 13 and C, the condition of any bit currently on the common data bus may be sampled and output by the status multiplexer means 3P2 to the common status bus 21 for testing, through the exclusive OR operation conducted at the ROM address register means 111 for branch operations. Typically, such testing may be employed to ascertain whether or not chtracter information presently on the common data bus is underscored as indicated by a One (1) in bit position DB,, or similarly, testing of this type might be employed in the classification of information presently on the common data bus. The output of the status multiplexer means 382 is connected through conductor 438 to an output of the OR gate 416. Thus, when the status multiplexer 382 has been strobed to the exclusion of the status multiplexers 331 and 343, whenever bit position on the common data bus is selected through the conditon of ROM bits B4 - Bb will be applied through the OR gate as6 to the common status bus 21 it being noted that since the multiplexer means 381 and 3113 apply O's indicative of their disab:ed conditon to the OR gate 461, the I or 0 output condition of OR gate 416 will be appropriately reflective of the output condition a the status multiplexer means 382. Furthermore, as the multiconductor data cable 31 is directly connected to the common data bus 19 as illustrated in FIG. 2, the sampling of individual bit conductors therein through the operation of the status multiplexer means 382 is available regardless of whether or not the printer unit illustrated in FIG. 6 is presently operational.

Accordingly, it will be appreciated by those of_ordinary skill in the art that the printer interface illustrated in FIG. 7 acts to render the printer unit depicted in FIG. 6 an independent peripheral while appropriately interfacing the same with the automatic writing system as a whole. With respect to data directed to the printer unit, the printer interface accepts data from the common data bus in two passes and assembles the san• into twelve bit character information for application to the printer unit on data lines D1.0 - DLit. In addition, through a decoding and properly timing of instructions issued on the common instruction word bus, various operational commands are issued to the printer in a format in which they may be directly received thcreby to cause the printer unit illustrated in FIG. 6 to appropriately process data according to a character format, a carriage displacement-format, or paper indekinAformat, while restore printer functions and ribbon Wide functions are additionally ccntrolled. Finally, the printer interface illustrated in FIG. 7 acts to accept status information generated by the printer and to apply the same OR 8 command basis 10 the common status bus so that the same may be tested within the condition, as defined by ROM bit 810, specified within branch instructions and in addition thereth various other status conditions are conveniently monitored at the printer interface. Such status conditions as have here been noted, include the monitoring of the various states of individual bit conductors within the common data bus 19, as well as the memory and address conditions associated with the random access memory 34. Furthermore, it will be noted that additional status monitoring conditions may be accepted at the printer interface and, as will be readily appreciated by those of ordinary skill in the art, even though certain status conditions are shown as being monitored at the printer interface, the same could be conveniently monitored at other locations wherever open multiplexer inputs were available or additional multiplexer units could be conveniently accommodated.

THE PRINTER DATA ROM

The printer data ROM peripheral indicatec'. by the dashed block 14 in FIG. 2 acts in response to eight (8) bit information present on the common data bus to supply, when appropriate, twelve (12) bit print information to the printer unit so that the same may be gated onto data lines DL.0 - DL, t for actuating, in response to character strobe information, the appropriate printer function. The data supplied through the common data bus 19 to the printer data ROM peripheral indicated by the dashed block 14 may originate from the keyboard or an active record media and is supplied to the printer data ROM peripheral indicated by the dashed block 14 from the main register M through the common data bus 19 for translation into the twelve (12) bit format necesnary for printer functions. The twelve (12) bits of appropriate data read from the printer data ROM peripheral indicated by the dashed block 14 are read onto the common data bus 19 and loaded into the main register M in the form of two eight (8) bit passes and as each eight (8) bit character is received, the same is stored within appropriate character locations within the gem• eral purpose registers 83 until both eight (8) bit passes have been completed and th.: microprocessor indicated by the dashed block 16 is ready to cause the translation of the appropriate twelve (12) bits of data to the printer unit in two eight bit passes as afori...aid. Thereafter, the sixteen (16) bits of data read from the printer data ROM peripheral indicated by the dashed block 14 are rearranged, as necessary, and loaded into the main register M whereupon they are subsequently gated through the common data bus 19 to the printer unit whereat the twelve (12) bits of data forwarded to the printer interface 27 into eight (I) bit passes are assembled into the appropriate twelve (12) bit format, as described above, Ind applied through data lines D1.0 - DLtt to the printer unit to implement the printer function thereof in the presence of a character strobe. Of the twelve bits of print information fat ••srded to the printer unit through the operation of the printer data ROM peripheral indicited by the dashed block 14, the seven bit word conmined on data lines DI..13- DL4 defines the character to be printed, the three bit word on data lines DLL - DLL defines the width through which the ribbon is to be displaced during the print function while the two (2) bit data word contained on data lines DLitt and DLI I defines the hammer impact with which printing is to be implemented. It also should be noted that as certain embodiments of the instant invention may be utilized in conjunction with a language translator peripheral wherein position codes from various foreign language format keyboards may be employed, appropriate outputs from such language translator peripheral may be employed as an input to the printer data ROM peripheral indicated by the dashed block 14 so that an appro. priate format print instruction will be issued to the printer unit regardless of the language format employed at the keyboard. The nature of the language translator peripheral, together with its incorporation within the instant invention, will however best be appreciated, upon reading of British provisional specification Ser. No. 31701/75 filed on July 29, 1975 and commonly assigned. Here, however, it is sufficient to appreciate that translated data originating from a record media or the keyboard is further translated by the printer data ROM peripheral indicated by the dashed block 14 into the appropriate format for assembly by the printer interface 27 into twelve bit information for application to data lines DLo - DL I a and that such twelve bits of information are read from the printer data ROM peripheral) in two eight bit passes, rearranged as necessary by the microprocessor indicated by the dashed block 16 and subsequently gated back onto the common data bus, in two eight (8) bit passes, for assembling into a twelve bit format by the printer interface 27 and subsequent application to the printer unit.

Referring now to FIG. 8, there is schematically illustraced, an exemplary printer data storage peripheral suitable for use in the embodiment of the invention illustrated in FIGS. 1 and 2. More particularly, as shown in FIG. g, the printer data ROM peripheral comprises address latch means 440, printer data ROM means 441, and gate array means 442. The function of the address latch means 440 is to accept data from the common data bus and to maintain the same in storage therein for the purposes of addressing the printer data ROM means 441 until such time as the microprocessor is ready to receive the addressed eight hit output of the - printer data ROM as initiated by the selective enabling of the gate array means 442. Accordingly, .e address latch means 440 may take the conventional form of an eight bit latch which acts in the well known manner to load inputs supplied to the inputs thereof annotated Di - D4 and DI. - D4. in the presence of a clock pulse and supply such inputs as loaded therein to the outputs thereof as indicated by Qi and Qt. - until new information is loaded therein. The address latch means 440 may take any conventional format but may be conveniently formed by a pair of Model 7475 four bit latches conventionally available from the Texas Instrumeat Corporation whose clock inputs are commonly connected and whose D and Q outputs are cOnnected* the manner illustrated in FIG. $ wherein the primed inputs and outputs. would correspond to the outputs of one four bit latch

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TABLE I

M31/L SE / Ilea	0	1	2	3	a	7	a	•	411	11	CD111
0	FP IS	1111	DBAI	a	3	PC	s	M	DI	s	IS 13 32	R
1	FS IS			a	2	CS	u	M	BE	s	17 14 M	r
2	AP 33	SF	AD	n	3	11C	U	C	BE	i	At K. 33	y
3	FD A2	34	AC	n	1	C2	c	O	11D	a	OA 10 31	s
4	33 BS	-1	AI	e	4	C4	y	u		s	81 57 49	1
3	FP A2	31	A1	B	n		n	t	4E	s	83 43 49	1
6	FP 115	13	AS	s	4	33	9	P	9A	t	83 SA 32	1
7	FP At	61	A7	i	r	IF	9	4	9F	s	Sr 3D	1
11	IS FI	114	AS	g	g	C3	0	U	OA	8	09 38 54	1
9	AP A3	IM	AS	R	6	DI	4	n	9A	1	IS Sr	e
A	PD SD	FI	EI	a	3	CP	8	t	IA	3	II 38 43	r
I	A3 D7	PS	ES	g	f	BB	s	4	3E	9	IA 30 52	a
C	FD A4	92	W	s	R	DS	1	4	9E	2	811 37 IV	s
D	FD FII	3D	F7		e	30	1	4	99	*	SD $6 39	u
E	24 A2	10	09			C7	8		33	*	SE 59 39	x
E	PD A4	61	IF			CS			•1	8	5$ 54 SO	

TA 10 .E II

	0	1	2	3	4	3	•		a		4.
		space	•		r		p				iT
			1	A	Q	•	q				
		"	3	B	a	b	r				•
3			3	C	S	c	s				
		Pk,	4	D	T	d	t				
						•					
		• bac pace		r							
7											
				H	X						
9						7					
A			:								
				•	r •		e				
		•		1.	•4 C						
D		•	•	M	4	111					
		• • I..r				a	. fft				
				•0	i I	a	to 13.1				

while the unprimed inputs and outputs would cone-@pond to the inputs and outputs of the second latch. As was briefly mentioned shove, seven bits of information are sufficient to represent all of the printable alphameric information employed within the instant invention while all eight bits of information conveyed through the common data bus 19 are required to inpreeent the alphameric, control, and function information conveyed within the instant invention mid the code assignments employed are web that all alphameric character representations in a non•delineated format have a 0 in the most eipificant bit of the eight (1) bit code assigned thereto so that when the same is delineated. the delissated nature thereof may be simply and readily indicated by the insertion of a One in a bit location ado& mod with the data bit 7. Therefore, it will be appreciated by those of ordinary skill in the AM that the alphamark character being conveyed on the bus may be appropriately represented by the condition of data bits DB0 - DB6 while the condition of data bit DB7 is representative ofth or ondelinested state of *character belitiramelated. - ' • •

For this reason, the Vint seven (7) inputs connected to the address latch means 440 through conductors 443 - 449 are connected directly through the multiconductor data =Me 46 to corresponding conductors within the common data bus 19 employed for translating the condition of data bits DB0- D13 6 as it is these bits which are of paramount significance with regard to the identity of alphameric characters. Thus it will *be* appreciated by those of ordinary skill in the art that the inputs associated with data bits DB 0 - DB6 as applied to input conductors 443 - 449 of the address latch means 440 are sufficient in and of themselve_ to designate all alphameric characters which are to be printed and hence if only an eight (8) bit code were employed to define character information to the printer, this seven (7) bit input w. •dd be sufficient to provide an appropriate addres..nerefor. However, as was seen above, twelve bits of information are required to drive the printer unit and this is formed, as shall be seen below, from two eight bit data words read from the printer data ROM means 441 onto the common data bus and accordingly, two addresses for each character to be printed must be supplied to the address latch means 440 for a multiple addressing of the printer data ROM means 441 for each alphameric character to be printed.

Under these circumstances two eight bit addresses are supplied to the address latch means 440 for each alphameric character to be printed wherein each eight (8) bit address has data bits DB0 - DB 6 in a common state while the address supplied to input D'4 of the address latch means 440 is forced to a Zero (0) condition to achieve an addressing of the low order eight (8) bits while the same is forced to the One state to achieve reading of a sec•¯ad 't ht (8) hit word, four (4) bits of which will be • .v.c' tl to form the high order four (4) bits conveye to the printer. For this reason, the input D'4 of the aJdress latch means 440 is connected through 450 to the output of an AND gate 451. The AND gate 451 may take any conventional rem of this well known class of logic *device* and hence *r.cts* to. provide a high level output on conductor 450 only when both of the inputs thereto are high. A first input to AND gate 451 is connected to a terminal annotated B4 which, as shall now be appreciated by those of ordinary skill in the art, is connected through the multiconductor cable 48 to the bit conductor within the common instruction word bus 20 which receives the condition of ROM bit B4 during each instruction cycle. The condition of ROM bit B4 daring instructions to the printer data ROM illustrated in FIG. & as shall be seen below, acts to control whether or not high or low addressing bits are loaded into the address latch means 440 during a Oven instruction cycle for those instructions wherein addressing is appropriate. More particularly, reference to the Operand List attached hereto as Appendix C will readily reveal that only four instructions, as listed within the grouping of keyboard control instructions, are directed to the. printer data ROM and bear *the* notations MisXL,.XLs- '.4,-XL=ML and XL= MH wherein the last two instructions described are directed to loading low order and high order addresses into the address latch means 440. Furthermore, a comparison of the bit contr.. t of each of these twn instructions. ie.. XL= MI. and XL= MH will reveal that the only difference is that ROM bit B4 resides in a Zero (0) condition for addressing the low order translator bits while the same resides in a One (I) condition for an addressing of the high order translator bits. Thus, it will be seen that whenever an instruction is issued for Baring the Contents of the main register M into the address latch means 440, the tint seven (7) bits contained on bit conductor* DB0 DB6 will be applied to the address means 440 on conductors 443 - 449 while the state of ROM bit 84 as applied to one in in of AND gate 541 will be low when it is desired to address low order bits and high when it is desired to address the high order bits. The terminal annotated B4 is additional")' connected through conductor 452 to one input of an OR gate 453.

The second input to AN:. gate 451 is connected though conductor 434 to the output of an OR gate 455. The OR gate 455 may take any conventional form of this viL ' known class of logic *device* and hence acts to provide a high or enabling output whenever either of the inputs thereto are high while providing a low or disabling output only under such conditions where both of the inputs thereto are low. A first input to the OR gate 455 is connected to a terminal annotated Bs which, as will be appreciated by those of ordinary skill in the art, receives the bit condition of ROM bit Bs on the common instruction word bus 20 during eack instruction cycle. Furthermore, reference to Appendix C will also indicate that for both of the instructions XL= ML and XL = MH, the condition of ROM bit Bs is high so that during the addressing of the printer data ROM indicated in FIG. II, AND gate 451 will be enabled by • high level on conductor 454 due to the condition of ROM bit Bs and hence whether or not the high or low order bits for a print command are addressed will turn on the condition of ROM bit *B4.* It should also be noted that ROM bit Bs is in a Zero (0) condition for both the M = XL and XL = M instructions listed. The terminal annotated Bs is also connected through conductor 456 to an input of the OR gate 453. A second input to OR gate 455 is connected to the termilisl annotated DB7 and it will be appreciated by those of ordinary skill in the art that this terminal receives the condition of data bit DB7 each time eight (8) bits of data are gated from the main register M onto the common data bus 19. This input, will enable the application of an address to the address latch means 440 which effectively reflects all eight (8) bits on the common data bus when an XL= M instruction is issued; however, such instructions, though available are not presently emplo, . 1 within the instant invention. Accordingly, it will be appreciated by thos ē of ordinary skill in the art that addresses applied to the address register means 440 for the purposes of reading either high or low order data for the formation of print information essentially comprise d-ta bits DB0- DB• as output from the main register M while the condition of data bit Dai is essentially masked by the condition of ROM bit Bs and the action of OR gate 455 so that whether or not high or low order bits are addressed will turn on the condition of ROM bit B4. Tbus, whenever an XL=ML or XL=MH instruction is issued, the address applied to the address latch means 440 will be formed by the alphameric character defined by data bits DB0 - DB6 and first and second addresses_are formed through the manipulation of the condition on condaciflit 450 which effectively reflects the condition of ROM bit B4 during instructions where ROM bit Bs is high.

The clock input to the address latch means 440 is connected through conductor 457 to the output of

AND gate 45$. The AND gate 4.38 may take the same conventional foretell es AND pie 431 sad hence acts to pro,....... output thereof only when both inputs thereto • A lint input to AND pee 4$11 is ***acted . conductor 459 to the output of OR gate 453. The gate 453 may take the same form as OR gate 455 and hence acts to provide a high or enabling output when either of the inputs thereto are high while providing a low level output whenever both of the inputs thereto are low. Accordingly, as one input to OR gate 433 is connected through conductor 432 to the terminal annotated 84 while the second input eareto is connected through conductor 456 to the ter-Initial annotated By it will be appreciated by those of ordinary skill in the art that the AND gate 458 will be enabled for clocking the address latch means 440 for all instructions containing ROM bit B4 or By in a One (I) condition which involves all of the translator instructions associated with the printer data ROM illustrated in FIG. 8 except the instruction annotated M = XL in the Operand List which, as will be appreciated by those of ordinary skill in the art. does not involve the loading of an address in the address latch means 440 but instead is associated, as shall be seen below, with the reading of addressed data from the printer data ROM means 441 and a loading of the same into the main register M for subsequent application to the printer interface 27.

The second input to the AND gate 458 is connected through 460 to the output of an AND gate 461. The AND gate 461 may t. .e the same form as AND gate 468 and hence acts to provide a high level output whenever both of the inputs thereto are high while providing a low level output for all other sets of input conditions. The function of the AND gate 461 is to provide a gating or enabling level to AND gate 458 during predetermined clock intervals when the printer data ROM illustrated in FIG. 8 has been addressed. A first input to the AND gate 461 is connected through conductor 462 to the terminal annotated Clock while a second inp... thereto is connected through conductor 463 to an AND gate 464. The clock input to AND gate 461 determines the appropriate interval when the output thereof should go high while the input thereto from AND gate 464 is high only when instructions directed to the printer data ROM, illustrated in FIG. II, have been appropriately decoded. More particularly, the clock input connected to conductor 462 represents an ANDing of clock phases M. CB, and CC which, as shall be appreciated by those of ordinary skill in the art from the deicriptive matter set forth above provides a 500vis interval for gating data into the address latch means 440 when either ROM bits Bs or B4 are high during an instruction directed to the printer data RCS(as decoded by AND gate 464. The AND gate 464 is convent' lel and acts in the well known manner to produce a high level at the output thereof connecting to conductor 463 only when both of the inputs thereto are high. Accordingly, the output of AND gate 464 acts to enable AND gate 461 under conditions where in an instruction directed to the winter data ROM has been decoded so that the. output of AND gate 461 will go high during the appropriate Lime interval during the presence of such itlitillICti011. A lirst input to the AND gate 464 is connected to a tenni-isal annotated Basic P ROM Decode. This decode, although not shown in FIG. 1. represents au AND lag of ROM bits B11- B_t, B3, Bland Bounder such conditions wherein ROM bit Deis equal to a One (I) while the remaining bits listed are equal to a Zero (0) as will be seedily apparent upon a consideration of the translator iestructions listed in Appendix C. A second input to AND gate 464 is connected to a terminal annotated 113 and hence a high will be present oa this input for in-S where Bt is equal to a Zero (0). A decoding of the condition of ROM bit SI is here necessary because a will be seen hereinafter, both the program time delay and the printer data ROM have 411000tially the same decode except for the condition of ROM bit 331 and knee while the upper input to AND gate 464 acts to decode an instruction addressing either the printer data ROM shown FIG. 8 or the program time delay means, the condition of ROM bit 131 equal to 0 distinguishes therebetween and defines an instruction IS wherein the printer data ROM is being addressed. Accordingly, the input to AND gate 438 connected to conductor 460 will go high during an appropriate SOOns interval when the printer data ROM is addressed while the output of OR gate 433 will go high to fully condition AND gate 438 to clock the address register means 440 for all translator instructions except the M = XL instruction, as listed in Appendix C, which causes the printer data ROM to be loaded into the main register M.

The outputs of the address latch means *440 are* applied in parallel through conductors 465 - 472 to the inputs of the printer data ROM means 441 and hence due to the operation of the address !itch means 440. as described at 3Ve, it will be appreciated by those of ordinary skill in the art that once an eight (8) bit address is clocked into the address register means 440, the same will be applied to the outputs thereof connected to conductors 465 - 472 and will be maintained thereon until a new address has been loaded into the addres. register means 440. Thus, once the microprocessor indisated by the dashed block 16 has caused a given address to be loaded into the address register means 440, it may return at some later time to receive the eight (8) bit data word read from the printer data ROM means 441 in response thereto by simply enabling *the* gate array means 442. The printer data ROM means 441 may comprise a conventional read only memory having two hundred fifty six (256) storage location for eight (8) bit words. Although any conventional non-destructive read only memory may be employed, the printer data ROM means 441 may be conveniently formed by a pair of 1024 MSI ROM chips as conventionally available from Harris or INTEL semiconductor manufacturers. These chips are conventionally 256 bits long by four (4) • bits wide and hence a pair of such chips which are commonly addressed will readily provide the requisite 236 x8 storage locations. As well known to thosi of ordinary skill in the art, such printer data ROM means 441 acts in the conventioaai manner to apply the contents of an addressed storage location to the outputs thereof *connected* to conductors 473 - 480 so that the eight (4) bits stored in an addressed storage location are nondestructively read therefrom and applied in parallel to conductors 473 - 4110 until a new address has been loaded into the address latch means 440.

Ws stated above. twelve (12) bits of data are required for each print instructioc and data is stored within the printer data ROM means 441 in :•rek manner that an address for the low order bits read. data from the printer data ROM 441 which is ally associated wi addressed character while an address for high or reads an address location within the printer data ROM 441 which comprhes row bits of data associated with the addressed character while an address for high order bits reads an address location within the printer data ROM 441 width comprises four bits of data associated with the adilitessed character and four (4) bits of data which are emaciated with anotner character while the operation of the microprocesw.. is relied upon to separate the appropriate four (4) bit, within the eight high order bits read out and forward the same to the printer interface for assembly into twelve (12) bits of print information. This operation, may best be appreciated by way of example. Therefore, exemplary contents for the 256 eight (8) bit storage locations within the printer data ROM 440 are reproduced belriw in Table I, while exemplary addresses for printable characters are set forth in Table II. In both Table I and table II all data column and row notation is set forth in Hex code and the addresses specified are configured in such manner that the most significant bits are defined across the top of the table as column designations while the least signifh..-nt four (4) bits are defined along the ordinate as row notation. Looking first at Table 11, it will be appreciated that no addresses are present in Column II and hence the eight (8) bit code associated with each printable character listed therein effectively has a Zero (0) in the eighth (8) bit position associated with DB7. Thus, for instance, when the alphameric character w is inserted at the keyboard, the binary equivalent of Hex 77 is applied to the common data bus 19 while when the alphameric character 7 is introduced, the binary equivalent to Hex 37 is applied to the common data bus. These addresses, it will be appreciated by those of ordinary skill in the art, would be applied through conductors 443 - 447 to the address latch means 440 while the condition of input conductor 450 would be varied from Zero to Ore to obtain the low and high order bits, respectively; however, this does not effect the uniqueness of t:.e address defined as only a seven (7) bit bode is required for each address in each case. Data for the twelve (12) b' print information is then formed as follows:

The input address when conductor 450 resides at a Zero (0) level results in the loading of an address in the address latch means 440 which will access a location within the printer data ROM means 441 containing an eight (8) bit code associated with the lowest eight significant bits of the necessary print information. If the address loaded resides in columns 0 - 3 in Table II, the most significant part of the printer data word is obtained by incrementing the column designation by +8 while residing in the same row. This will be accomplished, as will be appreciated by those of ordinary skill in the art by changing the address bit on conductor 450 from a Zero (0) to a One (1) condition. The new address will access a new eight (8) bit storage location within the printer data- ROM means 441 whose most significant Hex bit represents the required data needed for the remaining four (4) bits in the twelve (12) bits of print information being formed. Conversely, if the seven (7) bit address loaded into the address latch means 440 when conductor 450 resides at a Zero is in columns 4 - 7 of Table 11, the most significant part of the printer dita word is obtained by incrementing the column address by +4 which is again achieved by changing the condition of conductor 450 to a One (1). When this is done, the least significant Hex bit in the newly addressed Incation within the printer data ROM stuns 441 constitutes the additional four (4) bits of required data necessary to form the twelve bit print information. Whether the addressed portion defined on data lines 447 - 449 falls within a Hex code or column address equal to - 3 or 4 - 7 is determined, under program control, by comparison operations conducted within the ALU and once the result thereof is determined, the microprocessor retains either the high or low odes four bits read' from the shifted address and appropriately positions them with respect to data lines DL0 - DL3 so that the twelve (12) bits of print infonnatinn may be formed at the printer interface 27. Thus, returning to a specific example, reference to Table Il will indicate that when a w is to be printed, the initial address therefor as obtained from Table 11 is 77 and such address, referring now to Table 1, will result in the eight (8) bit code CA being read from the printer data ROM means 441 as representative of the lower eight (8) bits of print information or the information specifying the spoke address data and the lower siinificant bit of the width data word. As this address defines in columns 4 - 7, an incrementation of the column address by four through the application of a One (1) through conductor 450 results in a new address in Table II equal to B7 and the least significant Hex bit in this location represents the required data. Therefore, the eight (8) bit code 9A will be read from the printer data ROM means 441 and the A portion thereof will be selected by the microprocessor indicated by the dashed block 16 so that twelve (12) bis,print information ACA will be formed at the printer interface 27 and forwarded to the printer unit. Conversely, for the character 7, the address for the low order bits, as obtained from Table II with conductor 450 at a Zero (0) level is 37 which causes the eight (8) bit code A7, as seen in Table I, io b. read from the printer data ROM means 441. As this address resides in column 0 - 3, an incrementing of the column address by eight, as accomplished by the application of a One (1) to conductor 430 will result in a new address equal to B7 and the eight (8) bit code stored in this location as seen in Table I is 9A. Therefore, as the low order address resulted from column 0 - 3. the rd. croprocessor indicated by the dashed block 16 will select the most significant Hex bit in this storage location as the molted four (4) bits of data and cause the twelve (12) bit print information 9A7 to be formed at the printer interface 27 for forwarding to the printer unit. Thus, in this manner, print codes applied to the common data bus in a seven (7) bit format are employed through manipulation of the eighth bit of the address associated therewith to derive two eight (8) bit codes and twelve (12) bits of print information for application to the printer unit.

The contents of each location within the printer data ROM means 441 as addressed on conductors 456 - 472 in the aforesaid manner are applied through conductors 473 - 480 to th• inputs of the gate array means 442. The gate array means 442 may take any conventional form of gating array which acts to apply the inputs thereof connected to conductors 473 - 480 to the outputs connected to terminals D110 - DB7 whenever the enable input connected to conductor 481 is high. Typically, the gate array means 442 may be formed by eight (8) AND gates in parallel wherein each AND gate has one input connected to an associated one of inputs 473 - 480 and its output connected to an associated one of terminals DBo - DB7 while the second input to all of such eight (8) AND gates are commonly connected to conductors -481 so as to be enabled thereby. The relationship between the address latch means 440, the printer t$6 ROM means 441 and the gate array means 442 essentially permit the microprocessor indicated by the dashed block 16 to load a given address into outon ad means 440 during one instruction cycle and subse- ay obtain the contents of the addressed location from the printer data ROM means 441 from the tc of the gate array means 442 during a subsequent tion cycle when the same is ready to receive such . As will be appreciated from Appendix C, the loading of the various addresses within the address latch steins 440 is accomplished through XL-ML and XL- MH instructions while the loading of the output of the printer data ROM through an enabling of gr.: array means 442 is accomplished through an rim XL instruction.

The enable input to the gate array means 442 is connected through conductors 481 and 482 to the output of an AND gate 483. Additionally, the conductor 442 is connected to a terminal annotated DB ta M which, u shall be appreciated by those of ordinary skill in the art connects to a main register M and acts as a gating signal so that the same may accept eight (8) bit data from the common data bus 19. This means, that whenever an M tm XL instruction has been issued, data will be gated onto the common data bus 19 from the gate array means 442 while a gating signal is applied from conductor 482 to the main register M so that the same may accept the eight (8) bits of data gated onto the common data bus 19. The AND gate 483 may Om the same form as AND gate 438 and hence acts to provide a high or enabling level at the output thereof connected to conductor 482 whenever both of the inputs thereto are high while providing a low or disabling output on conductor 482 for all other sets of input conditions. A first input to AND gate 413 is connected through conductor 484 to the output of AND gate 464. As it will be recalled that the AND gate 464 acts to decode the presence of instructions directed to the printer data ROM illustrated in FIG. 8, it will be appreciated that the input to AND gate 483 connected to conductor 484 goes high to provide an enabling level to this gate any time an instruction to the printer data ROM is issued and decoded and this level stays at a high or enabling level for the full duration of the instruction cycle. The second input to AND gate 483 is connected through conductor 485 and inventor 466 to the output of the OR gate 433. Since the inputs to OR gate 453 are connected to receive the condition of ROM bits Bs and B4 during each instruction, it will be appreciated by those of ordinary skill in the art that the output of OR gate 453 will go low to produce a high level at the output of investor 486 only when the condition o: both ROM bits Bs and 114 are low. However, as will be apparent from Appendix 6, this only occurs for an M si XL instruction when instructions are being issued to the printer data ROM illus- . Mated in FIG. 8 and hence the output of AND gate 483 41111:40 high to enable the main register M to accept -okIR (8) bit data from the common data bus and also Amble the gate array means 442 what a M XL in- inaction is decoded.

Aloe printer data ROM peripheral illustrated in FIG. -ir.iindered operative under microprocessor control ! ·alletiene a character gated onto the common data bus litailiiktilled as a printable chvacter and a mode of oper- Atli)! fbr the automatic writui$_s$ system according to the invention has been 'elected wherein a print out- 'operation at the printer unit is operative. The aipha- haracter information gated onto the common LAU lb 19 may have originated at the keyboard. a Alcoa media which is active in a play mode of opera- – debt Or in appropriate embodiments, at • language

translator peripheral disclosed in the aforesaid British Provisional Application.

Typically, once such data has been identified as printable data by the microprocessor, the printer data ROM is enabled to as in its role of providing print data for the microprocessor so that twelve bit print information may be assembled therein for subsequent forwarding *La* the printer interface 27 and the pri-ter unit. Typically, once printable alphameric character information has been identified by the microprocessor indicated by the dashed block 16, the printer data ROM illustrated in FIG. 11 will be addressed and print information retrieved in two passes will be assembled into twelve (12) bit print information for application to the printer interface 27. The first instruction issued by *the* read only memory 80 for accessing print information from the printer data ROM illustrated in FIG. 8 will normally tat, the form of an XL= M instruction where the DB7 level is imposed on conductor 450 for loading into the address latch means due to the condition of ROM bit B4 in the instruction while the condition of data bits DB0 - DB, are present in the main register M would be directly applied through the data bus for the remaining portion of the address initially supplied for the high order bits to the address latch *means* 440. This address is clocked into the address latch means 440 due to the action of AND gate 458 so that in response to the XL= MH instruction, an eight (8) bit address is latched into the address latch means 440 which is approriate to access the high order bits of i print instruction for the alphameric character presently loaded into the main register M. This address, as will be appreciated by those cf ordinary skill in the art, is directly applied to the printer data ROM means 441 through conductors 465 - 472 and in response thereto eight (8) bits of information will be read from the printer data ROM means 441 and applied to conductors 473 - 480. Once this address has been latched into the address latch means 440, the program may or may not require this information immediately. At any rate, when the data is required, an M XL instruction is issued. During this instruction cycle, the only thing that happens is that the information from the printer data ROM 441, as applied to conductors 473 - 480 is gated through the gate array means 442 and loaded into the main register M; it being noted that the gating level generated by AND gate 483 in response to an M mg XL instruction acts both to enable the gate array means 442 and to generate a DB to M level so that the output of the gate array means 442 as applied to the common data bus 19 may be accepted by the main register M. Subsequently, an XL se ML instruction will issue which causes a second eight (8) bit address to be loaded into the address latch means 440. In this case, the bit content asso..iated with input conductors 443 - 449 is the same as loaded for an XL nuMH instruction; however, the bit level on conductor 450 is now in a low condition due to the condition of ROM bit 84 and hence, the address loaded into the address latch means 440 is appropriate for accessing the low ors bits of print information for the alphameric character under consideration. This address is applied through conductors 465 - 472 to the printer data ROM 441 and will mule, as aforesaid, the eight (8) low order biti-dfprint information to be read therefrom and applied to conducton 473 - 480. Subsequently, an hl si XL instruction again issues to cause the eight (8) low order bits to be applied through the gate array means 442 to the common data bus 19 and loaded into the main register M o 0 0 0 due to the enable level DB to M generated on Conductor **M.** ***Accordingly.*** at this juncture, sixteen (16) bits of print infformation haf be read from the printer data ROM means *441* aniptuided into the main register M in two passes.

The four pertinent high order kits received and the low order eight (8) bits ***received*** by the microprocessor are appropriately ordered and gtored within the GI and Go register locations within the peneral purpose registers U. Additionally, the microprocessor acts, under program control, to ascertain the mode of printing employed and calculate the ribbon advance data which is to be forwarded in the ***twelve*** (12) hits of print information being assembled. For in...ance, if proportional spaced printing is taking place, the ribbon advance information read from the printer data ROM means 441 appropriately defines ribbon advance displacement; however, in ten pitch or twelve pitch modes of printing, constants read from the read only memory $0 appropriate for the uniform width of printing employed are substituted therefor in the twelve (12) bits of print information being assembled within the GI and Go register locations. Additionally, the character width thus calculated is also retained in storage for use in the formulation of a escapement command which precedes and that which is to follow the printing of an alphameric character. More particularly, it will be recalled that escapement within the instant invention takes the form of an escapement equal to one-half the width of both the preceding and succeeding character prior to the printing of information. Therefore, the width of the previous character printed is already stored and hence one-half this width plus one-half of the width of the new character to be printed, as currently identified in registers Go and GI is employed to assemble the escapement command. This command is then executed whereupon the carriage is displaced to the appropriate position for printing the character. Once registers GI and Gc, have been properly set up, the low order bits (0-3) stored in register GI are loaded into the high order data bit latches at the printer interface 27 and subsequently Go is loaded into M for application to the printer interface so that the whole twelve (12) bits of print information now assembled at the printer interface may be strobed to the printer unit. Thus it will be appreciated by those or ordinary skill in the art that the printer data ROM illustrated in FIG. $ is directly addressed by the alphameric character information defined on the common data bus and read through the manipulation of a high order bit to provide twelve bi•-. of print information. Once such print information is assembled, at the microprocessor, appropriate escapement commands are executed at the printer unit and thereafter the whole twelve bits of print information are assembled at printer interface for application to the printer unit. It may also be noted,, as aforesaid, that in cases where deferred escapement has operated, i.e. where a 100ms interval has elapsed, so that the microprocessor causes automatic escapement to operate whereby the printer unit resembles the operation of an ordinary typewriter to an operator, the forwarding of appropriate escapement information to ***the*** printer unit prior to the execution of a print command, would involve the subtraction of one-half the uniform escapement width assumed for purposes of deferred escapement plus the addition of une•half the width of new characters to be printed from the sum of one-half the width of the previous character printed plus onehalf the width of the standard escapement already executed at the printer unit under a deferred escapement approach. Titus, in proportionally spaced modes of printing where a narrow character is to be printed in the next command, and deferred escapement **has opened, escapement may electively ocecur to the appropriate character print position in a reverse direction.**

THE KEYBOARD CONFIGI.'" ♦T1ON

FIGS. 9A and 9B illustrate keyboard configurations suitable for use in conjunction with the instant invention ***and*** more particularly wit:iin the apparatus depicted in **FIG. 2 wherein FIG. 9A is** a keyboard configuration espeuially adapted for embndirette.s of this invention employing record media in the form of a tape or the like and FIG. 9B is a keyboard configuration more suitable for embodiments of this invention employing a magnetic card as the record media. The keyboard configurefit s:.own in FIGS. 9A and tOR may take the form of conventional electronic keyboards which include 44 or 4.6 standard character keys, the latter arrangement not being illustrated as this format is only preferred for embodiments of the instant invention which are to be employed outside the United States. In addition, each of the keyboard configurations include a plurality of added function keys, which as shall be seen below, are denominated Mode Keys, Action Keys arid Encoded Function Keys. As sucn, the keyboards illustrated in FIGS. 9A and 9B may take any of the well know forms of electronic keyboard arrangements conventionally available in the marketplace such as those manufactured by Honeywell Incorporated or Keytronics Corporation. Because the keyboard arrangements illustrated in FIGS. 9A and 9B are highly similar, and differ only in areas associated with the cariab.:.; y of the record media employed, common reference numerals will be relied upon to define keys performing equivalent functions in the FIG. 9A and 9B embodiments set forth to clearly • point out theit corresponding nature. Where however, a commonly placed key has a different function due to the record media, it will be differently referenced and described in specie in conjunction with the description o: the Figure in which it appears.

In essence, each of the standard character keys are capable of three functions; to wit, lower case, upper case and an encoded function. As each character is struck, the ***key*** provides the eight (8) bit modified ASCII code (U.S. ASCII) associated with a given character for transmission to the console and such eight bit modified ASCII code will ***be*** inputted in parallel format into the automatic writing system according to the present invention through the eight (8) bit data cable 23 **illustrated in FIG. 2. More particularly, the keyboard configurations illustrate' in 7'1GS. 9A and 9B comprise a standard keyboard is.aay indicated by the dashed block 490. a code key .11, a margin lever 492, a tab clear and set lever 493, a line space lever 494, a font pitch lever 495, a carriage position pointer 4%, a margin release key 497, forward and reverse paper index keys 495 and 499, a space** expand key SOO, mode control keys indicated by the dashed blocks **501 and 502, justify mode key 503, action keys indicated by the dashed blocks 5C4 and 505 and a pair of thumbwheels 506.**

THE STANDARD KEYBOARD ARRAY

The standard keyboard array indicated by theekslied block 490 includes the inajority of lassie operational keys found in any typewriting system. Thus, the standard *keyboard* array enclosed within the dashed block

a:carded. and the idle loop somrsa et As ilk.

'Weer heels smocimsed pith the Mirk of the kaiteetry indicated by 4fig Imago@ 11115 1 a fee technique which first testette rare data ins 7 characu code entered. if the aeons a VERO the rode will represelit either a record only Ley, a onetird *and* function key, a block mark or eject code, a prides character code or a code which causes a function to be executed at the winter wherein the definitiot offt record mode character also %chides character *kaformsdon* which at this junctures nerdy to be reeorded sock as a center code, column heading or the Eke. If data bit 7 is a ONE (I) a finsetioo code may be present. Therefore, the character node loaded next has data bit positions DB4, DB5 and DB6 tested to ascertain whether the same are equal to ZERO (0). If dais condition is true, certain function codes will be defined by the character, which function codes may be individually tested for; however, if the condition is false, the condition of data bit DB6 is next tested to marten whether or not the same is set to ZERO (0). If this result is true through the fanning approach being employed, additional functions are indicated while if it is false, further analysis of data bits DBS and D134 separately occur and in this manner additional groups of function codes may be classified and thereafter separately identified. If neither condition occurs, individual analysis of the code inserted may be employed to finally identify the code inserted from one *of the small number of codes which remain. Thus, in this manner, when a keyboard entry is indicated by the arrow 1015, a branch from the idle loop 'mans and this keyboard entry is appropriately proved in the manner indicated.

When no keyboard entry is present, as indicated by 4ne arrow 1012 annotated NO, but the stop key was depressed as indicated by the arrow 1031, a STOP bit is set in the manner indicated by the rectangle 1032. This stop bit is set in 0 register location 0E-4 and thereafter, as indicated by the arrow 1033 and the diamond 1034, the condition of the mingle cycle flag as set in 0 register location GS-1 is checked to ascertain whether or not the same was set during a margin control mode of operation or the like. If the results of the test indicated by the diamond 1034 are affirmative, as indicated by the arrow 1035 annotated YES, the single cycle bit is reset as indicated by di rectangle 1036 and thereafter, as indicated by the arrow 1037, entry point 1004 of the idle machine routine is returned to. The resetting of the simile cycle bit indicated by the rectangle 1036 is here implemented because the presence within the idle loop indicates that we have already stopped and hence, the condition initiated upon the setting of this flag has been IRMO-

• gle cycle bit was not set as indicated by the 1038 annotated NO; the justify Rag established in location 00-2 s tested, in the manner indicated by the diamond 1039 to ascertain whether or not the mode has been established. If not set, as indicated grow 1040, processing of the STOP condition within the play/skip/dup routine indicated Oval 1041 and described in conjunction with . However, if thejitaftfy * was set, *as* indicated w 1042, the entry of the stop key character is meaningless as presence within the idle loop 'ibis mode is indicative that the system has al- _ mopped. Therefore, it ie treated as an erroneous sei6Orlibereupon an error butler might sound in the ae.

sammer imicoed by die moms& 11043, and a rearm In she idle lonp at ,the bastion bufscated by oval ION come: accortsisly. wW be apprecissed from the Sow chart Mestrated is FIG. that whenever a power up operation axon or the idle machine tontine depicted denim is otherwise mitered, predetermined un-Bel cooditions are established when appropriate. updating, monitoring and resetting functions are initiated and them the system awaits the entry of keyboard information. If the entry of keyboard informations other than a atop aide, the character, fuection *or* control information represented thereby is appropriately procemed under program control while if the stop key *is* depressed, operating conditions within the system are ascertained and appropriate processing occurs. If neither condition obtains, cycling within the idle loop continua until such time as a keyboard entry is presented.

ESCAPEMENT AND CHARACTER PRINTING

Referring now to FIG. 17, there is a simplified flow chart illustrating the escapement and character printing program sequence of operation initiated in the automade writing system according to the instant invention tinder program control. The escapement and character printing program sequence of operation illustrated in FIG. 17 is entered at a position indicated by tip oval 1050 as soon as the analysis of the character at the keyboard has been completed and a character representing printable character information or a printer function has been ascertained. The first step of the escapement and character printing routine, as indicated by the rectangle 1051 is to fetch the weight of the character stored in 07 (ran the printer data ROM so that appropriate initial escapement of the printer may be initiated. Printer data is stored within the printer data ROM, it will be recalled, in the form of twelve (12) bits wherein 7 of the low order bits define the spoke position of the cLaracter, the next three bits define character width while the remaining two bits of information defmes the hammer force to be employed for printing purposes. Therefore, the step of fetching the weight of the character indicated by the rectangle 1051 involves multiple addressing of the printer data ROM so that data in two passes 1 read therefrom and loaded into the main register M. In the first reading, the eight least significant bits from the printer data ROM are obtained. Since the seven Inset significant bits in this group represents spokeidentification information, they are masked off and only the Web order bit is retained. This bit is shifted right so that the same represents the last significant bit of the information being assembled and thereafter the four high order bits of printer information are obtained from the printer data ROM. In this case the two most significant bits of the four bits obtained are masked off as the same moment hemmer force to be employed while the two least significant bits are shifted left so that three bits of character width information are obtained and properly ordered. Thereafter, the value 2 1 added to the resultant width obtained so that the absolute width of character infonnadon for the character identified is defined. Once the weight of the character has been thus obtained in the manner indicated by the rectangle 1051, the condition of the deferred escapement flag atablk,I4 in register location 0E-4 is checked in the manner :iatted by the diamond 1052 to ascertain whether or not the same is in a set condition.

The deferred escspenness ass is set in mew good= OF-6 *say* eine deferred esospeman has bees bleated • espouse as a hate ea she pses enhe aperasor OD meet CbOlOVIT leaniatios to me interval compelsfag Gee Modred rellhieosuls (100 ma). lime pardcabay, it mil be readied et under several operating amdidons, escapement prior to Wading at each ahemter occurs wherein the iviitiah estaptimest emaciated with the printing of a character its half the weight of a pftviously printed cherecter *sad* one half the weight of s newly entered character. However, in order to provide the operator with the appearance of dealing with the normal typewriting fuection, should the operator hesitate in entering character infor-mtion for an interval of 100ms, the carnage escapement is initiated at the printer under program control and this carriage escapement is equal to half the Width of the character just printed plus one half of the width of a standard character. This width is six units for 10 pitch, five units for 12 pitch and five units for proportionally spaced inforcT.tion and hence the printer unit, ander t."-%e conditions, yields the appearance of being in position for the printing of new character information which corresponds to that with which an operator is normally acquainted. Whenever deferred escapement is executed in this manner, a flag is set in register location OF4 to provide an advisory indication to the microprocessor that the normal escapement procedure has been altered. Tice setting of the deferred escapement bit, under these condition, in register location OF4 acts to establish a ZERO (0) therein and hence the location of a ZERO (0) in register location OF4 is indicative that deferred escapement has occured while the location of a OM; (1) therein is indicative that the 100ms interval established for deferred escapement has not yet timed out.

If the test indicated by the diamond 1052 is affirmative, as indicated by the arrow 1053 annotated YES. one-half the character weight or pitch assigned for standard escapement is subtracted, in the manner indicated by the rectangle 1054 from one half the character width obtained by the step indicated by the rectangle 1051. Therefore. as standard escapement has operated, under these conditions, the program step indicated by the rectangle 1054 will produce a displacement increment representing necessary displacement, right or left, to achieve carriage positioning at a location corresponding to one half the escapement associated with the previously printed character plus one half the width of the character just entered in the same meaner as if deferred escapement had not operated. Conversely, if the deferred escapement flag had not been set, in the manner indicated by the arrow 105.5 annotated NO, the weight or width in units of the last character printed is added to the weight in units of the character to be printed as obtained in program step 1051. This step is indicated by the rectangle 1056 and as character weight set forth in increments, the program step indicated by the rectangle 1056 effectively acts to add one half the width of the character previously printed to that of one half the width of the new character to be printed to assemble an appropriate width for carriage displacement. It should be noted that character widths being discussed will vary only in the case of proportionally spaced printing while if ten (10) pitch or twelve (12) pitch modes of printing have been selected, character width will be common for all characters and although assembled in this manner, such width will be defined in

sena* of cassuen read from she rend only memory. The dem required meet the weight of the hat character primed amocimed with the profess step :diated by ghe rectangle 1056 1 maietaisted is the H register in locations 119-3 - no that the same s readily available to the program.

Reprdlem of whether initial escapement information amembled through the program step indicated by the rectangle 1054 or that defined by the rectangle 1056, the seat step in the program, as indicated by the arrows 1057 and 1051 as well as the diamond 11159 is to lest wheel:: or not the resulting *escapement* information is positive or negative. Positive escapement information indicates a dispLcensent of the carriage to the right which is the normal printing direction while negative escapement information indicates that escapement to the left is required to effectively back up the carnage to accommodate a condition wherein a subsequently entered character is mailer in width than the standard escapement information employed during a deferred escapement. Thus, in a proportionally spaced printing mode, should deferred escapement operate and character information associated with a lower case *r* be subsequently entered at the keyboard, the carriage will effectively have to bebacked up to permit the appropriate printing of the subsequently entered character. If the test indicated by the diamond 1059 is affirmative as indicated by the arrow 1060 indicating thet a backing up of the carriage is required, the carriage is displaced in the manner indicated by the rectangle 1061 in a leftward direction. This is accomplished, as will be apparent to those of ordinary skill in the art, by forwarding the displacement information assembled in program steps 1054 or 1056 to the printer unit together with a direcdon bit issued under program control defining leftward escapement. Similarly, if the test indicated by the diamond 1059 is negative in the manner indicated by the arrow 1062, annotated NO, displacement information is issued to the printer unit in the manner indicated by the rectangle 1063 to cause the printer unit to displace a distance in increments equal to the distance assembled by steps 1054 or 1056 but in this case, a direction bit is appended to the displacement information to cause escapement to occur towards the right.

Once escapement has been implemented in the manner indicated by the rectangles 1061 or 1063, the daisy wheel print element carriage located at the printer unit Y properly positioned for the printing of the nest charmer. Therefore, as indicated by the arrows 1064 and 1065, the program nest proceeds to the testing step indicated by the diamond 1066. The test indicated by the diamond 1066 acts to test whether a print auto flag has been set in register location GA-3 and hence whether or not escapement and character printing is occurring according to a high speed print routine further described in emaciation with FIG. 34 or whether aomal escapement and character printing is occurring. Although the high speed print routine will be described hereinafter in detail, at this juncture of the disclosure it i sufficient to recognize that in the high speed print routine, escapement and character printing information ie loaded in a printer stack and information is forwarded to the printer as fast es the one may be accepted while in normal print routines escapement and character information is effectively forwarded to the printer wiiitIch an individualized basis. Accordingly, if the print auto flag test indicated by the diamond 1066 is affirmative, as indicated by the arrow 1067 annotated YES, the assent-

Med escapement *comarod* as defined by *he* sera iii~ iimisised by the toted by ibe feCOISteet 1111 and N13 la boded within die printer slack la the minener Mimed by the recess- gle IOW The primmer_ mock it will be leaned is mob- idled within ItAi#,_1,".tillin,u 2C4 — EF old loaded, .allsemear print iirifienny is be inter- leaved with weerwnwoo the klentr twelve commands ready to be NA= to the printer 811 2:., ''. Pmts. Upon atnI1 pleden of the Program the I1 11, b we Prelim manlier iodicated by the arrow 108P to set up printer data within register locations 01 and 00 in the manner indicated by the rectangle 1070. This involves, as will be apparen t to those of ordinary gm in the an. letting up the four high order bits of the print inforimation in 13 register location GI and the eight low order bits m location 00; both of said register locations being general purpose locations. Furthermore, it should be additionally noted, that the setting up of the printer data in register locations GE and GO in the manner indicated by the rectangle 1070 additionally involves a manipulation of the width information in each twelve bit character in similar manner to the manipulation performed in association with rectangle 1056. Thus, it was seen in conjunction with rectangle 1056 that one half of the width information associated with the character to be printed was added to one half the width of the character previously printed to obtain proper posttioning information for the carriage so that the new character could be printed at the location defined. Similarly, in setting up printer data in conjunction with the program step indicated by the rectangle 1070, the three bits of character width information read from the printer data ROMs are modified for purposes of ribbon displacement. Thus, as the ribbon at the printer unit should be displaced an amount equal to one half that associated with the previous character plus one half the amount associated with new character information, so that entirely new ribbon is available for printing, although the same may be modified for conservation purposes, the character width information assembled within register locations 01 and 02 is changed to refleet a displacement corresponding to one half the width of the previously printed character and one half the width of the character to be printed.

if the test indicated by the diamond 1066 is negative, as indicated by the arrow 1071 annotated NO, the program issues a command to the printer unit, in the mannet indicated by the rectangle 1072, to displace the carrier and cause the ribbon to be raised to an appropriate print position just prior to printing." 1iis is done, as it will be recalled, that any time printer activity has terminated for one half semnd, the ribbon is placed a down position so that the operator's view of the print position is not obscured. Therefore, prior to the actual printing of character information A Raise The Ribbon to A Print Position Command is forwarded to the printer unit to ensure that it is in an up or print position. After the command indicated by the rectangle 1072 has been inisoi. this branch of the program also proceeds in the manner indicated by the arrow 1073 to the program peps associated with rectangle 1070 so that printer data termination is set up in register locations 01 and 00 in the manner described above so that the same may be forwarded to the printer unit or, under appropriate circumstances to the printer stack.

After twelve bits of print information have been asambled in register locations 01 and 00 in the manner rectangle 1070 the print amp nag is meted in the me suer indicated by the dimmed 10'74 so n may ainis be nseermicen whether a am a high speed prim operation is in progress mud hence whether or ant when the assembled ,rioter data should be forwarded to the primer calk or aftermatively must be loaded within the bit Oster met If the test indicated by the diamond 1074 septive, as indicated by the arrow 075 annotated ssw°61°° N10. the assembled printer data may be forwarded to w tbe printer unit as soon as the same *is* available-to proems new data in the aerichronons manner in which piv'°'anit achieved thereat. However, prior u. =tu ally forwarding, various status conditions must be monitored prior to placing twelve bits of printer information do the common data bus 19 in two Passes- More Pardeelarly, as indicated by the rectangle 1076, status condi-.ions associated with tape motion and keyboard entries are toted on the common status bus to accommodate any data entry condition about to occur. Thereafter, as indicated by the arrow 1077 and the rectangle 107$, the contents of register location 01 associated with the high order bits are placed on the data lines for loading into the printer interface while the contents of register location 00 *is* loaded into M to place the same in readimu for forwarding to the printer interface in a second pew Thereafter, as indicated by the arrow 1079 and the diamond 1000, the character busy status condition moelated with the printer unit is tested'on the common status bus to ascertain whether or not the printer is in a condition to receive print informaton. If the character busy status indication is indicative that the printer unit is still processing previously forwarded data. as indicated by the arrow 1001 annotated YES, the monitoring function associated with rectangles 1076 and 16711 is reentered and continued until the printer unit clears and is in a ready condition to receive and process new print information. When this occurs. as indicated by the arrow 1082 annotated NO, the low order information is forwarded to the printer interface and thereafter, as indicated by the rectangle 1013, a character strobe is forwarded to the printer unit to cause processing of the twelve (12) bit print information which has been loaded at the printer interface. Thereafter, as indicated by the arrow mu, the weight of the character which has just been processed and now resides in register location 07 I placed into the deferred escapement register, i.e., the lower half of register location H9 to load the same for processing of the next character. In addition, the dehued escapement bit is placed in a ONE (1) condition to effectively clear the flag pursuant to the initiation of a new timing opera:inn. Thereafter, in the manner indicated bv the arrow 1006 and the oval 1087 a return to "1, .'7 initiated.

If me print auto flag test Indicated by the diamond 1174 is affirmative, as indicated by the arrow 100$ annotated YES, a high speed print routine is in progress and hence loading of print information is the primer may not be initiated. Therefore, as indicated by the rectangle 1009, the assembled print information is loaded into the printer stack within the RAM. Thereafter, as indicated by the arrow 1090, the deferred escapement register is loaded and the deferred escapement bit is ckriiiml in the manner indicated by the rectangle 1085 n*tilupon a return to the idle routine indicated by the oval 1087 may commence.

PLAY. SKIP AND DI:PLICATE FUNCTION'S

Referring sow so FIG. K dwre is shore a flow don ENNIO% the program eminence of operadoe for play. skip aid 61p5me oaks of operation. The flow d art illustrated in FIG. 111 is entered, as indicated by the oval 11* if the system has been set up for en automatic mode of operation from an active record media and an sake key has bete depressed unless the system has beer established in a justify mode of operation or a mon =try, exclusive of a margin control single cycle entry is present.

Upon an entry of the play/skip/duplicate routine illustrated in FIG. 1$, the program ac•-. as indicated by the arrow 1101 to initially test whether or not this routine has been entered, as indicated by the diamond 1102, pursuant to • single cycle mode of operation in margin control or has been normally entered in response to the depression of an action key initiating playback, skipping or duplication from an active media. A margin control single *cycle bit is* set in general purpose register location 05-1 under conditions where a margin control mode of operation has been established and during playback, the margin tone is entered and the look ahead processing of the instant invention, as will be Amber described in conjunction with FIG. 21, has cycled through the characters to be printed within the margin zone and has not found a character for which a carriage return may be initiated. Under these conditions, the margin control single cycle bit is set at the beginning of the hot or margin control zone and the operator is permitted to play out one character at a time by depression of the character/stop key in order to achieve an appropriate point at which to enter a hyphen and hence cause the automatic return of the carrier within the margin zone established. Accordingly, if the test of the margin control single cycle bit maintained in general purpose register location 05-1 is affirmative, as indicated by the arrow 1103 annotated YES, normal proessing is not occurring and hence the program immediately proceeds to processing under the PSD loop indicated by the dashed rectangle 1104 which, under these circumstances, will cause processing to occur on a per character basis.

If, however, the margin control single cycle bit tested in the step indicated by the diamond 1102 is negative, as indicated by the arrow 1105, annotated NO, normal processing under the play, skip or duplicate conditions imposed is to occur from the active media and the read only buffer which is being loaddd therefrom. Therefore, as indicated by the rectangle 1106, the next character to be processed is fetched from the read only buffer and loaded into the main register M, analyzed and if appropriate, Waled into general register location 07 foi bolding purposes during further processing. FurtherMOM as will be apparent, should the read only buffer be empty, the processing step indicated by the rectangle 1106 would include the fetching of the nett line of data from the active record media followed by the insertion of the first character thereof into register location 07. In the fetch operation indicated by the rectangle 1106, the line is searched and any spaces or tabs which occur before a centering code or a carriage return are skipped to ensure appropriate formatting. Furthermore, when the initial character fetched and inserted in register location 07 is of a kind with which a second character is normally associated, the second character is also fetched and subsequent to loading in the main register eared to *register* locution Cri fee bolding puriwees &rim peocemita. Chinamen of this vie Eisen typically Wade a search lode which is followed by.* block ember or the like and hence s rendered meaningless wirbc...:t the ten smolt identifier therefor available to the procaww. Upon completion of the fetch operation Wanted by the rectangle 1106, the program proceeds.. as indicated by the arrow 1207 to processing within the PSD loop indicated by the dashed rectangle 1104 per se. The PSD processing loop indicated by the das:ad rectangle 1104 is shown in detail in the right hand portion of F10.111 where the detailed processing steps thereof are set forth within an enlarged block also annotated 1104. In essence, processing within the PSD loop involves character analysis through a fanning out routine similar to that explained for the keyboard analysis and causes appropriate processing to occur for the certain characters which have been analyzed therein.

More particularly, turning now to the enlarged dashed block 1104, in the right hand portion of FIG. 111, the detailed processing steps associated with the PSD loop will be described. When the PSD loop is entered, IS indicated by the arrow 1107, general purpose register location 0$-S is initially tested, as indicated by the diamond 1100 to ascertain whether or not the margin control flag maintained therein has been set upon the establishment of a margin control mode of operation. If the testing of this flag condition, as indicated by the diamond 1100 is negative, as indicated by the arrow 1109 annotated NO, the program immediately proceeds to junction point C, from which normal processing in response to the depression of an action key may proceed. Thus, as indicated by the outgoing arrow 1110 from junction point C. and the hexagon 1111, the program initially proceeds to evaluate the edit and control stop conditions associated with the action key depressed and sets a stop bit if the same is applicable. Thus, if a word key were depressed, this condition would be indicated by a flag set in register location 01-0 and the stop condition associated therewith would be a space code which would cause appropriate termination of automatic processing in response to the depression of the word action keys. Similarly, appropriate stop conditions for the remaining action keys will be apparent from the disclosure set forth above.

After the edit control stop condition has been evaluated and any appropriate stop bit set, the program, as indicated by the arrow 1112, next proceeds to ten, as radiated by the diamond 1113, whether or not the mode causing entry into the play/skip/dup routine illustrated in FIG. 1$ was the skip key. This test, as indicated by the diamond 1113, is performed by testing the condition of the skip mode flag established in general purpose register location 09-1. If the skip mode has been set as indicated by the arrow 1114, the dump bit is set in the manner indicated by the rectangle 1115 provided a revise mode of operation is established and if processing in an auto mode is occurring and the character in 07 is a stop (non-transferrable), the stop bit is set. The dump and stop bits are set within general purpose register locations On and 4, respectively, and it will be appreciated by those of ordinary skill in the art that the dump bit is set in a revise mode to indicate to the microprocessor that re-recording of the record media with the contents of the read/write buffer must occur. Thu-, while in a normal skip mode of operation,ithi active media which is being read is not normally recorded, the setting of the dump bit is indicative that a modification thereof has c:curted *aid* hence te-recasibag of this lint use the media men occur upon the complains of the of the read/write heifer. *Sissisaly.* the mop bit ao that •non-transiterable slop reconkd as a §sinis being rodsthe dip mode is bemored. Upon greanpietion of the program seeps Indicated by the sea- • ante 1115, as indicated by arrows 1116 and 1117, nor- sat'processing within the left hand portion of the play/. thip/dup routine Must rated in FIG. *II* is returned to at a location subsequent to that of the dashed block 1104 as indicated by the commonly annotated arrow 1117.

it the *skip* mode has not been established, the tea indicated by the diamond 1113 will be negative as indi- elated by the arrow 1118 annotated NO. Under tt se conditions, as indicated by the diamond 1119, the pro- gram tests to ascertain whether or not the dup mode has been established. This test is implemented by a testing of the status of the dup mode flag established in general purpose register location 09-0. If the dup mode has not been set, as indicated by the arrow 1120 annotated NO, the presence of a play mode is confirmed. Therefore, under these conditions, the program acts, as indicated by the hexagon 1121 to execute the !Unction of the character being processed, as presently loaded in regis- ter location 07. The process step indicated by the lieu- gon 1121 will generally involve causing the printer to print the character loaded in location 07 ma:mining of course a printable character is present therein. Thus, the program steps implicit in the step indicated by the hen- son 1121 are highly similar to the keyboard analysis and printer program sequences of operation set forth above, however, additional functions will be here included due to the possible presence of encoded function characters associated with switching record media, switching and searching the record media, skip codes, tint line, first line find, and the like.

Conversely, if the test indicated by the diamond 1119 it affirmative, at indicated by the arrow 1122 annotated YES, the duplicate mode of operation is confirmed and hence, no printer execution or multiple transport switching function may be implemented, but instead the mere duplication of character information recorded on one record media to the other is required. Accordingly, for these conditions, the main path of the program is rejoined by the arrow 1122 at the output side of the hexagon 1121 so that regardless of whether or not a printer execution of transport function execution was required, the program may now proceed to an imple- mentation of the recording requirement associated with the character loaded in register location 07 under con- ditions where either a dup or play mode of operation has been confirmed. Therefore, as indicated by the arrow 1123. the program next proceeds to a recording gpf the character loaded in register location 07 in the gimanner indicated by the hexagon 1124. The recording . weep denoted by the hexagon 1124 here takes the form of an analysis and execution routine wherein a recordable - character is identified through a fanning action similar that employed for keyboard analysis and execution ..and assuming a recordable character is identified, this haracter is loaded into the read/write buffer for subse- *pent recording en the record media upon the comple- Jim of an assembly of a line of information. Characters `which would not qualify *as* recordable characters lavould here take the form of characters which initiate functions of the system such as transport switching, ,,searching, switch and search, first line find or first line tAstablishing characters. Upon implementation of the leconisag Sep ineScased by die nicsangle 111131. the wpm. proceeds as indicated by the arrow 1125 to the main step skated by the diamond 106. As indicated by the note, a stack is esteblisbzd o register Saab= H4 - H7 for Me as aseporary storage of issertions or modifications of characte.̄s used in response to margin control modes of operation. Therefore, prior to exiting from the PSD loop, the status of this stack is tested to ascertain whether or not the some is empty. If the stack is empty as indicated by the arrow 1117, exit from the PSD loop occurs and a return to the left hand portion of the flow chart depicted in FIG. 18 occurs.

However, if the stack is not empty, as indicated by the arrow 1127 annotated NO, the stack established in register locations H4 - H7 was loaded due to the tune- dons initiated under the margin control mode of opera- tics and hence cow be emptied. Accordingly, under these conditions, as indicated by the rectangle 1128, the character at the top of the stack is loaded into register location 07 and the stack is pushed up through one character position. 'Thereafter, as indicated by the arrow 1129, the junction point C for this portion of the PSD loop is re-entered whereupon that character may be processed in the manner indicated by the hexagons 1111, 1121 and 1124 as well as diamonds 1113, 1118 and 1126 until the stack is emptied and the PSD loop is exited from. White the foregoing discussionpf the PSD loop enclosed within the dashed block 1104 proceeded on the basis that junction point C was entered in re- sponse to a negative finding from the test indicated by the diamond 1108, junction point C may be entered if other condition obtain. For instance, if the test anent the margin control mode, as indicated by the diamond 1108 is affirmative, as indicated by the arrow 1130 anno- fated YES the program next proceeds to test whether or not the centering bit has been set in the manner indi- cated by the diamond 1131. The test indicated by the diamond 1131 acts to effectively test the condition of the centering bit flag established in general purpose register location 044 which is set whenever centering under program control is to occur. If the test indicated by the diamond 1131 is affirmative, as indicated by the arrow 1132 annotated YES, it is indicative that the line of information presently being processed is to be xn- tered and hence even though the margin control mode of operation was established in the manner indicated by the testing in the preceding step of the program, no margin control mode modification should here occur since centering is to take place. Thus, when the center- ing bits set as indicated by the arrow 1132, the path of arrow 1109 is joined to immediately shift proceseng to junction point C whereupon actual processing may be implemented in the manner aforesaid.

If the centering bit has not been set, as indicated by the arrow 1133 annotated NO, the program nest tests in the manner iadicated by the diamond 1134 whether or aot the play mode has been established. This condition is ascertained through testing the play flag established in general purpose register location 09-3 therefor. If the test conducted indicates a negative result as shown by the arrow 1135 annotated NO, the automatic writing system is established in either a skip or dup mode of operation and hence even though the margin control mode may have been set for the bit being processed. no margin control mode modifications are required. There- fore, as indicated by the arrow 1135, juncticArielint C any be immediately entered for processing through to the end of the PSD loop. If however, the test indicated tz "3 1134 is affanmative. as ineSesued by the arrow 1136 smootased YES. the margie control mode of °Fermi= i esublhhed cad ploy modes desperation arbean Therefore. a indicated by the hems= 1137 *tad* my *necessary* modification to the Chsracter In aim occur *lades* the rules for margin Control meohfished. Although the analysis routines emaciated with the hexagon 1137 wilt be described in detail in connection with FIG. 21, it should be appreciated that in essence, the program steps associated with the hexagon 1137 act to test the character loaded in 07 in light of the print pcsitidn of the printer unit and to modify the character if necessary, in accordance with the rules for the position at '; 'tich printing is currently occurring. Thus, for instance, if a carriage return character were loaded in 07 and the print position was to the left of the margin zone, a spec, code would be substituted therefor and inserted into the temporary staa established in register locations H4 - H7. Similarly, should a space code occur at a print position within the margin tone, a carriage return character would be substituted therefor and placed in the stack; however, under most conditions, printable character information would be processed in the same manner that processing would occur were the automatic writing system established in an auto mode except under such conditions where operator intervention in the margin zone were required. Hence for printable characters, normally no modification would occur. Thus, as indicated by the dashed arrow 1138, when no modification of character information is required, a return to junction point C for normal processing through the loop occurs. However, when a character is modified and inserted through the stack, the main body of the PSD loop, as indicated by the arrows 1139 and 1140 is rejoined at the diamond 1126 so processing of this character information from the stack may occur. Thus, this takes place, in the same manner as if the auto kLy had been depressed and processing within the PSD loop is occurring. Furthermore, an additional alternative may occur as indicated by the arrow 1141 when the analysis and modification step denoted by hexagon 1137 results in a skip operation. This may occur, it will be recalled, for instance, when a non-mandatory hyphen appears to the left of the margin zone and hence is skipped while processing is automatically continued. Thus, under these conditions, re-entry underskip mode conditions directly to the exit point indicated by the arrow 1117 occurs. A similar branching routine to an exit in the manner indicated by the dashed block 1141 is produced when a :toe 'it is set pursuant to a single cycle mode of operation.

When the PSD loop is exited from in the manner indicated by the arrow 1117, a return to the basic flow chart illustested is the left band portion of FIG. 1$ occurs. Since the PSD loop indicated by the clashed block 1161 accounts for most actual processing operations for character information, the remaining portions of the flow chart illustrated in FIG. 11I are related to a -letting of the Stop Flag if appropriate, ascertaining whether or not the flag is set and performing various clan up routines before the stop flags executed and a return to the idle loop kilnitiated. Thus, as indicated by the rectangle 1143, the stop bit is set if the line counter is active and the line count is exceeded. Thereafter, as indicated by the arrow 1144 and the diamond 1145. the stop bit maintained in general purpose register location *GF4* is tested to ascertain whether or not it is set. if the lbg has sot bees set a. indicated by the arrow 1146 annotated NO. return in the loop to fetch the next character in the moaner indicated by the roman& 1106 is initiated for processing *ilk next character of inforskidoo. However, if the stop bit has been set as indicated by the WOW 1147 annotated YES, various clean up operations prior to actual stopping are initiated. Thus, u Indicated by the rectangle 114$, pending underscore codes are executed so that ontoplete proceasing associated with a given character is csirri-d mot. Additionally, as indicated by the oval 1149, an entry point is here provided so that exiting from • pending stop code to this portion of the play/skip or dup routine may occur. Thereafter, as indicated by the diamond 1150, the play mode flag established in 09-3 is tested to ascertain whether processing is occurring in a play mode. If an affirmative result occurs, as indicated by the arrow 1151, exiting to the idle 3 position of the idle routine illustrated in F10. 16 occurs. However, if the results of the teat indicated by the diamond 1150 is negative, as indicated by the arrow 1152, a skip or dup mode operation was initiated and has been completed. Therefore, as indicated by the rectangle 1153, a buzzer is initiated for approximately 256ms to advise the operator that the dup or skip mode initiated has been completed. Thereafter, as indicated by the diamond 1154, the skip flag maintained in the general purpose registers 09-1 is tested It, establish whethle the skip or dup mode of operation was actually in ptlYgress. If the result is negative, as indicated by the arrow 1155 annotated NO, immediate exit to the portion of the idle loop indicated by the oval 1156 occurs, since processing took place according to a dup mode of operation. However, if the skip mode was established as indicated by the arrow 1157 annotated YES, a timer, as indicated by the rectangle 1154 is set for a one second interval and thereafter the idle loop is returned to in the manner indicated by the oval 1159. Thus. in this manner, processing will occur whenever an action key is struck when a play. skip or dup mode of operation has been established.

EDIT CONTROL STOP CONDITIONS

Referring now to FIG. 19, there is shown a row chart illustrating a programmed sequence of events which occur for the edit control stop conditions associated with play, skip and duplicate mode operations. The program represented in FIG. 19 is entered any time the play, skip or duplicate flags are set and an action key at the keyboard depressed and specifically, this routine is entered from the play/skip/dup program illustrated in FIG. 1$ at a point within the PSD loop indicated by the hexagon 1111. Accordingly it will be appreciated by those of ordinary skill in the art that the entry point to the edit control stop condition flow chart illustrated in F10. 19 is entered at a point in the PSD loop shown in FIG. 1$ corresponding to the location of hexagon 1111 and any time a return to the main program from the edit control stop condition flow chart illustrated in FIG. 19 I indicated, pick up in the main routine will occur at the output side of the hexagon 1111 shown within the PSD loop at a location indicated by the arrow 1112.

The edit control stop condition flow chart illustrated in FIG. 19 may be entered at a location indicated by the oval flag 1160. At the outset it should be noted that the edit control stop condition program is active each time a character is being processed and relies upon three bits set in the general purpose register as an aid in detecting atop conditions as a function of what has p. 7;9₄sly

.114C1etiel 1 of the '129 Patent Compared With Prior Art

Claim 1	**Admitted Prior Art of Preamble Considered with the** Kocher, Dubauskas and Holter References
For use in a rotary wheel printing system having a translatable carriage; means for translating said carriage along a print line, a rotary printwheel mounted on said carriage, said rotary printwheel having a plurality of individual print characters distributed about the radial center thereof; means for rotating said printwheel; means for impressing said print characters against a print member;	Admitted Prior Art. Kocher: Also discloses rotary printwheel
first position indicating means for generating signals representative of the instantaneous position of said printwheel, said first position indicating means including an encoder disc mounted for rotation with said printwheel and having a plurality of alternately arranged opaque and translucent positions arranged in a substantially circular timing track about the radial center of said disc;	Admitted Prior Art. Kocher: Also discloses photo-electric cells 24, 26 which utilize the rotary printwheel as the encoder disc.
and means responsive to said printwheel position signals for actuating said imprinting means;	Admitted Prior Art. Kocher: Print Control 36.
the improvement wherein said first position indicating means includes **a first light source mounted adjacent a first surface of said disc,**	Kocher: Lamps 25, 27. Dubauskas: Lamp 40. Holter: Gallium arsenide light emitting diodes (LED's) Ll **to L6 develop light to be reflected from surface being sensed.**

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a pluralitrof light sensitive devices mounted adjacent the opposite surface of said disc and responsive to the angular displacement of said opaque and translucent timing track portions when said printwheel is rotated for generating a pair of position trains having a substantially constant phase difference;	Kocher: **Uses first and second photocells 24, 26 which interact with the printwheel which operates as an encoder disc to develop a pair of position trains B and** D having **a substantially constant phase** difference. Dubauskas: Has light sensitive **device 38 which receives light and generates position information.** **Holter: Photocells P1 to P5 sends reflected light developed by LED"s L1 to L6.**
and first feedback means for maintaining the intensity of said light source substantially constant;	**Dubauskas: Light intensity control** circuit **98 including compensating photosensitive device 102.** **Holter: Feedback circuit of Fig. 6 including comparator** amplifier 50, power amplifier 51 and photocell P6.
said first feedback means including power means for applying electrical power to said light source;	Dubauskas: The constant voltage source 105, and amplifying means 104 drive lamp 40. Holter: The power amplifier 51 drives LED's LI to L6.
first light sensitive means disposed adjacent: said opposite side of said disc at a position to continuously intercept light radiation emitted by said first light source for generating an electrical signal representative of the intensity of said light radiation adjacent **said light** sensitive devices;	Dubauskas: Compensating photosensitive device 102. Holter: Photocell P6 receives reflected feedback illumination.
comparison **means** for comparing **said intensity signal with a standard signal representative of a pre—established desired light intensity**;	Dubauskas: Amplifying means 104. Holter: Comparator amplifier 50.

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mans for_ **operating a correction lignal when said intensity signal litiffers from said standard signal**	Dubauskas: **Circuit including amplifying means 104 receiving standard signal from resistor voltage divider.** Holter: **circuit including comparator amplifier 50 receiving standard signal from variable resistor 54.**
and means for coupling said correction signal to said power means to vary the magnitude of said light intensity for re—establish said desired light intensity.	**Dubauskas: Connection to lamp 40.** Holter: Power Amplifier 51.

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UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of ; 70 I 97

CERTAIN ROTARY WHEEL PRINTING SYSTEMS

Investigation No. 337-TA-185

ERRATA

The following corrections to the Initial Determination, issued February 15, 1985, are hereby noted:

1. The final sentence of Finding of Fact 130 on page 78 is corrected to read as follows:

> Therefore, this reference alone would not render obvious the '129 device.

2. Paragraph 5 of the Initial Determination and Order, on page 294 is corrected to note that pursuant to Rule 210.53(h) the Initial Determination shall become the determination of the Commission forty-five (45) days after the service thereof, unless the Commission, within forty-five (45) days after the date of filing of the Initial Determination shall have orderedreview of the Initial Determination or certain issues therein, pursuant to 19 C.F.R. 210.54(b) or 210.55 or by order shall have changed the effective date of the Initial Determination.

John J. Mathias

John J. Mlas
Administrative Law Judge

issues: March 1, 1985

CERTIFICATE-OF SERVICE

I, Kenneth R. Mason, hereby certify that the attached ERRATA was served upon Denise T. DiPersio, Esq., and upon the following parties via first class mail, and air mail where necessary, =March 4, 1985.

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CERTAIN ROTARY WHEEL PRINTING SYSTEMS

Investigation No. 337-TA-185

INITIAL DETERMINATION

John J. Mathias, Administrative Law Judge

Pursuant to the Notice of Investigation in this matter (49 Fed. Reg. 8502, March 7, 1984), this is the Administrative Law Judge's Initial Determination under Rule 210.53(a) of the Rules of Practice and Procedure of this Commission. (19 C.F.R. 210.53(a)).

The Administrative Law Judge hereby determines that there is a violation of Section 337 of the Tariff Act of 1930, as amended (19 U.S.C. S 1337, hereafter Section 337), in the importation of certain rotary wheel printing systems into the United States, or in their sale. The complaint herein alleges that such importation or sale constitutes unfair methods of competition and unfair acts by reason of alleged infringement of the claims of U.S. Letters Patent No. 4,118,129. It is further alleged that the effect or tendency of the unfair methods of competition and unfair acts is to destroy or substantially injure an industry, efficiently and economically operated, in the United States.

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PROCEDURAL HISTORY

On January 27, 1984, a complaint was filed with the U.S. International Trade Commission under Section 337 of the Tariff Act of 1930, as amended (19 U.S.C. S 1337, hereafter Section 337) on behalf of Qume Corp. (Qume), 250 Qume Drive, San Jose, California 95131. The complaint alleged unfair methods of competition and unfair acts in the importation into the United States of certain rotary wheel printing systems, or in their sale, by reason of alleged infringement of the claims of U.S. Letters Patent No. 4,118,129 ('129 patent). The effect or tendency of these unfair acts and unfair methods of competition was alleged to be to destroy or substantially injure an industry, efficiently and economically operated, in the United States. The complainant requested that the Commission institute an investigation, and after a full investigation, issue a permanent exclusion order and permanent cease and desist orders.

Upon consideration of the complaint, on February 27, 1984, the Commission ordered that an investigation be instituted pursuant to subsection (b) of Section 337 to determine whether there is a violation of subsection (a) of Section 337, as alleged in the complaint. The notice of such investigation was published in the Federal Register on March 7, 1984. (49 Fed. Reg. 8502).

The following twelve parties were named as respondents in the Notice of Investigation:

Nakajima All Co., Ltd.
25-7, Hokozaki-cho
Nihonbashi, Cho-Ku
Tokyo 103, Japan

Teletex Communication Corp.
3420 East Third Avenue
Foster City, California 94404

Olympia Werke Aktiengesellschaft
Olympiastrasse, Postfach 960
Wilhelmshaven, Federal Republic of
Germany

Olympia USA, Inc.
Box 22
Summerville, New Jersey

Matsushita Electric Industrial Co., Ltd.
1006 Oaza Kadoma
Kadoma City 571, Japan

Matsushita Electric Corp. of America
One Panasonic Way
Secaucus, New Jersey 07094

Sharp Corporation
22-22, Nagaike-cho, Abeno-ku
Osaka 545, Japan

Sharp Electronics Corporation
10 Sharp Plaza
Paramus, New Jersey 07552

Tokyo Juki Industrial Co., Ltd.
23-3, Kabuki-cho 1-chome
Shinjuku-ku, Tokyo 160
Japan

Juki Industries of America, Inc.
421 North Midland Avenue
Saddle Brook, New Jersey 07662

Triumph-Adler Aktiengesellschaft
Fuerther Strasse 212
Nuremberg D-8500
Federal Republic of Germany

Adler-Royal Business Machines, Inc.
1600 Route 44
Union, New Jersey 07083

Denise T. DiPersio, Esq., Unfair Import Investigations Division, U.S. International Trade Commission, was named as Commission investigative attorney, a party to this investigation.

By Order No. 1, issued March 5, 1984, then Chief Administrative Law Judge Donald K. Duvall designated John J. Mathias as Administrative Law Judge in this investigation. (49 Fed. Reg. 9629, March 14, 1984).

Responses to the complaint and notice of investigation were filed with the Commission by the following respondents: Olympia U.S.A., Inc. on March 28, 1984; Olympia Werke AG, Nakajima All Co., Ltd., Matsushita Electric Industrial Co., Matsushita Electric Corp. of America, Tokyo Juki Industrial Co., Ltd. Juki Industries of America, Inc., Triumph-Adler AG, and Adler-Royal Business Machines, Inc. on April 2, 1984; and Sharp Corp. and Sharp Electronics Corp. on April 6, 1984. Respondent Teletex Communication Corp. (Teletex) did not file an appearance, nor did it respond to the complaint and notice of investigation.

A preliminary conference was he.11 in this matte: before Administrative Low Judge John J. 1'hAlinias on April. t, 1984. Appnaran'es were made on behalf of complain;.nt, the Commission investigative staff, and each of ¯the foregoing respondents except Teletex.

Order No. 13, issued June 8, 1934, was an in :.;1 Ceterminaticn grantinj Qume's motion to hmene com;lain'c and notice of investigation to join three addition=.i companies as parties respondent. On Jul} 13, 1984, the Commission issued a notice of its Decision- Net TI) Restu Initial Determination Joining Respondentt. (49 Fed. %F.,. 7.91.E July 18, 1984). AccoiJingly, the following three co' awiea te.e as respondents to this investigation:

Towa Sankiden Corp.
4-2, kithan-cho, Chiyoda-Ku
Tokyo 103, Japan

Primages, Inc.
600 Johnson Avenue
Bohemia, New York 11716

PLAMages, Inc.
Hsin Chu, Taiwan
Republic of China

Respondent Towa Sankiden Corp. filed a response to the amended complaint and notice of investigation on August 13, 1984; Primages, Inc. filed a response on August 14, 1984. Order No. 28, issued August 21, 1984, denied Qume's second motion to amend the complaint to add two companies as parties respondent.

Order W.. 19, issuol August 21, 1114, was an initial determination granting in part respondents Primages' action to designtte this investigation 'more ccliplicAted.' This order designated the inveatigatrn °more complicated' anl extended the statutory deadline by sixty-s'K. Os 2ptrAlber 5, 1984, i'ho Commission issued a • notce of ig:s Deterwii:ation Not To Rel'iew'initial Determination Designating Investigation More Coxvicrtec: And Ilctending the Deadline for CoLoletion of the Investigation by Sixty-One Days. (49 Fed. Reg. Z5873, September 1.2, 1984).

Order No.. , irsced 1..ugr.:;' 23, 1984, granted a joint motion by Qume and respondents Olympia Werte A.G. and Olympia U.S.A., Inc. (Olympia) to terminate this investigation as to Olympia on the basis of r settlement agre'ament. On September 20, 1984, the Commission issued a notice t.,Z :te Decision Not To Review Initial Determination Terminating- eirpia Werke Aktiengesellschaft and Olympia U.S.A., Inc. (49 Fed. Wog, 37861, September 26, 1984).

A joint motion to terminate this investigation as to respondents Matsushita Electric Industrial Co., Ltd. and Matsushita Electric Corp. of America on the basis of a settlement agreement was granted by Order No. 37, issued September 14, 1984. On October 18, 1984, the Commission issued a notice of its Decision Not To Review Initial

Det•IrmInt.tion Terminating Matsushita Electric Industrial Co., Ltd. and Matsuenita Electric Corp. of America. (49 Fed. Reg. 42805, October 24, 1984).

Order No. 52, issued November 29, 1984, granted a joint motion to terminate this investigation as to respondents Tokyo Juki Industrial Co., Ltd. and Juki Industries of America on the basis of a settlement agreement. On December 31, 1984, the Commission issued a notice of its Decision Not To Review Initial Determination Terminating Respondents Tokyo •7uki Industrial Co., Ltd. and Juki Industries of America, Inc. (50 Fed. Reg. 1138, January 9, 1985).

Order No. 54, issued December 11, 198 4 granted a joint motion to terminate this investigation as to respone 'iAs Primages, Inc. (U.S.A.) and Primages, Inc. (ROC) on tilt: basis of seLtlement and cot,sLnt order agreements. On January 14, 1985, the Commission issued a notice of its Decision Not To Review Initial Determination Temihiyting Respondents Primages, Inc. and Primages, Inc.-ROC, together with the issuance of a Consent Order. (50 Fed. Reg. 3039, January 23, 1985).

A prehearing conference was held in this matter on October 29, 1984. The hearing commenced immediately thereafter before Administrative Law Judge John J. Mathias to determine whether there is a violation of Section 337 as alleged in the complaint, as amended, and set forth in the amended notice of investigation. Appearances were made on behalf of complainant Qume, the Commission investigatfv' staff, and respondents Nakajima All Co., Ltd. (Nakajima), Sharp Cori.. (Sharp), Sharp Electronics Corp. (SEC) (collectively referred to hereafter as Sharp), Triumph 'idler AG (Triumph-Adler), Adler-Royal Business Machines, Inc. (Adlek•-Royal) (collectively referred to hereafter as Adler), and Towa Sankiden Corp. (Tows). The hearing concluded and the record closed on November 9, 1984.

On November 7, 1984, Qume filed a third motion to amend the complaint and notice of investigation to add as an alternative allegation that the effect or tendency of the alleged unfair acts and unfair methods of competition is to prevent the establishment of an efficiently and economically operated industry in the United States. (Motion Docket No. 185-77). This motion is opposed by the participating respondents, as well as by the Commission investigative attorney. For the reasons stated hereinafter, Motion 185-77 is denied.

Order No, 51, issued November 29, 1984 granted Qume's motion to receive into evidence CX 199, and denied its motion to receive CPX 280. Order No. 55, issued January 9, 1985, was an order to show cause why certain of complainant's exhibits should not be received in evidence without limitation. All parties filed responses to this order. Qume filed a motion on January 24, 1985 for leave to reply to -

respondents' and the Commission investigative attorney's responses to Order No. 55. (Motion Docket No. 185-83). Leave to reply is granted. Disposition of the status of the documents identified in Order No. 55 is set forth infra.

On January 14, 1985, respondents filed a motion to strike "Qume's Cross-Reference List Between QRFFs and RTFFs." (Motion Docket No. 185-80). Qume has opposed this motion. Motion No. 185-80 is granted. Qume's cross-reference list is hereby stricken, and has not been considered herein.

On January 14, 1985, respondents filed a motion to strike or disregard Qume's Rebuttal Findings of Fact (Technical). (Motion Docket No. 185-81). This motion is opposed by Qume. Motion 185-81 is denied.

On January 14, 1985, respondents also filed a motion to strike complainant's filings pursuant to 19 C.F.R. 210.20(a)(5), 210.20(c)(1), and 210.20(c)(2). (Motion Docket No. 185-82). Both Qume and the Commission investigative attorney oppose this motion. The documents which respondents seek to have stricken include a copy of the complaint (without exhibits) filed by Sharp against Qume in the U.S. District Court for the Northern District of California, a copy of the complaint filed by Towa against Qume in the same court, and a copy of an agreement concluded between Qume and Epson Corp. on December 1, 1984. For the reasons stated by the Commission investigative attorney, Motion 185-82 is denied.

The issues have been briefed and proposed findings of fact and conclusions of law submitted by the participating parties. The matter is now ready for decision.

This initial determination is based on the entire record of this proceeding including the evidentiary record compiled at the final hearing, the exhibits admitted into the record at the final hearing, and the proposed findings of fact and conclusions of law and supporting memoranda filed by the parties. I have also taken into account my observation of the witnesses who appeared before me and their demeanor. Proposed findings not herein adopted, either in the form submitted or in substance, are rejected either as not supported by the evidence or as involving immaterial matters.

The findings of fact include references to supporting evidentiary items in the record. Such references are intended to serve as guides to the testimony and exhibits supporting the findings of fact. They do not necessarily represent complete summaries of the evidence supporting each finding.

The following abbreviations are used in this Initial Determination:

Tr. Official Transcript, usually preceded by the witness' name and followed by the referenced page(s);
CX Complainant's Exhibit, followed by its number and the referenced page(s);
CPX - Complainant's Physical Exhibit
RXT Respondents' Technical Exhibit, followed by its number and the reference page(s);
RXE Respondents' Economic Exhibit, followed by its number and the referenced page(s);
RXPT Respondents' Physical Exhibit;
SX - Staff Counsel's Exhibit, followed by its number and the referenced page(s);
CF - Complainants' Proposed Finding;
RTF - Respondents' Proposed Technical Finding;
REF - Respondents' Proposed Economic Finding;
CB - Complainant's Post Hearing Brief;
RB - Respondents' Post Hearing Brief;
SB - Staff Counsel's Post Hearing Brief;
CRB - Complainants' Post Hearing Reply Brief;
RRB - Respondents' Post Hearing Reply Brief;
SRB - Staff Counsel's Post Hearing Reply Brief;
FF - Finding of Fact;
W.S. - Witness statement, usually preceded by the exhibit number and the name of the witness and followed by the page of the witness statement being cited;
CRF - Complainants' Reply Finding;
RRF - Respondents' Reply Finding;
CPS - Complainant's Prehearing Statement.

FINDINGS OF FACT

I. JURISDICTION

1. Service of the complaint and notice of investigation was perfected on all respondents. In addition, all respondents except Teletex Communication Corp. (Teletex) entered appearances through counsel and responded to the complaint and notice of investigation. (Response to Notice of Investigation and Complaint by Nakajima All Co., Ltd. filed April 2, 1984; Response of Olympia U.S.A., Inc. to the Complaint and Notice of Investigation, filed March 28, 1984; Response of Olympia Werke Aktiengesellschaft to the Complaint and Notice of Investigation, filed April 2, 1984; Response of Matsushita Electric Industrial Co. Ltd. to Complaint, filed April 2, 1984; Response of Matsushita Electric Corp. of America to Complaint, filed April 2, 1984; Response of Sharp Corp. and Sharp Electronics Corp. to Complaint of Qume Corp., filed April 6, 1984; Response to Notice of Investigation and Complaint by Juki Industries of America and Tokyo Juki Industrial Co., Ltd., filed April 2, 1984; Response of Triumph-Adler Aktiengesellschaft to Complaint, filed April 2, 1984; Response of Adler-Royal Business Machines, Inc. to Complaint, filed April 2, 1984). Although respondent

Teletex did not enter an appearance or respond to the complaint and notice of investigation, it did provide discovery upon requests made by Qume and the Commission investigative attorney. (SX 30, 31).

II. PARTIES

2. Qume Corporation (Qume) is a California corporation having its principal place of business at 2350 Qume Drive, San Jose, California 95131. Qume was acquired by International Telephone and Telegraph Corp. (ITT) in 1978. Qume's operations are segregated into three divisions: the Printer Division, Memory Products Division, which manufactures floppy disk drives, and the Terminals Division, which sells CRT terminals. (SX 2, at 1; Gower, CX 165, at 2-3).

3. Qume Caribe, Inc. (Qume Caribe) was incorporated in Puerto Rico in 1978, and currently has facilities in Las Piedras and Humacao. Qume Caribe is engaged in the manufacture, sale and service of daisywheel printers and accessories. Qume Caribe is a wholly-owned subsidiary of ITT-Grinell Corp. (SX 2, at 2; Moren, CX 167, at 3-4; Gower, Tr. 263-64).

4. Qume Taiwan, Inc. (Qume Taiwan) was incorporated in Taiwan in 1982 and is engaged in assembly of subassemblies for floppy disc drives, and printer circuit boards and power supply assemblies for printers. In June 1984, Qume Taiwan commenced production of the Virgo printer. (SX 2, at 2; Booth dep., CX 140, at 31-35).

5. Nakajima All Co., Ltd. (Nakajima) is a Japanese corporation with its offices at 25-7 Hakozaki-cho, Nihonbashi, Chuo-Ku, Tokyo, Japan. Nakajima is a sales company which sells products produced by related Nakajima companies. Those products include rotary wheel typewriters and printers. Nakajima exports to the United States rotary wheel typewriters and printers manufactured by Nakajima All Precision Co., Ltd. (Respondents' Proposed Stipulation No. 4, Respondents' Joint Prehearing Statement on Technical Issues, at 8; accepted by complainant, Tr. 7; SX 26, at 2).

6. Teletex Communication Corp. (Teletex) is a California corporation located at 3420 E. Third Avenue, Foster City, California 94404. Teletex imports into the United States and sells rotary wheel printers purchased from Nakajima. (SX 29; SX 30, at 1-2).

7. Sharp Corporation (Sharp) is a Japanese corporation having its principal place of business at 22-22, Nagaike-cho, Abeno-ku, Osaka 545, Japan. Sharp manufactures rotary wheel printing systems in Japan at its Industrial Instruments Group and exports them to the United States by its International Business Group. (SX 28, at 2-3).

8. Sharp Electronics Corp. (SEC) is a New York corporation having its principal place of business at 10 Sharp Plaza, Paramus, New Jersey 07652. SEC imports and sells in the United States, rotary wheel

typewriters manufactured by Sharp in Japan. (SX 27, at 2-4, 7-8).

9. Triumph-Adler Aktiengesellschaft fur Buro-und Informationstechnik (Triumph-Adler) is a corporation of the Federal Republic of Germany, having its principal place of business at Fuerther Strasse 212, D-8500, Nuremberg 1, West Germany. Triumph-Adler manufactures rotary wheel typewriters in Germany and exports such typewriters to the United States. (SX 24, at 3, 7).

10. Adler-Royal Business Machines, Inc. (Adler-Royal) is a Delaware corporation having its principal place of business at 1600 Route 22, Union, New Jersey 07083. Adler-Royal is wholly-owned by Triumph-Adler North America, Inc., 500 Day Hill Road, Windsor, Connecticut 06095, which is a holding company and a wholly-owned subsidiary of respondent Triumph-Adler. Adler-Royal imports into the United States and sells rotary wheel typewriters manufactured by Triumph-Adler in Germany. (SX 25, at 3-4, 8-9).

11. Towa Sankiden Corp. (Towa) is a Japanese corporation having its principal place of business at Tohpre Building, No. 4-2 Goban-cho, Chiyoda-ku, **Tokyo, Japan. The following companies are engaged in the production of rotary wheel printing systems as subcontractors to Towa: Takahashi Kogyo Ltd.; Daikiu Kogyo Co., Ltd.; Kawaguchiko Seimitsu Co., Ltd.; Hamamatsu Electronics Co., Ltd. Towa's rotary wheel printing systems are exported to the United States by the following companies:**

Uchida Yokoo Co., Ltd.; Gakken; Kandentsu Co., Ltd.; Nasco Corp.; Nagata Tsusho; Sumitomo Corp.; Zuikoh 2us:',,in Co., Ltd. Towa Corporation of America, an affiliate of Towa, located at 1313 S. Pennsylvania Ave., Morrisville, Pennsylvania 19067, !mports into the United States and sells rotary wheel printing systems manufactured by Towa. (EX 32, at 2-6).

12. Olympia Werke Aktiengesellschaft (Olympia) is a corporation of the Federal Republic of Germany with its offices at Olympiastrasse, Postfach 960, Wilhelmshaven, Federal Republic of Germany. Olympia manufactures rotary wheel printers and rotary wheel typewriters in Germany which are sold in the United States. Qume has concluded a settlement agreement with Olympia which has been approved by the Commission. (Qume - Olympia Settlement Agreement, CX 210; Procedural History, supra).

13. Olympia U.S.A., Inc. (OUI) is a domestic corporation having its principal place of business at Box 22, Summerville, New Jersey. OUI imports into the United States and sells rotary wheel printing systems designed and manufactured by Olympia in Germany and by Nakajima All Precision Co., Ltd. in Japan. OUI has been terminated from the investigation on the basis of a settlement agreement entered into by Qume and Olympia, and approved by the Commission. (Complaint, 1 431 RPTF No. 16, accepted by complainant, Complainant's Comments on RPTF, at 3; Qume - Olympia Settlement Agreement, CX 210; Procedural History, swore).

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14. Matsushita Electric Industrial Co., Ltd. (MEI) is a Japanese corporation having its principal office at 1006 Oaza Kac.oma, Kadoma-shi, Osaka 571, Japan. MEI manufactures rotary wheel printing systems in Japan and has exported to and sold in the United States such printing systems. Qume and MEI have concluded a settlement agreement which has been approved by the Commission. (Que - MEI Settlement Agreement, CX 210; Procedural History, supra).

15. Matsushita Electric Corp. of America (MECA) is a domestic corporation and wholly-owned subsidiary of MEI, located at One Panasonic Way, Seacaucus, New Jersey, 07094. MECA imports and sells in the United States rotary wheel printing systems manufactured in Japan by MEI. MECA has been terminated as a respondent in this investigation on the basis of a settlement agreement concluded between Qume and MEI. (Qume - MEI Settlement Agreement, CX 210; Procedural History, supra).

16. Tokyo Juki Industrial Co., Ltd. (Juki) is a Japanese corporation with its offices at 23-1, Kabuki-cho 1-chome, Shinjuku-ku, Tokyo 160, Japan. Juki manufactures rotary wheel printers and typewriters in Japan. Qume and Juki concluded a settlement agreement which has been accepted by the Commission. (Respondents' Proposed Stipulation No. 11, Respondents' Joint Prehearing Statement on Technical - issues, at 9; accepted by complainant, Tr. 7; Qume-Juki Settlement Agreement, CX 210; Procedural History, supra).

17. Juki Industries of America, Inc. (J1A) is a domestic corporation wholly-owned by Juki, with its offices at 421 North Midland Avenue, Saddle Brook, New Jersey 07662. JIA imports and sells in the United States rotary wheel printers and typewriters manufactured by Juki. JIA has been terminated as a respondent in this investigation on the basis of a settlement agreement concluded between Qume and Juki, which has been accepted by the Commission. (Respondents' Proposed Stipulation No. 12, Respondents' Joint Prehearing Statement on Technical Issues, at 9; accepted by complainant, Tr. 7; Qume - Juki Settlement Agreement, CX 210, Procedural History, supra).

18. Primages, Inc. (Primages - Taiwan) is a corporation of the Republic of China (Taiwan) with its offices at Hsin, Chu, Taiwan, Republic of China. Primages - Taiwan manufactures rotary wheel typewriters in Taiwan. Primges - Taiwan has been terminated as a respondent in this investigation on the basis of a settlement agreement and consent order agreement entered into by Qume and Primages which has been approved ry the Commission. (Respondents' Proposed Stipulation No. 13, Respondents' Joint Prehearing Statement on Technical Issues, at 9-10; accepted by complainant, Tr. 7; Procedural History, supra).

19. Primages, Inc. (Primages USA) is a domestic corporation wholly-owned by Primages - Taiwan, with its offices at 600 Johnson Avenue, Bohemia, New York 11716. Primages USA imports and sells rotary

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wheel typewriters in the United States. Primages USA has been terminated as a respondent in this investigation on the basis of settlement and consent order agreements entered into with Qume, which have been accepted by the Commission. (Respondents' Proposed Stipulation No. 14, Respondents' Joint Prehearing Statement on TeChnical Issues, at 10; accepted by complainant, Tr. 7; Procedural History, supra).

III. PRODUCTS IN ISSUE

20. Rotary wheel, or daisywheel, printers are serial impact, "fully formed" character printers which produce correspondence quality print. Since the time that daisywheel technology was introduced onto the market, it has largely displaced electromechanical typewriters, such as the IBM Selectric element type of printer. The industry has gradually come to accept daisywheel printers as the standard for letter quality printing. (Oliver, CX 169, at 11; Billadeau, RXE 134, at 15; Billadeau, Tr. 2193, 2262).

21. When Qume first introduced its printers, its primary customers were original equipment manufactures (OEMs) of word processing systems. It was common for these customers to utilize the printer as a component of the system, i.e., a centralized printer would be connected to a central processor or computer supporting several workstations for word processing input. In recent years, however, the advent of relatively inexpensive professional/personal computers has led to a

return to the decentralized configuration of one printer for one word processor. (Lee, CX 164, at 3, 7; Shires, CX 166, at 4-5).

22. This daisywheel technology has been adapted to electronic typewriters. The more sophisticated electronic typewriters now have all of the components of a word processing system built in on a reduced *scale.* These typewriters have a small central processor, thin window liquid crystal or other type of display to preview what will be printed, a keyboard, and a daisywheel printer. Many of these typewriters can also be interfaced with computers, so that they operate as an output printer. (Lee, CX 164, at 6-8; Shires, CX 166, at 5-6).

23. Since 1976, Qume has manufactured the following models of rotary wheel printers:

Widel		Speed
Sprint Micto 3	3/35	35 cps4/
	3/45	45 cps
	3/55	55 cps
	3/X302/	30 cps
	3/X40	40 cps
Widetrack	3/WT40	40 cps
Twintrack	3/TT75	75 cps
Sprint 5	5m52/2/	45 cps
	5/55212/	55 cps
Widetrack 11 2/3/		40/50 cps
Sprint 7	7/30	30 cps
	7/45	45 cps
	7/55	55 cps

Sprint 8	8/20	20 cps
	8/35	35 cps
	8/50	50 cps
	8/40-130	40 cps
Sprint 9	9/45	45 cps
	9/55	55 cps
Sprint 10	10/35	35 cps
	10/40	40 cps
	10/50	50 cps
Sprint 11	11/40	40 cps
	11/55	55 cps
	11/40 WT	40 cps
Virgo		25 cps

1/ characters per second
2/ model now discontinued
3/ sold with integrated keyboard.

(SX 3, at 2, 7).

24. Qume sells in the United States the Letter Pro 20, a 20 cps daisywheel printer manufactured in Japan for Qume under the terms of a license and supply contract with Tohoku Ricoh Co., Ltd., an associated company of Ricoh Co., Ltd. (Shires, CX 166, at 3; CX 209, Settlement Agreement between Qume and Ricoh, 11 D, 1(b), 13).

25. Nakajima manufactures and exports to the United States the following models of rotary wheel typewriters and printers:

Typewriters

Model	Speed	External Interface	Interface Capability
AS-300	13.3 cps		
AE-330	13.3 cps		X
AE-335	13.3 cps	X	X
AE-350	13.3 cps		X
AE-354	13.3 cps		
AE-355	13.3 cps	X	
Printer			
AP-650	13.3 cps	X	X

(SX 26, at 6; Enomoto dep., CX 524, at 40-42; Snyder dep., SX 31, at 17).

26. Sharp manufactures and exports to the United States, and SEC imports and sells in the United States, the following models of rotary wheel typewriters:

Model	Speed	External Interface	Interface Capability
ZX400'	20 cps		
ZX410	20 cps	X	X
ZX500	20 cps		
ZX505	20 cps		
2101/	20 cps		

1/ The model 210 is sold by Sharp to Exxon Office Systems.

(SX 27, at 4; SX 28, at 4, 5, 7, Ex. A; Matsui dep., CX 653, at 80-83; Yoshisato dep., CX 657, at 23-24; CX 610, 613, 619).

27. Triumph-Adler manufactures and exports to the United States, and Adler-Royal imports and sells in the United **States the** following mpadels of rotary wheel typewriters:

Model	Speed	**External** Interface	**Interface Capability**
1005/5005	17 cps		X
1010/50101/	17 cps		X
1011/50111/	17 cps		X
1020/5020	17 cps		X
1030/5030	17 cps		X
1035/5035	17 cps		X
1040/5040	17 cps		X
1041/5041	17 cps	X	X
Satellite II/ Alpha 2001	10 cps		X
310/410	14 cps	X	X
Satellite III	14 cps	X	X

1/ Models now discontinued.

(SX 24, at 7; SX 25, **at 8-10, 12-13**; **CX 1174, Answer to Interrogatory** Nos. 3, 5; Gharibian dep., CX **800, at 15-18**; **Ayling**, **RXE 133**, **at 6-7**; CX 365-369, 371, 382-384).

28. Towa manufactures **and exports to the United States the following models** of rotary wheel **printing systems**:

Model	Speed	**Typewriter Printer**	**External Interface**	**Interface Capability**
R1 Printext	16 cps	**P**	**X**	**X**
R2 Executive 77	15 cps	T/P	X	X
R3 Excellence 55	12 cps	**T**		

(SX **32**, at 8-10, Sekiguchi, RXT 157, **at 5-8)**.

IV. PATENT IN SUIT

29. U.S. Letters Patent 4,118,129 ('129 patent) entitled "Rotary Wheel Printing System" issued to complainant Qume as the assignee of Willy J. Grundherr on October 3, 1978. The patent is sometimes referred to herein as the "Grundherr II" patent. (CX 1; RTF 32, not objected to by complainant).

30. The '129 patent generally relates to a rotary wheel (daisywheel) printing system with an electronic circuit arrangement of particular character for positioning the print wheel and actuating the hammer of the printing system. The print wheel is mounted on a translatable carriage that moves horizontally along a line of print like any familiar single element typewriter, e.g., the "golf ball" typewriter made by IBM. The print wheel is rotated into a printing position and a hammer strikes the character at that position to form an imprint of the character on a print medium. (RTF 33, modified in accordance with CX 1 changing "printer" to "printer system," and as modified, not objected to by complainant).

31. Infringement is alleged by complainant of claims 1 through 7 of the '129 patent by respondents Sharp and SEC (CPS, at 38), and of

claims 8 through 10 by all respondents. (CPS, at 32). However, complainant has stipulated that claim 1 is representative of claims 1 through 7, and claim 8 is representative of claims 8 through 10. (Prehearing Conf. Tr. 82-83; CX 1).

32. Claims 1 and 8 of the '129 patent are "Jepson" claims which describe the prior art relating to rotary wheel printing systems and then state the improvement therein which comprises the invention. (CX 1).

33. Claim 1 provides that what is claimed is for use in a rotary wheel printing system having

> (a) a translatable carriage;
>
> (b) means for translating said carriage along a print line;
>
> (c) a rotary print wheel [daisywheel) mounted on said carriage, said rotary print wheel having a plurality of individual print characters distributed about the radial center thereof;
>
> (d) means for rotating said print wheel;
>
> (e) means for impressing said print characters against a print member;
>
> (f) first position indicating means for generating signals representative of the instantaneous position of said print wheel, said first position indicating means including an encoder disc mounted for rotation with said print wheel and having a plurality of alternately arranged opaque and

translucent portions arranged in a substantially circular timing track about the radial center of said disc; and

(g) means responsive to said print wheel position signals for actuating said imprinting means;

THE IMPROVEMENT WHEREIN SAID FIRST POSITION INDICATING MEANS INCLUDES

(h) a first light source mounted adjacent a first surface of said disc,

(i) a plurality of light sensitive devices mounted adjacent the opposite surface of said disc and responsive to the angular displacement of said opaque and translucent timing track portions when said print wheel is rotated for generating a pair of position trains having a substantially constant phase difference, and

(j) first feedback means for maintaining the intensity of said light source substantially constant, said first feedback means including:

(i) power means for applying electrical power to said light source;

(ii) first light sensitive means disposed adjacent said opposite side of said dist at a position to continuously intercept light radiation emitted by said first light source for generating an electrical signal representative of the intensity of said light radiation adjacent said light sensitive devices;

(iii) comparison means for comparing said intensity signal with a standard signal representative of a pre-established desired light intensity;

(iv) means for generating a correction signal when said intensity signal differs from said standard signal; and

(v) means for coupling said correction signal to said power means to vary the magnitude of said light intensity to re-establish said desired light intensity.

(CX 1, C51. 13, line 63 through Col. 14, line 36).

34. Claim 8 provides that what is claimed is for use in a rotary wheel printing system having:

(a) a translatable carriage;

(b) means for translating said carriage along a print line;

(c) a rotary print wheel mounted on said carriage, said rotary print wheel having a plurality of individual print characters distributed about the radial center thereof;

(d) means for rotating said print wheel;

(e) means for impressing said print characters against a print medium;

(f) first position indicating means for generating signals representative of the instantaneous position of said print wheel;

(g) means adapted to be coupled to an external data source for receiving a multi-bit character representative of a character to be printed; and

(h) means responsive to said print wheel position signals and the character stored in said receiving means for actuating said impressing means;

THE IMPROVEMENT WHEREIN SAID LAST-NAMED MEANS INCLUDES

(i) a memory device having

(i) a first portion for storing a plurality of multi-bit characters each representative of the location on said print wheel of a different one of said print characters and

(ii) a second portion for storing a plurality of individual hammer intensity characters each representative of the intensity with which the associated print character in said first portion is to be impressed against said print medium, different ones of said hammer intensity characters rrpresenting different hammer intensities,

(j) means for sequentially fetching (or reading out) the multi-bit location character and the associated hammer intensity character specified by the character stored in said receiving means, andli

(k) means coupled to said memory means for converting the individual fetched hammer intensity characters to corresponding actuation signals for said impressing means having a magnitude dependent upon the intensity assigned to the corresponding hammer intensity character.

V. BACKGROUND OF THE INVENTION

35. The inventor of the '129 patent device is Willy J. Grundherr. (CX 1). Mr. Grundherr is an electronics engineer, having graduated from the Swiss Federal Institute of Technology in 1961. He had a varied background as an electronics engineer in Switzerland and (CX 1, Col. 15, lines 35-68).

1/ An expert for respondents, Mr. Wakerly, testified to the effect that "fetching" and reading out" are synonymous with regard to this portion of claim 8. (Wakerly, Tr. 1473; Also see, Tr. 1830). See also Certificate of Correction issued November 27, 1984 by the Patent and Trademark Office (PTO), which changes "fetching" to "reading out" and "fetched" to "read out" in claim 8. (ALJX 1) the United States prior to 1971, when he first began to work on a rotary wheel printing system. Such prior work experience included the design of analog and digital circuitry. In his last position prior to his work on rotary wheel printing systems, he worked as a project engineer designing subsystems for computer systems, including controllers for magnetic tape drives, disc drives, paper tape readers and punches, and interfaces with specialized equipment such as A/D and D/A converters. (CX 171, Grundherr W.S., at 1-3).

36. On April 1, 1971, Mr. Grundherr went to work for Diablo Systems, Inc., in Hayward, California. (CX 171, Grundherr W.S., at 3).[2/] There he became involved in the early stages of the electronic design for a rotary wheel printer. His task was the design of the digital circuitry for that printer. In addition to the digital circuitry, he designed some of the analog circuitry for possible use in the printer. By the end of December 1971, or the beginning of January 1972, the first prototype of a daisy wheel printer was exhibited by Diablo. During the period April 1, 1971, through the end of that year, Mr. Grundherr not only designed the printer's digital and analog circuitry, but he was also involved in designing a printer exerciser and a printer controller to permit the printer to be driven from a Data General computer. (CX 171, Grundherr W.S., at 3-4).

2/ Sometime in 1972, Diablo was acquired by Xerox Corporation. (Koenig, Tr. 1858-60; Campbell, Tr. 2017-19; CX 171, Grundherr W.S., at 5; Grundherr, Tr. 715; Lee, Tr. 1210).

37. TOward the end of 1971, it was decided at Diablo that the rotary wheel printer then being designed should have two hammer intensities. (CX 171, Grundherr W.S., at 4). The prototype models employed a servomotor to drive the daisy wheel and to move the carriage. (CX 171, Grundherr W.S., at 5). A magnetic incremental encoder was used to feed back position information from the print wheel. (Grundherr, Tr. 676; CX 171, Grundherr W.S., at 5).

38. After the prototypes were exhibited at the end of 1971, and early 1972, Diablo completely redesigned the printer's circuit boards to improve its performance, before putting the printer into production. This took at least another three to four months. This printer was known as the Hy Type I and Mr. Grundherr's work on it resulted in U.S. Letters Patent 3,858,509 (the '509 patent), also sometimes referred to herein as the Grundherr I patent. (Grundherr, Tr. 672).

39. The '509 patent is entitled "Control Logic for Print Wheel and Hammer of High Speed Printing Apparatus," and was issued on January 7, 1975. The inventor thereof is listed as Willy J. Grundherr and the assignee is listed as Xerox Corporation. The filing date was July 10, 1972. (RXT 41).

40. The invention is described *in* general terms in the Abstract of the invention as follows:

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Control logic for the print wheel and hammer of a high speed printing apparatus includes a read only memory containing identification words related to the sequential character position of the rotary printing wheel. These identification words are accessed by inputed ASCII characters and compared with the actual position of the print wheel to provide a difference count which drives the print wheel to its new location. The identification words of the print wheel characters are stored in two's complement format to provide for easy differencing with the actual print wheel position. Also, the identification words in read only memory contain an additional binary bit which provides information to the hammer logic unit as to whether the specific character is to be hit hard or lightly.

(RXT 41).

41. In the '509 device and the Hy Type 1 printer a read only memory (ROM) with a 256 x 8 bit capacity is used to store binary coded identification words corresponding to the sequential physical location of each of the type elements around the print wheel, as well as hammer intensity information. Only 7 bits were utilized to accomodate the 96 characters on its print wheel. The eighth bit of the character identification word was used in this invention to provide information as to whether the hammer should hit a particular character either hard or lightly. (RXT 41, Col. 3, lines 15-33; CX 79; CPX 79). The claims of the '509 patent show that in this device the ROM must be accessed simultaneously for both the character location and hammer intensity information. (RXT 41, Col. 6, lines 5-14, 41-52; Col. 7, line 9 through Col. 8, line 9).

42. While with Diablo Mr. Grundherr also worked on a printer designated Mark I, which was a special version of the Hy Type I printer. (CX 171, Grundherr W.S., at 5; Campbell, Tr. 2022; Koenig, Tr. 1859). It was part of a program of the Xerox Corporation known as the ZODIAC program. (Koenig, Tr. 1859; Campbell, Tr. 2021-22). The ZODIAC program entailed a word processing system intended to compete with the IBM mag card system. (Campbell, Tr. 2021).

43. The design of the overall system for the ZODIAC program was the responsibility of a company called ISS, which was acquired by Xerox at the same time it acquired Diablo. (Campbell, Tr. 2021, 2054-56; Koenig, Tr. 1860), Diablo was in charge of building a printer for the system. (Koenig, Tr. 1859).

44. The Mark I printer was designed to incorporate the capability to handle proportional spacing, that is, to be able to move the carriage horizontally in increments of 1/120 of an inch, as compared to increments of 1/60 of an inch in the By Type I, and had four levels of hammer intensity, instead of the two levels in the By Type I. (Campbell, Tr. 2023-24). The circuitry which controlled the character position selection and hammer intensity was contained in a control unit which was separate from the Mirk I printer. (Campbell,_ Tr. 2026-27, 2046, 2054-56). The control unit was the responsibility of ISS. The people at Diablo had nothing to do with its development. (Campbell, Tr. 2050, 2053, 2054-57).

43. In the ZODIAC system the print wheel position, hammer intensity and other related information was stored in a ROM in the control unit. When the ROM was addressed for printing it loaded a 12 bit register which passed the print wheel position and hammer intensity information to the Mark I printer. (Campbell, Tr. 2026-27, 2048, 2056). The people at Diablo knew only that there were 12 data lines coming in from the control unit and that such data had to be processed by the printer. (Campbell, Tr. 2050, 2054-57).

46. Although the record shows that Mr. Grundherr, as well as others at Diablo, worked on the Mark I printer, it does not establish knowledge on their part as to how the print wheel location and hammer intensity data were generated by the circuitry of the control unit. (FF 44-45, supra). Mr. Grundherr designed the electronics for the Mark I printer, as well as a controller (interface) and an exerciser for that device. There were also at least ten prototypes of the Mark I printer built before Mr. Grundherr left the project. (Grundherr, Tr. 674, 711-12).[1/] However, the uncontradicted testimony of Mr.

2/ The controller designed by Mr. Grundherr was obviously not the same as the control unit or controller described by Mr. Campbell, for which ISS had sole responsibility. (Campbell, Tr. 2046, 2053, 2054-57). Mr. Grundherr described the "controller" designed by him as an interface between an external data source and the printer. The data was supplied to the printer through this controller. (Grundherr, Tr. 711-13). Mr. Grundherr further explained that he was able to check out the functions of the printer through the exerciser which he designed. (Grundherr, Tr. 713). Thus, the evidence shows he could check out the functions of the Mark I without having access to the ISS control unit.

Campbell shows that Mr. Grundherr and the other employees of Diablo were never informed of the circuitry of the control unit designed by ISS. They only knew what data were being transferred to the printer through the 12 data lines coming in from the control unit. (Campbell, Tr. 2050, 2054-57, 2063, 2065). The Diablo people had a simulator or exerciser by which they could test the operations of the Mark I device. (Campbell, Tr. 2065; Grundherr, Tr. 713).

47. The ZODIAC program resulted in a word processing system, which included the Mark I printer, and which became the subject of U.S. Letters Patent 4,138,719, issued on February 6, 1979 to Swanstrom et al., and assigned to Xerox Corporation. (RXT 218; Campbell, Tr. 2034-40). The foreign application priority date on such patent is November 11, 1974.

48. Mr. Grundherr left Diablo/Xerox in May 1973 and went to work for Ancilex Corporation, which later became Qume Corporation. (CX 171, Grundherr W.S., at 10). Ancilex had only recently been founded, in March 1973, by David Lee and Lon Israel. (CX 164,'Lee W.S., at 2). In these early stages of Ancilex Corp.'s existence, its personnel included Jack Jamieson and Ernie Hess, as well as Messrs. Grundherr and Lee, who were former employees of Diablo/Xerox. (CX 171, Grundherr-W.S., at 10-11).

49. At Ancilex (Qume) Mr. Grundherr was given overall responsibility for the development of the electronics for the new printer that company had decided to build. He also worked on the development of an exerciser and controller for the computer interface which were intended for use with the printer. It was their goal at Ancilex to develop a daisywheel printer which was a better product and a lower priced product than the Hy Type I printer which, by this time, was on sale by Diablo/Xerox. The first prototype of Qume's printer was completed by the end of 1973. (CX 171, Grundherr W.S., at 11-12).

50. Later in 1973, Mr. Grundherr reviewed the work he had done on the prototype Qume printer with a patent attorney to determine the patentability of his contributions to such printer. He worked with Mr. Kujawa, a patent attorney, in the preparation of the patent application and, after reviewing the final draft and agreeing with its disclosures, signed it. He also executed an assignment assigning the entire right to his invention to Qume. (CX 171, Grundherr W.S., at 23-24). That application eventually resulted in the '129 patent here at issue. (CX 1).

VI. <u>THE PROSECUTION HISTORY OF THE '129 PATENT</u>

51. The patent application was filed on July 1, 1974, at the PTO and assigned Serial Number 484,055. It named Willy J. Grundherr as the inventor and Qume as the assignee. (RXPT 3, 3rd page).

52. By Office Action mailed March 5, 1975, the examiner subjected claims 1-14 to restriction or election requirement. The examiner found that restriction to one of several inventions was required. Be grouped: claims 1-7 together as being drawn to a rotary printing wheel having a light means-disc apparatus to indicate the position of the print wheel; claims 8-10 as drawn to a rotary printing **wheel** haVing a memory device and related structure for storing multi-bit characters and the print hammer intensities related thereto; and claims 11-14 as drawn to 'a control system used with a rotary print wheel for indicating the optimum direction of rotation of the print wheel. In accordance with these classifications, he found that the inventions were distinct from'one another, in that they had attained a separate status in the art and were separately classified, so as to require divergent fields of search. In addition, he found that the separate inventions were capable of supporting separate patents. **(RXPT** 3, Office Action of 3/5/75).

53. By amendment filed March 17, 1975, the applicant traversed the examiner's three-way restriction requirement, stating that the claims as grouped by the examiner all emphasize different aspects of the same overall system. For the purpose of complying with the prOCedural requirements of the Office Action, however, applicant elected Group II (claims 8-10) for further prosecution. (RXPT 3, Amendment of 3/17)75).

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54. B.y Office Action of October 10, 1975, the restriction requirement of March 5, 1975 was withdrawn, but claims 1-14 were rejected. Claims 8-14 were rejected under 35 U.S.C. 112 as being indefinite on the grounds that the phrase said individual fetched hammer intensity" in claim 8 had no apparent antecedent basis and no clear meaning (because the word fetched was improper) and because the word "said" was misspelled on line 4 of claim 11. Claims 1-7 were rejected under 35 U.S.C. 103 as unpatentable over Bossi (3,773,161) in view of Jones (3,232,404) and Allington (3,859,539). Claims 8-10 were rejected under 35 U.S.C. 103 as unpatentable over Bossi as applied in view of Grundherr (3,858,509 - Grundherr I). Claims 11-14 were rejected under 35 U.S.C. 103 as unpatentable over Bossi in view of Jones and Grundherr. Other prior art, Van Buskirk (3,631,250), Kocher (3,566,782), Gilbert et al. (3,866,533), Anglin et al. (3,837,457), Beery (3,712,212), Foley (3,353,483), Becchi (3,651,916), Tutert el al. (3,366,214), and Garnett (3,755,687) were made of recor'd to show light intensity control, printer with photoelectric cells, impression control positional control, impact control, coded disks, printing device with photoelectric cells, code comparison, and light intensity control, respectively. (RXPT 3, Office Action of 10/10/75).

55. An amendment was filed on January 13, 1976, in response to the Office Action of 10/10/75. Claims 1 and 5 were amended to more clearly define the encoder disc and feedback loop which are the subject

thereof, in order to further distinguish these and their dependent claims from the prior art cited by the examiner. Claims 8-14, although intended to be amended, were accidentally omitted from this amendment. The REMARKS section of this filing refers to "amendments" to the latter claims, to provide for "a memory device having a <u>first portion</u> for storing a plurality of multi-bit location characters and a <u>second portion</u> for storing a plurality of individual hammer intensity characters, and means for <u>sequentially</u> fetching the multi-bit location character and the associated hammer intensity character ...," but the cited amendments were erroneously left out of the filing. (RXPT 3, Amendment of 1/13/76, see <u>particularly,</u> at 5, 6, 9-10, 11).

56. In the latter filing of the applicant, the Grundherr '509 patent was distinguished from applicant's device as follows (based on the amendments which were erroneously omitted from the filing):

> In Grundherr, each multi-bit location character stored in memory 43 includes a single bit in the most significant bit position which specifies one of two alternate hammer intensities for that location character (see Fig. 4). Thus, in Grundherr the hammer intensity bit is an integral part of the location character. Accordingly, it cannot be said that the Grundherr ROM 43 has a first portion for storing the location characters and a second portion for storing associated individual hammer intensity characters.
>
> In addition, once a particular location character is specified by an ASCII character stored in registers 41, 42, both the bits representing the character location and also the hammer intensity bit are simultaneously fetched

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from ROM 43, the location bits being routed to adder units 57, 58 and the intensity bit being routed to the hammer logic via gate 44. In the applicant's device, on the other hand, after an ASCII character is placed in register 83 (Fig. 8) the multi-bit location character located in the upper half of ROM 91 is read out to arithmetic unit 93 until the select control signal changes state, indicating that the print wheel is in position. Thereafter, the hammer intensity character associated with that location character is fetched from the lower half of ROM 91 and routed to the hammer drive unit 95 to control the intensity with which the hammer is operated. Stated differently, in Grundherr the location bits and the intensity bit are simultaneously read out during the print wheel rotation and hammer firing cycle, while in the applicant's system as claimed a location character is first read out after which the associated hammer intensity character is sequentially read out. It is further noted, that it is technically impossible to modify the Grundherr arrangement in order to provide sequential read out of the location bits and the intensity bit while still remaining within the scope of the Grundherr disclosure since every bit in the addressed row of ROM 43 is immediately read out once that row is addressed by the character in registers 41, 42.

Claims 11-14 stand rejected under 35 U.S.C. 103 as unpatentable over Bossi in view of Jones, Grundherr, and Markkanen et al. or Deyesso et al. Independent claim 11 as presently amended defines the memory device as including means responsive to an access control signal for <u>sequentially</u> reading out a multi-bit address character and the associated hammer intensity character specified by a character stored in a first storage means, and defines the timing and control means as including first means for generating the access control signal to effect read out of the multi-bit address character and <u>subsequent</u> read out of the associated hammer intensity character when a differential signal from an arithmetic unit indicates that a print wheel is corrected a [sic] aligned for printing a symbol represented by the character stored in

> the first storage means. The arguments above setting forth the deficiencies in the Grundherr reference apply with equal force to claim 11. (Emphasis in original).

(RXPT 3, Amendment of 1/13/76, at 10-11).

57. The applicant did not treat the Beery '212 patent individually in the REMARKS section, but argued that it and the other remaining references cited by the examiner had been "carefully considered but are not seen to supply the deficiencies in the references cited as noted above." (RXPT 3, Amendment of 1/13/76, at 12). Mr. Kujawa, the patent attorney in charge of this application, testified herein that he was of the opinion that no greater reference to Beery '212 need be made. In so deciding he "relied on the fact that the Examiner had clearly reviewed this patent, applied the Grundherr '509 patent and other references against the claims; and merely cited Beery '212 as of interest in the disclosure of a printing system incorporating an impression control function." Thus, he considered Beery '212 to be merely cumulative prior art. (CX 174, Kujawa W.S., at 9).

58. By Office Action of March 26, 1976, the examiner rejected claims 1, 3-5, 7-16.[1/] Claims 1, 3-5, 7 and 15-16 were rejected under 35 U.S.C. 103 as unpatentable over Bossi in view of Jones and Allington. Claims 8-14 were again rejected under 35 U.S.C. 112, as being indefinite. Claims 8-10 were again rejected under 35 U.S.C. 103

4/ Claims 2 and 6 had been cancelled and claims 15 and 16 added in this amendment. (RXPT 3, Amendment of 1/13/76).

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as unpatentable over Bossi in view of Grundherr, and claims 11-14 were again rejected under 35 U.S.C. 103 as unpatentable over Bossi in view of Jones and Grundherr. (The amendment affecting the latter three rejections were those which had been omitted from the filing). In making the rejections of claims 8-10 and 11-14, the examiner noted the fact that he did not understand applicant's arguments regarding alleged limitations on these claims, since such limitations do not appear in the claims. (RXPT 3, Office Action of 3/26/76, see particularly, at 4, 5).

59. The Office Action of 3/26/76 was made FINAL. (RXPT 3, Office Action of 3/26/76).

60. Upon receipt of the final rejection, Mr. Kujawa realized that the intended amendments to claims 8 and 11 were erroneously omitted from the 1/13/76 filing. Since the application was then under final rejection, he decided that the best way to proceed would be to file a streamlined continuation application and a preliminary amendment to correct this error. (CX 174, Kujawa W.S., at 10-11).

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61. The continuation application was filed on June 28, 1976, and it was assigned Serial Number 700,654. (RXPT 2). In the application Mr. Kujawa asked the PTO to make a copy of the former application. Thus, the original, unamended application was made part of the file. (Kujawa, Tr. 1085).

62. The preliminary amendment to correct the earlier erroneous omissions was not filed until December 10, 1976. (RXPT 2, Preliminary Amendment of 12/10/76).

63. In about April 1977 Mr. Kujawa **checked on the status of this** application and found that it **was stuck in the application branch for clerical reasons. In order to speed up the prosecution, he then filed a copy of** the original application together with **a declaration stating it was a true and correct copy. However, he mistakenly designated the serial number of the continuation application with the original, parent serial number -- 485,055. (Kujawa, Tr. 1088; RXPT 2, Advisory Letter and Declaration filed 4/18/77).**

64. By Office Action of August 23, 1977, Examiner Rader rejected claims 1-14 of the application. The grounds for rejection were much the same as in the **parent file. Claims 8-14 were again rejected under 35** U.S.C. 112 **as being indefinite for the same reasons - cited in the Office Action of 10/10/75 in SN 485,055. Claims 1-7 were**

again rejected under 35 U.S.C. 103 as unpatentable over Bossi in view of Jones and Allington. Claims 8-14 were again rejected under 35 U.S.C. 103 as unpatentable over Bossi, but in this instance, in view of Lundquist (4,004,503), Deyesso et al. (3,789,971), or Markkanen et al. (3,586,953) -- instead of Grundherr. (RXPT 2, Office Action of 8/23/77).

65. Upon receipt of this Office Action, it became apparent to Mr. Kujawa that the preliminary amendment had still not found its way to the examiner, since claims 15 and 16, added by way of the preliminary amendment, were not referred to in the Office Action. (CX 174, Kujawa W.S., at 12; RXPT 10, Rader Dep. at 25, 26).

66. The Office Action of 8/23/77 set a shortened statutory time period for response to such action which would expire three months from the date thereof -- on November 23, 1977. (RXPT 2, Office Action of 8/23/77).

67. Mr. Kujawa prepared another amendment dated November 23, 1977, incorporating the same limitations as the preliminary amendment and incorporating new remarks to address the new combination of references used to reject claims 8-14. (CX 174, Kujawa at 12).

68. However, in mailing the new amendment on the last possible date, Mr. Kujawa failed to date the certificate on the first page of

the amendment and, since the amendment was not received in the Patent Office until November 28, 1977, the application went abandoned. (Kujawa, Tr. 1088).

69. On December 20, 1977, Mr. Kujawa mailed a petition and declaration to the PTO requesting that the holding of abandonment be withdrawn. He contended **that** the PTO should give effect to the typing date of November 23, 1977, shown on the first sheet of the amendment. The PTO denied such petition on the ground that Section 1.8 of Title 37 of the Code of Federal Regulations requires that the certificate state the date of deposit which was not done. It was also noted **that there was no basis to assume that a typing date must also represent the mail** deposit date. (RXPT 2).

70. On March 13, 1978, **Mr. Kujawa filed a Renewed Petition To Revive stating the facts concerning the omission from the Certificate of the date of mail deposit of the November 23, 1977 Amendment and noting the hardship on applicant if the application were to be abandoned due to this technical error. Affidavits of14r. Kujawa and his secretary were attached to the petition. (RXPT 2).**

71. On May 12, 1978, the petition was granted-and the delay in prosecution was held to be unavoidable. (RXPT 2).

72. By Office Action of May 25, 1978, all of the claims were

allowed on the basis of applicant's communications of December 10, 1976, November 28, 1977 and March 13, 1978, and a telephone interview with Mr. Kujawa on May 24, 1978. (RXPT 2, Office Action of 5/25/78).

73. After the Office Action of August 23, 1977 (FF 64, supra) there was a change in the examiner assigned to this application. The original examiner, Ralph T. Rader, who had been in charge of this application since the parent application, SN 485,055, was replaced by Paul T. Sewell. (RXPT 2, Office Action of 8/23/77, Office Action of 12/9/77)

74. At some time after Mr. Rader had issued his Office Action of 3/26/76 in the parent application file (FF 58-59, supra) and prior to his Office Action of 8/23/77 in the continuation application file (FF 64, supra), Mr. Rader decided that the Grundherr '509 patent was not a good reference as against this particular application, since the '509 patent had an issuance date of January 7, 1975, which was after the filing date of the parent application and, the two (Grundherr I and Grundherr II) show the same inventive entity (Willy J. Grundherr). Be made a handwritten notation to this effect in the upper right-hand corner of the search sheet at the rear of the parent file, SN 485,055. (RXPT 3, Search sheet, 4 pages from rear of file; RXPT 10, Rader dep., at 30-32).

75. There is no evidence of record that this examiner's opinion

of the validity of the '509 patent as a reference against the Grundherr II application was ever communicated to Mr. Kujawa. However, Mr. Rader did not rely on Grundherr '509 in his Office Action of 8/23/77. (RXPT 2, Office Action of 8/23/77).

76. Section 304 of the Manual of Patent Examining Procedure provides as follows:

> Where applicant has pending two applications with overlapping subject matter claimed therein, and assigns one of the applications in its entirety, which assignment is duly recorded in the Patent and Trademark Office, the assigned application at once may become a reference against the second application for all common subject matter disclosed, irrespective of the dates of filing of the two applications, and also of any subsequent assignment of the second case to another assignee.

(Manual of Patent Examining Procedure, S 304 (1976)).

77. The '509 patent reveals that it was assigned to Xerox Corporation. (RXT 41).

78. Concurrent correspondence between Mr. Kujawa and foreign patent associates and correspondence between the patent law firm and Qume executives reveal that Mr. Kujawa was convinced throughout the prosecution of this patent application that the '509 patent was a valid prior art reference in this application. (RXPT 72, 73, 74, 75, 79, 189). His testimony, which I credit, confirms this fact. (CX 174, Kujawa W.S., at 18; Kujawa, Tr. 1055).

79. The evidence of record herein does not show conclusively whether or not Examiner Sewell considered the '509 patent in allowing the claims in SN 700,654, the continuation application. Mr. Sewell had no recollection as to whether he reviewed the '509 patent at any time during the portion of the examination that he conducted in SN 700,654. (RXPT 7, Sewell Dep. at 25-26). He did testify that it was the PTO's general practice, when considering continuation applications wherein he inherited the application from another examiner, to give full faith and credit to the prior examiner's work. If everything is in order in the file wrapper, then unless there is something which needs to be checked, there isn't reason to go back to the parent, in general." (RXPT 7, Sewell Dep., at 43-44). However, at the same time he stated that he did not have a general practice in examining continuation applications with respect to reviewing parent applications -- "Each case is done on a case-by-case basis." (RXPT 7, Sewell Dep., at 44-45). Moreover, in his allowance of the claims in this application he cited to certain communications from applicant, including that of 10/10/76, which stated as follows in the REMARKS section:

> This amendment effects certain editorial corrections to the specification of the application, and adds limitations to more perspicuously <u>distinguish the nature of the applicant's invention from the references cited and applied in the course of prosecution of the parent application serial no. 485,055,</u> filed July 1, 1974 for ROTARY WHEEL PRINTING SYSTEM.

(RXPT 2, Amendment of 10/10/76, emphasis added).

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80. There is also no evidence to establish whether or not Mr. Sewell considered the Beery '212 patent in allowing the claims in SN 700,654. (RXPT 7, Sewell Dep., at 27-28). This patent was not used as a reference in any of the rejections, following the Office Action of 10/10/75. (RXPT 3).

81. In contemporaneous correspondence, primarily with foreign patent agents and attorneys, Mr. Kujawa stated the opinion that the most pertinent prior art references against Grundherr II, were the Grundherr '509 patent and the Beery '212 patent. Of course, in such communication he expressed the belief that the suit patent herein, Grundherr II, could be distinguished from each of these patents for various reasons given therein. (RXT 75, 189; see also, RXT 77-79).

82. Also contemporaneously with the prosecution of the parent application and the continuation application relating to the suit patent, complainant Qume was engaged in litigation with Xerox in which Xerox charged Qume and its co-founder David Lee with, 'among other things, infringement of the '509 patent, theft and misuse of trade secrets, and breach of contract and breach of trust. (RXPT 8-2, at 3.4-3.5; Lee, Tr. 1267; Kujawa, Tr. 1116).

83. In connection with that litigation Qume took certain positions regarding the charges made against it in such litigation. Included among those positions were its arguments that:

> (a)"The electronic system employed in the '509 patent is comprised of well-known electronic components .... The basic building blocks disclosed in the '509 patent are shown as comprising a Character Register (A), Read Only Memory (hereinafter ROM) (B), an Adder/Print Control Unit (C), a Print Wheel (D), and a Printer Hammer Unit (F)
> None of the individual components of the Fig. 1 system are ar se new, and each of the components operates in its conventional and intended manner ....
> There is no new element in the entire system and each of the elements performs its conventional and intended function. As the patentee Grundherr himself has testified, the overall function of the combined elements produces nothing more nor less than what would be obvious and expected to anyone of ordinary skill in the arts.

(RXPT 8-2, Qume's Trial Memorandum in Respect of the Patent Issues, <u>Xerox v. Qume,</u> at Bates Nos. 14905-12).

> (b) In arguing that the subject matter of the '509 patent "in all significant aspects was put into practice by IBM in its manufacture and sale of the IBM Selectric typewriter ...," Qume stated that:
>
> "The choice by Grundherr of using a ROM rather than some other perhaps more expensive or bulky memoty system was both obvious and understandable. Not only would Grundherr's selection of a ROM, not constitute an invention, but it could possibly be said that Grundherr would have been derelict in his engineering competence had he selected some other more expensive or cumbersome system for this particular circuit arrangement.

(RXPT 8-2, at Bates Nos. 14925-26).

> (c) In arguing that the '509 patent was invalid over the Beery prior art reference, Qume argued that the principal difference between the '509 patent and Beery '212 was that the '509 patent specifies that the character location and hammer intensity data must be

"simultaneously" read out of the memory device, whereas in Beery '212 such data are generated "sequentially." It urged further, however, that in comparing these two patents, "[t)he patent examiner was simply in error in reaching a legal conclusion that the difference between 'sequential' and 'simultaneous' activity rose to the level of invention."

(RXPT 8-2, at Bates Nos. 14917-23, 14924).

(d) At another point in its trial memorandum, however, Qume did urge that the "simultaneous" generation of position and hammer force signals in the '509 device distinguished it from the Qume device (the '129 device) which generates this data "sequentially." (RXPT 8.2, at Bates Nos. 14920-23).

84. The positions taken by Qume in the Xerox v. Qume litigation included a number of alternate defenses, including allegations of invalidity of the '509 patent and non-infringement thereof by the Qume device. (RXPT 8.2 at Bates Nos. 14900-56, Qume's Trial Memorandum in the Xerox v. QumP litigation). Moreover, other contemporaneous internal documents of Qume and its patent attorneys take positions which are ooposed to some of those taken in that litigation, including those noted in subparagraphs (a) through (c) of FF 83. (See, e.g., RXT 72, 73, 74, 75, 77-79 and 189).

85. Applicant did not inform the patent examiner during the prosecution of either the parent application, or the continuation application, that it considered the '509 patent and the Beery '212 patent to be the most pertinent prior art references (FF 81), nor of the arguments set forth in FF 83, which it had made in the Xerox v.

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Qume litigation. (Kujawa, Tr. 1151; RXPT 2, 3).

86. Applicant also did not inform either examiner that the By Type I printer, based on the '509 patent, and its maintenance manual were on sale and distributed more than one year before the filing date of application SN 485,055. (Grundherr, Tr. 673; Kujawa, Tr. 1135, 1167).

VII. THE RELEVANT ART AND DEFINITION OF PERSON OF ORDINARY SKILL IN THE ART

87. The relevant field of art involved in this matter is the design and implementation of control logic for printing systems, especially rotary wheel printing systems. (CX 1, 5, Grundherr, Tr. 850-52; Beery Tr. 1006-14; Campbell, Tr. 2029-34; RXT 128, Simpson **W.S.** at 2-4, 6, 7; Simpson, Tr. 1497, 1510, 1514-15, 1520-23, 1524, 1525, 1526, 1528-29, 1530, 1534, 1536, 1538; see particularly, Simpson, **Tr.** 1528-29, 1530 and 1534).

88. It is the contention of respondents, based upon the testimony of two of their **expert witness, that the field of art relevant to claim 8 of the suit patent was solely one of** logic **design. (RTF 92-98; Highleyman" Tr. 1594-96; Wakerly, Tr. 1424-25; See also, RXT 127, Bernstein W.S., at 16-17). It is significant that both Dr. Highleyman and Wakerly hold doctorate degrees in electrical engineering and extensive backgrounds in the electrical and computer engineering**

fields. Neither could be considered as merely persons of <u>ordinary</u> skill in the field of logic design. (RXT 216; Wakerly, Tr. 1396-1400). Another expert presented by respondents, Dr. Bernstein had a Ph.D. in mathematics. Although he had no formal training in engineering, he has had practical experience in the engineering field from reading texts and dealing with engineers. (Bernstein, Tr. 1656-57). His experiences in the computer field have included both software and hardware design. (Bernstein, Tr. 1665). He considers himself to be a person of superior skill in the art, at least in some respects. (Bernstein, Tr. 1711).

89. In defining the relevant art and a person of ordinary skill in the art, I find the testimony of another of respondents' witnesses, Mr. Claude 0. Simpson to be far more instructive. Mr. Simpson is an electronics engineer who, in the period 1972-74, was doing work which is highly relevant to these issues. In 1971 he started a company known as Data Applications International (DAI) in Brussels, Belgium. The activities of this company were directed to computer systems engineering, consulting and programming. One of DAI'S initial clients was INTEL which was one of the leaders in the electronic field and who was responsible for the introduction of microprocessor chips. (RXT 28, Simpson w.S., at 1-2).

90. In the fall of 1972, Mr. Simpson was contacted by Triumph-Adler (one of the respondents herein) at the suggestion of

their local INTEL sales engineer. Triumph-Adler, was then interested in learning how microprocessors could be programmed and integrated into circuitry for its typewriters. (RXT 128, Simpson W.S., at 2-3).

91. Mr. Simpson "first agreed to provide a three day training course in microprocessor technology. His lecture notes and class exercises were directed toward a typewriter environment ... During the class sessions,the discussion and exercises were directed toward the theoretical design of a set of firmware logic modules that would control the movement of a type head in response to a position specified by a multi-bit input code whose origin could, for example, be the result of key depression ... Basically, the discussed design would control four (4) stepping motors by pulse sequencing ...." (RXT 128, Simpson W.S., at 3).[1/]

92. After the three day course, Mr. Simpson was asked to stay on at Triumph-Adler for an additional two days to discuss his class model and further refinements with Triumph-Adler personnel. At the end of this further study period Triumph-Adler gave DAI a contract to complete a feasibility study for a typewriter with the design concept advanced during the course. A development program in association with Triumph-Adler was formalized. Together, they proceeded to further formulate design specifications for a typewriter whose logic was completely controlled using a microprocessor. (RXT 128, Simpson W.S.,

5/ Mr. Simpson uses the term "firmware" to refer to a program for a microprocessor that has been resided in a ROM, and the program is then not changeable. (Simpson, Tr. 1543).

at 6). Work on the Triumph-Adler project progressed through 1973. The DAI typewriter control firmware was coded and tested during the summer and fall of 1973. The final delivery by DAI of the control programs and their acceptance by Triumph-Adler was made in the fall of 1973. (RXT 128, Simpson W.S., at 10-11).

93. Triumph-Adler completed work on the prototype of the typewriter, by integrating the control programs and data tables from DAI, in the winter of 1973-1974. Mr. Simpson actually typed on the machine at this time. (RXT 128, Simpson W.S., at 11). This work by DAI and Triumph-Adler spanned the time period of November 1972 to January 1974. (Simpson, Tr. 1497).

94. The work of the Triumph-Adler engineers and their input into this project was a very essential part of this cooperative venture between DAI and Triumph-Adler. As Mr. Simpson testified

> We never had said we knew about typewriters. In fact, the original discussion evolved around controlling the type ball and spinning it and stepping it and so on. Obviously we didn't know anything about impact strength. We didn't know anything about the accuracy with which you have to pulse the motors to achieve certain speeds and so on. And this was what was brought into the discussion by the Triumph engineers is that sort of discussion and trying to match that with our logic proposals.

(Simpson, Tr. 1528).

95. DAI provided "the program, the detailed level." It wrote the program for the controller and assisted the Triumph-Adler design engineers in. interfacing and making the controllers together with the mechanical drive motor and the specifications therefore. (Simpson, Tr. 1534).

96. According to Mr. Simpson, microprocessors were relatively new in 1972-1973. DAI acted as an application group for INTEL to go to their prospective customers and explain to them how microprocessors might be useful inside logic designs, and that is the way Mr. Simpson came in contact with Triumph-Adler. (Simpson, Tr. 1524). It is significant that after this project was complete DAI had no further contact with Triumph-Adler. Mr. Simpson "assumed that their engineers had been trained enough to go forward themselves." (Simpson, Tr. 1530).

97. DAI agreed to keep all of its work for Triumph-Adler confidential for a two year period. DAI did not publish any of its work and Mr. Simpson was unaware of any publication by Triumph-Adler. (Simpson, Tr. 1498).

98. The cooperative venture of DAI and Triumph-Adler, as outlined in FF 89-97, above, is illustrative of the relevant field of art and the state of that art in the period 1972-1974, the relevant time period for this investigation. It makes it clear that the

relevant field of art is not simply logic design completely divorced from printirig system technology, as contended by respondents. (FF 88). Rather, the relevant field of art is the design and implementation of control logic for printing systems, especially rotary wheel printing systems. (FF 89-97).

99. Such experience also negates the testimony of respondents' experts who testified that the manner of address of a ROM as used in the '129 patent was well known in the art during this time period and that it was obvious to employ a ROM in the manner set forth in claim 8 of the suit patent. (RTF 97-98). It is clear that the ROM technology was new enough and enough of a mystery in the printing system field, so that the engineers at Triumph-Adler did not know how to utilize it during this 1972-1974 period. It was thus necessary for them to hire an outside specialist to explain this new technology to them. (FF 89-97).

100. Furthermore, this experience shows that the logic designer could not by himself produce an electronic typewriter'or other printing system such as the Qume printer, without **specific experience in that** field. (FF 94).

101. The testimony of Mr. Simpson accords with that of Messrs: Grundherr and Beery concerning the definition of a person of ordinary skill in the relevant art. Mr. Grundherr indicated that it would take at least six to nine months experience working with printers to make an

electronics engineer into a person of ordinary skill in this art. technician, without an electronic engineering degree, would require at least five years of experience. (Grundherr, Tr. 850-52). Mr. Grundherr added that whether such person were an engineer or a technician, he or she would also have to be a creative person. (Grundherr, Tr. 851). Mr. Beery, in describing a person of ordinary skill in the art testified that one important element was that

> You have to be down in the arena and have done it and if you weren't down in the arena, if you haven't practiced this, you weren't proficient at it. You weren't familiar with the problems associated with printing.

(Beery, Tr. 1006).

Mr. Beery went on to indicate that it might take an engineer as much as five years to become proficient in printer designing. (Beery, Tr. 1008). He further indicated that experience solely in logic design would be insufficient. The person must understand the problem. (Beery, Tr. 1009). It was Mr. Beery's opinion that both the use of the ROM by Grundherr and the feedback loop (claim 1) were inventions. (Beery, Tr. 1009).[6/]

6/ If the Grundherr and Beery testimony were standing alone, I would have to consider their personal interest in this investication. Mr. Grundherr is, of course, the inventor of the '129 device. Mr. Beery is an employee of ITT, the parent corporation of complainant Qume (CX 173, Beery W.S., at 2) and a former employee of Qume (Beery, Tr. 953-54). However, in view of the corroboration by the Simpson testimony, I must credit their testimony concerning the relevant field of art and the definition of a person of ordinary skill in that art, regardless of their interests.

102. Accordingly, I find that a person of ordinary skill in the relevant art, during the period 1972-1974, was an electronics engineer with at least six to nine months hands-on experience in the design and implementation of control logic for printing systems, either the golf-ball type printing system or a rotary wheel printing system, or a technician with at least five years experience in the design and implementation of control logic for such a system. 7/

VIII. PRIOR ART

A. Claim 1

103. In all three rejections of claim 1 and its dependent claims, twice in the parent file and once in the continuation file, the examiner rejected claims 1 and its dependent claims under 35 U.S.C. 103, as unpatentable over Bossi, in view of Jones and Allington. (RXPT 3, Office Actions of 10/10/75 and 3/26/76; RXPT 2, Office Action of 8/23/77).

104. The Bossi patent (3,773,161) "relates to serial high-speed impact printers employing the on-the-fly principle of printing ... which accomplish printing by means of a printing hammer and a strike resisting platen, or printing bed." (CX 9, Col. 1, lines 5-10). One such printer would employ a daisywheel type "type-carrying member"

7/ I have included golf-ball type printing systems in this definition since the testimony of Mr. Simpson indicates there are many similarities involved in these two technologies. (RXT 128, Simpson W.S., at 3-9, Simpson, Tr. 1497).

which is "maintained in appropriate motion so that all of the characters of the type-carrying member pass sequentially through **a** predetermined printing position. The type-carrying member is mounted on a printing carriage on which the printing hammer is mounted, and the entire carriage moves either by a continuous or a step-by-step motion along the print line." (CX 9, Col. 1, lines 11-21). The "Background of the Invention" goes on to describe some disadvantages in the prior art of such printers. (CX 9, Col. 1, lines 25-67). The Bossi invention is described as remedying these problems by providing for "two distinct printing hammers to operate selectively in **two distinct** phases of motion of the printing carriage and two distinct **sectors** of the type-carrying member ... thereby permitting the successive printing of two characters in consecutive printing positions and with a very short interval of time from one to the other. (CX 9, Col.2, lines 3-13). The preferred embodiment in Bossi includes a daisywheel type-carrying member, i.e., a type-carrying **member consisting of a plurality of radial reeds, or blades. "The characters are provided in relief, each on the extremity of a reed." (CX 9, Col. 2, lines 44-47;** Figs. 1, 2a and 2b).

105. The Bossi device, as noted in FF 104, is an on-the-fly printer which includes a timing disc which rotates in synchronism **with the character member and in fixed relationship with the movement of the printing** carriage. This disc is keyed to the shaft of the motor **and**

cooperates with certain sensors (optical, magnetic or other) which supply suitable pulses for character timing and recognition. (CX 9, Col. 2, lines 51-54). The disc presents a sequence of notches on its periphery, each notch corresponding to a character position on the character member. A sensor generates, in correspondence with the passage of each notch in front of a detecting head, an electric pulse, which is applied to the input terminal of an electronic binary counter. The disc and the detecting head constitute, in general terms, a detecting means for detecting the position of rotation of the type carrying member with respect to a reference point. The output leads of the counter supply a binary code representing the different characters which reach a printing position in successive intervals. The output signals are applied to input terminals of a comparison circuit which receives other input leads thereof, a binary code representing the character to be printed. When the code of the character in the printing position matches the code of the character to be printed, the comparison circuit issues a print command which is applied selectively to one of the two hammers provided on the printer. (CX 9, Col. 5, line 46 through Col. 6, line 13).

106. The Jones reference (U.S. Letters Patent 3,232,404) refers to a "Keyboard Operated Printer With Electtical MeansPreventing Operation of Plural Keys." (CX 7). It relates to a keyboard operated printer with a continuously rotating (on-the-fly) type wheel. In this

device sigmils from a code wheel are matched with coded keyboard signals to effect printing when the proper character is presented from the rotating wheel. (CX 7, Col. 1, lines 54-60). The patent calls for a rotating encoder disc mounted for rotation with the print wheel. (CX 7,Col. 2, lines 14-20). In the preferred embodiment the encoder disc is an opaque disc which is coded by punching groups of parallel binary bit holes therein. Thus a lamp and photo diode array produces distinctive binary coded signals to the amplifier section for each character presented on the type wheel. (CX 7, Col. 2, lines 21-25).

107. The Allington patent (3,859,539) refers to an "Optical System." (CX 11). This patent is directed to an apparatus for use in quantitative photometric analysis. (CX 11, Col. 3, lines 64-67). This system includes a primary light source, a radiating member, a light intensity monitoring system, a prolate spheroid reflector, and a system utilizing the light radiated from the radiating member to provide beams of light for use in instruments. (CX 11, Col. 2, lines 13-18). Its purpose is to maintain the primary light source constant. This is done through a feedback which controls the intensity of the light emitted from the primary light source. (CX 11, Col. 2, lines 19-32). In this device the monitoring photocell must be mounted closely adjacent the primary light source,so as to monitor the light directly from the primary light source. Thus, a change in the intensity of the light emitted by the lamp causes a relatively large change in the amount of

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light flux received by the photodetector compared to the change in the intensity of light in the light beams. (CX 11, Col. 6, lines 17-25). This patent also teaches that relocation of the monitoring photo sensor to a location adjacent a light receptor, rather than monitoring the primary light source directly, leads to impairment in the performance of the feedback. (CX 11, Col. 1, lines 44-55, Col. 2, lines 53-67).

108. The examiner also referenced several other patents in his Office Action of 10/10/75 which bear somewhat on the invention in claim 1 of the '129 patent. He cited to Van Buskirk (3,631,250) to show light intensity control, Kocher (3,566,782) to show printer with photoelectric cells, Anglin et al. (3,837,457) to show positional control, Foley (3,353,483) to show coded discs, Becchi (3,651,916) to show printing device with photoelectric cells, Tutert et al. (3,366,214) to show code comparison, and Garnett (3,755,687) to show light intensity control. (RXPT 3, Office Action of 10/10/75). None of these references are as pertinent as his three primary references. Van Buskirk's invention is not related to a printing system and there are material differences in intended operation of the encoder disc and feedback loop from those in the '129 device. (RXT 26). The Kocher patent is dealt with more fully below „since it is one of the prior art reference principally relied upon by respondents in their proposed finding. (FF 112, below). Anglin et al. is concerned with a single element printer having a closed loop digital electronic control. In

thil3 invention the feedback loop performs a different function from that in the '129 device. It is not used to maintain a light source at a sensor device substantially constant, but rather, in this instance the feedback loop is directly used for position control of the printing element in a golf-ball type printers. (RXT 40). Foley deals with a laminated timing wheel for high speed printers. It merely reveals the use of a coded disc, consisting of similarly formed laminae, which determines the location of each print character at any instant as it moves along a printing line. It is intended for use in a chain-type high speed printer (rather than a daisywheel) and, since it is a mechanical timer, has no light emitting diodes, sensors or feedback loop. (RXT 11). Becchi reveals a printing device with interchangeable printer members. It deals with an on-the-fly daisywheel printer. The timing device utilizes a light beam and photoelectric cells placed on each side of the print wheel to determine character position. There is no encoder disc or feedback loop. (RXT 28). Tutert et al. provides for a code comparison system for setting a type roller. In this invention a code wheel is attached to a stepper motor for the purpose of setting a type roller or similar type carrier. The encoder disc is dissimilar to that in the '129 device and there is no feedback loop. (RXT 12). Lastly, the Garnett patent refers to a pulse generator in a flowmeter which is indifferent to vibration by external means. This device, contrary to the '129 device, is intended to increase the intensity of light from the light source when the light intensity at

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the phototransistor increases. Thus, the encoder wheel and the feedback loop in this device are substantially different from that in the '129 device. (RXT 32).

109. Several other patents are cited by respondents, in their proposed findings and briefs, as prior art relating to claim 1. Those principally relied upon are: Dubauskas (3,775,617); Holter (3,760,162); and Kocher (3,566,782). It is alleged that one of ordinary skill in the art could easily have constructed the electro-optical encoder device of claim 1 of the '129 patent, at the time the '129 device was made, by combining the concepts from the Dubauskas patent (RXT 28) and/or the Holter patent (RXT 33) with an optical encoder such as that of the Kocher patent (RXT 21). (RTF 160-16[1]).

110. The Dubauskas patent (3,775,617) is concerned with a "Servo Apparatus With Photosensitive Device and Compensating Circuit. (RXT 38). It consists of a servo-control apparatus for use with equipment having a servo feedback loop. (RXT 38, Abstract). It does not refer to an optical encoder (RXT 38, Abstract), but is cited by respondents to show that the use of a feedback loop on a rotary optical position sensor was known at the time of Grundherr's work. (RTF 160). In this device a compensating circuit consists of a light source, a second or compensating photosensitive device, a movable member

interposed between the light source and the compensating photosensitive device, and a galvanometer which is connected to the movable member (preferably by mounting the movable member directly on the galvanometer spindle). (RXT 38, Col. 3, lines 30-51). This movable member is also referred to therein as a light control member. (RXT 38, Col. 3, lines 60-61). This movable light control member is a substantially flat sheet with a transparent portion through which light can pass and an elongate opaque portion having a wedge-like configuration and being located within the transparent portion. (RXT 38, Col. 3, lines 40-45, Fig. 5). This member is adapted to progressively vary the light which passes from the light emitting means to the control photosensitive device in response to rotation of the member. (RXT 38,1ines. 37-40). The arrangement is such that deflection of the movable coil of the galvanometer results in deflecting movement of the light-control member. (RXT 38, lines. 58-61). In this servo-system, when it is in a balanced condition, the galvanometer will have a predetermined position by which a certain amount of light from the lamp is allowed to strike the sensing surface of the control photosensitive device. Upon a change in the condition influencing the transducer (including such conditions as heat, pressure, strain, etc.) the galvanometer will be driven either up scale or downscale, depending on the direction of the change of condition. Deflection of the galvanometer will effect a corresponding deflection in the light control member, so as to allow either more or less light to strike the sensing surface of the control

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photosensitive device. The change in light and the response of the control photosensitive device is such as to re-establish the balance of the bridge.-- (RXT 38, Col. 5, lines. 22-66).

111. The Holter patent (3,760,162) refers to "Photoelectric Readers." (RXT 33). It involves a "photoelectric reader used in a money-dispensing system to read information that is impressed on a punched-card blank by a bank-customer's embossed credit card...." It includes an extra photoresponsive device that receives reflected light from a part of the blank outside the field of the impressions. Serial energization of light-emitting devices that illuminate the blank is regulated in dependence upon the output of the extra photo-responsive device to tend to maintain this output constant and thereby compensate for temperature and other variations that would otherwise affect the readout of the information imprint. (RXT 33, Abstract). Again, this invention does not involve a photo-encoder. It does regulate the level of illumination of an illuminated field in accordance with variations in a signal that is derived from a photo-responsive device. (RXT 33, Col. 1, lines 4-14). This latter aspect of the Holter invention is intended to compensate for variations in the response characteristics of the photoelectric readers involved herein, such variations arising, for example, from temperature changes. (RXT 33, Col. 1, lines 24-31). The light emitting devices in such readers may be gallium-arsenide devices (LED devices). (RXT 33, lines 21-23; Bernstein, Tr. 1839).

Respondents cite to this patent primarily to show that the need to compensate LED light sources for aging was known at the time of Grundherr's work on the '129 device. (RTF 161).

112. The Kocher patent (3,566,782) **is concerned with an** "Address Synchronizer." (RXT 21). It **entails a "synchronizer for the** address counter of an **on-the-fly print wheel with two photoelectric cells, one of which generates pulses in response to all character pads, or spaces, of the wheel, and the other in response to all spaces but one. The unpaired pulse is used for settling the address counter."** **(RXT** 21, Abstract). The **Kocher patent reveals a rotary wheel, on-the-fly, printing device which utilizes a photoelectric assembly to determine the address of a character to be printed. In this device one character pad in the daisywheel is radially shorter than the others. The two photoelectric cells provide narrrow beams of light through which the character pads pass successively. Thus the character pads and the spaces between them provide dark and light elements to which the photoelectric cells respond. The one photoelectric cell is set so as to respond to all of the character pads of the print wheel. The other is set so as to respond to all of such character pads, except for the one which is radially shorter than the others. A coder receives an input signal identifying a character to be printed and transmits a number representative of the address of that character to a coincidence detector. A continuously running address counter driven by pulses from the photocell presents, in succession, the numerical addresses of the**

characters on the print wheel, and when an address so presented corresponds to the address of the character to be printed, a signal is transmitted to the print control, which actuates the hammer. (RXT 21, Col. 1, line 52 through Col. 2, line 14). Although this device includes an optical encoder device, it does not provide for an optical encoder disc such as that used in the '129 patent, nor does it utilize a feedback loop to compensate for variations in the signals produced by the photoelectric device utilized therein. (RXT 21).

113. As for the references cited by the examiner, both the Bossi and Jones patents relate to on-the-fly daisywheel printing devices, which differ in material respects from the '129 device, especially in determining character location for printing purposes. In the '129 patent the print wheel does not rotate continuously. When a character to be printed is identified, the optical encoder system first determines the current position of the print wheel and the location of the character to be printed, in relation to the current position. The '129 device then determines the shortest distance to the character to be printed and rotates the print wheel in the selected direction to the point where the desired character is in the print position. The optical encoder system therein provides position reference signals used to control an associated position counter unit and an electronic servo control system for driving the associated motor, the servo control system having both a position and a rate mode of operation. (CX 1, see particularly, Abstract). The Bossi and Jones devices on the other

hand are concerned only with comparing a desired character to be printed with the character position on a continuously running wheel. When the tw match up the hammer is actuated. In addition to other obvious differences, the control system is not concerned with the rate mode of operation. (CX 7 and 9). Due to the very nature of the Bossi and Jones devices they do not recognize any problems of signal deterioration and, therefore, do not require any compensating mechanism such as the feedback loop of the '129 patent. (CX 7, 9).

114. Allington (CX 11) is directed to an apparatus for use in quantitative photometric analysis. (FF 107). Given the different nature of that art from the field of art here at issue, there is no evidence of record why a person of ordinary skill in the design and implementation of control logic for a rotary wheel printing system would look to the teachings of this non-analagous art to find a solution to a problem in rotary wheel print systems controls. This is especially so, when it is considered that Bossi and Jones do not recognize such a problem. (FF 113). Dr. Bernstein's testimony is not instructive in this regard. (RXT 127, 155; Bernstein, Tr. 1602 et seq.). Furthermore, Allington itself has material differences from the control device in the '129 patent. In Allington, the monitoring photocell must be mounted closely adjacent the light source,so as to directly monitor the light source. The change of intensity of the light source in this device causes a relatively large change in the amount of light flux received•by the photodetector compared to **the**

change in the intensity of the light in the light beams. The Allington patent thus teaches that relocation of the light sensor to a location adjacent a -1̄ight receptor is to be avoided. (FF 107). In the '129 device the sensor is located adjacent the light receptors (Figs. 5-7; Col. 5, lines 6-39) and this device is more concerned with the intensity of light at the photoreceptors than at the primary light sources. (CX 1, Col. 5, line 6 to Col. 6, line 23; claim 1, at Col. 14, lines 25-28).

115. Accordingly, I find that Bossi, either alone, or in view of Jones and Allington, does not render claim 1 of the '129 patent unpatentable under 35 U.S.C. 103. (FF 113-114).

116. The additional references by respondents also fall short of rendering the suit patent unpatentable under 35 U.S.C. 103. (FF 117-118, below).

117. Even assuming that the use of a feedback loop on a rotary optical position sensor was known during the relevant time period (RTF 160) and that the need for compensating light sources, particularly LED light sources, for aging was known at the time of Grundherr's work on the '129 device (RTF 161), the Dubauskas and Bolter patents, in view of the Kocher patent still have not been shown to render the '129 claim 1 device obvious to a person of ordinary skill in the art. (RTF 163). In findings 110-112, above, I have described various material

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differences between each of these patents and the '129/claim 1 device. The principal evidence concerning the relationship between these patents and the Grundherr optical encoder disc with feedback loop is the testimony of Dr. Bernstein. (RXT 127, 155; RTF 160-164). Dr. Bernstein is self-professedly one of "superior" skill in the art. (Bernstein, Tr. 1711). Moreover, Dr. Bernstein admitted that he knew of no commercially available optical encoders in 1973 that had the feedback compensation system of the '129 patent. (Bernstein, Tr. 1720). On the other hand, a person of ordinary skill in the art, Mr. Beery, characterized Mr. Grundherr's encoder with the feedback loop as "super creative." (Beery, Tr. 1009-10). Under the circumstances, the evidence does not support respondents' position that these references would have rendered the claim 1 device obvious to a person of ordinary skill in the art, during the relevant time period.

118. Respondents also argue that the rotary optical encoders used by Grundherr in the '129 device were commercially available at that time and that all of the components of the feedback loop were standard components at that time. They thus allege that Grundherr took standard components and combined them in a standard way with a standard feedback loop to add to a standard optical encoder in making the '129 device. (RTF 155-159). The record does not support this position. First of all, the optical encoders used by Grundherr and purchased from Litton and Disc had to be made to Qume's specifications and were not commercially available. Grundherr was not able to use

the encoders which were commercially available. (Grundherr,Tr. 735, 839). As for the components of the feedback loop, the photocell, the Zener diode, the differential amplifier, the load and the power transmitter, Mr. Grundherr's testimony indicates that they were standard components at that time. (Grundherr, Tr. 791-92; RTF 157). However, this does not suggest that their inclusion in the '129 device was obvious. Mr. Grundherr also admitted that feedback loops were standard at that time, as urged in respondents' technical finding 158. However, he further testified that, as far as he knew, it was never done before with an optical encoder." (Grundherr, Tr. 792). This latter testimony was suppported by respondents' own expert, Dr. Bernstein, who testified that he knew of no commercially available optical encoders in 1973 that had a feedback compensation system such as that in the '129 device. (Bernstein, Tr. 1720).

B. <u>Claim 8</u>

119. In the first two rejections of claims 8-10, the examiner rejected these claims under 35 U.S.C. 103 as unpatentable over Bossi, in view of the Grundherr '509 patent. (RXPT 3, Office Actions of 10/10/75 and 3/26/76). In the first of these rejections the examiner also cited to Gilbert et al. (3,866,533) to show impression control, and Beery (3,712,212) to show impact control. (RXPT 1, Office Action of 10/10/75). In the last rejection, in the continuation file, the examiner rejected claims 8-14 under 35 U.S.C. 103 as unpatentable over

Bossi, in view of Lundquist (4,004,504), Deyesso et al. (3,789,971), or Markkanen et al. (3,586,953). (RXPT 2, Office Action of 8/23/77).

120. Bossi, as noted in finding 104 above, relates to serial high speed impact printers employing the on-the-fly principle of printing. In this device a daisywheel type print wheel is employed and there are a plurality of hammers mounted to move with the print wheel. (RXT 37). The examiner found that Bossi teaches the basic printer as claimed, including a translatable print head mounted on a carriage with encoder disc keyed to the shaft of the motor for character timing and recognition. (RXPT 3, Office Action of 3/26/76, at 2). I have already distinguished this device from the '129 device insofar as the encoder disc and claim 1 are concerned. (FF 104-105). In this device a comparison circuit is used in conjunction with a counter to identify the character to be printed and to determine when that character is in the printing position. The on-the-fly principle of this device differs significantly from the character selection process of the '129 patent. (CX 1). This device does not provide for different hammer intensities based on the identification of the character to be printed, as in the '129 device. (RXT 37, Col. 5, lines. 11-31).

121. Grundherr '509 was cited by the examiner as teaching control logic for a print wheel and hammer which compares the actual position of the print wheel with the desired position to provide a difference count for driving the print wheel to a new location. He

also noted that there is an additional bit in the memory device for each character which provides information to the hammer logic as to how the specific character is to be hit. (RXPT 3, Office Action of 3/26/76). Due to the errors of patent counsel this examiner never had before him the amendment to original claim 8, which described the memory system thereof and the sequential fetching of the character and intensity data. (FF 55, 60, 65, above).

122. The Grundherr '509 patent utilizes a 256 x 8 bit ROM to store the character position and hammer intensity information. Since only seven bits were necessary to accomodate the 96 characters on the print wheel of this device, "the most significant or eighth bit of the character identification word is used ... to provide information as to whether the hammer should hit a particular character either hard or lightly." (RXT 41, Col. 3, lines 10-33). In this device the character and hammer intensity data are accessed simultaneously from the memory device. (RXT 41, Col. 6, lines 5-14, 43-50, Col. 7, lines 9-10).

123. Although the '129 device also utilizes a 256 x 8 bit ROM as a memory device for storing character and hammer intensity information, it does so in a significantly different manner. In the '129 device a 256 x 8 bit ROM is again used, but in this case a second half or word of the ROM is utilized. In the first half the '129 device stores information concerning the identity of the position on the print wheel of the characters to be printed. The second half is

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used to store hammer intensity characters which specify the desired intensity with which the print hammer is to be actuated for the individual characters on the print wheel. A SELECT unit specifies which of the two portions of the ROM is to be addressed at a particular time. (CX 1, Col. 6, lines 55-63). This system allows the '129 device to adjust the hammer striking force over a wide range of magnitudes (CX 1, Col. 2, lines 14-16, Col. 12, line 56 through Col. 13, line 24), as compared to the Grundherr '509 device which allows only 2 hammer intensities -- hard or light. (RXT 41, Col. 3, lines 29-33). The '129 patent also requires the character position information to be accessed sequentially to the hammer intensity information, rather than simultaneously, as in Grundherr '509. (CX 1, Col. 15, lines 59-62).

124. Respondents contend that the improvements in the '129 device, over the '509 device, would have been obvious. They urge that it would be obvious to one skilled in the art at that time to store print wheel position and hammer intensity information in two different portions of a ROM and read out the two portions sequentially in view of the print wheel control logic of the '509 device. (RTF 143). They produced several experts who testified as to knowledge in the "logic design" art and as to printed publications, describing how a ROM could be used in this manner. (RXT 130, Wakerly W.S., at 15-21; RXT 160, Highleyman W.S., at 21-23; RXT 127, Bernstein W.S., at 15-18).

125. I have already found, in connection with determining the

relevant field of art at the time of the '129 invention, and the identity of a person of ordinary skill in that art, that the relevant field of art is the design and implementation of control logic for printing systems, especially rotary wheel printing systems. (FP 87-102). I have also found that the testimony of Drs. Wakerly, Highleyman and Bernstein was not instructive on the identification of the relevant field of art and that the best evidence in this record concerning that issue **is the testimony of another of respondents' witnesses, Claude O. Simpson, concerning his experiences with respondent Triumph-Adler in the 1972-1974 time period. (FF 89-101). On the basis of that and other evidence, I must find that the use of a ROM in the relevant technology in the 1972-1974 time period was relatively new and that the manner of use in the '129 patent was** a significant and patentable improvement **over the '509 device. (FF 88-102, 148, 152).**

126. The '129 device not only used the ROM differently, but it "sequentially" accessed the character position and hammer intensity information, in contrast to the "simultaneous" accessing <u>required</u> by the '509 patent. It also included an additional component, the SELECT unit which provided the sequential access to the two different halves of the ROM. Further, the '129 patent would allow a multitude of hammer intensities to be associated with the different characters on the print wheel, whereas the '509 **device allowed for only two different hammer intensities. (FF 122-123).**

127. There is nothing in the Grundherr '509 patent, which when combined with Bossi would render the '129 device unpatentable. The Bossi patent supplies nothing more than the basic rotary printer device to the examiner's logic. (RXPT 3, Office Actions of 10/10/75 and 3/26/76; RXPT 2, Office Action of 8/23/77). Even in this regard, the Bossi patent presents vastly different control problems, since it is an on-the-fly printing device. (FF 104, 120). Thus, the combination of these two patents teaches nothing more than the individual patents, insofar as they bear any relationship to the suit patent here in question.

128. The Lundquist patent is concerned with an arrangement in a printer of the kind having a "type drum with printing types arranged line-wise around the periphery." (RXT 45, Abstract). In the Office Action of 8/23/77 the examiner cited this reference, in connection with Bossi, Deyesso et al. or Markkanen et al. as rendering the applicant's device unpatentable. He urged that Lundquist teaches a memory device which produces excitation of predetermined electro-magnets on the basis of information in the memory as to impact intensities. He stated that it would be obvious to provide a memory device for use in controlling impact intensity in view of Lundquist. (RXPT 2, Office Action of 8/23/77, at 3). The Lundquist device did provide for "a memory device for storing information for selecting a type to be printed and electromagnets to be excited" (the electromagnets being the control for

impact intensity). (RXT 45, Col. 5, line 50 through Col. 6, line 2). In distinguishing the '129 device from Lundquist in the final amendment filed herein, applicant pointed out that the Lundquist device did not have a memory device "having a first portion for storing individual multi-bit hammer intensity characters." It was also pointed out that in Lundquist "the code disk characters are simultaneously processed for both position and intensity information during the print wheel rotation and hammer firing cycle, while in the applicant's system, as claimed, a location character is first read out after which the associated hammer intensity character is sequentially read out." (RXPT 2, Amendment dated 11/23/77, at 12, 13).

129. The Deyesso et al. patent cited by the examiner is directed to a "Servo Control System For Serial Printer Print Head." (RXT 39). The examiner cited this reference along with Bossi and Lundquist, in finding the '129 device unpatentable. He cited to the Deyesso patent as "teaching a print head positional control system for determining the minimum displacements in each of two directions in order to move the print head to a new position. Also apparatus is provided for moving the print head at a number of different velocities depending on the magnitude of each displacement." (RXPT 2, Office Action of 8/23/77, at 4). The object of the Deyesso device is to provide a print head positional control system with the capability of positioning the printhead relative only to its present position, rather than using a homing position prior to determining how to move the print

head to a new position. (RXT 39, Col. 1, lines 29-46). This device does not provide a portion of a memory device to store a "plurality of individual hammer intensity characters each representative of the intensity with which the associated print character ... is to be impressed against the print medium." (CX 1, Claim 8; RXT 39, Col. 13, lines 32-66). Therefore, it differs substantially from the '129 device.

130. Markkanen et al. is concerned with a "Stepper Motor Control System." (RXT 24). The examiner cited to this patent, in combination with Bossi and Lundquist, as teaching a stepper motor control system wherein binary coded signals representing the desired position of the motor are applied to a logic circuit which develops signals indicating the direction of rotation of the motor in order to reach the desired position in the shortest direction. (RXPT 2, Office Action of 8/23/77, at 4). Again this device does not teach a memory device having two portions, one for storing print wheel position information, and the other for storing hammer intensity information, with each being accessed sequentially during operation. (RXT 24). Therefore, this reference alone would render obvious the '129 device. (CX 1, Claim 8).

131. Furthermore, these four patents taken together -- Bossi, Lundquist, Deyesso et al., and Markkanen et al. -- do not render the '129 device unpatentable. In this regard, Examiner Rader cited these references against claims 8-14 of Qume's device without having seen,

due to various errors in the prosecution of this patent, the amended claim 8 which spelled out the two-part memory device therein and the sequential accessing of the character position and hammer intensity information during the operation of this printer. (FF 55, 60, 65, above). Moreover, Examiner Sewell ultimately allowed the amended claims 8-10 over such references in the file. (RXPT 2, Office Action of 5/25/78). I find no evidence in this record which would be instructive as to how these references would be combined to render obvious the '129 device to a person of ordinary skill in the art.

132. The Gilbert et al. patent cited peripherally by the examiner to show impression control in the Office Action of 10/10/75, is concerned with "Electrical Print Impression Control." (RXT 43). This device controls the impression of an impact printer in accordance with the thickness of the forms on which the printing is being performed. (RXT 43, Abstract). As such, it does not pertain to any of the inventive features of claim 8 of the '129 patent. (RXT 43, CX 1). The other reference cited peripherally by the examinet in that Office Action which had a bearing on claim 8 was the Beery patent. Since this is one of the principal references in respondents' contentions concerning the validity of claim 8, I will treat it more fully below in connection with respondents' other such references.

133. Respondents principally rely upon several other items of alleged prior art as rendering claim 8 of the '129 patent invalid.

They are: The Hy Type I printer and its Service Manual; the Beery patents (3,573,589 and 3,712,212); and the Zodiac system of the Xerox Corporation. (RTF 84-87, 88-91, 102-104, 140-145).

134. The Hy Type I printer and its manual were sold in 1972. (Grundherr, Tr. 673, 680). The Grundherr '509 patent covers the improvements which Grundherr claimed in this device. (RXPT 12-3, Grundherr Dep., at 104, 105). My review of the Hy Type I manual (RXPT 5) and the '509 patent (RXT 41) reveals that the '509 patent reveals all portions of the Hy Type I printer which are pertinent to the claims of the '129 patent. The only portions of the description of the Hy Type I device which respondents can point to as not being described in the '509 patent are the carriage motor, and the carriage transducer, both of which have a bearing on the movement of the carriage and are not a part of the invention claimed in the '129 patent. (RTF 228; Grundherr, Tr. 683). In both claims 1 and 8 of the '129 patent, the first portion of these Jepson type claims refers to the system having "a translatable carriage" and "means for translating said carriage along a print line." (CX 1, claims 1 and 8). However, in each case these are cited as elements of the prior art upon which the invention improves. The actual invention of the '129 patent is that portion following the language " ... the improvement wherein ..." in each case. (CX 1, Claims 1, 8). Thus, this portion of the description of the Hy Type I device is not essential to a comparison of that device to the '129 invention. The '509 patent is just as descriptive as the

actual printer and manual for the purpose of showing similarities and differences between the Hy Type I printer and the invention claimed in Claims 1 and- 8 of the '129 patent. (RXT 41; CX 1).

135. In view of my finding above that the '509 patent did not render the '129 device obvious, either separately, or in combination with Bossi, I find that the Hy Type I device and its Manual similarly do not render the '129 device obvious. (*FF* 120-127).

136. The Beery patents are U.S. Letters Patent 3,712,212 for a "variable Printer Intensity Control" and U.S. Letters Patent 3,573,589 for a "Position Servo System For a Motor Including Detenting At Destination." (RXT 31 and 22, respectively). The '212 patent contains a cross reference to the '589 patent. (RXT 31, Col. 1, Cross Reference To Related Patents And Patent Applications). As noted above, the examiner made reference to the Beery '212 patent and several other patents in the Office Action of 10/10/75 in the parent application of the '129 patent. (RXPT 3). No further reference to the Beery patents was made during the balance of the prosecution of the parent and continuation applications. (RXPT 2, 3).

137. The two Beery patents are related to a check imprinting device, the S-100, which Mr. Beery developed for Burroughs Corporation when he was employed by that firm. (CX 173, Beery W.S., at 3-5). The purpose of the S-100 machine was to imprint certain information on the

lower right-hand corner of a cancelled check. In operation, the amount to be imprinted on the check would be keyed in on the keyboard of the device. The operator would then drop the check into the machine. The check would travel down a track to the check imprinting station. A first sensor would detect the presence of the check. The check would be inhibited at this point by a set of drive rollers. The operator would then hit the "motor bar" (normally the plus key) which **would cause the roller bars to operate at low speed. The check would then enter the rolls where a second sensor would sense the lead edge of the** document and start a timing sequence from **an electromechanical clock (disk) that was rotated by the A.C. motor of the machine drive. This electromechanical disk is described in the '212 patent as disk 26. Once sequencing started, the document would move at a constant speed and** printing would take place while the check **was moving at about 2.5 inches per second. Normally twelve characters would be printed and then the check released. (CX 173, Beery W.S., at 6-8):**

138. Due to the need to have the depth of embossment of the numeric characters precisely controlled, Mr. Beery struck upon the idea of varying the energy to the hammer to achieve good machine readability. To accomplish this he utilized the electromechanical disk that was already used for print wheel positioning. He then utilized a set of gates to separate the two critical low area characters, 2 and 7, from the medium energy characters. He also identified the only high energy character, which was 8. He thus had three energy levels for

hammer intensity. Basically, he achieved this with the electromagnetic disk. (CX 173, Beery W.S., at 8-9).

139. In operation, a logic circuit commands "stepper motor start" and the motor starts to turn. The outer edge of the disk has small slots and as the disk moves from one character to the next, a slot comes under an optical detector. Each time this occurs, the optical detector is examined to see if it is on the right character. If the right character is reached, the motor stops stepping. If the right character has not been reached, the motor continues to step by a pulse produced by the outer slot in the disk. Once the print wheel is in position, the device waits for the hammer to fire. (CX 173, Beery W.S., at 9-10).

140. The hammer fire energy is derived from the position of the electromechanical encoder disk through a series of logic gates. There is no input from the keyboard character code to derive the hammer intensity. The electromechanical disk only provides information as to the instantaneous position of the disk. It is this information that provides the input to determine whether the wheel is moved or not moved, continues to move or stops. It is also this information that provides through a series of logic gates the hammer intensity information. Hammer intensity information is being generated at all times. Thus, as a wheel rotates from position 5 to position 0, you serially have the impact energy information for 5, 4, 3, 2, 1, and 0.

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It is only utilized, however, when the hammer print command is generated. (CX 173, Beery W.S., at 10-11).

141. Mr. Beery testified that his device, as described in the'212 patent, does not utilize a memory to generate hammer intensity information. He emphasized that the code entering the logic from the keyboard does not have to be converted to a disk position because the code used in the disk for a given character is the same code that appears in the counter. For a character, all that is necessary is to determine coincidence between the code of the disk, and code entering the logic from the keyboard. (CX 173, Beery W.S., at 11-12).

142. The Beery patents, '212 and '589, together describe a rotary wheel printing system with three or more levels of hammer intensity control. (FF 136-14, RXT 127, Bernstein W.S., at 11-12; RXT 130, Wakerly W.S., at 21-25; RXT 22 and 31). The '589 patent discloses a "keyboard encoder" that converts each keystroke into a code corresponding to character position on the print wheel. The Beery '212 patent, which includes the '589 patent *by* reference, also describes the translation of the keyboard information into printwheel information, but in less detail. (RXT 130, Wakerly W.S., at 22; RXT 127, Bernstein W.S., at 11; RXT 22, Col. 2, lines 46-75; RXT 31, Col. 5, lines 45-65). The '212 patent is principally concerned with the hammer intensity control for the Beery device. (RXT 31). It accomplishes the tasks of providing variable hammer intensity, three or more

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intensities, through a hard-wired network of gates. (RXT 127, Bernstein W.S., at 11). The logic of these series of gates and their respective connections to the output of the photocell units 24 is such that the hammer driving circuits are kept informed of the position of the type wheel and particularly each printing character thereon so that regardless of direction of rotation of the wheel and the position at which it is stopped to perform the printing operation the driving circuits corresponding to the characters to be printed are either independently energized or simultaneously energized to provide different current values for energizing the solenoid coil [for providing the desired hammer force]." (RXT 31, Col. 4, lines 31-41).

143. As previously noted, Mr. Beery testified that his device does not utilize a memory to generate hammer intensity information; (FF 141). Respondents' experts, on the other hand, refer to the hard-wired system of gates described in finding 142, as a memory device, and equate it to the ROM used in the Grundherr '509 and '129 patents. (RXT 127, Bernstein W.S., at 11-13; RXT 130, Wakerly W.S., at 22-25). Moreover, both of these witnesses, also read the operation of such "memory device" on the provisions of claim 8 of the '129 patent. (RXT 127, Bernstein W.S., at 12; RXT 130, Wakerly W.S., at 22-24).

144. Mr. Beery explained that as the encoder disc rotates, in the operation of his device, there is a continuous hammer energy that is not dependent upon the keyboard. It is dependent, rather, on the

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disk position. In clarification, he pointed out that if you pressed key 7 on the keyboard, but by chance something went wrong and the disk ended up at-Right, the printer will print at the energy level of the code that is there, 8, rather than at the level indicated by the original data source, the keyboard 7. There is, therefore, in his opinion, no interaction between the data source, the keyboard, and the hammer intensity control of the '212 patent. (Beery, Tr. 968-69).

145. Regardless of whether the hard-wired system of gates which provides the variable hammer intensity in the Beery device is considered a "memory device," I find that it operates in a substantially and materially different manner from the device described in claim 8 of the '129 patent. Claim 8 provides for a "memory device" having

> a second portion for storing a pluralitv of individual hammer intensity characters each representative of the intensity with which the associated print character in said first portion is to be impressed against said print medium ... means for sequentially fetching the multi-bit location character and the associated hammer intensity character specified by the character stored in said receiving means. ...

(CX 1, Claim 8).

The Beery device neither stores nor fetches the hammer intensity data in the manner specified in claim 8 of the '129 patent. The hammer intensity data in the Beery device is not "fetched" or read out in the manner specified in claim 8. As described by Mr. Beery, the hammer intensity data is continuously present and is not "fetched" in reaction to the deppession of a key on the keyboard. When the encoder disk stops and is in position and the driver circuits are activated, the hammer intensity which is continuously associated with that disk position is exerted, whether or not the disk is in the proper position. (FF 144; RXT 31). As described by Mr. Beery there is no sequential fetching. The hammer intensity information is continuously present, but only comes into **play when the driver circuits are activated. (Beery, Tr. 968-69; Wakerly, Tr. 1474).**

146. Additionally, I find that regardless of whether the hard-wired hammer intensity circuit of the Beery device can be considered a "memory device," they do not constitute a "memory device" within the intent and meaning of claim 8 of the '129 patent. (See FF 147, 148, 152, below).

147. As shown by the testimony of Dr. Wakerly the term "memory device" is subject to more than one definition. (RXT 130, Wakerly W.S., at 8; Wakerly, Tr. 1472). Since this term is not self-evident in meaning it is necessary to look to the specification of the '129 patent to determine, its meaning therein. Reference to the specification reveals that the term "memory device" refers to electronic devices such as ROMs, rather than hard-wired circuitry. (CX 1, Col. 4, lines 37-41; Col. 6, line 55 through Col. 7, line 31; Col. 13, lines 12-24).

148. As I found above, the use of microprocessors and ROMs was not known in the art at this period of time and represented a significant-advance over prior art hard-wired circuitry. (FF 88-89). As stated by one of respondents' witnesses, Mr. Campbell from Xerox Corporation,

> (Iln 1971 there wasn't a lot of ROMs used to do this kind of thing. We felt that the use of a microprocessor with ROMs to do this kind of -- to control a magnetic word or control a word processing system was unique, as is evidenced in that patent.

(Campbell, Tr. 2034). The patent to which he refers is a patent representing the control unit design for the magnetic automatic writing system which later became the Xerox 800, a portion of which was received in evidence herein as RXT 218. (Campbell, Tr. 2036-37). That patent bears a foreign application priority date of November 11, 1974, which is more than four months after the filing date of the parent application in the prosecution of the application for the '129 patent. (RXT 218; CX 1). Thus, as I have already found, the Use of a ROM in the manner described in the '129 patent was a patentable improvement over the prior art in rotary wheel printing systems. (FF 88-99).

149. Lastly, respondents cite to Xerox's Zodiac system with its ISS controller and Mark 1 printer as being prior art, in that it was allegedly conceived and reduced to practice in 1971. (RTF 84). It is

urged that this system included the identical memory device and sequential reading out of character position and hammer intensity as recited in claim 8 of the '129 patent. It is further argued that while the ROM of the Zodiac system was physically located in the ISS system controller, rather than in the Mark I printer, that such difference is of no significance in relation to the express terminology of claim 8. (RTF 85).

150. On the contrary, the location of the ROM in the Zodiac system is very material to the issues in this investigation. Even though the ISS controller may have been conceived and reduced to practice in 1972 as alleged, the Zodiac system did not take off commercially until 1976, and the priority date on the application for a patent thereon was not until November 11, 1974. (Koenig, Tr. 1897-98, RXT 218). Thus, the system of storing character position and hammer intensity data in a ROM and subsequent reading out of such data therefrom utilized in the Zodiac system can only have a bearing on the validity of the '129 patent if it can be shown that Grundherr had knowledge of such system, either directly or through other Qume personnel, or through some published article concerning the workings of this system. While the evidence reveals that Messrs. Grundherr and Lee and others at Qume had worked on the Mark I project while still at Diablo/Xerox, it does not establish knowledge in any of them as to how the ISS controller worked. (FF 42-46, Campbell, Tr. 2054-56).

151. The uncontradicted testimony of Mr. Campbell establishes that the only information available to the Diablo employees, concerning the working of the ISS controller, was that there were twelve data lines coming in from the controller to the printer which had to be in some way processed by the printer. (Campbell, Tr. 2056). The other evidence of record which shows the receipt by Grundherr, and other Diablo employees of various specifications for the Zodiac system, including provision for multiple hammer intensities, and the production of prototype models of the Mark I printer, do not establish knowledge on their part of the internal workings of the ISS controller. (RXT 86-124, 142-150).

152. Accordingly, the Zodiac system can not be found to anticipate the '129 invention. To the extent it utilized the same memory device in the same fashion to provide character position and hammer intensity information to a printer, its method of doing so was not shown to be known to the inventor of the '129 patent. (FF 150-151). The patent of the Xerox system, which covers both the ISS controller and the Mark I printer contains a later priority date than that of the '129 patent (FF 150) and there is no evidence of record of any prior publication of the details of the workings of the ISS controller. Furthermore, the fact that the patent for the Xerox 800 system includes the ISS controller device (Campbell, Tr. 2036, 2054), lends support to Mr. Campbell's testimony that the use of ROMA to

perform the functions specified therein was a patentable feature over the prior art, during the time period relevant to the issues herein 1972-1974. (Campbell, T . 2034).

IX. OTHER ARGUMENTS RELATING TO VALIDITY

153. Respondents urge that claim 1 of the '129 patent is invalid because the rotary optical encoder is misdescribed in both the specification and the claims of the '129 patent. In this connection, it is urged that Claim 1 of that patent requires the feedback circuit to maintain the intensity of the light source substantially constant and that the Grundherr rotary optical encoder must not maintain this light source constant in order to maintain the required constancy of the encoder output signals A and 8. (RTF 146-150). In making this argument respondents cite to certain portions of claim 1 and the specification, without regard to the entire context surrounding them. While claim 1 does state

> ... first feedback means for maintaining the intensity of said light source substantially constant ...

the entire context of that claim clearly reveals that said constancy refers to the intensity of the light at a point "adjacent the light sensitive devices." (CX 1, Col. 14, lines 26-28) (Emphasis added). When the portion of Claim 1 cited by respondents is read in context with the entire claim it is clear that the '129 device acts in the way specified in the claim. In fact, the last portions of that claim state

> means for generating a correction signal when said <u>intensity signal</u> differs from said standard signal; and means for coupling said correction signal to said power means <u>to vary, the magnitude of said light intensity</u> to re-establish said desired light intensity.

(CX 1, Col. 14, lines 31-36). (Emphasis added). Similarly, respondents' citation to Col. 6, lines 21-23 of the specification takes certain language of the specification out of context in a misleading manner. A reading of the entire section of the specification dealing with the optical encoder and feedback loop makes it clear that the light intensity at the photoreceptor is the light intensity which is to be maintained constant and that the light intensity at the LED source may be varied in order to keep that light intensity constant. (CX 1, Col. 5, line 6 through Col. 6, line 23). Indeed, this was made clear before the PTO. In distinguishing the '129 device from the Allington feedback system it was pointed out that the purpose of the feedback loop in the Allington device was to maintain the primary light source constant. In contrast, it was noted that in the '129 device it is only when the intensity of the light source reaching the area of the sensors varies that the source intensity is automatically adjusted. It is clearly pointed out herein that there might be variations in intensities at the light source (the LED source) in the '129 device, without adjustment, so long as the light intensity at the sensors was maintained. (RXPT 2, Amendment of 3/28/77, at 10-11).

154. It is also argued that the specification of the '129 patent does not set forth the best mode contemplated by Grundherr of carrying out his invention of a feedback loop in a rotary optical encoder. This argument is based on the testimony of Mr. Grundherr that the original design rotary encoders utilized a mask between the photocells and the light source to improve the performance. (RTF 151-154). Mr. Grundherr indicated in his testimony, however, that the mask was not essential to the operation of the feedback loop which he invented. (Grundherr, Tr. 789). It was also indicated that the mask was in the units as they were purchased from Litton and Disc. (Grundherr, Tr. 790). Moreover, the mask would not be part of the improvements over prior art which constituted the invention. (CX 1, Col. 1, lines 12-36).

155. Next, respondents urge that Qume's failure to inform the PTO that the optical encoders used in the '129 device were commercially available and that the feedback loop "was totally standard" breached its duties of candor and good faith. (RTF 292-298). As found in finding 118, above, Grundherr did not utilize the commercially available optical encoders in the '129 device. The encoders were built to his specification. Moreover, although the individual components of the feedback loop were commercially available and feedback loops, as such, were known at the time, the evidence indicates that they had not been utilized on optical encoders in this manner before. (FF 118).

156. Respondents also urge that the '129 patent misrepresents that a variable hammer force printing system as presented in that patent was mew, whereas such systems were not new in the prior art and that the applicant was aware of that fact. (RTF 174; RB at 21). The basis for this allegation is the portion of the "Background of the Invention" which reads

> In the past, hammer drive units have been designed to provide a consistent hammer striking force regardless of the character being printed ...

(CX 1, Col. 1, lines 52-54).

Respondents point out that Grundherr and probably Kujawa, the patent attorney, were aware of the '509 patent and the By Type/ printer which had two hammer intensities and that Mr. Grundherr was aware that the Mark I printer under development at Diablo had four hammer intensities. (RTF 174; RB at 21 et seq.).

157. This portion of the "Background of the Invention" cited by respondents does not state that all past hammer drive units had only a single striking force. (CX 1). Furthermore, Examiner Rader was certainly aware when he cited the Grundherr '509 patent as a prior reference that it provided two hammer intensities. (RXPT 3, Office Action of 10/10/75; RXT 41). In fact, reference to the '509 patent would also reveal the disclosure in the "Background of the Invention" section of that patent that prior art devices had used mechanical

arrangements to vary the hammer impact intensity. (RXT 41, Col. 1, lines 18-23). Then too, Examiner Rader in his 10/10/75 Office Action referred to Gilbert et al. as showing impression control, and Beery as showing impact control. (RXPT 3, Office Action of 10/10/75 at 3-4). Finally, the examiner's reference to Lundquist in the continuation file shows further awareness by the PTO of prior art printing systems with variable hammer intensity controls. (RXPT 2, Office Action of 8/23/77 at 3-4; RXT 45, Coll, lines 21-55). Accordingly, I find there was no deception involved in the accused statement.

158. Finally, the failure to call the examiner's attention to U.S. Letters Patent 3,239,049 to Voit, which discloses the variable intensity impression mechanism employed in the IBM Selectric typewriter and the one-page IBM Technical Disclosure Bulletin disclosing a character impression control mechanism, did not constitute a misrepresentation of the prior art. (RTF 257-258). Again, the accused statement in the "Background of the Invention" <u>did not</u> speak in exclusive terms and the examiner was obviously aware of the fact that some prior art included variable hammer intensity. (Fr 157). It was the manner in which the applicant's device provided variable hammer insensity which was the key to its represented patentability, not that it was the first device to provide that feature. (CX 1). Thus, even if the accused language is not as clear as it might be, it certainly is not a material misrepresentation. Insofar as the Voit patent is concerned, it has not even been relied upon by respondents

herein as pertinent prior art. (See, RXT 0, Respondents Technical Exhibit List). A reference by Kujawa to such patent as being "also of interest" in a letter to a foreign patent agent can hardly raise the failure to disclose such a patent to the level of a misrepresentation. (RTF 257-258).

X. SECONDARY CONSIDERATIONS

159. In the period of 1974 to 1978, Qume's yearly sales in daisywheel printers more than doubled during every 12-month period and increased from nothing to nearly by 1979. (CX 165, Gower W.S., at 3, 5; CX 203).

160. The features of the Qume printers covered by the '129 patent played an important part in this success. (See FF 256-262, below, concerning Qume's practice of the '129 patent). The optical encoder design contributed to a smaller, faster, more reliable printer, with fewer moving parts, and the multiple hammer intensity feature improved print quality and prolonged the life of the printwheels. (CX 165, Gower at 3; CX 164, Lee W.S., at 3; CX 174, Grundherr W.S., at 14, 22-33; Grundherr, Tr. 598-600, 779).

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XI. INFRINGEMENT

161:¯ All of the accused products of respondents, as well as the prior art in rotary wheel printing systems, include the following elements of claims 1 and 8 of the '129 patent:

(a) for use in a rotary wheel printing system having a translatable carriage;

(b) means for translating the carriage along a print line;

(c) a rotary print wheel mounted on the carriage wherein the print wheel has a plurality of individual print characters distributed about the radial center thereof; and

(d) means for rotating the print wheel.

(Stipulation, Tr. 636-637).

A. Claim 1

162. Only Sharp Corporation and Sharp Electronics Corporation (hereafter collectively referred to as Sharp) are accused of infringing claim 1 of the '129 patent. (CB at 18).

163. The Sharp products which are accused of infringement herein are rotary wheel electronic typewriters having the model designations: ZX 400, ZX 410, ZX 415, ZX 500, ZX 505 and 210. (CF 50, not objected to by respondents).

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164. The encoder system in the Sharp ZX 410 is typical of the rotary encoders used in the Sharp typewriters and is generally shown in CX 130, CX 131 and CX 132. (RTF 329, not objected to by complainant).

165. The Sharp rotary encoders are utilized to control the positioning of the print wheel and the translatable carriage motor shafts in the Sharp typewriters. (RTF 330, not objected to by complainants).

166. In addition to those elements of claim 1 stipulated to be included in all of respondents' accused products, the Sharp typewriters all include "means for impressing said print characters against a print member...." (CX 128; CF 329, not objected to by respondents).

167. The Sharp typewriters at issue also includes "a first position indicating means for generating signals representative of the instantaneous position of the print wheel ... [which includes] an encoder disc mounted for rotation with ... (the] print wheel and having a plurality of alternately arranged opaque and translucent portions arranged in a substantially circular timing track about the radial center of said disc." (CF 330, not objected to by respondents).

168. The Sharp typewriters also include a "means responsive to said print wheel position signals for actuating said imprinting means." Mr. Ueda, of Sharp Corporation, testifying in his deposition indicated that hammer intensity information is defined to a particular print wheel character. (CX 653, Ueda dep., at 21 of second day). He

also testified- to the effect therein that the host processor first obtains,from a ROM a print wheel character position and then subsequently,obtains from a different address portion of the same ROM a multi-bit hammer intensity rank. That hammer intensity rank is then processed by the, host processor, along with other information to develop a hammer intensity signal. The host processor then passes both the wheel position information and the hammer intensity information to the wheel controller. The wheel controller then converts the hammer intensity signal to a signal for actuating the hammer. (CX 653, Ueda dep., at 19-21 of second day). The host processor, the ROM and the wheel controller, therefore, together constitute a means which is responsive to the wheel position signals, among other things, for actuating the hammer drive. Certainly the hammer intensity signal and the ultimate hammer drive are related to and responsive to the character position selected. (CX 653, Ueda dep., at 19-21, of second day). The fact that other information is utilized by the host processor in developing a hammer intensity signal does not detract from that fact. (CX 653, Ueda dep., at 20 of second day).

169. The first position indicating means in Sharp's typewriters includes a light source mounted adjacent a first surface of the encoder disc. (CF 332 (a), this portion of this proposed finding not objected to by respondents).

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170. The first position indicating means in Sharp's typewriters also includes a plurality of light sensitive devices mounted adjacent the opposite- surface of the disc and responsive to the angular displacement of the opaque and translucent timing track portions when the print wheel is rotated for generating a pair of position trains having a substantially constant phase difference. (CF 332 (b), this portion of this proposed finding was not objected to by respondents).

171. The next element in claim 1 requires that the first position indicating means include "a first feedback means for maintaining the intensity of said light source substantially constant." It is respondents' position, based on the testimony of Dr. Bernstein, that the Sharp encoders do not include this feature. (RTF 331-339).

172. In the Sharp rotary encoder, the shaft to be controlled is coupled to a rotating disc with timing slots. On one side of the disc is a light source. On the other side of the disc is a fixed mask which interacts with the timing slots and the light source when the disc is rotated. This latter interaction provides four light beams of special characteristics from the single light source. Each of these beams is intercepted by a light sensor. The light sensor is a four channel sensor, with four receiving elements. (RXT 155, Bernstein W.S., at 5-6; Cx 130). Each light receiving element in the solar battery wafer (the four channel sensor) has the same layout as the fixed slit mask in terms of geometry. (CX 133, Fig. 35).

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173. The A and B beams in the Sharp encoders are designed to come on as each desired slot position goes past, but with a slight shift between them (a 90 degree phase shift) which provides for detection of both position and direction. (RTF 332, not objected to by complainant; CX 133).

174. The Z-beam in the Sharp rotary encoders is on only when the encoder disc is in the particular home position. (RTF 333, not objected to by complainant).

175. The F-beam is the feedback beam and it passes through a slit which has a width that equals several pitches of the rotating slit disc in order to receive a continuous stable beam regardless of the disc rotating angle rate. (CX 133, Fig. 35).

176. Dr. Bernstein testified that the F-beam is rendered discontinuous and choppered and thus, not constant, but that a portion of the F-beam light from the source will reach some part of the optical sensor at any given time. (RXT 155, Bernstein Rebuttal W.S., at 6; Bernstein, Tr. 1780-81, 1786). In his witness statement and upon cross examination Dr. Bernstein characterized the amount of light from the F-beam being continually intercepted by the senor as "a goodly portion." (RXT 155, at 6; Bernstein, Tr. 1795, 1799). Such testimony does not directly contradict the information on CX 133, the excerpt from a Sharp manual, which, as noted immediately above, describes the light being received by this sensor from the F-beam as "a continuous stable beam." (CX 133, Fig. 35).

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177. Dr. Bernstein has testified further that the F-signal is compared to a desired value to adjust the long term average intensity of the lig}1 source to compensate for aging of the light source and sensor, but that due to the choppering effect of the rotating disc it is not possible to use this beam to compensate for rapid changes in the characteristics of the light source and sensor. (RXT 155, at 6; Bernstein, Tr. 1780-81). He further testified that the circuitry contains a capacitor C 4 and resistor R 2 which force all variations below 0.5 milliseconds to be ignored. (RXT 155, at 6).

178. Dr. Bernstein then testified that this lack of short term stability in the light source, as well as mechanical variations in the slotted disc, can cause the A and B signals of the Sharp encoders to show significant variations in amplitude and offset (as much as 50% of the minimum amplitude). (RXT 155, at 6-7; Bernstein, Tr. 1618-19, 1622-23, 1782-83; Cx 132, table 12). Dr. Bernstein concluded from this that the Sharp encoders "do not meet the criteria for stability of the A and B signals mentioned by Grundherr and could not function in the device he designed." (RXT 155, at 7). (Grundherr had testified that in his system it was necessary to maintain the amplitude and offset of the A and B signals substantially constant for the reliable operation of the servo system of the print wheel -- Grundherr, Tr. 792; CX 171, Grundherr W.S., at 13-17).

17q. I find that Dr. Bernstein has overblown the significance of possible variations in the amplitude and offset of the A and B signals in the Sharp device. First of all, his calculation of the magnitude of such variations as being "as much as 50% of the minimum amplitude" exaggerates the extent of variation by comparing it to the minimum amplitude. The exhibit to which he refers as the basis for his calculation shows a plus or minus 20 percent variation for all of the A and B phase outputs. (Bernstein, Tr. 1806). Secondly, the Sharp manual shows that the extent of such variations is to be controlled in the Sharp system, since the manual instructs the user to replace the motor should the output waveform exceed the range of .4 volts to .6 volts. (CX 132, at 3). As for short term problems caused by dust in a slit of the slit disk, the manual instructs the user to clean the slit disc with a cameraman's lens cleaning air blower, but states that such "a problem is usually not encountered in these Products under normal use." (CX 132, at 3).

180. Dr. Bernstein's views as to the significance of the "choppering" effect on the F-signal and mechanical variations in the slotted disc and their combined effect on the A and B signals (FP 176-178, above), is principally based on his own observations, measurements and estimates. (RXT 155, at 4-5; Bernstein, Tr. 1794-1802). In addition to other variations between his views and the information in the Sharp manual, he expressed the opinion that dust will collect in this device "very fast" and indicates that dust

particles being carried around in one of the slots could cause significant short term variations for which the Sharp encoder could not compensate. (Bernstein, Tr. 1800-01; RXT 155, at 6). His view of the probability of this happening directly conflicts with the statement in the Sharp manual that "such a problem is not encountered in these Products under normal use." (CX 132, at 3). Other conclusions concerning short term fluctuations of this sort are based on his observation of the material from which the disc is made, its shape, and its responsiveness to external vibrations, noise and electrical interference. (Bernstein, Tr. 1800).

181. I must question Dr. Bernstein's expertise in these areas, since he is not an engineer. His experience in these areas is that of avocation not vocation. (Bernstein, Tr. 1652-72). He has not been shown to be qualified to testify as to these matters. I must therefore, accept the Sharp manual as the best evidence of record revealing the workings of the Sharp encoder. Although the depositions of the Sharp executives here of record reveal some errors in the manual which appear to be principally of a typographical nature, there is no evidence of record from a Sharp official, or other qualified expert in the relevant field, that the manual misdescribes the Sharp encoder and/or its operation. In fact the testimony of Mr. Ueda, on deposition, verifies the overall accuracy of the manual. (CX 653, Ueda dep., at 74-79).[2/]

Mr. Ueda is an electrical engineer and an assistant manager for Sharp Corporation. (CX 653, at 29-30 of second day of deposition).

182. Accordingly, I find that the first position indicating means of Sharp's encoders include a "first feedback means for maintaining the intensity of said light source substantially constant," within the intent and meaning of claim 1 of the '129 patent. As I found above, in connection with the validity issues in connection with claim 1, an overall reading of that claim reveals that this means maintaining the light substantially constant at the point of the "light sensitive devices." (FF 153).

183. Next, the first feedback means in the Sharp encoders include "power means for applying electrical power to said light source." The circuit diagrams in CX 133 (Fig. 38) and CX 132 (Fig. 38 on p. 27) reveal the existence of this element in the feedback circuit; the transistor connected to the light source. (CX 132-33, Fig. 38).

184. The Sharp encoders also include "first light sensitive means disposed adjacent said opposite side of said disc at a position to continuously intercept light radiation emitted by said first light source for generating an electrical signal representative of the intensity of said light radiation adjacent said light sensitive device." Dr. Bernstein and respondents deny the presence of this element of claim 1 on the bases that there is a mask between the disc and the feedback sensor on Sharp encoders, and that the light is not "continuously" intercepted. (RXT 155, at 8). Claim 1 only requires that the light sensitive means be disposed adjacent the opposite side of the disc at "a position to continuously intercept light" from the light source. (CX 1, claim 1). This does not preclude use of a mask

and, in fact, a mask was used by Grundherr in his prototype models. (FF 154). As for the continuous reception of light thereby, Dr. Bernstein admitted that there was always a "goodly portion of the light" which reached this light sensitive means. (Bernstein, Tr. 1795).

185. The Sharp encoders also have a "comparison means for comparing said intensity signal with a standard signal representative of a pre-established desired light intensity." There is a comparator connected between the feedback sensor and the power supply, as shown on Fig. 34 of CX 133. This is also shown by the comparator OP4 connected between the lowermost light sensor and the transistor connected to the light source in Fig. 38 of CX 133 and 132. (See also CX 171, Grundherr W.S., at 41-42). The Sharp encoders further include "means for generating a correction signal when said intensity signal differs from said standard signal." The differential amplifer OP4 compares the voltages at its two inputs and in response to this comparison generates a correction signal in its output whenever the input voltages differ. (CX 171, Grundherr W.S., at 41-42; CX 133, Figs. 34 and 38; CX 132, Figs. 34 and 38).

186. Finally, the Sharp encoders have "means for coupling said correction signal to said power means to vary the magnitude of said light intensity to re-establish said desired light intensity." The correction signal from the differential amplifier OP4 is applied to

the transistor Tr. to control the current flowing from the voltage source Vcc to the LED light source. (CX 171, Grundherr W.S., at 41-42; CX 132, Fig. 38; CX 133, Fig. 38).

187. Therefore, the Sharp encoders include each and every element of claim 1 of.the 129 patent and are an infringement thereon. To the extent that the Sharp encoders might not tompeniate for short term, rapid changes in the characteristics of the light source and sensor as efficiently as the Grundherr device, as claimed by Dr. Bernstein and respondents, such devices would Still have to be considered the equivalent of the '129 encoder, since they perform basically the same function in basically the same way. (FF 165-186; see <u>also</u> FF 200-201, below).

B. <u>**Claim 8**</u>

1. <u>**The Sharp Typewriters**</u>

188. In addition to the elements stipulated as being in common, as noted in finding 161, above, and the means for itpressing the print characters against a print medium, found to be in the Sharp typewriters in finding 166, above, the Sharp typewriters include all of the other elements of claim 8 of the '129 patent. (FF 189-215, below).

189. A representative block diagram of the Sharp ZX-410 typewriter is shown in RXPT 37 and CX 128. The block labeled thereon as D7801-060 is a main central processing unit (main CPU or host CPU). (RTF 301, 302, not objected to by complainant).

190. Data for printing may flow along two alternate paths in the Sharp typewriter. One path is from a keyboard through a key controller (key controller CPU) through the main CPU, and the second path is from a communications interface through the main CPU. (RXPT 37; CX 128; RTX 155, Bernstein Rebuttal W.S., at 9; Bernstein, Tr. 1624).

191. The keyboard has a standard typewriter layout supplemented by levers for pitch selection (10, 12, 15 characters per inch or proportional spacing) and nine levels of impression control, as well as by other function keys and controls. (RTF 306, not objected to by complainant).

192. In the keyboard mode of operation, the keys of the keyboard close contacts in a matrix and the key identity is determined by the key controller CPU which producers a multi-bit keycode character representative of that key. (CX 653, Ueda dep., at 51-53; RTF 307, not objected to by complainant).

193. The keycode character produced by the key controller CPU is transferred from it to the main CPU where it is converted to an

internal 8-bit internal ASCII character. (CX 653, Ueda dep., at 52-53; RTF 308, not objected to by complainant);

194. The 8-bit internal ASCII character, in turn, is used to look for the appropriate wheel number to be printed. The internal code is converted into a wheel position code. The wheel position information is stored in a ROM. (CX 653, Ueda dep., at 53). The 8-bit wheel number received from the internal code represents the position of the daisy *wheel.* (CX 653, Ueda dep., at 54).

195. From the wheel number the hammer intensity rank is picked up. The hammer intensity rank is located in the same ROM. This is a rank which varies according to the size of the character to be printed. (CX 653, Ueda dep., at 54).

196. The host processor performs the operation of picking up the 8-bit wheel position information and the hammer intensity rank. The hammer intensity rank is also in the form of a multi-bit (4 bits) character. The 8-bit wheel position number and the 4-bit hammer intensity rank information are stored temporarily in the main CPU or host processor. (CX 653, Ueda dep., at 54-55).

197. The hammer intensity information is then generated from the hammer intensity selector information and spacing pitch information. The host processor uses information in the same ROM to generate the hammer intensity information on the basis of the selector and spacing information. (CX 653, Ueda dep., at 55-56).

198. Once the hammer intensity information is generated, it and the wheel number information is sent by the main CPU to the wheel controller. The two sets of 8-bit information are sent one after another -- sequentially. (CX 653, Ueda dep., at 56).

199. The wheel controller selects the wheel spoke which corresponds to the wheel number information it receives. The wheel controller then checks whether the other movements such as the carriage movement and ribbon movement are complete. If it is, it goes ahead to operate the hammer. (CX 653, Ueda dep., at 56-57).

200. In selecting the proper wheel spoke, the wheel controller receives the wheel number information from the main CPU. This tells it which spoke is to be selected. It determines the amount of rotation necessary by detecting the difference between the wheel number which is in position "NOW" and the instructed wheel number. When the difference is detected, the instruction as to what angle the rotation should be is given. Speed information dependent upon the required amount of rotation is given to the servo circuit. The position of the wheel is monitored by certain circuits in the device. The instantaneous position can be known because the wheel controller counts the signals from these circuits. (CX 653, Ueda dep., at 57-59). There is an address position in the wheel controller that stores information representative of the position of the wheel. (CX 653, at 59).

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201. The signals WFTA and WFTB (the wheel position signals) represent the optical encoder rotation. (CX 653, at 60).

202. When the print wheel comes to the desired position, the electric current to the motor is shut off and the print wheel stays stationary until the character is printed and the next letter to be printed is selected. (CX 653, Ueda dep., at 66-47). At the time the signal indicates that the wheel is at the zero position (the desired position) the hammer is operated, assuming that the ribbon and carriage are in a stationary position as well. (CX 653, Ueda dep., at 67-68).

203. The signal that actuates the hammer comes from the wheel controller. It is supplied to the hammer drive circuit. (CX 653, at 70). The hammer intensity information is developed in the host processor. It obtains a multi-bit hammer intensity rank from the ROM (from which it had earlier obtained the multi-bit wheel position character) and after combining the hammer intensity rank with other information (hammer intensity selector information and spacing pitch information), it develops a hammer intensity signal which it transfers to the wheel controllers. (CX 653, Ueda dep., at 19-20 of second day).

204. When the wheel controller siglials the hammer drive circuit to actuate the hammer, the drive circuit varies the impact force of the hammer according to the pulse length or pulse width of the hammer signal. The width is set according to the time that the wheel

controller takes to make the hammer signal low level. There are 16 different levels of hammer intensity in the ZX 410 typewriter. (CX 653, Ueda dep., at 70-73).

205. All of the Sharp typewriters operate in aubstantially the same fashion, with the exception that the ZX-410 is the only one with a built-in communications interface option. (Bernstein,Tr. 1634).

206. All of the Sharp typewriters include "a first position indicating means for generating signals representative of the instantaneous position of said print wheel." (FF 200-201).

207. All of the Sharp typewriters have a "means adapted to be coupled to an external data source for receiving a multi-bit character representative of a character to be printed." In each of the Sharp typewriters the keyboard is an external data source for the internal electronic circuitry of the device. Dr Wakerly, one of respondents' experts agreed that the keyboard was certainly external to the internal control logic circuitry. (Wakerly, Tr. 1456). Mr. Simpson, another of respondents' witnesses, testified further that "input to the microprocessor could be from any source ... a dateline ... another computer .. we didn't elect to care who generated the code as long as the code got generated...." (Simpson, Tr. 1527). The internal circuitry in the Sharp typewriters, particularly the main CPU, the ROM containing wheel position and hammer intensity rank information and

wheel controller are adapted to be coupled with the external data source (the keyboard), through the keyboard controller. (FF 190, 192-196). The main CPU receives a multi-bit character representative of the character to be printed (the key which was pushed) from the keyboard controller. (FF 192-193).

208. Additionally, the ZX-410 contains an additional such means, that is, the communication interface option. Such option certainly provides "a means adapted to be coupled to an external data source," such as a computer for receiving multi-bit characters from such computers. (CX 653, Ueda dep., at 79-81). The fact that the interface itself is available only as an option and is installed by a service man or dealer does not detract from the fact that its internal circuitry is adapted to be coupled to such an external data source. (RTF 320; FF 190).[9/]

209. The Sharp typewriters also have "means responsive to said print wheel position signals and the character stored'in said receiving means for actuating said impressing means." Respondents argue that there is no character stored in said receiving means, because the character is "transient." In the Sharp system the keycode character produced by the key controller is converted in the main CPU to a different 8-bit internal ASCII character. (FF 193). That character, in turn, is used to look up certain wheel table information which is stored in a ROM and to develop therefrom a wheel position code which is

9/ The extent to which other Sharp typewriters may be "interfaceable" will be dealt with in the injury section.

stored temporarily in the main CPU. (FF 194, 196). From the wheel number a hammer intensity rank is then picked up from the same ROM and it is also stored temporarily in the main CPU. (FF 195, 196). The transient nature of the codes generated in this process does not detract from the fact that the Sharp devices include a means responsive to said print wheel position signals and the character stored in said receiving means for actuating said impressing means. (FF 194-199).

210. The Sharp typewriters also include "a memory device having a first portion for storing a plurality of individual multi-bit characters each representative of the location on said print wheel of a different one of said print characters and a second portion for storing a plurality of individual hammer intensity characters each representative of the intensity with which the associated print character in said first portion is to be impressed against said print medium, different ones of said hammer intensity characters representing different intensities." Mr. Ueda of Sharp, in his deposition, admitted that a ROM in the Sharp circuitry stores wheel position information in one part thereof, and hammer intensity information in the other part. (CX 653, Ueda dep., at 5 of second day).

211. Respondents argue, based on Dr. Bernstein's testimony, that there is no unique hammer intensity character present in memory which is associated with an individual print character. (RTF 324). Dr. Bernstein's position is based on the fact that there is an

additional control by external switches for hammer intensity,. (Bernstein, Tr. 1632-33) **As noted in finding 191, above,. the keyboard has** switches, or levers, which provide additional control ***for* hammer intensity. The** host processor (main CPU) **takes. the hammer intensity rank which it receives from the ROM, and uses it, along with'selector and spacing information taken from the tame ROM to generate the hammer intensity. (FF 196-197). Most certainly that hammer intensity is related to the individual character to be printed. Moreover; the original, stored hammer intensity rank is hammer intensity informatiOn and it is related directly to the wheel number selected and "representative" of the intensity with which that character is to be impressed. (FF 194-196). The fact that this hammer intensity rank is combined with other information, such as the different'impression controls available from the keyboard, does not take,the operation of the Sharp devices outside the scope of this element of the '129 patent.**

212. The Sharp typewriters also have a "means for sequentially fetching the multi-bit location character and the associated hammer intensity character specified by the character stored in said receiving means." Mr. Ueda has also admitted that the main CPU or host processor sequentially accesses from the same ROM, first the wheel position data stored therein and then the hammer intensity information. (CX 653, Ueda dep., at 5-6, 19-20 of second day, and 54 of first day). Dr. Bernstein argues that this sequential accessing does not fulfill this requirement of the '129 patent because at "the time I am doing the

fetches of location character and hammer intensity character I have discarded the things that I could have identified as coming from the receiving means." (Bernstein, Tr. 1633). This represents an overly narrow reading of the '129 patent. The main CPU converts the keycode character from the key controller into a 8-bit ASCII character which is only temporarily stored in the main CPU until it is used and discarded. (FF 193, 194). That 8-bit character is used to fetch the wheel position information which is stored in the ROM. (FF 194). The host processor then fetches the hammer intensity rank from the same ROM, based on the wheel number which it has fetched. Even though the main CPU only temporarily stores the 8-bit internal ASCII character and discards it once its function is completed, this does not take the Sharp devices outside a literal reading of this element. Certainly, the wheel position and hammer intensity information here fetched is specified by the character information stored in the main CPU, whether this latter information is permanently stored or not. Furthermore, these two items of information are sequentially fetched, notwithstanding Dr. Bernstein's testimony that such information is actually transferred out ... within a few tens of microseconds." (Bernstein, Tr. 1633; See CX 653, Ueda dep., at 5-6, 19-20, of the second day).

213. Lastly, the Sharp typewriters have a "means coupled to said memory means for converting the individual feteched hammer intensity characters to corresponding actuation signals for said

impressing means having a magnitude dependent upon the intensity assigned to the corresponding hammer intensity character." As noted above, the main CPU obtains the hammer intensity rank from the ROM. The main CPU uses information from the same ROM to generate hammer intensity information. (FF 195, 197). The hammer intensity information, is then sent to the wheel controller by the host processor. Once the wheel is in position for printing, the wheel controller sends the signal which actuates the hammer. The hammer drive circuit varies the impact force of the hammer according to the pulse length or pulse width of the signal. (FF 198, 203-204).

214. Respondents also seek to distinguish the Sharp typewriters from the '129 device on the ground that the Sharp typewriters read out both wheel position information and hammer intensity information for a given character to be printed prior to any positioning of the print wheel to print that character. They urge that, due to file wrapper estoppel, the '129 device is limited, so that the print wheel must be in position before the hammer intensity information is fetched. (RTF 316-318). Respondents cite to pages 12-13 of the Amendment dated 11/23/77, in the Continuation Application (RXPT 2) in support of this contention.

215. Respondents' position is not well taken. The portion of applicant's "remarks" before the PTO, referred to in this argument, was intended to distinguish the '129 device from the Lundquist patent and

is concerned with claims 8-14, riot just 8-10. (RXPT 2, Amendment of 11/23/77, at 12-13). As such, it addresses broadly the requirements of these claims. Claim 11, which is riot at issue in this investigation, does require the print wheel to be "correctly aligned for printing" before the hammer intensity is fetched, but claim 8 does not. (CX 1, claims 8, 11). This portion of the remarks" also points out the two part memory device and the sequential fetching of the wheel position and hammer intensity information therefrom, which elements were all that was necessary to distinguish the '129 device from the Lundquist device. (RXPT 2, Amendment of 11/23/77, at 12-13; FF 128). Thus, it was unnecessary to argue that claim 8 requires the wheel to be in position before the hammer intensity is fetched, in order to justify claim 8 over Lundquist. Therefore, even if the cited language were read as being addressed to claim 8 as well as claim 11, it should not limit the scope of claim 8 in this manner. It is significant that claim 8 was ultimately allowed by the examiner, after this amendment, without requiring any amendment to claim 8 to provide that the print wheel must be in position before the hammer intensity information is read out. (CX 1, claim 8; RXPT 2, Office Action of 5/25/78).

216. Accordingly, it is found that each of the Sharp typewriters infringe claim 8 of the '129 patent. (FF 188-215).

2. Triumph-Adler

217. **The, following Triumph-Adler typewriter models are alleged by complainant to infringe the '129 patent. SE 1005, 5005, 1010, 5010, 1011, 5011, 1020, 5020, 1030, 5030, 1035, 5035, 1040, 5040, 1041 and 5041, Satellite II and TA-310 and 410. The SE models beginning with a "1" are sold under the "Adler" trademark, and those beginning with .a "5" are sold under the "Royal" trademark. The TA-310 is sold under the "Adler" name and the TA-410 under the "Royal" name. All are manufactured in Germany by respondent Triumph-Adler and imported into the United States by respondent Adler-Royal Business Machines, Inc. (RTF 346-348). Respondents argue that complainant has offered proof of infringement only as to the "Adler" models. (RTF 346). However, this assertion is ridiculous. The record is replete with evidence that the two models are the same, within each numerical grouping, i.e., 1005/5005, 1010/5010, 1020/5020, etc., and that when complainant elicited evidence as to an "Adler" model the evidence'went to the "Royal" model as well. (See, RXE 133, Ayling W.S., at 5-6, 14-15, Ex. AY-1; CX 122-23, 300, 302-305, 307, 316-345; CX 393, Ayling dep., at 21, 24-25, 38, 47,51; CX 398, Gruber dep., at 10; Ayling, Tr. 1311, 1317, 1320, 1322, 1343; Stipulation at Tr. 1555-56). In fact, when complainant's counsel attempted to question Mr. Mueller concerning the- TA-410, respondents' counsel pointed out that the 410 and the 310 were the same and suggested that if complainant's counsel would put the questions to Mr. Mueller in terms of the 310, he would get the answers he was seeking. (Mueller, Tr. 1555-56).**

218. All of the accused Triumph-Adler typewriters include the first five elements of claim 8. (RTF 352; Stipulation, Tr. 636-37). Despite having stipulated that the first four of such elements are included in such devices at Tr. 636-37, these respondents now attempt to distinguish element (4), "means for rotating said print wheel," on the ground that the '129 patent specification discloses a "conventional reversible DC motor," whereas the Triumph-Adler machines all employ a "stepping motor" to rotate the print wheel. (RTF 352). I must hold respondents to their stipulation made in the early stages of the hearing. Moreover, claim 8 does not specify the type of motor to be used, but only requires "means for rotating said print wheel." The stepping motor certainly is such a means. (CX 1, Claim 8). Therefore, I hold that these typewriters include all five of the first five elements of claim 8.

219. The Triumph-Adler typewriters also include "first position indicating means for generating signals indicative of-the instantaneous position of the print wheel," or the substantial equivalent thereof. (FF 220-223, below).

220. Dr. Highleyman has testified for respondents as to the differences between conventional' reversible D.C. motors and stepping motors. He explained that a conventional reversible D.C. motor is one which operates by applying a constant voltage to the motor windings. As the rotor rotates, mechanical commutators shift the phase of the electromagnetic energy of the rotor relative to fixed stationary magnets which cause the motor to rotate. In a stepping motor, there is

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no mechanical commutator and constant voltages are not employed. There is a plurality of individual stationary coils serving **as** a stator surrounding a rotor made up of fixed magnets. By appropriately and sequentially energizing the plurality of stationary coils in discrete steps, the rotor can **be** made to follow the magnetic fields generated by the applied stepping voltages in discrete precise steps. Apart from structural differences, one operational difference is that the stepping motor moves in discrete rotational steps, whereas the conventional D.C. motor rotates continuously. Thus, a stepping motor is designed **to be driven to a predetermined** rotational **position by selecting appropriate windings for sequential energization. In contrast, the rotational position of a conventional D.C. motor can only be effectively controlled by continuously monitoring its instantaneous position. (RXT 160, Highleyman W.S., at 4-5).**

221. The stepper motor in the Triumph-Adler typewriters. operates in this manner. In the process of determining **wheel position in these devices, the main processor interrogates the keyboard to determine which key has been depressed. The keyboard is a matrix type arrangement in which the individual keys are switches that close a circuit. Once the main processor determines that it is an alphanumeric character, it undertakes everything it has to do with the movement of the carriage. Then it sends the matrix code to the slaver processor or the UPI. The UPI then calculates the difference between the actual position of the print wheel and the desired position of the print wheel. This results in the rotational direction and alio determines how many pulses (accelerating pulses, constant speed pulses, and** deceleration pulses) are required to move the wheel to that position.

For each position of the daisywheel, one pulse is applied to the stepping motor. Then all the pulses are put out according to the number of registers. The acceleration pulses needed are immediately stored in a "counter." the constant speed pulses and the deceleration pulses are stored in two "registers." When the acceleration count reaches zero then the constant speed pulses are taken over by the counter. Then when those have reached zero, the counter accepts the deceleration pulses which are counted off to zero. In addition there is an "indicator" which contains the various pulse widths. When you have applied all of the acceleration pulses and decremented the counters for constant speed pulses to zero and the number of deceleration pulses to zero, you will have arrived at the new position, if the device has functioned properly. (CX 395, Elbinger dep., at 23-34, 37-39). The fact is that the print wheel may lag slightly behind in this operation, but the motor is basically designed to make one step corresponding to each position on the print wheel. (CX 395, at 37-39).

222. Thus, in this stepper motor system, the circuitry of the Triumph-Adler typewriters determines the desired position of the type wheel, compares it with the present position and determines the number of positions the wheel must turn and the direction it must go to reach the desired position. It then knows how many pulses must be applied to the stepper motor to "step" the wheel to the desired position. Then through the action of the counter, the registers and indicator it

controls the application of those pulses to move the print wheel to the desired location. (FF 221). Due to mechanical lag time there might be some lag time between the application of pulses and arrival of the print wheel at the desired location. For this reason there is a brief waiting period at the end of the pulse emissions. There is a fine adjustment pulse issued at this point to ensure proper positioning. (CX 395, Elbinger dep., at 37-40). However, unless the typewriters are to print gibberish, rather than the text corresponding to the input, this procedure must result in the machine printing the letter represented by the depressed key.

223. Therefore, these typewriters do fulfill the requirement of claim S regarding the positioning of the print wheel. The present position of the print wheel is determined by the internal logic of the devices, as well as how far the wheel must go to attain the desired position. Each pulse applied to the stepper motor is indicative of the movement to the next character of the print wheel, in the direction of the desired position. The number of pulses is counted and controlled by the counter, along with the registers, and the indicator. Therefore, the count therein is "indicative" of the position of the print wheel at any given moment, even though it may not always be precisely correct. (FF 221-222). This eleMent of claim 8 does not provide that the signals must show precisely where the wheel is at any given time; but only that such signals be "indicative." Therefore, the typewriters in question meet this requirement, despite the fact they

use a stepper motor instead of a conventional D.C. motor. (CX 1, claim 8). At the very least, they are the functional equivalent of the '129 device in this regard, since they do substantially the same thing in substantially the same way. They move the print wheel from a known present position to a desired position and keep track of that movement to ensure that the device prints the correct character. (Fr 221-222).

224. These typewriters also include "means adapted to be coupled to an external data source for receiving a multi-bit character representative of a character to be printed." I have noted above, in connection with the Sharp typewriters that the keyboard is such an external data source. (FF 207). This point is underscored in this instance by the fact that Triumph-Adler manufactures one typewriter in which the keyboard is not physically attached to the rest of the unit, but rather is attached thereto by cable. (Mueller, Tr. 1566; CX 350). The external data source (the keyboard) is adapted to be coupled with "means ... for receiving a multi-bit character representative of a character to be printed." (RXT 161, Mueller W.S., at'4-7).

225. Character selection in these machines begins with the keyboard. The keyboard has a standard complement of alphanumeric character and typewriter function keys. The keyboard switch matrix is scanned by the keyboard scanner. The keyboard scanner is a 40 to 127 repetitive counter that puts out 7 bit binary numbers sequentially representative of number 40-127. Four bits of each of the 7 bit binary

numbers scanning code issuing from the counter are used to scan the switch matrix rows in sequence and the other 3 bits are used to scan the columns in turn during each row scan. When a key is depressed it acts to close a switch in the matrix bridging a particular column and row location. When this occurs, a single discrete pulse issues from the keyboard and is applied to a logical "AND" gate in the logic electronics to thereby gate or pass a 7 bit binary code extant in the counter to a 'Piro buffer in the memory. (RXT 161, Mueller M.S., at 4-7; RXT 211).

226. Respondents argue that since the signal emanating from the keyboard is a single discrete pulse, instead of a mult-bit character, that this system cannot be read on the '129 device. (RPF, at 199-200). There is nothing in this element of claim 8 that requires the external data source to provide a multi-bit character to the "means," or which requires the means which receives the multi-bit character to receive it directly from the external data source. This section of the claim rather, specifies two requirements -- means adapted to be coupled to an external source, and the same means must be a means for receiving a multi-bit character representative of a character to be printed. (CX 1, claim 8).

227. In the Triumph-Adler machines the means stated in this segment of claim 8 is found in the logic electronics consisting of the main CPU and the RAMs or ROMs. (RXT 213). The main CPU receives the

multi-bit character from the FIFO buffer. It then addresses the RAM or ROM to obtain the spoke location code and the impact index code. (CX 398, Gruber dep., at 31-32; RXT 161, Mueller W.S., at 7-8, 9; RXT 213). The character code represents a character to be printed. (CX 398, Gruber dep., at 31-34). The main CPU is adapted to be coupled to the keyboard through the keyboard scanner and the FIFO buffer. (nix 161, Mueller W.S., at 6-7). Thus, this element of claim 8 i2 fulfilled in this combination device. With regard to combining the CPU and MANS or ROMs, Mr. Enomoto of respondent Nakajima has testified that a ROM can be part of a CPU or entirely separate in such a device. It makes no difference. (CX 524, Enomoto dep., at 26).

228. The next element of claim 8 requires "means responsive to said print wheel position and the character stored in said receiving means for actuating said impressing means." (CX 1, claim 8). Respondents argue that the Triumph-Adler machines cannot have this "means" based on their prior arguments that these devices do not have the "first position indicating means ..." and stored "multi-bit character" required in the earlier elements. (RTP 355). I have already dismissed respondents' arguments concerning these earlier elements. (FT 223, 226-227).

229. The main CPU calculates and stores both the character cede and impact information. The means responsive to the print wheel position signals is constituted by a portion of the CPU. The CPO,

under prugram cuntrul effects printing operations by **characters stored in the receiving buffer of the CPU. The circuitry includes a printer controller .hat is coupled to the memory means to convert the individual hammer intensity characters to corresponding actuation signals to fire the hammer at a selected intensity. (CX 398, Gruber dep., at 32-34; CX 396, Muller dep., at 6, 19-24; CX 395, Elbinger dep., at 24-28; CX 122, 123; RXT 213). I find, therefore that this element of claim 8 is also present in the Triumph-Adler typewriters.**

230. Respondents next argue that thete typewriters do not contain the dual portion memory device required in the next elements of claim 8. Respondents urge that this portion of claim 8 specifies and requires a single memory device, such as the ROM in the '129 specification. It is further argued that since some of the Triumph-Adler typewriters do not use the "first" and "second" portions of a single memory device to store wheel position and hammer intensity information, that they cannot conceivably infringe the '129 patent. As for the remaining models, it is pointed out that these memory segments may or may not be located in one chip. It is also contended that claim 8 requires "direct addressing" of the hammer intensity information, whereas in the Triumph-Adler machines an "indirect addressing" is employed. In this regard it is stated that in the latter devices the impact intensity time duration codes are found in a third memory segment and are not only markedly reduced in number but are not addressed by the characters in the FIFO buffer. (RTF 356).

231. Nothing in Claim 8 limits the "memory device" therein to a single-chip device having only two portions for storing data. The language of that claim also does not require that "a second portion' the memory device be "directly" accessed for the hammer intensity information. (CX 1, claim 8). There is no question but that the Triumph-Adler typewriters contain a memory device, whether that device is constituted by one, or more than one, chip -- ROMs and/or RAMS. (See, RXT 213). In each case, that memory has a 'first portion' in which multi-bit position characters are stored and "a second portion' in which multi-bit intensity information is stored. (RXT 161, Mueller W.S., at 7-10). These two portions are addressed sequentially. (RXT 161, Mueller W.S., at 7, 9; Mueller, Tr. 1574-75). Even if claim 8 were read to mean only a single ROM comprises the memory device, the circuitry of the Triumph-Adler typewriters would have to be considered the functional equivalent, since they perform the same basic functions in substantially the same way.

232. Furthermore, the fact that the hammer impact information is indirectly addressed does not take such typewriters outside this portion of claim 8. Mr. Mueller points out that the original impact index codes are used to address a separate table in a ROM which contains only 15 hammer intensity time duration codes. (RXT 161, at 7-8). This further processing, or indirect addressing, does not destroy the relationship between the hammer intensity information and

the associated print character. The stored individual hammer intensity characters are still "representative of the intensity with which the associated print character ... is to be impressed." (CX 1, claim 8). It is just that these characters undergo further processing to arrive at the final hammer intensity signal. (RXT 161, Mueller W.S., at 7-10). Again, this Triumph-Adler system is, at the very least, the functional equivalent of the '129 device in this regard.

233. The next element in claim 8 is the "means for sequentially fetching the multi-bit location character and the associated hammer intensity character specified by the character stored in said receiving means." Respondents' contentions concerning the presence of this element in the Triumph-Adler machines revolves around identification of the "receiving means" and the character stored therein. They also raise again the fact that first a hammer index code is "read out" and this is then utilized to address a separate table of impact intensity time duration codes. (RTF 357). The introduction of additional steps does not prevent these machines from reading on this Portion of claim 8. In certain of these typewriters all of the spoke location codes are stored in a RAM when, the machine is turned on. (RXT 161, Mueller W.S., at 7). In others the spoke location is stored in a ROM. (RXT 161 at 9). The table in the RAM or ROM is addressed by the sdan counter number in the FIFO buffer to access out the spoke location number. That spoke location code is then used to address a second table in the same RAM or ROM to obtain the impact index code. (RXT 161, at 7-8,

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9). The impact index code is, in turn, used by the host processor to address a table in a ROM to get the hammer impact intensity. time duration code, which are read out and stored with the spoke location codes in a RAM. Both of these items of information are later transferred out to and stored in registers associatedwith the printer electronics for utilization by the stepper motor and hammer drive circuitries. (CX 161, Mueller W.S., at 8, 10). Although there are additional steps involved in the Triumph-Adler circuitry, the same work is accomplished thereby, in substantially the same manner as in the '129 device. I,therefore, find that this element, or its functional equivalent, are found in the Triumph-Adler typewriters.

234. Finally, the Triumph-Adler typewriters include "means coupled to said memory means for converting the individual fetched hammer intensity characters to corresponding actuation signals for said impressing means having a magnitude dependent upon the intensity assigned to the corresponding hammer intensity signal," or the functional equivalent thereof. Respondents argue that in the '129 device the hammer drive unit is directly connected to the ROM memory and that such direct connection is essential to read on claim 8. They urge that in their machines the conversion of the hammer intensity signals to actuating signals occurs at a situs far removed from the memory means. (RTF 358). This vastly overstates the differences in the Triumph-Adler typewriters. The host processor in the latter machines uses the original impact index codes to address an additional

table to obtain the hammer intensity time duration. Although this information undergoes additional transfers before it is ultimately used by the hammer drive circuitry, the nexus between the memory means and the hammer drive logic is certainly not destroyed. It is clear that the processor which determines the hammer actuation force is connected to the memory in order to generate actuation signals of the particular level desired for a particular character. (CX 161, Mueller W.S., at 6-8, 9-10; RXT 213; CX 122, 123). This is, at the very least, the equivalent of this last element of claim 8.

3. Towa Sankiden Corporation

235. The Towa devices involved herein are as follows: the R 1 Printext, a printer; the R 2 Executive 77, a combination printer/typewriter with a built-in interface; and the R 3 Excellence 55, an electronic typewriter. (CF 52, not objected to by respondents).

236. Respondents urge that the R 1 printer of 'Towa is distinguishable from the '129 device in several material respects. Thus, it is alleged that:

> (a) The R 1 does not have a first 'position indicating means for generating signals representative of the instantaneous position of said print wheel (RTF 363-365);

(b) The R 1 does not have a single memory device with two portions -- it contains two separate ROMs which store the position and hammer intensity -information (RTF 366);

(c) The R 1 uses different multi-bit characters to specify the position and hammer intensity information, in contrast to the '129 device in which both the position and hammer intensity information are specified by the same character stored in the receiving means (RTF 367); and

(d) The R 1 does not change the "magnitude" of its hammer actuation signal, only the duration (RTF 368).

The first of these positions is quite similar to the argument raised by Triumph-Adler concerning its typewriters. (FF 220-221). Again, it is based on the use of a stepper motor in contradistinction to the conventional D.C. servo motor used by Grundherr in the Qume device. (RXT 157, Sekiguchi W.S., at 12). Just as in the Triumph-Adler typewriters, the Towa printer does include "a first position indicating means for generating signals representative of the instantaneous position of said print wheel." The system operates similarly in principle to that described in connection with Triumph-Adler. In the Towa device the registers and counters constitute the means for indicating the instantaneous position of the print wheel. (See CX 430, Sekiguchi dep., at 25-37, 92-99). It is clear that this stepper motor system is at least the substantial equivalent of the '129 device. The registers and the counters must accurately control the pulsing to the stepper motor. or the printer will print gibberish, instead of the desired text. (CX 430, Sekiguchi dep., at 25-37).

237. The use of two separate ROMs to store position and hammer intensity information in the Towa printer is also at least the substantial equivalent of the '129 device. As noted in connection with the Triumph-Adler typewriters above, nothing in claim 8 requires that the "memory device" consist of a single ROM or chip. (FF 231). It would certainly be far too convenient to escape the protection of the '129 patent by the simple expedient of splitting up the information between two ROMs. In this device the ROM-M or ROM-1 is used to **store the spoke address information and the ROM-S or ROM-2 is used to store hammer intensity information. (RTF 366; RXT 157), Sekiguchi W.S., at** 8). Therefore, this device still has a two-part **memory** system with one part being used to store the spoke address information and **the other part used to store hammer intensity information. I fiad that this** reads on the requirements of claim 8 of the '129 patent, or, at the very least, is the equivalent thereof.

238. I also find that both the position information **and the** hammer intensity information are specified by the same multi-bit character within the intent and meaning of claim 8 of the **'129 patent. The 7 bit position information which is transferred from ROM-M** by CPU-24- to CPU-S is certainly utilized in **the selection** of hammer **intensity information. The fact that it is combined with other information does**

not detract from this point. (RXT 158, Wakerly W.S., at 12-13; CX 430, Sekiguchi dep., at 90-94, 99-100). As I found in connection with the Triumph-Adler machines above, the indirect accessing of hammer intensity information does not remove the system from the coverage of the '129 patent. Such arrangement is, at the very least, the equivalent of the '129 device. (FF 232).

239. Lastly, the term "magnitude" as used in the '129 patent is not limited to the specific type of actuation signals used in the preferred embodiment. Magnitude refers broadly to size or extent. (Webster's New Collegiate Dictionary). Dr. Wakerly, the expert upon whom respondents rely in this regard, does not point to any language in the '129 patent which limits the use of this term in the manner he contends. (RXT 158, Wakerly W.S., at 13). The "magnitude" of the actuating signals can be of any dimension which will affect the intensity with which the hammer impacts the character to be printed. (CX 1, claim 8). As Mr. Archer points out, this can be effected either by varying the amplitude of the current which is applied to the hammer circuit, or by changing the duration of the pulses. In either case you affect the "magnitude" of the hammer intensity. (Archer, Tr. 232). The selection of "duration of the pulses" by Towa, as the means for varying the magnitude of the hammer intensity does not distinguish its device from the '129 patent device. (See, Grundherr, Tr. 763).

240. Respondents make the same arguments for the Towa R"2 typewriter/printer. Although the circuitry is slightly different in the R 2 from the R 1, the operations are very similar. The R 2 also uses a stepper motor and this forms the basis for respondents first argument, (RTF 370). It also stores the position and hamMer information in separate ROMs. (RTF 371). It is again urged that different multi-bit, characters specify the position and haMmer intensity information in the R 2. (RTF 372). Lastly it is argued that the hammer actuation signals in the R 2 have a "duration," not a "magnitude." (RTF 373). I reject these arguments on the same basis as'' my findings above in connection with the R 1 printer. (FF 236-239).

241. In connection with the R 3 typewriter respondents make two of the same arguments -- that it has no signal representative of the instantaneous position of the print wheel, and that the hammer actuation signal has a "duration" not a magnitude. Again, I reject these arguments on the same basis as above. (FF 236,'239).

242. It is also contended that the R 3 has no means adapted to be coupled with an external data source for receiving a multi-bit character representative of a character to be printed. (RTF 375). However, the same arguments apply to the R 3 as were earlier applied to, the Sharp and Triumph-Adler typewriters. The keyboard is the external data source. In this device, the single ROM converts the keyboard

signal into-a.multi-bit character representative of the character to be printed. (CX 430, Sekiqùchi dep., at 190-194). Therefore, I find that the R 3 contains this element of claim 8.

243. Lastly, respondents urge that the R 3 "simultaneously" reads out the location and associated hammer intensity information, instead of "sequentially" as required by the '129 patent. (RTF 377). This is based on the assertion that it "takes place entirely within one software instruction cycle." (RTF 377). This information is not read out simultaneously because it is in an 8-bit ROM (CX 430, Sekiguchi dep., at 190-94) and it is impossible to read more than eight bits at a time from an 8-bit ROM. (Wakerly, Tr. 1424). The "software instruction cycle" referred to by respondents uses 16 bits. Although this information is accessed through this one instruction cycle, there must be two successive accesses of the ROM to obtain this information from the ROM. (Sekiguchi, Tr. **1385-88). As far as the memory device is concerned, therefore, the respective position and hammer intensity information is "sequentially" read out.**

244. Accordingly, I find that the R 1, R 2 and R 3 devices of respondent Towel all infringe claim 8 of the '129 patent. (FF 236-243).

4. <u>Nakajima All Co., Ltd.</u>

245. The Nakajima products involved herein are the model AS-300, AE-330, AE-350, AE-354, AE-335 and AE-355 typewriters, and the model AP-650 printer. It also manufactures a TTX 1.014 printer for Teletex. All are rotary wheel printing systems. (CF 63-67, not objected to by respondents).

246. The AS-300, AE-330, AE-350 and AE-354 typewriters are all microprocessor based, stepper motor positioning units. They do not have built-in interfaces. (RTF 379, 384, not objected to by complainant as to these facts).

247. The AE-335 and AE-355 typewriters have built-in interfaces. They too, are microprocessor based and have stepper motor positioning units. They differ from the pure typewriter models only in that they have built-in computer interfaces. (RTF 384, not objected to by complainants as to these facts).

248. The model AP-650 printer and the printer manufactured for Teletex are the same device. They are also microprocessor based and have a stepper motor positioning unit. (RTF 386, not objected to by complainant as to these facts).

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249. Respondents claim that all of these machines lack elements 6 and 8 of the '129 patent, i.e., "firatposition indicating means for generating signals representative of the position of said print wheel," and "means responsive to said print wheel position signals and the character stored in said receiving means for actuating said impressing means." (RTF 379, 384, 386).

250. It is also urged that the AS-300, AE-330, AE-350 and AE-354 typewriters do not infringe elements 7, 12 and 13 of the '129 patent, i.e., "means adapted to be coupled to an external data source for receiving a multi-bit character representative of a character to be printed, "means for sequentially fetching the multi-bit location character and the associated hammer intensity character specified by the character stored in said receiving means," and "means coupled to said memory means for converting the individual fetched hammer intensity characters to corresponding actuating signals for said impressing means having a magnitude dependent upon the intensity assigned to the corresponding hammer intensity character."

251. All of the Nakajima typewriters and printers have stepper motor positioning units without a feedback unit such as that on the Qume device. (RTF 379, 384, 386, not objected to by complainant as to these facts). Respondents arguments concerning the absence of element 6 in to these devices are essentially the same as those treated in

connectiun with Triumph-Adler and Tuwa, above. (FF 220-221, 236).Similar to those devices, the Nakajima typewriters and printers have registers which indicate the desired position of the print wheel and control the movement of the print wheel. These registers "imply the assumed position of the print wheel at all times." (RXT 158, Wakerly W.S., at 3, see also, CX 524, Enomoto dep., at 19-22, 29). Thus, they are "representative of" the instantaneous position of the print wheel. The system of pulsing, with registers, used in the Nakajima system is, at the very least, the functional equivalent of the conventional D.C. motor with feedback system utilized in the preferred embodiment of the '129 patent. (FF 220-223, 236).

252. The Nakajima typewriters and printers also include control logic for actuating the print hammer in response to the character stored in the receiving means. (CX 524, Enomoto dep., at 17-19; CX 501, sec. 3.09; CX 509, 510, 520, 521). The fact that other information may be ultimately used to arrive at the final hammer intensity dues riot destroy this nexus. The system employed by Nakajima is, at the very least, the equivalent of the '129 device in this regard. (FF 232, 238).

253. The Nakajima typewriters without built-in interfaces also satisfy the requirement regarding an "external data source." As noted above, in connection with the other respondents, the keyboard is an external data source. The evidence of record shows that the

electrunics of the Nakajima typewriters du nut **differentiate between characters coming from the keyboard via the keyboard buffer and those originating from a host computer. (CX 508, 509; CX 524, Enomoto dep., at 17-23). Accordingly, all of the Nakajima typewriters include element 7 of claim 7 of the '129 patent. (FF 207, 224, 242).**

254. The Nakajima typewriters also include element 12 of claim 8, or its functional equivalent. There is sequential fetching of location character and hammer intensity information. In these devices, however, there are intermediate steps through which these operations are performed. The original location information is converted into position information, using a table in the ROM. The latter position information is used for position control and is also stored in a register RCP. After the printwheel has stopped and has a character in position to be printed, that information in register RCP is converted through the ROM into hammer intensity information. This information is further processed before being used to modulate the width of the hammer actuation pulse. (RXT 158, Wakerly W.S., at 3-4). This indirect addressing does nut remove such machines from under the coverage of element 12 of claim 8. There is still a sequential fetching of the location and hammer intensity information and the hammer intensity information is still specified, even if indirectly, by the character stored in the receiving means. This is, at least, the equivalent of the device specified in this element of claim 8. (FF 232, 238).

255. Finally, the argument as to the meaning of the term "magnitude" in element 13 of claim 8 is rejected for the same reasons given above in connection with respondent Towa. The fact that pulse width modulation, rather than amplitude modulation, is used to obtain different hammer intensities in the Nakajima typewriters does not distinguish these machines from the '129 device. (FF 239).

256. Accordingly, all of the Nakajima typewriters and printers at issue herein are found to infringe claim 8 of the '129 patent. (FF 245-255).

XII. THE QUME PRODUCTS ARE COVERED BY THE '129 PATENT

257. The optical encoders in Qume's printers, from the inception of the Q series until the present, all work in the same manner to compensate the output with a feedback loop. (RTF 389, not objected to by complainant).

258. Respondents urge that the Qume optical encoders do not operate in the manner disclosed in the '129 patent. (RTF 388). This contention is based on the earlier arguments of respondents regarding the validity of claim 1, in which it is urged that this claim requires the circuit to maintain the light output of the source light substantially constant. (RTF 388, 146-150). I have already rejected

these argumen.ts in the section dealing with validity. (FF 153). Therefore, I find that all Qume devices include an optical encoder which conforms to the requirements of claim 1 of the '129 patent.

259. The evidence also reveals that all of the Qume printers embody each and every element of claim 8 of the '129 patent. (Grundherr, Tr. 605-19; Archer, Tr. 185-87, 226; CX 172, Shah W.S., at 4-20; Shah, Tr. 857-58, 866, 876-905; CPX 16). This does riot include the Letter Pro, since Mr. Shah did not know the details of that device. (Shah, Tr. 866).

260. Respondents contend that the Qume printers do not practice claim 8 in two respects. First, it is alleged that claim 8 and the specification of the '129 patent require that the character position and hammer intensity information be stored in separate parts of a "single" ROM and that there is no credible evidence of record to show that the Qume printers comply with such a requirement. Secondly, it is argued that claim 8 of the '129 patent has been limited by file wrapper estoppel to the fetching of the hammer intensity character pnlv after, the positioning of the print wheel and that the Qume printers do not operate in this manner. (RTF 391-394).

261. As to the first argument, there is nothing in claim 8, or any of the quotations from the file wrapper cited in respondents technical findings 391 and 392 which states that the "memory device" of

claim 8 must consist of a single ROM. It so happens that the preferred embodiment dues utilize only one, single ROM, but claim 8 is not specificalky su limited. As I have previously noted, it would be in unjustified limitation on this claim to allow an infringer to escape its provisions by the simple expedient of using two .ROMs or similar memory units. (FF 231, 237). Similarly, it would be-an unjustified limitation to apply its coverage to the Qume devices so as to limit such coverage to a printer using only one ROM as the "memory device."' As noted in the '129 patent specification:

> while the above description provides a full and complete disclosure of the invention, various modifications, alternate constructions and equivalents may be employed without departing from the true spirit and scope of the invention. Therefore, the above description and illustrations should riot be construed as limiting the scope of the invention, which is defined by the appended claims.

(CX 1, Col. 13, lines 56-62).

Moreover, there is evidence of record to show that at least some of the Qume printers utilize a single ROM or microprocessor as the "memory device." (Shah, Tr. 895-96).

262. Lastly, Claim 8 is riot limited to a device which fetches the hammer intensity character only after the print wheel is in position. As pointed out above, the portion of applicant's argument in

the file wrapper to which respondents refer in this contention (RTF 393) deals with the justification of claims 8-14, not just claims 8-10. This portion of applicant's remarks obviously pertained to claims 11-14, which do specifically require the print wheel to **be** stopped and in position before the hammer intensity is fetched. (CX 1, claims 11-14; RXPT 2; Amendment of 11/23/77 at 12-13). However, even if this section of the remarks were read as being addressed to claim 8 as well as claim 11, this still should not limit the scope of claim 8. Such a distinction was unnecessary to distinguish claim 8 from the prior art, since the sequential read out of character position and hammer intensity information was all that was needed to distinguish the prior art there in question from claim 8. (FF 215; RXPT 2, Amendment of 11/23/77 at 12-13). It is significant that claim 8 was allowed without requiring its amendment to specify that the **wheel must** be in position before the hammer intensity information is **fetched. (FF 215; RXPT 2, Office Action 5/25/78).**

263. Accordingly, I find that complainant's printers, with the exception of the Letter Pro, practice both claim 1 and claim 8 of the '129 patent.

XIII. XEROX PRODUCTS

264. Complainant has introduced no probative evidence to show that the Xerox Memorywriter, or any other Xerox products **embody the**

'129 in•eritiuti. CX 199 is a claim chart which purportedly reveals a comparison between the Xerox Memorywriter and claim 8 of the '129 patent. It was offered in evidence as a rebuttal exhibit and originally received in evidence because there was nu objection by respondents. (Tr. 983, 2155). However, it is simply a summary exhibit and contains no references as to the source of the information therein pertaining to the Xerox device. There was nu testimony substantiating this exhibit or its data. (Tr. 2156). Under the circumstances **it** has no probative value and cannot support complainant's position that the Xerox Memorywriter, or any other Xerox product, is covered by the '129 patent.

XIV. IMPORTATION AND SALE

265. Nakajima exports to the United States **rotary wheel typewriters and printers manufactured and assembled by Nakajima All Precision Cu. Ltd. Nakajima first shipped rotary wheel typewriters to customers in the United States in about June or July 1982. Nakajima printers have been exported to the United States since at least March**
C 1983. Customers for Nakajima typewriters include
C . United States customers
C for Nakajima printers include . Each customer sells Nakajima machines under its own name. (SX 26, at 2, 7-8; CX 1141).

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266. Between April 1983 and March 1984, Nakajima exported the following quantities of rotary wheel typewriters to the United States:

	Model	Quantity	Dollar Amount
C	AS-300		
c	AE-330		
C	AE-330 with interface		
C	AE-350		
C	AE-350 with interface		

(CX 1138).

267. Between March 1983 and April 1984, Nakajima exported approximately rotary wheel printers to customers in the United States, at a value of about . (CX 1141; SX 30).

268. Teletex began to import rotary wheel printers into the United States in February 1983. The printer imported by Teletex is purchased from Nakajima, and marketed under the model number TTX 1014. Between February 1983 and June 1984, Teletex imported approximately rotary wheel printers into the United States at a total value of

C . (SX 30, at 1-2).

269. Sharp began to manufacture rotary wheel typewriters in Japan for exportation to the United States in the latter half of 1982.

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SEC began to.impurt rotary wheel typewriters manufactured by Sharp into the United States in about October 1982, and began sales, marketing and distribution of these typewriters in,March 1983. Rotary wheel typewriters manufactured by Sharp have also been imported into and sold in the United States by Exxon Office Systems. (SX 27, at 3; SX 28, at 3, 7).

270. Between October 1982 and March 1984, Sharp exported rytary wheel typewriters to the United States as follows:

Model	Unit Sales	FOB Value
ZX 400		
ZX 410		
ZX 500		
ZX 505		
210		

(SX 28, Ex. A).

271. Sales and inventory of rotary wheel typeWriters imported into the United States by SEC for the period October 1982_ March 1984 were as follows:

C

Model	Unit Sales	Invoice Value	Invenorv:
ZX 400			
ZX 410			
ZX 500			
ZX 505			

(SX 27, Ex. A).

272. Triumph-Adler began to manufacture rutary wheel typewriters for export to the United States in 1981. Adler-Royal commenced importation of rotary wheel typewriters manufactured by Triumph-Adler in 1981, and has sold, distributed and marketed such typewriters in the United States since 1981. The typewriters manufactured by Triumph-Adler are sold in the United States under the Adler trademark and "10" series model numbers (e.g., 1005, 1011, 1030). The same typewriters are sold in the United States under the Royal trademark and "50" series model numbers (e.g., 5005, 5011, 5030). In addition, Adler-Royal sells a portable rotary wheel typewriter under the Adler and Royal trademarks and the product name "Satellite II." (SX 24, at 4, 7; SX 25, at 7-9).

273. Between 1981 and 1984, Adler-Royal has imported the following quantities of rutary wheel typewriters and sold such typewriters in the United States:

	Model	Units Sold	Total Sales
C	1005/5005		
C	1005/5005 XL		
C	1010/50101/		
C	1011/50111/		
C	1020/5020		
C	1030/5030		
C	1030/5030 K		
C	1035/5035		
C	1040/5040		
C	1041/5041		
C	Satellite II		

I/ Models now discontinued

(CX 1174, Resp. to Interrogatory Nu. 3, Ex. A).

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274. Towa manufactures in Japan and exports to the. United States rotary wheel printers and typewriters. These printers and typewriters were first exported to the United States in September or October 1983. There are three products manufactured and exported on behalf of Towa: the R1 Printext, a rotary wheel printer; the R2 Executive 77, a combination printer/typewriter; and the R3 Excellence 55, an electronic typewriter. (SX 32, at 1-2, 6-8).

275. During the period of October 1983 - July 1984, Towa exported the following quantities of rotary wheel printing systems to the United States:

Model	Units	Value
R1		
R2		
R3		

(SX 32, at 12).

XV. DOMESTIC INDUSTRY

276. Qume was founded in 1973 by David Lee and others to develop a letter quality daisywheel printer for data processing systems. Following several years of successful growth in sales, Qume was acquired in 1978 by ITT. In 1979, Qume consolidated its headquarters and manufacturing operations in a 239,000 square foot facility in San Jose,

Califurnia._ In 1978, due to an expansion in sales of printers, Qume determine that it needed another manufacturing facility. Qume then established a new facility in 1979 in Puerto Rico, which manufactured the same printer products as were manufactured in San Jose. The factors which led Qume to establish a facility in Puerto Ricu included the high unemployment there, availability of skilled technicians, and tax benefits. (Lee, CX 164, at 2-4; Lee, Tr. 99-100;, Lee dep., RXE. 112, at 104-07; Cubian, tr. 479-81).

277. Due to the fact that the cust of labor, materials and overhead is significantly lower in Puerto Rico than in San Jose, Qume has increased the amount of printer manufacturing in Puerto Ricu in order to average down its printer production costs. In early 1984, Qume decided to shut down its manufacturing operations in San Juse and transfer them to Puerto Ricu. (Gower, CX 165, at 3-4, 7-8; CX 201).

278. The Printer Division at Qume manufactures the entire Sprint line of rotary wheel printers, including the Sprint 3; Sprint 7, Sprint 8, Sprint 9, Sprint 10, and Sprint 11. Although Qume manufactures several models in the Sprint line pursuant to customer contracts, it is actively marketing only the Sprint 11 series at present. (Shires, CX 166, at 2; Lee, Tr. 81-82; CX 218).

279. The Sprint line of printers is now manufactured by Qume Caribe in six plants in Puerto Rico. Three plants are located in Las

Piedras, Puerto Rico, and three plants are lucated in Humacao, Puerto Rico. Total floor space at these facilities is approximately 260,000 square feet, of which 80% is devoted to printer production. (Mures, CX 167, at 4, Cubian, Tr. 478-79; CX 222).

280. Qume Caribe's printers are manufactured in three plants. In Las Piedras Plant #1, Qume Caribe manufactures the printed circuit boards and power supplies. In Las Piedras Plant #2, Qume Caribe manufactures mechanical subassemblies and electromechanical assemblies, including the optical encoder. At Humacao Plant #1, Qume Caribe conducts final, assembly. (Mures, CX 167, at 6).

281. Qume Caribe currently employs over 1,500 employuyeesand had a 1983 payroll of . Approximately 80% of this payroll is devoted to printer manufacturing. (Mores, CX 167, at 4; CX 223).

282. Qume Caribe purchases over 90% of its components and raw materials from the United States mainland and Puerto Rican suppliers. Of the 90%, approximately 15% are from Puerto Rican suppliers. The remaining 10% are purchased from European and Far Eastern. suppliers.' (Mures, CX 167, at 5).

283. Limited manufacturing of Sprint printer prototypes continues at Qume's San Jose, California facility. Approximately forty employees fr are involved in this activity in addition to manufacturing memory

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products. engineering and marketing departments for the Sprint series printers are also located in San Jose. (Gower dep., CX 1273, at 55, 56).

284. Qume Caribe's annual production of Sprint printers has grown from a total of in 1980, to more than in 1984. (Shires, CX 166, at 2; CX 218).

285. The entire Sprint line of printers produced by Qume and Qume Caribe in San Jose and Puerto Rico, is manufactured in accordance with the claims of the '129 patent. (FF 259, 263, <u>supra</u>).

286. Qume's Sprint line of printers ranges in speed from 20 cps fur the Sprint 8/20 to 75 cps for the Sprint 3 widetrack 75. (Shires, CX 166, at 2. See also FF 23, <u>supra</u>).

287. In 1982, Qume entered into an agreement with Raytheon to produce a low cost 20 cps printer. The quantity to be produced was 10,000 units. In 1983, Qume Caribe manufactured approximately 1,000 Sprint 8/20 printers which were a slower version of the Sprint 8/35. These printers were to be sold to Raytheon at per unit. Under the terms of Qume's agreement with Raytheon, by January 1984, Qume was to offer a 20 cps printer at a price of per unit. The terms of the agreement were not completed, at least in part because Raytheon went out of the word processing business in 1984. (Shires, CX 166, at 6-7; Shires, Tr. 423-26; CX 218).

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288. In 1983, Qume sold approximately 907 units of the Sprint 8/20. Except for the sale of approximately two units of the Sprint 8/20 in February 1984, there were no sales of this model between December 1983 and May 1984, and substantially no manfacture of this model since 1983. Qume is not pushing sales of the Sprint 8/20 because it is not profitable. (Lee, Tr. 115; RXE 40, Bates No. 951941; RXE 41; CX 218).

289. The LetterPro 20 printer is a low cost, 20 cps printer manufactured in Japan by Tohoku Ricoh for Qume pursuant to a licensing agreement and supply contract. (Shires, CX 166, at 3; CX 209, Settlement Agreement between Qume and Ricoh. See also FF 24, supra).

290. Qume decided to purchase the LetterPro 20 from Ricoh in order to have a presence in the low cost, low speed segment of the printer market while it developed a new product for this market segment. (Gower, CX 165, at 4; Gower, Tr. 286-87; RXE 90).

291. It has not been established on this record that the LetterPro 20 embodies the claims of the '129 patent. (FF 259, supra; Shah, Tr. 866).

292. In developing the LetterPro 20, Qume received specifications from Tohoku Ricoh, and then worked with them to make modifications to - those specifications. LetterPro units manuactured by Tohoku Ricoh were

tested in Qume's engineering arid quality laboratories and by the marketing group to determine whether they met specifications. Tooling fur the LetterPru 20 was paid fur by Qume, and developed by Tuhuku Ricoh. (Booth dep., RXE 113, at 21-23; Frost dep., CX 139, at 54-55; Shires dep., CX 1275, at 25).

293. Qume assisted Tuhuku Ricoh in developing a quality control program fur the LetterPru 20 which would satisfy Qume's standard product quality specifications. The quality control program is performed in Japan by Tuhuku Ricoh. Qume audits quality control on the LetterPru 20 in part by monitoring returns of the product. (Frost dep., CX 139, at 23, 49-51).

294. LetterPru 20 units are shipped directly to Qume in San Jose by Tuhuku Ricoh. Qume then ships the LetterPru 20 to its customers from San Juse. (Shires dep., CX 1275, at 24).

295. Certain engineering activities are performed with respect to the LetterPru 20 by Qume in San Jose. These activities include making modifications for specific customers, and development of an interface kit to enable the printer to be easily interfaceable with popular personal computers. The interface unit is subcontracted by Qume to another company in the United States. (Shires dep., CX 1275, at 21-22).

296. Qume also performs certain quality assurance activities with

respect to the LetterPru 20 in Sari Jose. These activities include reliablity testing which tests the reliability and performance of the product. Samples of the LetterPru 20 are tested at Qume in San Jose approximately monthly. Initially, this testing would have covered 20-30 units, and ongoing testing is generally dune on small quantities of about two at a time. Between about September or October 1983 through about August 1984, about 40-50 units have been tested. (Shires dep., CX 1275, at 21, 23-24).

297. Qume performs three stages of pre-production quality control tests. The A-Test is the initial quality control test performed on the hand engineered prututypes which is designed to verify that the product will work. (Ashkenazi dep., SX 4, at 32-33).

298. Prior to the release of a design for manufacture, design maturity must be demonstrated on engineering prototypes. The B-Test is a design qualification test which includes reliability demonstration testing, stress testing for margin characterizations, 'environmental testing, and function testing for performance characteristics. New product designs must pass the B-Test before final authorization for production start-up. (CX 22, at 3).

299. Prior to authorization of ongoing customer deliveries, process maturity must be demonstrated on manufacturing produced models in a quality assurance laboratory environment. The Stage 1 C-Test is a manufacturing product integrity test conducted on initial production

output. It is intended to verify successful transfer to manufacturing of the product design certified by the 13-Test, and includes product configuration review, conditions of 8-Test verification, agency compliance re-verification, and general function and reliability testing. Stage 1 C-Test authorizes a limited production rate. Stage 2 C-Test is a manufacturing process maturity test consisting of process capability and repeatability studies, function testing fur full specification compliance, reliability testing for burn-in characteristics, and overall reviews of procedure/process maturity, incurportion of Stage 1 C-Test conditions, and analysis of initial customer delivery acceptance levels. The Stage 2 C-Test must be passed before there is authorization fur unlimited production rates. Mt 22, at 3).

300. Qume estimates that it has incurred the following cults fur activities performed in the United States in connection' with the LetterPru 20:

(SX 5, at 2).

301. Qume estimates that it incurs additional costs in the United States with respect to each unit of the LetterPru 20, calculated as fulluws:

(SX 5, at 2).

302. The Engineering Activities specified in FF 300, supra consist of the following elements: engineering specifications, software development and interface, interface meetings with Ricoh, documentation, manual review, printer testing by Engineering (A-Test), customer assistance, materials (including Test Machines), R & D assessment, and trips by Qume personnel to Ricoh in Japan. Generally speaking, each of these engineering activities is related to the development and pre-production phase of the LetterPru 20. (SX 5, at 3; Ashkenazi dep., SX 4, at 13-17).

303. The R & D Assessment included in the engineering activities related to the LetterPru 20 is a fee paid by Qume to ITT for providing R & D assistance. The figure of   is based un estimated total sales of the particular product. (SX 5, at 3; Ashkenazi dep., SX 4, at 15-16).

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304. The Marketing Activities specified in FF 300, <u>supra</u> consist of marketing planning, marketing overhead, promotion and literature, selling expenses and trips by Qume personnel to Ricoh in Japan. The marketing planning activity occurred at the developmental stage of the LetterPru 20. Selling expenses include commissions, and the costs of actually selling the product, such as sales manager's offices and the order taking function. These selling expenses are a percentage of total revenue from the LetterPru 20. (SX 5, at 3; Ashkenazi dep., SX 4, at 17-20).

305. The Quality Assurance Activities specified in FF 300, <u>supra</u> include quality engineer, software testing, B and C Tests, test lab equipment and materials, and travel. The majority of these expenses occurred in the development stage of the LetterPro 20, but some expenses relate to ongoing quality control activities. (SX 5, at 3; Ashkenazi dep., SX 4, at 20-22).

306. The Project Management component included in FF 300, <u>supra</u> is comprised of a coordinator and trips to Ricuh in Japan. This activity' consists of initial negotiations with Ricuh, ongoing placement and scheduling of orders, and coordination of purchasing and importing. (SX 5, at 4; Ashkenazi dep., SX 4, at 22-23).

307. The Kit Development specified in FF 300, <u>pubra</u> relates to the develup.ment of a promotional kit by the marketing group which is intended to make the product sell better. (SX 5, at 4; Ashkenazi dep., SX 4, at 23-24).

308. The Tooling expense listed in FF 300, <u>supra</u> relates to particualr tooling unique to Qume's requirements for the LetterPru printer which Ricoh developed and Qume agreed to pay fur. (SX 5, at 4; Ashkenazi dep., SX 4, at 24; Shires dep., CX 1275, at 25).

309. The G & A Allocation and Interest specified in FF 300, <u>supra</u> are allocated to LetterPru based on an estimate of LetterPru sales. (SX 5, at 2; Ashkenazi dep., SX 4, at 24-25).

310. Qume manuactures the printwheel and ribbon for each LetterPru printer and ships them to Japan. (SX 5, at 2; Ashkenazi dep., SX 4, at 25. FF 301, <u>supra).</u>

311. In November 1983, Qume developed a plan and requested immediate authorization to manufacture a low cost daisy wheel printer. This printer is designated the ur Virgo. In this plan, it was proposed that the Virgo printer would be manufactured in Taiwan, and accessories would be produced in Humacao, Puerto Rico. The Virgo project was identified in this plan as Qume's next generation of low cost daisywheel printers replacing the Sprint 11 Plus line, and ultimately the

C LetterPru. The model Virgo was to be manufactured for

, with the plan that a version of Virgo would also be developed to sell in the distributur and small OEM marketplace. (RXE 13; RXE 21, at Bates Nus. 950606, 950608, 950612; Shires, CX 166, at 2-3).

312. The Virgu printer has a rated speed of 25 cps. (Gower, Tr. 291).

313. The Virgu printer embodies the claims of the '129 patent. (FF 256-262, supra).

314. Design engineering and development of the Virgu was performed at Qume in San Juse. The factors that contributed to Qume's decision to manufacture the Virgu at its facility in Taiwan included: Qume's prior and current manufacturing experience there; availability of most components and parts from local suppliers; readily available qualified and experienced engineering personnel, lower labor costs and availability of trained workers; availability of leased 22,000 square foot production facility; and tax benefits. (RXE 13; RXE 21, at Bates Nus. 950606, 950612; Shires, CX 166, at 2-3; Guwer, Tr. 281-84).

315. By September 1983, Qume had made approximately six units of the Virgo in San Jose for A-Test, ur preliminary evaluation purposes. (Booth dep., CX 140, at 26-27).

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316. Qume has also made certain modifications to the Virgo model which it manufactures for , including a 130 character print wheel, instead of a 96 character print wheel. (Booth dep., CX 140, at 28-29).

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317. Although Qume plans to sell the Virgo to OEM customers and to distributors, so far Qume's production of the Virgo has been entirely for Qume dues not expect to have manufacturing capacity for units until 1985. (Booth dep., CX 140, at 40-41; RXE 21, at Bates Nu. 950608).

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318. Production of the Virgo printer began in Taiwan in about June 1984. All Virgo printer manufacture occurs in one building in Taiwan, and there are approximately 200 employees involved in Virgo production. This facility uperates un one eight hour shift, five days per week. (Booth dep., CX 140, at 34-36).

319. The machinery used to manufacture the Viigu printer came from the United States, Taiwan and other places in the Far East. Large capital equipment, such as manufacturing process equipment, burn-in ovens and test equipment were sent from San Juse to Qume Taiwan. (Booth dep., CX 140, at 37-38, 60-61).

320. The raw materials for Virgo production come from both the United States and Taiwan. These materials include plastic moulded parts,

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sheet metal parts, printed circuit boards, discrete components, motors and electrical components. The parts most likely to come from the United States are those requiring technical expertise, such as precision plastic moulded gears. However, the majority of the raw materials come from Taiwan. (Booth dep., CX 140, at 58-59).

321. Qume Taiwan subcontracts certain subassemblies of the Virgo printer, such as several mechanical subssemblies, and one of the assemblies of the printed circuit boards. (Booth dep., CX 140, at 59).

322. As of August 1984, Virgo production in Taiwan was still in the start-up phase, resulting in limited production of about 40 units per day. In order to meet contract requirements fur , normal daily production of the Virgo would be approximately units per day. It is estimated that Qume Taiwan's maximum Virgo production capacity in its present facility is about units per day. (Booth dep., CX 140, at 64-66).

323. Qume estimates that it has incurred the following costs in the United States in connection with the Virgo printer:

(SX 6, at 2; Ashkenazi dep., SX 4, at 28).

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324. The Engineering Activities for the Virgo identified in FF 323, supra include printer development, software development, product introduction engineering, documentation, ribbon and accessories development, model shop, components engineering, R&D test engineering, and product compliance. The printer development cost reflects development activities for the Virgo from 1982-1984. All of the engineering activities are pre-production and development costs before the Virgo went into mass production. (SX 6, at 2; Ashkenazi dep., SX 4, at 28732).

325. The Quality Assurance cost specified in FF 323, supra consists:of the A, B and C Tests. These quality control tests are progressive pre-production tests intended to ensure the reliability and functionality of design and manufacturing parameters and procedures. (SX 6, at 2; Ashkenazi dep., SX 4, at 32-33. **al** FF 297-299, supra).

326. The Project Management cost specified in'FF 323, supra covers the Project Coordinator, who is responsible for inspecting the-manufacturing process and coordinating all aspects of the project. (SX 6, at 3; Ashkenzai dep., SX 4, at 33-34).

327. G & A Allocation identified in FF 323, supra comprises administrative expenses. This cost, as well as Interest, is allocated to the Virgo product on the basis of an expected level of Virgo **sales in** relation to total sales. (SX 6, at 3; Ashkenazi dep., SX 4, **at** 34-35).

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328. The Manufacturing Support cost identified in FF 323, <u>supra</u> includes the cost of prepruductiun units, soft tooling, hard tooling, inventory write-off, material handling and transfers, and training. (SX 6, at 3; Ashkenazi dep., SX 4, at 37, 40).

329. The category identified as Other in FF 323, <u>supra,</u> covers duties and freight rebate. (SX 6, at 3; Ashkenazi dep., SX 4; at 40).

330. The quality control program for the Virgo printer is carried out in Taiwan. (Frost dep., CX 139, at 51).

331. The Virgo printer is shipped directly to   from Qume Taiwan. (Gower, Tr. 333).

332. Xerox Curp. is a licensee of Qume under the '129 patent. Diablo Sytems, a subsidiary of Xerox, manufactures daisywheel printing systems. Diablo and Xerox manufacture the following models of rotary wheel printers and typewriters:

Diablu

HyType II
Model 620
Model 620 API
Model 630
Model 630 API
Model 630 API/ELS
Model 630 ECS

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Xerux

610 Memorywrtier
615 Memurywriter
620 Memurywriter
625 Memurywriter
627 Memurywriter
630 Memurywriter

(Oliver, CX 169, at 9-10; SX 3, at 11; SX 18-21; CX 190, 191, 1050).

333. It is not established on this record that the rutary wheel printing systems manufactured by Diablo and Xerox embody the claims of the '129 patent. (FF 264, supra).

334. The domestic industry consists of the facilities of Qume and Qume Caribe in San Juse, California and in Puertu Ricu in 1983 are devoted to the manufacture and sale of Qume's rutary wheel printers under the claims of the '129 patent. (FF 275-333).

XVI. EFFICIENT AND ECONOMIC OPERATION

335. Qume Caribe was started in May 1978 with five employees in order to manufacture printing supplies, ribbons, and print wheels. Qume Caribe began shipping supplies two ur three weeks after it started operation and, six months later, began producing printers at its first facility in Las Piedras, Puerto Ricu. (Mures, CX 167, at 3).

336. At first, the Las Piedras area had inadequate communications

facilities so that it was very difficult to communicate with Qume headquarters in San Jose, California. Qume Caribe was instrumental in convincing the government of Puerto Rico to modernize the telephone switching system in the Humacao-Las Piedras area. (Moren, CX 167, at 3).

337. When Qume Caribe opened in 1978, it started with 22,000 sq. feet of flour space in the Las Piedras plant. Today it has approximately 260,000 sq. feet in its six modern plants: three in Las Piedras and three in Humacau. Approximately 80% of this floor space is devoted to production of printers. (Moren, CX 167 at 4; CPX 23; Oliver, CX 169, at 5).

338. In order to increase the supply of trained technicians for its work force, Qume Caribe worked with the local community college in Humacau to develop an Associate Degree Program for electronic technicians. This program is now in place and trains iechnicians used by Qume Caribe and other companies in the Humacao-Las Piedras area. (Moren, CX 167, at 3-4).

339. Qume Caribe offers an employee benefit package which amounts' to over 40% of the payroll and includes medical insurance, savings plans, a pension plan which vests after 10 years, and tuition for job-related courses. These benefits have combined for an extremely low absenteeism rate of approximately 2.2% and a turnover rate which has consistently hovered around the 6% per year mark since 1981. (Moren, CX 167, at 4-5).

340. Qume Caribe has been awarded honors fur hiring the handicapped. Five percent of its work force is handicapped. Approximately 25 employees in wheelchairs and about 15 blind employees are working for Qume Caribe at present. (Mures, CX 167, at 5).

341. Qume Caribe's direct labor wages start at and rise to per hour. Qume Caribe's average hourly wage is . Technicians can earn up to per hour. (Mures, CX 167, at 6).

342. Qume estimates that it will have spent on daisywheel printer research and development from 1975 through the end of 1984. (Oliver, CX 169, at 5-6).

343. In order to reduce costs, Qume has redesigned products to reduce the number of parts, has sought the lowest cost vendors and renegotiated contracts with existing vendors, has improved overall supervision, and has to a significant extent automated its production and testing of printed circuit boards. (Guwer, CX 165 at 3; Guwer, Tr. 300, 328-32; CX 250, 264).

344. The Sprint 11 series printers have been designed and manufactured with fewer parts than earlier series of Qume printers, such as the Sprint 9. The Virgo printer is even more compact and contains fewer parts than the Sprint 11. (Gower, Tr. 328).

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L, 345. Qume's total printer advertising expenses ruse from

C in 1980 to in 1982. Qume spent on printer advertising in 1983 (through October 31). (SX 2, at 35).

346. Advertising expenditures have been running at about one

C percent of sales in 1980 and 1981 and were running from

C of sales for 1982-84. (Oliver, CX 169, at 6-7).

347. Qume Caribe has established elaborate and sophisticated procedures for quality assurance in the pruductiun of daisywheel printers, including incoming inspection of parts and components, checks throughout the production process, mechanical testing of the uutguing product, and replicating incoming printer inspection procedures of its own major customers to reduce chances of faulty products leaving its plants. (Oliver, CX 169, at 6; Dominguez, CX 168, at 1-5).

348. Qume Caribe's operations are automated and computer controlled to a significant extent. At Las Piedras Plant #1, there are five automatic inserting machines for the insertion of integrated circuits, axial components, radial components, sequencers and micro-processors into its printed circuit boards. The operation of these five machines, representing nearly a half million dollar investment, are coordinated by a microcomputer. The connections and circuits un these automatically assembled printed circuit boards are then automatically

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soldered in soldering machines that carry the printed circuit boards on a conveyer through a wave of molten lead. The finished printed circuit boards are then tested on four Zentel machines, costing a total of $600,000, which electronically inspect the parts and connections of each board, and display on a CRT an identification for any circuits that need to be reworked. (Moren, CX 167, at 6-7).

349. Approximately 161 Qume Caribe employees in six groups are involved in quality assurance with respect to Qume's Sprint series rotary wheel printers and printer supplies. (Dominguez, CX 168, at 1).

350. The first of these groups involves quality assurance for vendors. This group, consisting of 19 people, is responsible for statistical testing of incoming parts and components. The tests include physical inspection, tolerance tests of mechanical components, electronic tests of electronic components, and bare board testing of printed circuit boards. (Dominguez, CX 168, at 2).

351. The second of the groups, consisting of 25 employees, is responsible for quality control over printed circuit boards. **Their** duties include insuring the quality of power supplies, electronic modules and card cages, as well as printed circuit boards. **This group, located at** Las Piedras Plant **#1**, tests each and every completed PC board with a go-no-go test. This group has at its disposal the Zentel automatic testing equipment. (Dominguez, CX 168, at 2).

352. The third quality assurance group is located at the Las Piedras P1&t #2 and includes 22 people. This tiroup is responsible for quality assurance of mechancial subassemblies including the optical encoder, which is assembled and tested in a clean room. This group conducts structure testing of mechanical assemblies using a Hewlett-Packard computer which prints out its identification of any problem with mechanical components, including the drag force on the carriage, carriage speed and voltage, among others. Such testing is conducted on 100 percent of all mechancial subassemblies. (Dominguez, CX 168, at 2).

353. The fourth quality assurance group, numbering 58 people, is responsible for quality assurance in the final assembly of Qume's rotary wheel printers at the Humacao Plant #1. The first stage of quality control (during the final assembly of printers) involves the process of "bringing-up," where the electronic assemblies from Las Piedras Plant #1 are carried to the mechanical and electro-mechancial Assemblies from Las Piedras Plant #2 at Humacao Plant #1. During bring-up, one of every five printers is subject to a comprehensive nine print quality control audit. This includes visual, mechanical and electronic checks of nine features of each of the tested printers, including print quality. If one printer fails, it and the four other printers in the lot of five will be returned to the production person for complete readjustment and double checking of all electronic and mechanical adjustments. This stage of quality control

includes a process auditor who roves the floor and checks the equipment, gauges, tools and employees to insure maximum concern for quality. (Dominguez, CX 168, at 3).

354. The next stage in the quality assurance process includes the "hot box" or the burning-in of 100 percent of all printers coming off the line. The printers are burned-in anywhere from 24 hours at 105^{o}F for the Sprint 3; to 48 hours for the Sprint 10; and 12 hours at ambient temperatures for the Sprint 11. The reduced burn-in time for the Sprint 11 is made possible by the purchase of burned-in integrated circuits at increased costs, thereby reducing the burn-in time required. If any printer fails during the burn-in period for which it is clocked in and clocked out, it is returned for repairs and it must thereafter undergo "hot box" burn-in from the beginning. (Dominguez, CX 168, at 3-4).

355. Following hot box burn-in, each printer is tested and adjusted in an 11 minute test where all switch setting and electronic speeds are tested. (Dominguez, CX 168, at 4).

356. Following the post hot box test, each printer goes to "system verification" which is a series of tests lasting 8 to 10 minutes where each printer is fine-tuned mechanically and electronically. System verification includes nine tests conducted on a Qume developed and made elctronic tester called the "Fox." The Fox test conducts nine individual tests, checking electronic and mechanical adjustments, paper feed, print quality, hub adjustment and ribbon height. (Dominguez, CX-168, at 4).

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357. Following system verification, Qume Caribe conducts another manufacturing inspection. After the final quality acceptance, all printers are put through a reliability demonstration where they will run for six to twelve hours each at ambient temperatures to predict the reliability the customer will see in the first two to three months. During this test, three different print samples are also taken under the supervision of the process auditors. After passing the reliability demonstration, all printers go through Qume's version of their customer's inspection. During this procedure, Qume attempts to **duplicate** each of its major OEM customers' incoming inspection **procedures using** the word processing system with which its OEM customer will **operate the** printer. During this customer inspection, Qume uses the **customer's check** list of specifications which will be applied to the printer on the receiving end. (Dominguez, CX 168, at 4-5).

358. Qume has a quality assurance lab designed to measures (1) the quality of outgoing printers; and (2) the long term reliability **of** such printers. The reliability **department takes random samples of 10 printers per model per** week. Each printer is tested and reviewed for workmanship, cleanliness, and conformity to the specifications. I n addition, Qume Caribe conducts a functional test with the customer's system. Each printer is operated for six hours, and two of the **ten printers are** run for 100 hours. (Dominguez, CX 168, at 5).

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359. Qume Caribe must meet a Qume specification of hours of mean time between failure at 100% duty cycle. If the running average ever falls Eilow certain threshold levels, the entire manufacturing and quality control process is reviewed for that model and in some cases production is stopped. (Dominguez, CX 168, at 5).

360. Since 1981 Qume Caribe's revenues have grown from

C to an estimated in 1984. (Doren, CX 167, at 8).

361. The relevant domestic industry is efficiently and economically operated. (PP 335-360).

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XVII. INJURY

362. As of October 12, 1984, Qume had entered into 15 royalty bearing limited license agreements with manufacturers and importers of rotary wheel printers and typewriters. The total value of the license agreements is over currently paid or owed to Qume. Several of the license agreements include other initial non-cash considerations equivalent to almost Based on Qume's projection of future royalties payable under the various license agreements, Qume estimates the total value of the settlements to exceed over the next five years. The agreements require the licensees to submit annual reports on the numbers of shipments of rotary wheel printing devices made to the U.S. (Gower, CX 165, at 9-10; Gower Tr. 274-78; CX 209-212).

363. Qume entered into a settlement agreement with Ricoh Co., Ltd. effective April 28, 1983. under the terms of this agreement, Ricoh acknowledged that its rotary wheel printers, which it has exported to and sold in the United States, utilize the '129 patent. Ricoh obtained a license from Qume under the '129 patent to sell an additional rotary wheel printers in the United States, and agreed to pay a royalty therefor. In addition, Ricoh expressed its intention to redesign its daisywheel printers to ensure noninfringement of the licensed patent by any printers in excess of the licensed number. (Qume-Ricoh Settlement Agreement, CX 209).

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364. Qume entered into a settlement agreement with NEC Corp. effective June 10, 1983. Under the terms of this agreement, NEC acknowledged exportation of impact printers to the United States, and obtained a license from Qume under the '129 patent to sell a total of of those printers in the United States, and to pay a royalty therefor. NEC stated its intention not to utilize the licensed patent after the expiration of the license granted. This agreement contains no denial or admission of patent infringement by NEC. (Qume - NEC Settlement Agreement, CX 209).

365. Qume entered into a settlement agreement with Fujitsu Ltd. effective August 10, 1983. In this agreement Fujitsu stated that it had exported to the United States or had sold or intended to sell in the United States, rotary wheel printers. Fujitsu denied that any of its six models of rotary wheel printers infringe the '129 patent, whereas Qume contended that all models infringe the patent. Under the terms of this agreement, Fujitsu obtained a license under the '129 patent to sell Fujitsu printers in the United States, subject to payment of royalty. Fujitsu further stated its intention not to utilize the licensed patent after the expiration of the license granted. (Qume - Fujitsu Settlement Agreement, CX 209).

366. Qume entered into a settlement agreement with Tokyo Electric Co., Ltd. (TEC) effective September 1, 1983. In this agreement, TEC acknowledged that it, and its customer C. Itoh fi Co.,

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Ltd. have exported to or have sold in the United States rotary wheel impact devices. The products covered included TEC rotary wheel impact printers and any TEC typewriter with an external interface. There is no express admission or denial of patent infringement by TEC in this agreement. Under the terms of this agreement, TEC obtained a license under the '129 patent to sell rotary wheel impact devices in the United States, and agreed to pay a royalty therefor. TEC further expressed its intention to redesign its printers and typewriters with an external interface so that no units sold beyond the licensed number utilize the licensed patent. (Qume-TEC Settlement Agreement, CX 209).

367. Qume entered into a settlement agreement with Brother Industries, Ltd. effective September 29, 1983. In this agreement, Brother acknowledged that it had exported and had sold or intended to sell in the United States rotary wheel printers and typewriters. The products covered by this agreement include three models of rotary wheel printer and six models of rotary wheel typewriter with, or having the capability of having, an external interface. Brother denied that any of its rotary wheel impact devices infringe the '129 patent. Under the terms of this agreement, Brother obtained a license under the '129 patent to sell rotary wheel printers and the covered typewriters in the United States, subject to payment of royalties. Brother stated its intention not to utilize the licensed patent after the expiration of the license granted. (Qume - Brother Settlement Agreement, CX 209).

368. Qume entered into a settlement agreement with Silver Seiko Ltd. effective November 17, 1983. In this agreement Silver Seiko acknowledged that it had exported to or had sold or intended to sell in the United States rotary wheel printers and typewriters. Silver Seiko denied infringement of the '129 patent by any of of its models of rotary wheel impact devices. Qume contended that Silver Seiko's impact devices infringe the '129 patent. The products covered by this agreement include the rotary wheel impact printers which Qume contends infringe the '129 patent, and Silver Seiko rotary wheel impact typewriters with, or having the capability of having, an external interface. Under the terms of this agreement, Silver Seiko obtained a license under the '129 patent to sell in the United States rotary wheel impact printers and of the covered typewriters, subject to payment of royalties. Silver Seiko stated its intention not to utilize the licensed patent after the expiration of the license granted. (Qume - Silver Seiko Settlement Agreement, CX 209).

369. Qume entered into a settlement agreement'with Canon Inc. effective December 8, 1983. In this agreement, Canon acknowledged that it had exported to or had sold or intended to sell in the United States rotary wheel impact printers and rotary wheel impact typewriters. C Canon contended that none of its of rotary wheel impact typewriters infringe the '129 patent. Qume contended that rotary wheel typewriter models infringe the '129 patent. Under the

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terms of this agreement, Canon obtained a license under the '129 patent to sell in the United States a total of rotary wheel impact printers awl' of Canon typewriters, subject to payment of royalties. Canon stated its intention not to utilize the licensed patent in rotary wheel impact printers after the expiration of the license granted. (Qume - Canon Settlement Agreement, CX 209).

370. Qume entered into a settlement agreement with Daisy Systems Holland B.V. effective January 12, 1984. In this agreement Daisy Systems acknowledged that it has exported to or has sold or intends to sell rotary wheel printers in the United States. Daisy Systems does not expressly admit or deny infringement of the '129 patent. Under the terms of this agreement, Daisy Systems obtained a license under the '129 patent to sell in the United States rotary wheel impact printers, subject to payment of royalties. Daisy Systems stated its intention not to utilize the licensed patent after the expiration of the license granted. (Qume - Daisy Systems Settlement Agreement, CX 209).

371. Qume entered into a settlement agreement'with Ing. C. Olivetti & Co., S.p.A. (Olivetti) effective February 26, 1984. In this agreement, Olivetti stated that it has exported to or has sold or intends to sell in the United States, rotary wheel printers and typewriters. The products covered by this agreement include designated models of rotary wheel printers and typewriters. Olivetti does not expressly admit or deny infringement of the '129 patent. Under the

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terms of this agreement, Olivetti obtained a license under the '129

C patent to sell in the United States rotary wheel printers and . of Olivetti typewriters and rotary wheel printers, subject to payment of royalties. Olivetti stated its intention not to utilize the licensed patent beyond the limits of the license granted. (Qume - Olivetti Settlement Agreement, CX 209).

372. Qume entered into a settlement agreement with Olympia Werke Aktiengesellschaft effective May 25, 1984. In this agreement Olympia acknowledged that it has exported to or has sold or intends to sell in the United States rotary wheel impact printers and rotary wheel impact typewriters. Olympia does not expressly admit or deny infringement of the '129 patent. Under the terms of this agreement, Olympia obtained a license under the '129 patent to sell in the United

C States a total of rotary wheel impact printers and

C of Olympia typewriters, subject to the payment of royalties.

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C

C . (Qume - Olympia Settlement Agreement, CX 210).

373. Qume entered into a settlement agreement with Tokyo Juki Industrial Co., Ltd. (Juki) effective August 3, 1984. In this agreement, Juki acknowledged that it has exported to or has sold or intends to sell in the United States rotary wheel impact printing systems. Juki denied, and Qume contended, that Juki's rotary wheel

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impact printer infringes the '129 patent. Under the terms of this agreement, Juki obtained a license under the '129 patent to sell in the United States rotary wheel impact printers, in addition to additional rotary wheel impact printers and rotary wheel impact typewriters with external interface or having capability for external interface, subject to payment of royalties. (Qume - Juki Settlement Agreement, CX 210).

374. Qume entered into a settlement agreement with Matsushita Electric Industrial Co., Ltd. (MEI) effective August 15, 1984. In this agreement MEI acknowledged that it has exported to and sold or intends to sell in the United States rotary wheel impact typewriters and rotary wheel impact printers. MEI does not expressly admit or deny infringement of the '129 patent. Under the terms of this agreement, MEI obtained a license under the '129 patent to sell in the United States a total of rotary wheel impact printers and rotary wheel impact typewriters with or having the capability of having external interface, subject to payment of royalties.

. (Qume - MEI Settlement Agreement, CX 210).

375. Qume entered into a settlement agreement with Primages, Inc. effective October 10, 1984. In this agreement, Primages acknowledged that it has exported to or has sold or intends to sell in the United States rotary wheel impact printers. Primages does not expressly admit or deny infringement of the '129 patent. Under the terms of this agreement, Primages obtained a paid-up, limited license

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to sell in the United States and countries in which counterparts of the '129 patent have been issued, rotary wheel impact printers. Primages has indicated its intention not to utilize the licensed patent after expiration of the license granted. (Qume - Primages Settlement Agreement, CX 210).

376. Qume estimates **that the agregate volume of imports from** Brother, Canon, C. Itoh, Daisy Systems, Fujitsu, Juki, Matsushita, Nakjima, NEC, Olivetti, Olympia, Primages, Ricoh, Sharp, Silver **Reed**, TEC and Triumph-Adler from 1979 - 1983 is as follows:

1979	1980	1981	1982	1983

This estimate includes all serial impact, **fully formed printers and** electronic typewriters by each typewriter manufacturer. **The percentage** figure for typewriters is based on **Dataquest's estimate that electronic typewriters are interfaceable.** **(Oliver, CX 169, at 26-27).**

377. In 1983, the following quantities of rotary wheel printers and typewriters were imported into the United States under license to Qume:

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Licensee	Royalty Period	Quantity

1/ This number includes

(SX 7-13).

378. In February 1984, Dataquest reported the following prices for certain models of Qume printers:

Model		Price
Sprint	8/35	$1,585
	8/40-130	1,860
	8/50	1,725
	9/35	995
	9/45	2,225
	9/55	2,630
	10/35	1,695
	11/40 Plus	1,7761/
	11/40-130	1,776
	11/55 Plus	1,9901/
LetterPro		895

1/ Includes interface module

(CX 1050, 1096).

379. Qume is currently selling its Virgo model printer at a price of about . (Gower, CX 165, at 6).

380. Qume introduced the LetterPro printer in November 1983 at a dealer cost of and a suggested retail price of $899. In May 1984, Qume reduced the dealer cost of the LetterPro to , and the suggested retail price to $599. (Shires, CX 166, at 8).

381. Qume sells **the Sprint 11 to Sperry, an OEM customer at a** contract price of , **which includes both the printer and the interface module. (Shires, Tr. 417-18).**

382. In August 1983, Qume projected the following target prices for the Virgo:

	End User Price	**Price to OEMs**
Year'End 1983		
Year End 1984		
Year End 1985		
Year End 1986		

(RXE 21, at Bates No. 950626).

383. Qume perceived its primary competition for a low cost letter quality printer sale to to be NEC, Diablo, Ricoh, TEC, and Silver-Reed. Qume's offering to for this type of product was the Virgo. (RXE 21, at Bates No. 950626-27).

384. Qume initially intended to manufacture the Virgo printer in Puerto Rico, and its contract with indicates delivery FOB Puerto Rico. After evaluating the cost of producing the Virgo and the price it could be sold for, it was determined to produce the Virgo in Taiwan. (Gower, Tr. 307-08).

385. Nakajima's prices to its U.S. customers for its electronic typewriters and printers were as follows during the period of about April 1983 - March 1984:

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Model	Invoice Price
AS-300	
AE-330	
AE-330 with interface	
AE-350	
AE-350 with interface	
AE-650 printer	

(CX 1138, 1141).

386. Nakajima sells typewriters and printers in the United States to

Each customer sells Nakajima's products under its own brand name. (SX 26, at 7-8).

387. Teletex sells a rotary wheel printer manufactured by Nakajima under the name TTX 1014. This printer was sold at a suggested retail price of , but in May 1984, the price was reduced to Teletex se 3 these printers to distributors and dealers at discounts ranging from (SX 30).

388. Sharp's electronic typewriters are sold in the United States at the following suggested list prices:

Model	Dealer Cost	Retail Price
ZX - 400	$454 - 501	$ 795
ZX - 410	539 - 596	945
ZX - 505	739 - 816	1,295

These models are sold to Sharp dealers at discounts ranging from 37-45%, depending on the quantity purchased. The ZX-410 is equipped

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with a port to allow it to be interfaced. Sharp markets an interface for the ZX-410 identified as the ZX-007RZ. This optional interface is purchased separately at a suggested list price of $295, and is installed by the dealer. (Zochowski, RXE 132, at 2, 5; CX 625).

389. In January 1984, Sharp reduced the list price of its Model ZX-400 electronic typewriter from $895 to $795. (CX 633).

390. The Sharp ZX-410 was discontinued during the summer of 1984. This model has been replaced by the ZX-415. The ZX-415 is equipped with a port for an optional interface, which enables the typewriter to be interfaced with personal computers, such as the IBM PC. (Zochowski, Tr. 922-25).

391. The Sharp ZX-400 electronic typewriter offers four types of spacing - pica, elite, micro-elite and proportional. This typewriter has a 112-character printwheel and offers high quality print and a correction feature. The ZX-400 does not have a built-in interface or a port for an interface. However, the ZX-400 is interfaceable with interfaces manufactured by third parties. (Zochowski, RXE 132, at 2; CX 613-615, 619, 628, 629).

392. The Sharp ZX-505 is an electronic typewriter having the same four pitch capability as the ZX 400, plus a 32 character display and a 1K memory expandable to 9K or 17K by the addition of an 8K or 16k memory module. (Zochowski, RXE 132, at 2; CX 624, 629).

393. The range of end user prices for Adler-Royal electronic typewriters sold in the United States in 1983 is as follows:

Model	Dealer Cost	Retail Price
1005/5005		
1005XL/5005XL		
1011/5011		
1030/5030 8K		
1030/5030 16K		
1040/5040		
1041/5041		
310/410		
Satellite II		

(SX 25, Ex. A.; Ayling, RXE 133, at 7, 14-15).

394. The Adler-Royal 1005/5005 is a standard duty electronic typewriter which has 10 and 12 pitch typing and a print speed of 17 cps. This model has no text storage capability, and is Adler-Royal's lowest price machine capable of being interfaced to the Textriter. The model 1005/5005 XL adds automatic features, such as centering, decimal alignment, automatic carrier return, keyboard settable impression control, and additional 15 pitch and proportional spacing. (Ayling, RXE 133, at 5, 7-8).

395. The Adler-Royal 1010/5010 electronic typewriter has no text storage; the 1011/5011 has 2K for phrase storage; and the 1030/5030 has an additional 8K text storage. Each of these models can be interfaced with the Textriter. (Ayling, RXE 133, at 5, 6).

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396. The Adler-Royal 1040/5040 electronic typewriter has a 16K memory and 40. character plasma display. The 1041/5041 is an adaptation of the 1040 that has a disc drive connected to it through a cable and plug on the rear of the machine. The 1035/5035 is a less expensive version of the 1040 which has an LCD rather than a plasma display. The 1035 can be interfaced with the Textriter. (Ayling, RXE 133, at 5, 6).

397. The Satellite II is the same as the Alpha 2001. This model is a portable typewriter which comes with a case, but is smaller and has fewer features than Adler-Royal's office models. The Satellite II can be interfaced with the Textriter. (Ayling, RXE 133, at 6).

398. Adler-Royal has recently introduced the model 310/410 which is a compact typewriter that is smaller and has fewer features and is designed for home and small business use. This model is less durable than full size office models, and has a print speed of 14 cps. The 310/410 is equipped with an interface port. (Ayling, RXE 133, at 6-7).

399. Adler-Royal sells a typewriter add-on capable of performing word processing functions called the Textriter. Adler-Royal purchases the Textriter from Lexocorp, and sells it to Adler-Royal dealers, who in turn sell it to their customers. The Textriter includes a video screen, central processor, disc drive, control key pad, and a special Textriter interface unit. (Ayling, RXE 133, at 6, Ex. AY-3).

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400. Towa sells its rotary **wheel printers and typewriters in** the United States at the following prices:

Model	Wholesale Price	Sucig. Retail Price
R1 R4intext		
R2 Executive 77		
R3 Excellence 55		

(SX 32, at 8-9).

401. The Towa R2 Executive 77 rotary **wheel typewriter/printer has a** built-in **interface. There is a mode select switch on the machine that allows it to be converted from typewriter to printer. (RXT 157, Sekiguchi W.S., at 19, 23).**

407[1]. The Towa **R3 Excellence 55 is a low cost daisywheel typewriter. It does not have a built-in interface, and due to the design of the machine, it is not realistically interfaceable with an external interface. (RXT 157, Sekiguchi W.S.,'at 5-6, 38, 42).**

403. Towa has sold its rotary wheel typewriters and printers to the following distributors in the United States:

(SX 32, at 15-16).

404. Masis Systems, Inc. developed an interface for the Sharp Model ZX-400 electronic typewriter. This interface enables the typewriter to be connected to personal computers and operate as a

letter quality printer at a speed of about 20 cps. The interfaces are available in both RS232 Serial and Centronics Parallel modes at a dealer cost of and a retail price of . Since the middle of
C 1983, Masis has made approximately interface units for the Sharp ZX-400 electronic typewriter. (CX 632; Gharibian dep., CX 801, at 87-88).

405. Masis Systems has developed interfaces for the following Adler-Royal electronic typewriters: 1005, 1010, 1011, 1020, 1030, 1035, 1040, and Satellite. Since 1981, Masis has made the following sales of interfaces for electronic typewriters:

<u>Year</u>	<u>Quantity</u>	Price

C
C
C
C

1/ The interface price for the Satellite initially
C was and was reduced to
(Gharibian dep., CX 800, at 16-19).

406. Masis sells typewriter interfaces primarily to Adler-Royal dealers and to private individuals. In order to attach a Masis interface to an Adler-Royal typewriter, it is necessary to remove the cover from the machine, but it is not necessary to make any permanent

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modifications to the typewriters - i.e. it is designed to be a plug-in attachment. (Gharibian dep., CX 800, at 19, 28-29; Terborgh dep., CX 805, at 11).

407. The number of sales by Masis of typewriter interfaces has been decreasing rapidly because typewriter manufacturers are increasingly coming out with their own interfaces. In addition, Masis and other interface manufacturers have found that, due to the availability of low priced letter quality printers which have greater functionality than a converted typewriter, it is becoming less economically viable to interface typewriters. (Gharibian dep., CX 800, at 63-64, 66-68; Terborgh dep., CX 805, at 9, 12-13).

408. Lexocorp manufactures interfaces for the Sharp ZX-400, Adler-Royal models 1005, 1005 XL, 1010, 1011, 1020, 1030 and 1035, and is working on an interface for a Swintec (Nakajima) electronic typewriter. These interfaces are designed to make these electronic typewriters compatible with Lexocorp's Lexowriter. (La Rocco dep., CX 806, at 9-15, Ex. 1, 2).

409. Cord Ltd. manufactures interfaces for the following models of Adler-Royal electronic typewriters: 1005/5005, 1010/5010, 1011/5011, 1030/5030, Satellite II, and Alpha 2001, 2002. The Supercord interfaces are sold to dealers at prices ranging from . The suggested retail price ranges from . (Harris dep., CX 808, Ex. 1).

C 410. Cord has sold interface units which are compatible with several different brands of electronic typewriters. Approximately of these sales were interfaces for Adler-Royal typewriters. (Harris deg.., CX 808, at 13, 41-42).

411. The interface capability of an electronic typewriter allows the typewriter to be interfaced to a variety of other systems, such as computers, mailnet systems, cassette and disk storage devices, and a variety of paper handling devices such as automatic pin feed, platens, and automatic sheet and envelope feeders. In Adler's opinion, the interface capability of electronic typewriters which enables them to be used as an input terminal to communications systems will become a significant use of interfaceable typewriters. (Ayling, RXE 133, at 4).

412. In order to remain competitive in a market of ever increasing applications, Adler now builds dumb ports in some of their new state of the art products. (Ayling, RXE 133, at 4-5).

413. Adler does not manufacture interfaces fot its typewriters. However, two outside companies which manufacture interfacer for Adler-Royal machines, Cord and Masis, are Adler-Royal dealers. Adler does not know how many interfaces have been sold for its electronic typewriters or for what applications its typewriters and interfaces are purchased. (Ayling, RXE 133, at 2-3).

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414. Sharp offers an electronic typewriter which has interface capability in order to remain competitive in the marketplace. (Zochowski, Tr. 924).

415. Sharp and Adler-Royal both advertise the capability of their electronic typewriters to be interfaced with data sources such as computers. Interface manufacturers, such as Cord as Masis, also advertise this capability. (CX 306, 310-311, 316-327, 336-338, 345, 614, 625, 630, 633).

416. The electronic typewriter has been described as a "three-part combination of word processing software, a small computer and a printer." An industry publication, Dataquest, suggests that some models of electronic typewriters "may be reclassified as word processor or personal computers because of their functional capabilities." The ability of an electronic typewriter to be interfaced gives it the advantage that it can be used as a printer as well as a typewriter. (Oliver, CX 169, at 18-19).

417. Dataquest estimates that in 1983 there were deliveries of at least 502,000 electronic typewriters in the United States. Dataquest further estimated that between 7-8% of electronic typewriters delivered were physically shipped with computer interfaces. (Oliver, CX 169, at 19).

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418. Dataquest estimates that by 1987 there will be approximately 1.2 million electronic typewriters, excluding portables and compacts, delivered in the United States. The estimates of continued rapid growth of sales of electronic typewriters in the United States made by Dataquest are corroborated by other industry sources. (Oliver, CX 169, at 22-24).

419. As electronic typewriters have proliferated in the market at widely varying prices, ranging from $575 to $4,950 in 1983, there is also a divergence in speed, ranging from 14 cps to 30 cps. Early models of electronic typewriters rarely exceeded 15 cps. Adler and Sharp models in this investigation are capable of printing at 18 and 20 cps respectively. (Oliver, CX 169, at 21-22).

420. The marketplace for rotary wheel printers and typewriters can be divided into four distinct areas. The first, and broadest category is the market for portable typewriters, which are **the least** expensive units, primarily directed to the student or **education type** of market. The second category is the office marketplace, which **includes office grade machines capable of heavy use which offer a limited display and limited memory. The third range covers the text editing market, which includes typewriters which have the capability to move words and paragraphs, and to add or delete text from a memory storage.**

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The fourth category is the word processing market, which offers greater text editing capabilities than the third group, and could include calculations, software intensive word processing or information processing. The price of the machine increases from the first, and lowest group, to the fourth, most expensive group. (Zochowski, Tr. 916-17).

421. In Qume's five-year business plan for 1984-1988, the following observations about the market were noted:

> Qume's markets have changed dramatically since its founding in 1973, and will continue to change over the plan period. The biggest impact on its markets ... has been the emergence and growth of the market for microcomputers. The proliferation of microcomputers has altered the market growth, direction, customer profiles, product utility, and nearly every other aspect of Qume's traditional WP/DP environment.
>
> ...
>
> ... This business plan assumes a continued high rate of growth for the microcomputer industry, and further assumes that the peripherals business will continue to enjoy significant after-market opportunities as a result of this growth.
>
> The pricing, product quality, and delivery capability of Japanese and other offshore manufacturers has become a major competitive issue in the peripherals marketplace .... This plan assumes that the impact of the Japanese and other offshore manufacturers will continue to be a major market force, and that the eroding price common today will also continue until a point of stabilization has been reached.

(RXE 15, at 10).

422. In order to achieve the lowest possible manufacturing costs, it is Qume's strategy to utilize its San Jose facility as a prototype assembly line for most products, then to transfer the majority of fabrication to other low cost sites. (RXE 15, at 18).

423. In 1984, Qume Caribe's unit cost of production was in the range of lower for various models of Sprint printers than comparable production costs at Qume's facility in San Jose. (CX 201).

424. Material costs in Taiwan are lower than costs in Puerto Rico. In 1984, average labor rates in Taiwan were . (Gower, CX 165, at 4).

425. Qume's Puerto Rico facilities at Las Piedras and Humacao are devoted exclusively to the manufacture of printers and printer supplies and accessories. They are operated on a one-shift basis primarily, with some operations performed on a two- or three-shift schedule. Present output is by increasing the size of the second-shift work force. Greater capacity than is possible in Puerto Rico in the existing facilities by subcontracting the manufacture and testing of

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printed circuit boards. Additionally, capacity is available through methods improvement, greater product standarizat:on, reduction in model variety, and Mechanization. (RXE 14, at 11).

426. In its five-year business plan for 1984-1988, Qume noted that:

> Present market pricing trends have affected all of Qume's product margins. A major factor which has contributed to the price erosion is the evolving end market; the shift away from systems dedicated to the WP function and towards multifunctional microcomputers is a shift downwards in terms of dollars spent per system. The strategic response to this threat is twofold: cost reduce present product immediately, and add low end product to the line as quickly as possible.

(RXE 15, at 18).

427. Dataquest has noted the following change in the market for word processors:

> In word processing systems, it is common for two or more workstations to share a single fully formed character printer, with one of the workstations acting as the controller for the system. In some large systems, up to 8 printers may support up to 24 workstations. With the development of stand-alone word processing systems, however, it is increasingly typical for a fully formed character printer to provide output for a single workstation; and the increase in these low-volume systems is partially responsible for the emergence of lower-cost, lower-speed character printers.

(Oliver, CX 169, at 17-18).

428. Qume's existing printer products are directed to an office products market composed of OEMs, systems integrators and distributors. Traditionally, Qume's printer products have been used in
C dedicated WP systems. Until at least 1983, approximately   of Qume's

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sales have been in the OEM segment of the market. Qume anticipates that markets for more costly daisywheel products will have little growth, and that its currer t product sales will peak in 1984-1985. Qume perceives that greater market opportunities exist in the distributor sector, and has begun an effort to address the distributor market segment. It is Qume's plan that OEM sales will from their of sales to of Qume's total printer sales in 1985. (RXE 15, at 18, 37, 39).

429. In its 1984 Business Plan, Qume noted that there are differences between servicing OEM and distributor customers. Qume's larger OEM customers provide long lead times for their orders, which until recentlly has enabled Qume to forecast its requirements with reasonable reliability. By contrast, most distributor orders have 30 day lead times, with significant exposure to the distributor if delivery is delayed. In addition, distributors expect to purchase from a finished goods inventory, as opposed to special builds that OEM customers frequently require. (RXE 14, at 4-5).

430. It is more difficult to identify lost sales in the distributor network than it is lost OEM sales because of the different nature of these types of customers. OEM accounts are usually acquired by bids, and are characterized by negotiated terms, high volume and relatively long length of time. By contrast, there is no direct contact between the manufacturer and the end customer in distribution sales, and these are characterized by small volume purchases. Thus,

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where it may be easy to identify a lost OEM contract, it is difficult to identify a lost distributor sale, due to the indirect nature of the sale. Qumet OEM customers encounter the same difficulty in identifying lost customers, since they are primarily selling in the distribution segment of the market. (Shires, CX 166, at 9-10).

431. In developing a marketing requirements specification for a low cost printer, Qume has made several observations about the nature of this market. The low cost-low speed printer market is expected to surpass the medium speed market in total units shipped by 1985. The market served by the low cost printer is the personal computer market which uses off-the-shelf software packages. Thus, an essential requirement for the low cost printer is compatibility with popular personal computers and software packages. Although the applications of the personal computer are diverse, there are certain common features. First, volume of output is low - approximately ten pages per day. Second, the space for storage of the printer is small, e.g., a book shelf or desk drawer. Third, users are looking for the lowest cost letter quality printer solution that meets their application. Thus, the most important features are system compatibility and low price. If these requirements are met, the user is willing to exchange features, reliability and print quality. (RXE 25, at 3, 10).

A32. The average end user price for low speed printers, such as those manufactured by Brother, TEC, Silver Reed and Smith Corona is about $600. It is expected that prices for low speed printers will decrease at an annual rate of 15-20%. The optimum speed for this type of printer is about 20 cps. Due to the emphasis on low cost for these printers, certain software features are sacrificed, and the mechanical construction can only sustain light duty use. (RXE 25, at 4-6).

433. When Qume shut down its facility in San Jose, approximately people lost their jobs. There were several factors which entered into the decision to transfer manufacturing operations to Puerto Rico: (1) the relative production costs of San Jose and Puerto Rico; (2) the effects upon Qume of continued losses if Qume tried to compete against lower priced foreign products;. (3) the dislocation in the lives of the employees who would be laid off; (4) the morale of the remaining employees; (5) the direct costs associated with large scale terminations; (6) the costs.of moving'machinee, inventory and spares to Puerto Rico; and (7) potential problems inherent in a 5,000 mile separation between the research and development, marketing and administrative offices in San Jose and manufacturing and quality control in Puerto Rico. (Gower, CX 165, at 7).

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434. Qume has estimated that **it had the following two-shift** capacity for manufacture of rotary wheel **printers**:

	Year	**Estimated Capacity Units**
	1980	
C	1981	
	1982	

(SX 2, at 6).

435. Qume's total domestic printer production of all printer models since 1980 is as follows:

		1980	**1981**	**1982**	**1983**	**1984**1/
C	**Mainland**					
C	**Puerto Rico**					
	TOTAL					

1/ Through September 30, 1984

(CX 218).

436. Qume's total printer sales since 1975 are as follows:

	Year	**Units**	**Revenues**
C	**1975**		
C	**1976**		
C	**1977**		
C	**1978**		
C	**1979**		
C	**1980**		
C	**1981**		
C	**1982**		
C	**1983**		

(CX 202, 203).

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437. Qume's **list prices on selected models of printers for sale** to OEMs have been as follows:

	Model	7/81	11/82	2/84
C	2.0[5]			
C	9/45			
C	9/55			
C	11/40			
C	11/50			
C	LetterPro 20			

NC = No change

C **Add for Sprint 11/series interface modules**

(CX 204, at 7).

438. Qume's list prices on selected models of printers for sale to distributors have been as follows:

	Model	7/81	11/82	2/84
C	9/35			
C	9/45			
C	9/55			
C	11/40			
C	11/50			
C	LetterPro 20			

NC = No change

C **Ade for Sprint 11/series interface modules.**

(CX 204, at 8).

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439. Qume has calculated the following profit and loss figures for its domestic printer sales:

Printers ($ = 000's)

		1980	1981	1982	1983	1984 Forecast
C	Domestic Sales					
C	Standard Margin					
C	Gross Margin					
C	R&D Expense					
C						
	Profit Before Taxes					

(CX 214).

440. Qume's total comany consolidated after tax profits are as follows:

($000's)

1980	1981	1982	1983	1984 1/

1/ Through August 30, 1984

(Gower, Tr. 323-24; CX 214).

441. Qume's consolidated after tax profit for 1983 of

includes the license and royalty fees obtained from rotary wheel product manufacturers in settlement of Rotary Wheels I, and profits from non-printer products. (Gower, Tr. 180).

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442. Qume has recently concluded a contract with

. (Shires, Tr. 442-43).

443. Qume has recently concluded a contract with

(Shires, Tr. 443).

444. has recently expanded its existing contract with Qume by adding sales of

Qume's competition for this sale included Ricoh. (Shires, Tr. 443, 453).

445.

(Shires, Tr. 443-44).

446. Qume has concluded a new contract with

. (Shires, Tr. 444).

447. Qume faces substantial competition from foreign, primarily Japanese, manufacturers, notably NEC, Brother, Ricoh, TEC Fujitsu and Silver Reed. (Shires, Tr. 446, 448).

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448. Qume has an existing contract with for sale of a version of the Sprint 11/40. Qume has had discussions with about sales of the LetterPro which had not reached conclusion at the time of the hearing. Qume's competition for this sale includes Ricoh, TEC, Brother and Silver Reed. (Shires, Tr. 456).

449. In Qume's LetterPro Introduction Plan, the daisywheel market is depicted as being segregated by user' and system. The Personal Use segment is identified by the personal computer, having a printer speed requirement of 12-20 cps and a 1983 price range of

C . The LetterPro was targeted at for this use. The next segment is identified as small business, which utilizes low-end word processing and small business computers. This market segment requires a letter quality printer having a speed of 20-35 cps and a price range of in 1983. The LetterPro is targeted at for this market segment. The third market segment is identified as medium sise business, utilizing full function word processing and small business computers. The printer requirement is rated at 35-55 cps, with a 1983

C price range of . The LetterPro is targeted at in this segment. The fourth market segment is designated as large business, which utilizes cluster word processing, has a printer requirement of

C 55-70 cps, and a 1983 price range of The LetterPro is not targeted to this segment. (Shires, Tr.432-33; RXE 50, at Bates No. 954730-32).

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450. The low end of the daisywheel market which supports personal computer usage is a decentralized system which has a relatively infrequent duty cycle and the user can settle for slower speeds. By contrast, the centralized, multi-user clustered word processing system requires printers with higher speeds and the ability to sustain a heavy duty cycle. (Shires, Tr. 433, 459).

451. Another significant printing technology currently on the market is dot matrix printing. There have been advances in dot matrix technology in recent years which have improved the print quality. In addition matrix printers are noted for their ability to print graphics. In spite of these improvements, together with lower cost and graphics capability, dot matrix printers are still not capable of producing the standard of letter quality print produced by daisywheel printers. Thus, at least at present, in the market which requires letter quality print, the daisy wheelprinter has not been supplanted by dot matrix technology. (Oliver, CX 169, at 11-12; Shires, CX 166, at 6-7; Shires, Tr. 435-46).

452. Other non-impact printing technologies, such as laser, ink jet, and thermal transfer have also emerged in recent years. These technologies show great promise for letter-quality print in the future. However, in their present developmental stages, reliability, technological shortcomings, cost of supplies, need for service, and overall price have prevented these technologies from being a current threat to the daisywheel market. (Oliver, CX 169, at 12; Shires, Tr. 433-35; Billadeau, RXE 134, at 13-14).

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453. Nakajima is an OEM oriented manufacturer of typewriters
C and printers. In 1983, its monthly production capacity was units. In 1984 this capacity was increased to units per month. Nakajima's actual production in 1983 was approximately units, and from January-May 1984, was approximately Since the time that Nakajima released its electronic typewriter, order quantities have exceeded production capacity. (CX 1133; SX 26, at 7).

454. Between March 1983 and April 1984, Nakajima exported at
C least printers to the United States at a value of about
C (CX 1141; SX 30).

455. Between April 1983 and March 1984, Nakajima exported more
C than rotary wheel typewriters to the United States, at a value of about . Of this total, more than typewriters were shipped with interfaces. (CX 1138).

C 456. From April to December 1983, Sharp sold rotary wheel typewriters in the United States, which was below their forecast of typewriters for the year. The Sharp ZX-410 was announced in July 1983, and SEC received its first shipment in February 1984. In about June or July 1984, the interface for the ZX-410 was shipped. By the time of hearing in this matter, SEC had shipped approximately units of the interface. (Zochowski, RXE 132, at 3, 5-6).

C 457. Between 1982-1984, Adler-Royal imported more than
C rotary wheel typewriters at a value of about . (CX 1174).

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458. As of March 1984, Towa had planned the following production capacity for its rotary wheel products:

	Model	Monthly Capacity
C	R1	
C	R2	
C	R3	

(SX 32, at 11).

459. Towa's actual production as of August 1984 was as follows:

	Model	Monthly Production
C	R1	
C	R2	
C	R3	

(SX 32, at 11).

460. During the period from October 1983 to July 1984, Towa manufactured the following quantities for export to the United States:

	Model	Production
C	R1	
C		
	R2	
C	R3	

(SX 32, at 12).

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461. From October 1983 —July 1984, Towa shipped to the United States units of the R1 printer, units of the R2 printer/typewriter, and units of the R3 typewriter. (SX 32, at 12). MM.

462. On the basis of respondents' activities in the United States market set forth herein, I find that the effect of respondents' unfair acts and unfair methods of competition has been to destroy or substantially injure the domestic industry. This is particularly evident in connection with Qume's activities in 1983 when it was manufacturing the Sprint 8/20 in Puerto Rico under contract to Raytheon and its subsequent elimination from domestic production of printers in this tow_speed category.. (FF 287, 288). Further, with respect to the respondents remaining in this investigation, I find that there is a tendency to substantially injure the domestic industry by reason of importation and sale in the United States of Nakajima's model AP 650 printer, Sharp's models ZX 400, ZX 410 and ZX 415 typewriters, Triumph-Adler's models 1005/5005, 1005/5005 XL, 1010/5010, 1011/5011, 1020/5020, 1030/5030, 1030/5030K, 1035/5035, 1040/5040, and 1041/5041 typewriters, and Towa's R1 Printext printer and R2 Executive 77 typewriter/printer. (FF 362-461).

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OPINION

GOP.

I. THE PATENT AND PRODUCTS IN ISSUE

This investigation involves allegations of infringement of claims 1-7 and 8-10 of U.S. Letters Patent 4,118,129 (the '129 patent). This patent describes an electronic rotary wheel (daisywheel) printing system. In such a system the rotary wheel, or daisywheel, has a plurality of radially extending spokes equiangularly distributed about the axis thereof. Each spoke terminates in an enlarged pad portion on which a raised character is to be printed, and a hammer strikes the selected character to impress it on the printing medium. (CX 1, Fig. 2A, Col. 4, lines 46-52, Col. 2, lines 35-46).

Claims 1 and 8 of the '129 patent were asserted by complainant herein to be representative. They each describe different aspects of the invention. Both of these claims are "Jepson" type claims which first describe various elements of the prior art in rotary wheel printing systems and then set forth the improvements therein which are claimed as the invention. (FF 33, 34). The improvement asserted in claim 1 is a feedback compensation system for an opticai encoder in a daisywheel printing system. The feedback system is intended to provide accuracy and reliability in the positioning of the print wheel for printing. (CX 1, claim 1). The improvement provided by claim 8 consists of the control logic for selecting and positioning the character of the print wheel to be printed and the hammer intensity which is to be applied to the selected character. (CX 1, claim 8).

The products involved are electronic printers of complainant Qume and the electronic printers and typewriters of respondents. The printers are designed to be coupled to a source such as a computer for obtaining the material to be printed, whereas, in the typewriters the source of the characters to be printed is the keyboard. Some of the electronic typewriters involved have built-in interfaces which allow them to be connected to computers, or built-in ports for attachment of interfaces. Others are interfaceable by other means. (FF 20-28, 190, 208, 235, 247, 404-414).

II. VALIDITY OF THE '129 PATENT

Respondents have made a number of assertions in support of their position that the '129 patent is invalid.

A. The Zodiac Word Processing System

First, respondents assert that Mr. Grundherr derived the invention of claim 8 from Messrs. Campbell et al. of Diablo/Xerox, where Mr. Grundherr was formerly employed. Thus, it is argued that he did not himself invent the subject matter of the '129 patent or that before the applicant's invention, the invention was made in this country by another who had not abandoned, suppressed or concealed it, and that the patent is therefore invalid under 35 U.S.C. 102(f) and (g). (RB at 7-9). The evidence does not reveal any knowledge on the part of Mr. Grundherr of the workings of the ISS controller which was the part of the Zodiac system containing the control logic. Moreover, the priority date for the patent application on the Xerox device representing the Zodiac system postdates the filing date of the parent application leading up to the '129 patent and there is no evidence of any other publication of this work. (FF 42-47). Therefore, respondents have failed to prove that Mr. Grundherr was not himself the inventor of the '129 device or that he had made use of the prior invention of another who had not abandoned, suppressed or concealed it.

B. Anticipation of Claim 8 by the Beery Patents

Respondents then argue that claim 8 of the '129 patent was anticipated by the two Beery patents for a check marking device. (RB at 9). I have reviewed the claims and specifications of these two patents -- Beery '212 and Beery '589 -- and have found that they do not in fact anticipate the '129 device. (FF 136-148).

C. Obviousness

1. Obviousness of Claim 8

Respondents next contend that claim 8 of the '129 patent is an obvious variation of the Diablo Hy Type I printer (the subject of the Grundherr '509 patent) and that the claim 8 device was therefore unpatentable under 35 U.S.C. 103. They urge that the '509 device used a ROM for the same purpose as the '129 device and differed only in the manner in which the ROM was addressed to obtain the character location and hammer intensity information. It is further argued that it would have been obvious to one skilled in the relevant art to make the changes inherent in the '129 device. (RB at 9-10).

Crucial to respondents' position in this regard is a determination of the relevant field of art and a definition of a person of ordinary skill in the art, during the relevant time period -- roughly 1972-1974. Graham v. John Deere Company, 383 U.S. 1, 17-18; 148 U.S.P.Q. 459, 467 (1966).

In reaching a determination of obviousness it is also "critical to the analysis to deliberately guard against using the teaching of the patent in suit in arriving at the conclusions." General Electric Co. v. United States, 198 U.S.P.Q. 65, 80 (Ct. Cl. 1978). The issue is "whether the teachings of the prior art would, in and of themselves and without the benefit of [complainant's] disclosure, **make the invention as a whole, obvious."** **In** re Nomiya, **Kohisa, and Matsumura, 184 U.S.P.Q. 607, 612 (C.C.P.A. 1975), quoting In re Sponnoble, 160 U.S.P.Q. 237, 243 (C.C.P.A. 1969). (Citations omitted; emphasis in original).**

Thus, it is essential to avoid hindsight and Monday morning quarterbacking in reviewing the invention and the prior art. It is necessary to view the art and the level of skill in that art, at the relevant time, to determine obviousness. Orthopedic Equipment Co., Inc. v. United States, 217 U.S.P.Q. 193, 199 (Fed. Cir. 1983). Moreover, the level of skill in the art is stated in 35 U.S.C. 103 to be "ordinary." Therefore, the question is not whether the subject matter would have been obvious "to the rare genius, or to a judge or other layman after learning all about the invention." Stratoflex, Inc. v. Aeroquip Corp., 218 U.S.P.Q. 871, 879 (Fed. Cir 1983).

Respondents have produced experts who have proclaimed the "invention" in claim 8 to have been a simple problem in "logic dedign" which would be obvious to any person of ordinary skill in "logic design." (FF 88, 124). However, this testimony ignores the relationship of the logic design problem to the operation of a rotary wheel printing system and comes from persons of superior knowledge looking at the '129 invention with obvious hindsight. (FF 88-102).

I have found other evidence of record to be far more relevant to the

issue of obviousness. The testimony and evidence offered by Mr. Simpson, one of respondents' witnesses, in particular, is illustrative of the relevant art and the definition of a person of ordinary skill in that art in the 1972-1974 time period. His testimony, along with that of Messrs. Campbell, Beery and Grundherr, shows that the relevant art was the design and implementation of control logic for certain types of printing systems, particularly rotary wheel printing systems, and that a person of ordinary skill in the art was an electronics engineer with six to nine months experience in this art, or a technician with about five years of hands-on experience in this art. (FF 89-102, 148, 152). Mr. Simpson's relationship with Triumph-Adler reveals that engineers in this field at this period of time were not sufficiently acquainted with microprocessors, and their applications, so as to render the improvement found in claim 8 obvious. Moreover, such evidence also shows that the "logic design" expert could not, alone, design the logic for a printing system. It took two years of cooperation between this logic design expert and the Triumph-Adler engineers to design and implement a control system for an electronic typewriter similar in concept to that of the '129 device. (FF 89-102).

Accordingly, I have found that neither the Hy Type I device, nor the Grundherr '509 patent which describes that device, render claim 8 of the '129 patent obvious. At the relevant period of time 1972-1974, it would not have been obvious to a person of ordinary skill in the art to use the ROM in the '509 device in the manner utilized in the '129 device. (FF 121-127, 134, 135).

2. Obviousness of Claim 1

Respondents also contend that claim 1 of the '129 patent is unpatentable over the prior art under 35 U.S.C. 103, because it takes "a commercially available photoelectric transducer and [places] on it [a] standard feedback loop made up of standard components." (RB at 10). They then refer to the Dubauskas, Holter and Kocher patents as rendering the '129 feedback device obvious. (RB at 10-11). I have analyzed the Dubauskas, Bolter and Kocher patents and found that they do not render claim 1 obvious. (FF 109-112, 116-118). Respondents have produced Dr. Bernstein, one who professes to have superior expertise, to support their argument as to obviousness in connection with claim 1. (FF 117). I have found his testimony to be unpersuasive on this point.• (FF 117). Mr. Beery, on the other hand, who was a person of at least ordinary skill in the relevant art, testified to the nonobviousness of this invention. (FF 117).

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Nor does the fact that the individual components of Mr. Grundherr's feedback device were all commercially available support respondents' arguments of obviousness. That all elements of an invention may have been old (the normal situation) or some old and some new, or all new, is however, simply irrelevant. Virtually all inventions are combinations and virtually all are combinations of old elements. A court must consider what the prior art as a whole would have suggested to one skilled in the art." Environmental Designs Ltd. v. Union Oil Co., 218 U.S.P.Q. 865, 870 (Fed. Cir. 1983). Further, the record does not show that all of the parts were commercially available, or that they had been combined in this manner before. (FF 118).

3. Secondary Considerations

Secondary considerations lend great weight to the other evidence of nonobviousness cited above. Qume printers have realized a remarkable success in the marketplace since their first introduction. (FF 159). Since the improvements set forth in the '129 patent were key elements in those printers (FF 160), they of necessity played an important part in that success.

D. <u>Lack of Enablement and Failure To Properly Claim - Claim 1</u>

Respondents next argue that claim 1 is invalid for failure to comply with 35 U.S.C. 112. They urge two bases for this contention. First, it is stated that the circuit presented in Figure 7 of the '129 patent is not operative to maintain the light output substantially constant as required in claim 1 and the specification. (RB at 12-13). Second, they urge that the best mode is not disclosed in the patent because the specification and the claim fail to disclose a mask between the encoder disc and the photosensors. (RB at 13).

The first of these arguments is simply a misinterpretation of the patent, caused by reading text out of context. The overall reading *of claim* 1 and the specification, including the figures therein, reveals that the device maintains the intensity of the light source constant at a point "adjacent [the] light sensitive devices," not at the light itself. With this understood, the circuitry agrees with the claim and the claim is enabling. (FF 153).

The "best mode" argument of respondents is also found wanting. Mr. Grundherr has testified that his device will work without the mask. Moreover, the mask does not relate to the part of this "Jepson" claim which is his invention. (FF 154). There is no evidence that applicant acted in bad faith or with *any attempt* to conceal what he felt *was the* best method of using his invention. Studiengesellschaft Kohle mbH v. Eastman Kodak Co., 206 U.S.P.Q. 577, 599 (5th Cir. 1980).

E. Inequitable Conduct Before the Patent and Trademark Office

Respondents argue that a number of acts of inequitable conduct occurred before the PTO. They specify six separate acts which they urge constitute such inequitable conduct. They are:

> 1. The withholding of the public use and sale of the Hy Type I printer more than one year before the filing of the application for the '129 patent;
>
> 2. The misrepresentation of the prior art in the "Background of the Invention" set forth in the '129 patent;
>
> 3. The withholding of the prior invention of another in the Diablo/Xerox Mark I printer;
>
> 4. The misrepresentation of the disclosure of Beery Patent No. 3,712,212 in Application SN 485,055 (the parent application);
>
> 5. The withholding of Beery Patent No. 3,712,212 during the prosecution of the continuation application; and
>
> 6. The failure to inform the PTO about the Littori and Disc optical encoders.

(RB at 20).

Proof of inequitable conduct before the PTO "requires proof by clear and convincing evidence of a threshold degree of materiality of the nondisclosed or false information ... [and) of a threshold intent." J.P. Stevens & Co., Inc. v. Lex Tex Ltd., Inc., 747 F.2d. 1553, 1559-60 (Fed.

Cir. 1984). See also Norton v. Curtiss, 167.U.S.P.Q. 532 (C.C.P.A. 1970). "Mere evidence of simple negligence, oversight or an erroneous judgement made in good faith not to disclose prior art is not sufficient to render a patent unenforceable." Orthopedic Equipment Co. v. All Orthopedic Appliances, 217 U.S.P.Q. 1281, 1286 (Fed. Cir. 1983). As pointed out in Kansas Jack, Inc. v. Kuhn, 219 U.S.P.Q. 857, 861 (Fed. Cir. 1983), "that something thought to be true when stated, or a piece of prior art thought unimportant to the PTO's decision, was later determined to have been untrue or important, will not automatically and alone establish that fraud or inequitable conduct occurred." Although the prosecution of the application leading up to the suit patent was far from error free, respondents have failed to prove inequitable conduct. (FF 51-86, 134-158).

1. The Nondisclosure of the Hy Type I Printer and Manual

The Hy Type I printer is the basis for the '509 patent. It was invented by Mr. Grundherr when he worked for Diablo/Xerox and his work thereon was the basis of his patent application. (FF 36-39).

Respondents' argument is based principally on the contention that the Grundherr '509 patent was not prior art to the '129 patent, because-it had the same inventor and its issue date was after the application date for the parent application of the suit patent. It is therefore urged that the Hy Type I printer and its manual, which had been marketed by

Diablo/Xerox more than one year prior to the filing date of the parent application of the '129 patent, should have been disclosed. They further contend that regardless of the validity of the '509 patent as a prior art reference, the Hy Type I printer and manual should have been disclosed because they were more material. (RB at 19-21).

There is no question but that Examiner Rader concluded at some point during the continuation application that the '509 patent was **not a** valid prior art reference. **(FF 74). There is no evidence, however, that applicant and his patent attorney were made aware of that conclusion. (FF 75). Moreover, there is some argument as to the correctness of such conclusion. Complainant points to S 304 of the Manual of Patent** Examining Procedure (M.P.E.P.) as indicating **that the prior application of** the same inventor may become a prior art reference to a **second application, if it has been assigned. The Grundherr '509 patent had been assigned to** Xerox. (CX 5). **Respondents have argued the inapplicability of that PTO rule in the present situation. (RRB at 5). However, the existence and arguable applicability of such a** rule, **Coupled with the fact that the examiner twice cited the '509 patent as a prior art reference, have some effect on proof of "threshold intent" herein.**

Examiner Rader cited the '509 patent as a principal reference *in* **two Office Actions in the parent application file. Since there is no evidence that applicant or his attorney were made aware of Examiner Rader's change of opinion, there was no reason for them to call** the By

Type I printer/manual to **the PTO's attention, unless they knew the '509 patent was not a valid reference, or unless that device and its manual were a more material reference.**

Although the manual naturally contains many technical details not found in the claims and specification of the '509 patent, my review thereof, along with the testimony and other evidence of record, has revealed that all elements of the Hy Type I printer as disclosed in the manual, which are material to a determination of the patentability of the "invention" disclosed in the '129 patent, are revealed in the '509 patent as well. Therefore, the Hy Type I printer and manual were not more material than the '509 patent for the purposes of the PTO, if the '509 patent was a valid reference. (FF 134).

To summarize, the applicant was twice advised by the examiner that the '509 device was a principal reference in rejecting. claim 8 under 35 U.S.C. 103. He is not shown to have had any knowledge that the examiner changed his mind. In fact, Mr. Rujawa, the patent codnsel, consistently advised foreign patent associates that the '509 patent was a principal prior art reference and this correspondence and his testimony herein reveals that he was convinced throughout the prosecution of the application that this was the case. (FF 78). Examiner Rader substituted the Lundquist patent for the '509 patent in his last rejection in the continuation file, having made an unannounced determination of the nonapplicability of the '509 patent.

Section 304 of the M.P.E.P. indicates that the prior application of an inventor may be prior art to certain later applications of the same inventor where the prior application was assigned. The '509 patent had been assigned to Xerox. I have found that the Hy Type I printer and manual were no more material to the patentability of the suit patent device than the '509 patent, insofar as their disclosures were concerned. Applicant's patent counsel never called the Hy Type I printer or its manual to the attention of the PTO.

In view of these facts, I cannot find a "threshold intent" on the part of the applicant to deceive the PTO, regardless of whether or not S 304 of the M.P.E.P. is applicable to the prior art status of the '509 patent. The evidence may reveal an "oversight or an erroneous judgement made in good faith," Orthopedic Equipment Co. v. All Orthopedic Appliances, 217 U.S.P.Q. at 1286, but respondents have not met their burden of showing "threshold intent" in their assertions of inequitable conduct in this regard. J.P. Stevens, 747 F.2d at 1560.

2. Misrepresentation of the prior art in the "Background of the Invention"

Respondents next contend that certain language in the section of the suit patent entitled "Background of the Invention" suggested or inferred that the variable hammer intensity feature of the device, as presented, was new, and that this was a material misrepresentation to the PTO. I have found that the language in question does not necessarily imply that all prior art systems had a single hammer intensity. (FF 157). Moreover, the evidence shows that the examiner had to be aware of the fact that prior rotary wheel printing systems had utilized more than one hammer intensity for their impressing means. (FF 157). Thus, in any case, this language in the "Background of the Invention" does not attain the "threshold degree of materiality" essential to proof of inequitable conduct. Since the examiner was clearly aware that prior devices used more than one hammer intensity there is no "substantial likelihood that [he] would have considered ... [this information] important in deciding whether to allow the application to issue as a patent." J.P. Stevens, 747 F.2d at 1559.

Nor was the failure to disclose the variable hammer intensity systems used by IBM in its Selectric and Mag Card typewriters shown to constitute inequitable conduct. A reference to these devices in arguments as to the validity of the '509 patent in the Xerox v. Qume litigation, or as being "also of interest" in a letter to a foreign patent agent (RB at 21-22; RXT 189, p. 2) hardly raises such devices to the level of a "material" reference, insofar as the prosecution of the suit patent was concerned. Respondents have produced no other evidence to show that the IBM devices included components that would have been material to the question of patentability of the suit patent device (RTF 257-258), and, as noted above, the examiner was well aware of the fact that variable hammer intensity existed in the prior art. (FF 158).

3. The withholding of information of the prior invention of another in the Diablo/Xerox Mark I printer

This argument of respondents is based on the same allegations as their contention that the '129 patent is invalid under. 35 U.S.C. 102 due to anticipation by the Mark I/Zodiac System, treated above. As I noted there, the evidence of record indicates that Mr. Grundherr was never aware of the control logic located in the ISS controller of the Zodiac systems. (FF 42-46, 149-152). Accordingly, there is no showing of knowledge on the part of applicant or his attorney that the memory device in that controller was addressed in a similar fashion to that described in claim 8. (FF 149-152). The most notable facts concerning the Zodiac system, insofar as this proceeding is concerned, is that it was ultimately patented also, and that the patent application therefor was dated after the application for the suit patent. (Fr 150, 152). In any event, without a showing of knowledge on the part of applicant and patent counsel as to the workings of the controller, there can be no showing of the necessary "threshold intent." Id.

4. Misrepresentation of the Beery patent in the parent application

In the first Office Action of the parent application, the Beery '212 patent was cited by the examiner. When Mr. Kujawa, the applicant's patent counsel, responded to that Office Action he dismissed the Beery reference within a group of other references merely as not supplying deficiencies that Kujawa had asserted existed in the primary references.

Respondents point out that Mr. Kujawa had asserted two deficiencies in the '509 reference at that time -- first and second memory portions for storing character location and hammer intensity information and sequential fetching thereof. It is then pointed out by respondents that concurrently with the prosecution of this application, Mr. Kujawa was participating as counsel in the Xerox v.Qume litigation in which one of Qume's contentions was that the printing system of the Beery '212 and Beery '589 patents taught a device with two separate memory devices separately storing character position and hammer intensity information, with the information being accessed therefrom sequentially. It is therefore urged that the response to the first Office Action was a misrepresentation, in that Beery did supply the deficiencies in the examiner's reference to the '509 patent. (RB at 23). Respondents further argue that the examiner did not have the withheld prior art before him since he did not have the 'Beery '589 patent before him and it was essential to a determination of the materiality of the Beery system. (RB at 24).

I have found, in the first place, that the Beery '212 patent not only includes the '589 patent by reference, but also gives a brief description of the function of the '589 features in its specification. (FP 142). Therefore, the examiner did have all of the essential facts before him to decide the materiality of the Beery device to the patentability of the suit patent device. Moreover, although there may have been some inconsistency in the positions Qume took in the Xerox v. Qume litigation and in the prosecution of this patent, their **internal communications** reveal that they were consistent in their **beliefs and positions regarding the patentability of their device over Beery and other references cited.** Moreover, I have found that the Beery devices did not **render the '129** device obvious to a person of ordinary skill in **the art, at the relevant time period. (FF 136-148).**

Accordingly, the reasoning of **the Federal Circuit in Orthopedic Equipment is applicable to the present situation. 217 U.S.P.Q. at 1287. As noted therein, "Me do not think it necessarily reflects bad faith for the same counsel to take inconsistent positions in different litigation. OEC have in this litigation been consistent that the material not disclosed is not relevant." Similarly here, the fact that Qume took positions which were not wholly consistent in the Xerox v. Qume litigation and in the patent prosecution does not amount to fraud or inequitable conduct. The information concerning the Beery patents and their relevancy to the Grundherr '129 application was clearly before the examiner. The examiner had mentioned the '212 patent, which included the. '589 device, in rejecting the claims of the application. Mr. Kujawa made a response, in kind, that the various peripheral references of the examiner did not cure the deficiencies in the principal references, which included Bossi as well as the '509 patent. The internal documents of Qume, including Kujawa's letters to foreign patent agents, show that** although he considered Beery to be a material reference, he did not consider it to supply all of the deficiencies of the other prior art. Moreover, the arguments in Xerox v. Qume were directed to the validity of the '509 patent, which Qume was accused of infringing, not to the patentability of the '129 device.

The information in question, the Beery patents, was independently found by the examiner. As noted in J.P. Stevens, 747 F.2d at 1563, if the examiner "actually knew about ... (the references] that knowledge might preclude a finding of materiality." It must be presumed that the examiner fully understood the Beery '212 patent, since he did cite it as a reference in this rejection. Mr. Kujawa's failure to be more explicit in the manner by which the Beery device could be distinguished from the suit patent device can hardly be considered to be inequitable conduct under these circumstances.

5. The withholding of the Beery '212 patent during the prosecution of the continuation application

Respondents make much of the fact that applicant made no explicit reference to the Beery '212 patent during the continuation application, despite the fact it had urged the applicability of the Beery patents to the '509 patent in the Xerox v. Qume litigation, and had contemporaneously told foreign patent associates that Beery '212 was an important reference in the foreign patent prosecutions related to this device. (RB at 24-25). Respondents then cite to J.P. Stevens to

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support their position that applicant's conduct in this regard was inequitable. (RB at 25). In that case, however, the facts did not show, as here, that the prior art in question had been cited by the examiner. 747 F.2d at 1564, 1566. Here the Beery '212 patent was already in the file wrapper of the parent application. The same examiner, Examiner Rader, was in charge of this application through a goodly portion of the continuation file, including through the rejection in the Office Action of 8/23/77, which was the last rejection in this prosecution. (FF 64). Thus, it was fair for Mr. Rujawa to assume that the examiner was still aware of that reference. "Fraud cannot consist of a failure to duplicate what is in the file wrapper." Environmental Designs, Ltd. v. Union Oil Co. of California, 713 F.2d 693, 698 (Fed. Cir. 1983), cert. denied, 104 S. Ct. 709 (1984).

6. The failure to inform the PTO about the Litton and Disc optical encoders

It is argued that Grundherr admitted that he had purchased standard optical encoders from Litton and Disc and simply attached a standard feedback loop to them to control the light intensity in the invention of the '129 patent. It is alleged that it was a violation of the duty of candor and good faith not to have informed the PTO of such alleged facts. (RB at 25). These allegations are a distortion of the record evidence. Mr. Grundherr clearly testified that the encoder discs used in his device were not the standard discs manufactured by Litton and Disc. (FF 118, 155). Moreover, although he testified that all of the individual components of his feedback loop were commercially available, he further testified that as far as he knew they were not used before in this manner with an optical encoder. (FF 118).

F. Conclusions As To Validity

In view of the above, I must find that respondents have failed to introduce evidence which would overcome the presumption of validity herein. Jones v. Hardy, 727 F.2d 1524, 220 U.S.P.Q. 1021, 1024 (Fed. Cir. 1984).

III. INFRINGEMENT

The burden of proof of infringement rests upon complainant herein. To find infringement it is necessary for me to

> determine that every element of a claim alleged to be infringed must *be* found in the accused device, Mobil Oil Corp. v. Filtrol Corp., 501 F.2d 282, 291 (9th Cir. 1974) -- that the accused device is a copy "either without variation, or with such variations as are consistent with its being in substance the same thing." Engelhard Industries, Inc. v. Research Instrument Corp., 324 F.2d 347, 351 (9th Cir. 1963), quoting Burr v. Duryee, 68 U.S. 531, 573, 17 L. Ed. 664 (1963).

American Hoist & Derrick Co. v. Manitowoc Co., 202 U.S.P.Q. 705, 706 (7th Cir. 1979).

A. Findings as to Infringement

My study of the evidence reveals that the accused products contain each and every element of the claims in issue, or the substantial equivalent of such elements. (FF 161-256). In making such findings I have followed the strictures of Autogiro Co. of America v. United States, 155 U.S.P.Q. 697, 705 (Ct. Cl. 1967), which notes that

> [T]he determination of patent infringement is a two-step process. First the meaning of the claims in issue must be determined by a study of all relevant patent documents. Secondly, the claims must be read on the accused structures .... What is crucial is that the structures must do the same work in substantially the same way and accomplish substantially the same result to constitute infringement.

Moreover, in determining infringement

> Every patent is entitled to a reasonable range of equivalents consonant with its contribution in advancing the pertinent art .... It is a basic tenet of patent law that direct infringement is established if the accused device embodies all the essential elements described in the patent claims. Under the doctrine of equivalents, an accused device does not avoid direct infringement by a transposition of elements ... the substitution of elements ... or the addition of elements.

Duplan Corp. v. Deering Milliken, Inc., 181 U.S.P.Q. 621, 629 (D.S.C. 1974) (citations omitted).

Thus, when an accused device does not literally read on the claims of a patent, infringement will not be avoided if that device "performs substantially the same function in substantially the same way to obtain the same result." Graver Tank & Mfg. Co., Inc. v. Linde Air Products Co., 85 U.S.P.Q. 328, 330 (S. Ct. 1950). A finding of equivalence is a factual determination which must be based upon an examination **of the** context of the patent, the prior art and the particular **circumstances** of the case. Id. at 330, 331.

Although the '129 patent is not a pioneer patent, and is **in fact** an improvements patent, it is still entitled to some range of **equivalents.** Duplan Corp. v. Deering Milliken, Inc., 181 U.S.P.Q. at 628. To **the extent that respondents' accused devices have not literally read on some of the individual elements of the claims here at issue, I have found** that they come within this fair range of equivalents. (See, e.g., FP **187**, **211**, 223, 231-234, 236-238, 251-252, 254).).

B. Assertion of "File Wrapper Estoppel"

Aside from the basic factual issues regarding infringement, it is respondents' contention that "file wrapper estoppel" limits the scope of claim 8 of the suit patent to a device wherein the print **wheel** has actually been rotated into position, **prior to the fetching of the hammer intensity.** (RB at 32, 35). I have found that claim 8 is not so limited.

Under the doctrine of file wrapper estoppel, a patent owner may not obtain a construction of a claim in an infringement suit that would have the effect of recapturing subject matter that was surrendered during the prosecution of the patent before the PTO. 4 D. Chisum; Patents, S 18.05 (1982); Exhibit Supply Co. v. Ace Patents Corp., 315 U.S. 127 (1942). The file wrapper contains the history of a patent's prosecution. This history provides a record of any limitations inserted by the applicant to overcome rejection by the Patent Office. Once a patent is issued, the doctrine of file wrapper estoppel prevents the patentee from disclaiming limitations which were made to induce the Patent Office to grant the patent. Restricted by this doctrine, a patentee cannot narrowly construe patent claims before the Patent Office and then broadly interpret these claims before a court. Autogiro Co. of America v. United States, 155 U.S.P.Q. at 704. This doctrine applies to amendments as well as to arguments which are contained in the file wrapper. Hughes Aircraft Co. v. United States, 219 U.S.P.Q. 473, 481 (Fed. Cir. 1983).

Because file wrapper estoppel keeps a patentee from reclaiming what has been surrendered, "it is necessary to determine what in fact the patentee gave up in order to receive its patent." Ziegler v. Phillips Petroleum Co., 177 U.S.P.Q. 481, 489, (5th Cir. 1973), cert. denied. 180 U.S.P.Q. 1 (1973). Courts dealing with interpretive problems under file wrapper estoppel have established principles which can be used in determining what an applicant in fact surrendered. When the issue involves the scope of a disclaimer, **an applicant should not be presumed to have made a disclaimer broader than necessary to answer the PTO's actual challenge. Hunt Tool Company v. Lawrence, 113 U.S.P.Q. 7, 13 (5th Cir. 1957); Nationwide Chemical Corporation v. Wright, 200 U.S.P.Q. 257, 260 (5th Cir. 1978); Omark Industries, Inc. v. Textran, 216 U.S.P.Q. 749, 757 (9th Cir. 1982). In the event a court is confronted by arguments of counsel which appear to differ from requirements in the claim language, it is the language in the claim which controls. Denominational Envelope Co. v. Duplex Envelope Co., Inc., 27 U.S.P.Q. 317, 323 (4th Cir. 1935); Catalin Corp. of America v. Catalazuli Manufacturing Co., Inc., 27 U.S.P.Q. 371, 373 (2d Cir. 1935). Finally, just as it is unfair to allow a patentee to reclaim territory surrendered during the patent prosecution, it is also unfair to restrict a patent on the basis of arguments which had no effect on the acceptance of the claims. See, e.g., Keys Fibre Co. v. Chaplin Corp., 89 U.S.P.Q. 489, 495 (D.Me. 1951) (arguments of counsel to PTO which effected no change in claims held not to establish estoppel).**

The focal point of the analysis, therefore, becomes what revisions, if any, resulted from arguments submitted to overcome rejection by the PTO. These revisions, when delineated, mark the territory which was surrendered by the applicant and which is thereafter prevented from recapture by file wrapper estoppel. Hunt Tool Co., 113 U.S.P.Q. at 12_ Keys Fibre Co., 89 U.S.P.Q. 489. These general principles can be applied in conjunction with a three part analysis offered in Special Metals Corp.

v. Teledyne Industries, Inc., 717 F.2d 128, 134 (4th Cir. 1983). When addressing the issue of file wrapper estoppel the court considered the following factors: (1) the nature of the PTO's objections; (2) changes that were made in the claims; and (3) the basis for allowance of the grant by the PTO. Id. at 134.

Respondent alleges that Qume's arguments in support of claims 8 through 14 can be read to limit claim 8 with regard to print wheel positioning. The file wrapper discloses that in responding to the PTO's rejection, Qume discussed claims 8 through 14 in a single argument. Admittedly, Qume's argument is less than clear, in that it begins by addressing all six claims and then treats certain claims individually. *(See* RXPT-2, Amendment of 11/23/77, at 12-13). To answer the estoppel defense, it is necessary to determine what portion of Qume's argument may be interpreted as applying to, and possibly limiting, claim 8.

The patent examiner rejected claims 8 through 14 Over Bossi, in view of Lundquist, Deyesso et al., or Markkanen et al. (FF 64). Qume responded to the rejection by amending the claims and specifying functions under each claim. (RXPT 2, Amendment of 11/23/77). Complainant amended claim 8 to specify that it defines the means for actuating the impressing means as including a memory device having a first portion for storing a plurality of individual location characters and a second portion for storing a plurality of individual hammer intensity characters, and a means for sequentially reading out" the location and hammer intensity characters. (Emphasis added). (RXPT-2, Amendment of 11/23/77, at 13). Thus, the distinguishing element of claim 8 was identified as the specified first and second portions which are read sequentially. Complainant overcame the examiner's rejection by demonstrating that the cited prior art did **not teach a memory device** with two distinct portions. In addition, Qume noted that the prior art taught a simultaneous read out, in contrast to the sequential read out specified by claim 8.

In contrast to respondents' allegation, claim 8 does not teach positioning of the print wheel before reading out the hammer intensity information for the selected character. However, claim **11, which is not at issue herein, does. Claim 11 teaches that the print wheel is first** aligned in accordance with the multi-bit address **character, and, after a signal indicates that the print wheel is in position, the associated hammer intensity character is read out. (FF 215, 262; CX 1, claim 11).**

As stated above, Qume is not presumed to have given disclaimers broader than necessary to induce the PTO to accept each claim. See Hunt Tool 113 U.S.P.Q. at 7; and Omark Industries, 216 U.S.P.Q. at 749. Claim 8 teaches a two portion memory device and a sequential read out system. To overcome rejection, Qume clarified claim 8's portioned memory and its sequential versus simultaneous read out. (FF 215, 262). It is not presumed from this clarification that Qume limited claim 8 as to print wheel positioning. Moreover, even if the remarks **in question could be**

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read as applying specifically to claim 8, such limitation was not necessary to distinguish claim 8 from the cited references. (FF 215, 262). Most importantly, claim 8 was allowed without requiring its amendment to include this limitation. (FF 215, 262).

To limit the scope of claim 8, as respondents suggest, would be to deprive Qume of territory which it did not surrender during prosecution of the '129 patent. Therefore, I find that claim 8 reads upon a device in which the hammer intensity information is accessed from memory before the print wheel is positioned. Id.; Keys Fiber, 89 U.S.P.Q. 489.

On this same basis, I conclude that the remarks of counsel before the PTO do not limit the application of the '129 patent to "a memory device" consisting of but one, single ROM. (FP 261).

C. Infringement By Respondents

In view of the above circumstances and legal prindiples I find that each of the accused products infringes the '129 patent as charged by complainant. (FF 161-256).

IV. INDUCEMENT

Complainant did not include inducement of infringement in its statement of the issues to be tried in its pretrial brief. Consquently, I recounted the issues to be tried at transcript page 82 of the Prehearing Conference herein and made no reference to this issue. Complainant made no motion to correct the statement to include inducement as an issue: I must find, therefore, that complainant never properly raised this issue as one to be heard in this investigation and may not now attempt to prove inducement on the basis of this record.

V. IMPORTATION AND SALE

The evidence of record in this investigation establishes that all named respondents have participated in the importation or sale of rotary wheel printers and/or rotary wheel typewriters in the United States. (FF 265-275). Thus, there is no dispute that the statutory requirement of importation into or sale in the United States of the accused product has been satisfied with respect to each respondent.

VI. DOMESTIC INDUSTRY

In order to prevail under Section 337, complainant must establish the existence of an industry in the United States. As a preliminary matter, • it is established that the industry requirement is based on geography, and that Section 337(j) defines the United States as "the customs territory of the United States as defined in general headnote 2 of the Tariff Schedules of the United States (TSUS)." 19 U.S.C. S 1337(j). The customs territory of the United States is defined in TSUS general headnote 2 as "the States, the District of Columbia and Puerto Rico." Schaper Manufacturing Co. v. U.S. International Trade Commission, 219 U.S.P.Q. 665, 667 (Fed. Cir. 1983).

A. Definition of the Domestic Industry

The definition of the domestic industry, although not set forth in the statute, is well established by the legislative history of Section 337 and long-standing Commission practice. In patent based investigations, the domestic industry "generally consists of the domestic operations of the patent owner, his assignees and licensees devoted to ... exploitation of the patent." H. Rep. No. 93-571, 93d Cong. 1st Sess. 78 (1973); Certain Ultra-Microtome Freezing Attachments, Inv. No. 337-TA-10, 195 U.S.P.Q. 653, 656 (1976) (Freezing Attachments); Schaper, 219 U.S.P.Q. at 668 n.9.

In the present investigation, Qume's domestic operations for its rotary wheel printers are located in San Jose, California, and Puerto Rico. Currently, Qume's primary manufacturing facility for its Sprint series of rotary wheel printers is located in Puerto Rico. (FF 276-279). I have found that Qume's Q series and Sprint series rotary wheel printers utilize the claims of the '129 patent. (FF 285).

In addition to the Sprint series of printers, Qume also manufactures in Taiwan a low speed rotary wheel printer under the name Virgo. (FF

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311-315, 318). I have found that the Virgo embodies the claims of the '129 patent. (FF 313), Qume also purchases a low speed rotary wheel printer, identified as the LetterPro, from Tohoku Ricoh in Japan. (FF 289-290). It has not been adequately established on this record that the LetterPrp utilizes the '129 patent. (FF 291).

The '129 patent has been licensed by Qume to both Xerox and IBM. (FF 332). Qume alleges, therefore, that the domestic industry includes the relevant domestic activities of Xerox and IBM in exploitation of the suit patent. In particular, Qume contends that Diablo, a subsidiary of Xerox, manufactures a series of printers under the '129 patent, and that the Xerox Memorywriter series of electronic typewriters are produced under the '129 patent.

Although Xerox and IBM, as licensees of Qume under the suit patent, are candidates for inclusion in the definition of the domestic industry, there is insufficient evidence on this record to determine that either Xerox or IBM actually exploit the '129 patent. (FF 254, 333). Accordingly, the domestic industry that has been proven to exist in this investigation is limited to the domestic operations of Qume devoted to exploitation of the patent.

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B. Time Frame for Defining the Domestic Industry - Rotary Wheels I and Rotary Wheels II

A central issue presented in this case concerns the appropriate time to define eNe scope of the domestic industry. It is suggested that the domestic industry should be defined as it existed on the date the complaint was filed, January 27, 1984. Qume contends, however, that the appropriate time frame is the time when the complaint in the first investigation was filed, or March 1983. Certain Rotary Wheel Printers, Inv. No. 337-TA-145 (Rotary Wheels I). The timing becomes significant due to respondents' contention that there is no domestic industry for low-speed printers.

It is respondents' position that the domestic industry in this case should be defined by the portion of Qume's domestic facilities which produce articles under the patent in suit and which is adversely affected by respondents' imported products. See Certain Headboxes and Papermaking Machine Forming Sections for the Continuous Production of Paper, and Components Thereof, Inv. No. 337-TA-82, 213 U.S.P.Q. 291, 303-04 (1981) revoked on other grounds, Notice of Revocation of Previous Determination and Exclusion Order and Request for Written Comments from Interested Federal Agencies, July 6, 1983 (48 Fed. Reg. 32094, July 13, 1983). (Headboxes). Respondents further contend that since January 27; 1984 Qume only manufactures high-speed printers in the United States, and that respondents only import low-speed printers and typewriters into the United States. Therefore, respondents assert, the focus of the domestic industry inquiry should be on the low-speed printer/typewriter segment of the domestic market, which is the segment targeted by respondents' imports. Since Qume does not now manufacture a low speed printer in the United States, and has never manufactured rotary wheel typewriters, respondents assert that there is no domestic industry.

Qume counters this argument with the proposition that although Qume now manufactures its low-speed printer in Taiwan and purchases another low-speed printer from a manufacturer in Japan, during 1983 it manufactured a low-speed printer in Puerto Rico, namely the Sprint 8/20. In addition, Qume claims that development work and manufacture of prototypes for the Virgo printer was done in the United States in 1983 and early 1984. In light of these factors, and in consideration of the nature of Qume's operations, complainant suggests that the appropriate time for consideration of the definition of the domestic industry is the time of filing the complaint in Rotary Wheels I. (CB'at 24-25; CRB at 28).

The Commission staff takes the position that Rotary Wheels I was a separate investigation having a different caption and different respondents. Therefore, domestic activities of Qume prior to January 27, 1984 are irrelevant to the present investigation. (SRB at 1-2).

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Although the Commission has in the past, in appropriate cases, segmented the domestic industry to consider only that part of the industry that is producing the patent and is adversely affected by respondents' importations, such an approach is not appropriate in the present investigation. See, e.g., Certain Heavy-Duty Staple Gun Tackers, Inv. No. 337-TA-137 (1982). The purpose of such a division of the domestic industry is to "focus on the actual point at which the infringing imports have an adverse impact" and to "assess the economic impact which the unauthorized importations and sale" have upon that segment only. Headboxes, 213 U.S.P.Q. at 304. In short, the scope of the domestic industry considered is defined by the nature of the injury alleged.

In this case, Qume has alleged that respondents' importations have caused injury to the entire operations of the domestic industry, including all models of domestically produced printers, irrespective of speed. The definition of the market for daisywheel printers is a central issue in the injury determination in this case, not to be short-circuited by a segmented definition of the domestic industry. Therefore, the domestic industry is defined principally by complainant's domestic operations devoted to exploitation of the '129 patent. Any determination as to models of printers to be included or excluded from that domestic industry must be based on the nature and extent of Qume's activities in the United States, not on the speed of the printer produced.

In determining the time frame for defining the domestic industry, considerable emphasis has been placed by the parties on Bally/Midway Mfg. Co. v. U.S. International Trade Commission, 219 U.S.P.Q. 97 (Fed Cir. 1983). In Bally/Midway, the C.A.F.C. concluded that under the circumstances of that case, the proper date for determining whether there was a domestic industry "was the date on which the complaint was filed rather than the date on which the Commission rendered its decision." Id. at 100. The Court also indicated that the focus of this inquiry is based on the actual business operations that the Commission is concerned to protect from unfair competition in the application of Section 337. Id. From this context, it does not appear that the Court saw any magic in the date of filing the complaint from which all analysis must flow, but rather that the industry must be defined in accordance with market realities.

The circumstances of the present case compel the conclusion that the date of filing the complaint has less significance then in most Section 337 investigations. A complaint was filed by Qume in. March 1983 alleging infringement of the '129 patent by six respondents. Upon institution on ' April 15, 1983, this investigation became inv. No. 337-TA-145, referred to as Rotary Wheels I herein. A short time later, Qume moved to amend the complaint to join an additional four respondents. Shortly thereafter, the investigation was designated "more complicated," and the statutory deadlines were extended to the maximum time permitted by the rules. At a preliminary conference held to discuss the "more complicated" designation in Rotary Wheels I, **Qume indicated the** possibility that it would seek to join additional **respondents in that** investigation. (See Additional Findings with Respect to **Designation** of this Investigation as "More Complicated" Submitted **Pursuant to Commission** Order of October 6, 1983, at **4, 110, Inv.** No. 337-TA-145, October 17, 1983).

The statutory time limits imposed by Section 337 prevented any possible extension of Rotary Wheels I by the addition of new respondents. Therefore, **on January 27, 1984, Qume filed a second complaint alleging infringement of the '129 patent, which complaint forms the basis of the present investigation. All of the respondents in Rotary Wheels I ultimately entered into settlement agreements with Qume, and the matter did not go to trial. (See FF 363-375). However, Rotary Wheels I was not finally terminated until after the commencement of the present investigation, Rotary Wheels II.**

Thus, although there are technically two investigations, they both involve the same patent, the same products -- i.e., rotary wheel printers and typewriters, and the same domestic industry. The evidence on this record establishes that **all of the respondents remaining in Rotary** Wheels II were engaged in the **importation and sale of the accused products in the** United States in at least **1983, during the pendency of Rotary Wheels I. (FF 265-275). In a very real sense, Rotary Wheels II is a continuation of** Rotary Wheels I.

Therefore, the notion that the domestic activities of Qume prior to January 27, 1984, should be disregarded for purposes of defining the domestic industry in this investigation, does not comport with a reasonable appraisal of the particular circumstances of this case. To the extent that a date must be fixed for defining the domestic industry, the date of filing the complaint in Rotary Wheels I, or March 16, 1983, is appropriate under the rationale set forth in Bally/Midway.

The record establishes that in 1983, Qume was manufacturing its Sprint series of rotary wheel printers in both San Jose and Puerto Rico. (FF 276-279). These printers are identified by a model number which includes the rated speed at which the printer operates. During the relevant time, Qume's Sprint printers were manufactured in speeds ranging from 20-75 cps, the majority of them ranging, in 5 cps increments, from 30-55 cps. (FF 23, 286).

In conjunction with respondents' contention that the domestic industry should be measured as of January 27, 1984, it is further alleged that Qume does not domestically manufacture a low-speed printer. This controversy is centered on Qume's Sprint 8/20 printer.

The facts relevant to this issue indicate that Qume entered into a contract in 1982 with Raytheon for the production of 10,000 low-speed printers. Qume modified its Sprint 8/35 printer to make the Sprint 8/20, and in 1383, approximately 1,000 20 cps printers were manufactured in Puerto Rico. The original contract price of per unit was to be per unit by January 1984. The contract was not fulfilled, in part because Raytheon went out of the word processing business. Qume sold the majority of the 8/20 printers manufactured during 1983, and has not manufactured any since. (FF 287, 288).

The primary significance of these facts relates to the issue of injury, and will be considered infra. However, for purposes of defining the scope of the domestic industry, I find that Qume's domestic operations in exploitation of the suit patent during the relevant time period include manufacture in Puerto Rico of the low-speed Sprint 8/20 printer.

C. <u>The LetterPro 20 and the Virgo</u>

Qume's presence in the low-speed segment of the printer market is currently accomplished with the LetterPro 20 and the Virgo. The LetterPro 20 is a 20 cps printer manufactured by Tohoku Ricoh in Japan and purchased by Qume for sale in the United States. (FT 24, 289). Qume and Tohoku Ricoh jointly worked out the specifications and quality control program for the LetterPro, and Qume paid for the customized tooling that was developed by Tohoku Ricoh. (FF 292, 293).

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Qume also sells the Virgo, a 25 cps printer, in the United States. This printer was developed by Qume in 1983, and the first prototypes were manufactured at San Jose. Production in Taiwan began in about June 1984. (FF 311-312, 314-315, 318).

when a portion or all of the production of a product which falls under complainant's patent occurs outside of the United States, determination of the existence of a domestic industry requires an evaluation of the nature and significance of the activities in the United States carried out in connection with that product. Certain Miniature, Battery-Operated, All-Terrain Wheeled Vehicles, Inv. No. 337-TA-122 (1982), aff'd sub. nom. Schaper Manufacturing Co. v. U.S. International Trade Commission, 219 U.S.P.Q. 665 (Fed. Cir. 1983). To reach this determination, the Commission has utilized analysis of the value added to the product by activities in the United States as a percentage of the product's total value. Certain Cube Puzzles, inv. No. 337-TA-112, 219 U.S.P.Q. at 322, 334-35 (1982) (Cube Puzzles).

In the present investigation, Qume has calculated the costs it has incurred in the United States in connection with the LetterPro and the Virgo. (FF 300, 301, 323). These costs include engineering, marketing and sales activities, quality assurance, project management, tooling/manufacturing support, kit development, and administrative expenses and interest allocation. (FF 300-310, 323-329). The record does not disclose what percentage these costs comprise of the total cost of production of either the LetterPro or the Virgo.

The types of expenses that may be considered to add value to a product consist of production-related costs, such as quality control, repair and packaging. Id. at 334-35. Activities incident to sale, such as advertising and promotion, or of a nature and on a comparable scale to any importer, may not be included in an assessment of the domestic industry. Schaper, 219 U.S.P.Q. at 669. Preliminary design, licensing, and the cost of accessories are also excluded from consideration. Id. at 667-68.

On the basis of these criteria, very few of Qume's costs incurred in the United States in connection with the LetterPro and the Virgo are probative of the value added for purposes of evaluating the existence of a domestic industry for the products. Of the costs indicated for the LetterPro, the engineering and marketing activities were largely pre-production expenses. The remaining marketing activities relate to promotion and cost of sales, and are thus not includable production-type expenses. (FF 302-304). Although Qume participated in establishing the quality control program for the LetterPro, the quality control function is carried out by Tohoku Ricoh in Japan, and Qume's activity appears to be only sampling and monitoring. (FF 293, 296). A large portion of Qume's Project Management expenses related to preliminary negotiations with Ricoh and the cost of trips to Japan. These expenses are not indicative of value added domestically to the LetterPro. (FF 306). The kit that Qume developed for the LetterPro is essentially an accessory that cannot be included as a production activity under the suit patent. (FF 307). The Tooling expense, although incurred by Qume, was developed in Japan by Ricoh, and is not appropriate for inclusion in the domestic industry. (FF 308). Finally, Qume's administrative and interest allocations are based on estimated sales of the LetterPro and cannot be considered an expense that adds value to the product. Accordingly, they are not appropriately included in an assessment of the domestic industry. (FF 309).

The costs specified by Qume as having been incurred in the United States in connection with the Virgo are substantially the same as those listed for the LetterPro, and are largely excludable from consideration of the domestic industry for the reasons stated above. In addition, Qume has included the cost of duties and a freight rebate in connection with the Virgo. (FF 323-330). These expenses are particularly attributable to importation, and are, therefore, excluded from any'evaluation of the domestic industry.

Some of Qume's witnesses have testified that commercial quantities of the Virgo were manufactured in the United States before production began in Taiwan. (Lee, Tr. 138-39; Gower, Tr. 307-09; Shires, Tr. 387). Other evidence in the record indicates, by contrast, that a small number of prototypes were made in San Jose in about September 1983. (FF 315; CX

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218). There is no independent evidence to corroborate the testimony that commercial quantities of the Virgo were made in San Jose. In view of the proposal of November 1983 to set up production of the Virgo in Taiwan (FF 311), there is no reason to conclude that Qume ever intended to manufacture more than pre-production prototypes in San Jose.

From the foregoing, it is clear that the costs attributed by Qume to activities occurring in the United States in relation to the LetterPro and the Virgo are not probative of the existence of a domestic industry for those products. If Qume were not engaged in other domestic production activities, its domestic activities relating to LetterPro and Virgo alone would not be sufficient to support the finding of a domestic industry.

On the basis of the evidence of record, I find that the domestic industry in this investigation consists of the domestic facilities of Qume during 1983 devoted to production of rotary wheel printers in accordance with the '129 patent, which includes production of the Sprint 8/20. (FF 287, 288, 334). This definition does not include any activities related to the LetterPro, which has not been proven to embody the suit patent, or the activities of Qume's lthensees, Xerox and IBM, who have not been shown to exploit the invention of the '129 patent. (FF 259, 264, 291, 333).

VII. EFFICIENT AND ECONOMIC OPERATION

Complainant must establish that the domestic industry, as defined, is economically and efficiently operated. Customarily, the Commission has considered the following factors to be indicative of efficient and economic operation: (1) use of modern equipment and procedures; (2) substantial investment in research and development; (3) effective quality control programs; (4) successful sales campaigns; (5) sustained profitable operations and (6) incentive benefit programs for employees. In-the-Ear Hearing Aids, T.C. Pub. No. 182, at 20-21 (1966); Certain Pump Top Containers, Inv. No. 337-TA-59 (1974); Certain Automatic Crankpin Grinders, Inv. No. 337-TA-60, at 14-15 (1979); Certain Spring Assemblies and Components Thereof and Methods for Their Manufacture, Inv. No. 337-TA-88, 216 U.S.P.Q. 225, 242 (1981) (Spring Assemblies).

The application of these criteria to Qume's domestic operations indicates that Qume scores high marks with respect to'the efficiency and economy of its operations. Both of Qume's facilities in San Jose and Puerto Rico are modern facilities which utilize skilled employees and offer attractive employee benefits which encourage longevity in employment. (FF 335-340). Qume Caribe's manufacturing operations have exhibited consistent growth over the years, and utilize state of the art equipment and procedures. (FF 337, 347-348). Qume has committed substantial resources to printer research and development, and has consistently sought to improve its products and reduce its manufacturing costs by reducing the number of parts needed and by automating its production and testing to the extent possible. (FF 343, 344). Qume's advertising expenditures have consistently increased since 1980, and its unit sales and revenues have exhibited consistent growth. (FF 345, 346, 360). In addition, Qume has established extensive and elaborate quality control procedures, which it carries out scrupulously at every stage of production to ensure a reliable, high quality end product. (FF 349-359).

Although respondents do not take issue with the foregoing indications of Qume's efficiency and economy of operations, they do allege that the domestic industry, to the extent there is one, is not efficiently and economically operated. This allegation is premised on respondents' contention that Qume has engaged in unfair trade practices and anticompetitive conduct. It is respondents' position that Qume brought this and the preceding investigation on the basis of a fraudulently obtained patent without sufficient ground for its charges of infringement by respondents' products. In addition, respondents contend that Qume's contract with Tohoku-Ricoh for the LetterPro was in reality an anticompetitive attempt to control the low-speed segment of the market and to prevent Tohoku-Ricoh from entering that market. Finally, respondents claim that Qume has engaged in unfair trade practices by obtaining unlawful subsidies from the Government of Taiwan in setting up its Virgo operations.

Respondents' novel theory concerning the efficiency and economy of Qume's operations, unsupported as it is by legal precedent or the weight of evidence of record, is without merit. My previous findings concerning the validity and infringement of the '129 patent negate any notion that Qume's investigation of this or the previous investigation was unfounded or anticompetitive. Furthermore, the statements made by Mr. Lee which form the basis of respondents' position concerning Qume's relations with Tohoku-Ricoh do not warrant the sinister implications suggested by respondents, particularly in the absence of any substantial, reliable and probative record evidence of unlawful or anticompetitive conduct by Qume in connection with its contractual relations with Ricoh. Finally, it is unclear how Qume's activities in Taiwan have any bearing on the efficient and economic operation of the domestic industry. Nevertheless, there has been no evidence presented on this record to support the proposition that the benefits obtained by Qume from the Taiwanese Government could by any stretch of the imagination be characterized as unlawful subsidies.

Accordingly, on the basis of the evidence of record, I find that the domestic industry as previously defined herein is efficiently and economically operated. (FP 361).

VIII. PREVENTION OF ESTABLISHMENT

On November 7, 1984, complainant filed a third motion to amend the complaint to include as an alternative allegation of injury that the effect or tendency of respondents' alleged unfair acts is to prevent the establishment of an efficiently and economically operated industry in the United States. (Motion Docket No. 185-77). This motion is opposed by respondents and the Commission investigative attorney.

Qume alleges that the basis for this motion is to respond to the position of respondents and staff, as first stated in their prehearing statements, that there is no domestic industry in the low end segment of the rotary wheel market, hence there can be no injury caused by respondents' importations and sales. It is Qume's position that the parties have been on notice of this alternative allegation since well before the hearing, thus no prejudice would result to the parties by this change in the scope of the investigation. As this motion was filed after the close of Qume's case-in-chief, Qume alleged that no additional proof on this issue was required.

Respondents and staff oppose Qume's motion on the basis that it is belated and does prejudice them by foreclosing the opportunity to obtain discovery or adequately respond to this new allegation. In addition, it is argued that the alternative claim of prevention of establishment is entirely inconsistent with Qume's primary position of injury to an existing domestic industry.

Rule 210.22(a) allows amendment of the complaint after institution of an investigation for good cause shown upon such conditions as are necessary to avoid prejudicing the public interest and the rights of the parties to the investigation by a change in the scope of the investigation which results from such amendment." In the present case, neither the complaint nor the notice of investigation alleged prevention of establishment as an issue in this case. In view of the different nature of proof required to prevail on this issue to meet the specific legal standards set forth by the Commission, which are distinct from the elements required to prove injury, the proposed amendment to the complaint does result in a significant change in the scope of the investigation. Notwithstanding complainant's assertion that the evidence presented at hearing would also support its claim of prevention of establishment, such belated notice to respondents and'staff of Qume's intention to pursue this claim effectively prevented them,from either preparing or presenting a defense to this allegation. The prejudice to the parties that would result from such a change in the scope of the investigation prevents favorable consideration of Qume's proposed amendment.

Qume also suggests that it is appropriate in this instance to simply conform the—pleadings to the evidence. Rule 210.22(c) provides that

> When issues not raised by the pleadings or. notice of investigation, but reasonably within the scope of the pleadings and notice, are considered during the taking of evidence by express or implied consent of the parties, they • shall be treated in all respects as if they had been raised in the pleadings and notice. Such amendments of the pleadings and notice as may be necessary to make them conform to the evidence and to raise such issues shall be allowed at any time, and shall be effective with respect to all parties who have expressly or impliedly consented.

There are several reasons why it is inappropriate to conform the pleadings in this instance. First, the issue of prevention of establishment is not readily within the scope of the existing pleadings. The notice of investigation, which defines the scope of this proceeding, provides only for an inquiry into whether there is an effect or tendency to destroy or substantially injure an industry, efficiently and economically operated, in the United states. This inquiry is premised on the existence of a domestic industry, and Qume has consistently alleged that there is a domestic industry. A new allegation, made at the commencement of trial, that a domestic industry has been prevented from being established is inconsistent with the issues as set forth in the notice of investigation and confirmed at the preliminary conference held early in these proceedings. Therefore, this amendment is not reasonably within the scope of the pleadings.

Second, the evidence presented at trial did not specifically raise the issue of prevention of establishment. The Commission has set forth the standard to be applied to determine this issue:

> the prevention clause of section 337 protects two categories of parties: (1) parties which have just begun manufacturing operations and for which section 337 violations would have the effect or tendency of frustrating efforts to stabilize such operations; and (2) parties which are about to commence production and for which section 337 violations would have the effect or tendency of frustrating efforts to found a business.

Freezing Attachments, 195 U.S.P.Q. at 657. The second category is referred to by the Commission as an "embryo industry." In order to be entitled to relief under this clause, there must be a showing of a readiness to commence production. This requirement is based on the Commission's concern that if a remedy were issued before complainant had demonstrated a readiness to commence production, the remedy could remove all incentive to establish a domestic industry, and complainant could simply continue to import the patented product. Id. at 657, 658.

The evidence on this record does not correspond to the embryo industry contemplated in Freezing Attachments. As will be discussed at greater length in connection with the issue of injury, complainant's - position has been that it was producing a low cost printer in the United States, and that due to respondents' actions, it has been forced to commence production offshore. This allegation does not correspond to a party who has never manufactured the patented article in this country, or who has only begun to manufacture in the United States. In past Commission decisions where this issue has been considered, the complainant has been a party who was previously engaged in manufacture abroad, and who is just beginning to manufacture in the United States. See, e.g., Certain Caulking Guns, Inv. No. 337-TA-13((1983): Certain Meat Deboning Machines, Inv. No. 337-TA-181 (1984).

The opposite situation has been alleged here. Although there has been some testimony to the effect that Qume would like to return its offshore production to Puerto Rico, there is no independent evidence of any concrete plans or steps taken to do so. (Gower, CX 165, at 9). Thus, this unsupported testimony cannot meet the threshhold requirement of a readiness to commence production, and I find that the evidence presented at trial was not sufficient to raise the issue of prevention of establishment.

Finally, it is quite clear that neither respondents nor the staff have in any way consented to this issue. In view of their express opposition to the proposed amendment, they cannot be said to have implicitly consented to it. In addition, the absence of the prevention of establishment issue from this investigation throughout discovery prevented respondents and staff from presenting any evidence at the hearing to counter complainant's allegations. The express opposition of respondents and staff to the amendment proposed precludes the possibilitx_of conforming the pleadings.

For the reasons stated herein, and in view of the procedural and substantive defects inherent in complainant's proposed amendment, Motion 185-77 is hereby denied.

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IX. INJURY

In order to prevail under Section 337, complainant must establish that the effect or tendency of respondents' unfair acts and unfair methods of competition is to destroy, or substantially4njure the domestiC industry. This element requires proof. separate and independent from ptoof of the unfair act. Furthermore, complainant must establish a causal connection between the injury suffered and the unfair acts of respondents. Spring Assemblies, 216 U.S.P.Q. at 243; Certain Limited-Charge Cell Culture Microcarriers, Inv. No. 337-TA-129, 221 U.S.P.Q. 1165, 1182 (1983).

A. Substantial Injury

The Commission has customarily considered relevant indications of injury to include evidence of (1) lost sales, (2) volume of imports and capacity to increase imports, (3) loss of profits, (4) loss of market share, (5) underselling, (6) declining sales, (7) excess domestic capacity, (8) inability to raise prices to meet increased production costs, and (9) trends in market demand. Certain Vertical Milling Machines and Parts, Attachments, and Accessories Thereto, Inv. No. 337-TA-133, 223 U.S.P.Q. 332, 348 (1984); Spiing Assemblies, 216 U.S.P.Q. at 242-43; Certain Roller Units, Inv. No. 337-TA-44, 208 U.S.P.Q. 141, 144 (1979); Reclosable Plastic Bags, Inv. No. 337-TA-22, 192 U.S.P.Q. 674, 680 (1977).

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1. Inclusion of imports of settled respondents from Rotary WhcLels I and Rotary Wheels II

A preliminary consideration in assessing injury to the domestic industry in this case is the issue of whether or not to include in that assessment the imports of settled respondents in both Rotary Wheels I and Rotary Wheels II. Complainant asserts that the imports by settled respondents in both investigations should be considered; the Commission investigative attorney believes that only the imports from the Rotary Wheels II investigation should be included; and respondents contend that only the imports of the remaining, nonsettling respondents should be considered.

It appears that the issue of inclusion of imports of respondents from an earlier investigation has only arisen on one occasion. In Certain Food Slicers and Components Thereof, Inv. No. 337-TA-76, 219 U.S.P.Q. 176 (1981) (Food Slicers II), the Commission declined to include in its consideration of injury the product of respondents from Food Slicers I, Certain Food Slicers and Components Thereof, Inv. No. 337-TA-38 (1978). Food Slicers I had been terminated approximately a year and a half before the commencement of Food Slicers II on the basis of settlement agreements in which respondents agreed to cease importation of the accused product. The Commission in Food Slicers II determined that there was no showing of any relationship between the products involved in the first and second investigation, nor was there any evidence that the respondents in the first investigation were in breach of their agreements not to import. Food Slicers II, 219 U.S.P.Q. at 182.

The Commission investigative attorney suggests that the rationale of Food Slicers II is applicable here, and that any factual differences between this investigation and Food Slicers II are distinctions without a difference. In addition, the Commission staff asserts that the respondents in Rotary Wheels I were parties to a separate investigation who did not participate in Rotary wheels II or appear to represent their interests, at the hearing. It is contended that the discovery in Rotary Wheels II was directed to the injury, if any, suffered by Qume at the hands of respondents in Rotary Wheels II. Finally, t!& staff asserts that Qume entered into settlement agreements with substantially all of the respondents in Rotary Wheels I, thus importation and sale of products by those parties is now licensed.

A review of the particular circumstances of this case leads me to the conclusion that the facts are significantly different than those present in Food Slicers II to the point that a different outcome is warranted. As noted above, in connection with the domestic industry analysis, Rotary Wheels II is essentially a continuation of Rotary Wheels I, inasmuch as the same patent, the same type of product and the same domestic industry are involved, and the two investigations overlapped in time. In addition, unlike Food Slicers I, the settled respondents in Rotary Wheels I have not ceased importation of their product, but rather continue to be a significant market force and source of competition to Qume, even though Qume receives the benefit of royalties from sales made by those companies.

A finding that the activities of respondents in Rotary Wheels I are irrelevant to Rotary Wheels II would distort the analysis of the rather complex market environment involved in this case and artificially ignore the realities of the marketplace. At the same time, it should be emphasized that by taking cognizance of the activities and impact of respondents from Rotary Wheels I in this injury determination, complaihant is not relieved of the obligation of establishing a nexus between the injury suffered and the activities of the respondents remaining in Rotary Wheels II.

In view of the Commission staff's assertion that the activities of the settled respondents from Rotary Wheels II should be considered in the determination of injury, the distinctions drawn to the Rotary Wheels I respondents_Are not persuasive. The Rotary Wheels II respondents also did nc Participate in this investigation or appear at the hearing, and their continued sales in this country now also are licensed. Accordingly, those particular factors are not dispositive of the appropriateness of considering the imports of settled respondents. For the foregoing reasons, to the extent that the activities of settled respondents are considered in this injury determination, little distinction will be made between the Rotary Wheels I and Rotary Wheels II respondents.

The Commission has on occasion considered "whether it is proper to aggregate the impact of imports by parties who have been terminated from an investigation on the basis of legitimate settlement or licensing agreements." In Food Slicers II the Commission stated the following position:

> We do not intend to discourage the amicable settlement of section 337 actions. We conclude that injury from imports by parties terminated from an investigation will as a general rule be relevant to the "effect" of imported devices, when there is some indication that an "unfair act" has occurred. In addition, import competition is an economic factor relevant to our consideration of tendency to injure. For example, the presence of significant import competition may be an indication that a domestic industry is vulnerable to injury. ... The relevance of such imports will be dependent on the facts presented.

219 U.S.P.Q. at 183-84. Although the Commission has suggested that the foregoing statement of Food Slicers II does not dictate in every instance that the imports of settled respondents be found relevant, the circumstances in

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which such imports are not relevant is still relatively uncharted territory. See Certain Trolley Wheel Assemblies, inv. No. 337-TA-161, at 10 (1984) (Trolley Wheels).

Respondents suggest that imports of settled respondents should be considered only when the settlement agreement is with an importer, rather than a manufacturer, as in Trolley Wheels. In Trolley Wheels, the Commission considered important the fact that the settlement agreement was concluded with the importer rather than the source of the infringing imports. Id. However, in Certai Heavy-Duty Staple Gun Tackers, Inv. No. 337-TA-137 (1983) (Staple Guns), the settlement agreements concluded by complainant covered both the manufacturer and the importers. Initial Determination, at 74. Although the Commission disagreed in its opinion in Trolley Wheels with the administrative law judge's interpretation in Staple Guns of the import of Food Slicers II, it did not disapprove of the judge's inclusion of the imports of staple guns by settled respondents in the injury determination in that case. See Staple Guns, Notice of Commission Decision Not To Review Initial Determination, issued December 29, 1983. (49 Fed. Reg. 668, January 5, 1984). See also Trolley Wheels, supra, at 10. Thus, although the identity of the settled respondent as an importer or manufacturer may be important in certain circumstances, it is not dispositive of this issue.

The Commission investigative attorney also notes that as a result of Qume's settlement agreements with respondents, the continued importations by those parties are now licensed. It must be presumed that both complainant and respondent derive some benefit from the amicable settlement of a Section 337 investigation. It does not appear from past Commission decisions that because complainant benefits from the terms of a settlement agreement, the activities

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of that terminated respondent before settlement are no longer relevant to the issue of injury. In Trolley Wheels, the settling respondent sent its remaining inventory of trolley wheels to complainant, and effectively stopped competing with complainant, thereby terminating the alleged unfair act. Trolley Wheals, supra, Order No. 9, issued February 27, 1984. In Staple Guns, the respondent manufacturer agreed to refrain from manufacturing and selling a staple gun that copied the appearance of complainant's gun. Staple Guns, supra, Order No. 25, issued October 11, 1983. In neither case did these factors preclude consideration of the impact of these respondents' activities before the conclusion of a settlement agreement. Accordingly, the fact that the settled respondents in this case are now importing rotary wheel printers and typewriters under license does not preclude consideration of the impact of their activities before they became licensees.

Another factor relevant to whether the imports of settling respondents should be aggregated is consideration of whether there is an unfair act. Recently, the Commission has stated its belief that there must be a finding of an unfair act with respect to a settled respondent in order to consider the impact of that party's importations. Certain Foam Earplugs, Inv. No. 337-TA-184, Notice of Commission Decision Not To Review Initial Determination; Deadline for Filing Written Submissions on Remedy, the Public Interest and Bonding, Supplementary Information, issued—January 22, 1985 (50 Fed. Reg. 4277, January 30, 1985) (Earplugs); Certain Bag Closure Clips, Inv. No. 337-TA-170, Notice of Commission Decision Not To Review Initial Determination; Deadline for Filing Written Submissions on Remedy, the Public Interest, and Bonding, Supplementary Information, issued September 7, 1984 (49 Fed. Reg. 35872, September 12, 1984) (Bag Clips).

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At the outset, it is noted that this requirement is much more strongly, although briefly, stated in Earplugs and Bag-Clips than the requirement in Food Slicers II that there be "some indication" that an unfair act has occurred. 219 U.S.P.Q. at 184. In Earplugs, the settlement agreements entered into by respondents specifically admitted infringement of the suit patent. Initial Determination, at 67-70, 106. In Bag Clips, the Commission disapproved of the administrative law judge's failure to make findings that the settled respondents had committed an unfair act, but found sufficient evidence to support a determination of injury by the remaining respondents. Bag Clips, Notice, supra at 2; Initial Determination, at 2-4, 13-16, 43-47.

The present investigation highlights the potential conflict between the requirement that an unfair act be found before considering the impact of imports from a settled respondent, and the stated Commission policy favoring settlement. This is particularly so in light of the Commission's Rules of Practice and Procedure that allow settlement without a finding of violation of Section 337. 19 C.F.R. 210.51(b)(2), (c); 211.22(a). Qume has concluded settlement agreements with thirteen former respondents from Rotary Wheels I and Rotary Wheels II. (FF 363-375). As negotiated terms in several of these agreements, infringement of the suit patent is specifically denied. (FF 365, 367-369, 373). In the case of Ricoh, infringement is admitted. (FP 363). The majority of these agreements contain neither admission nor denial of infringement. (FF 364, 366, 370-372, 374, 375). Nevertheless, even in agreements where infringement is denied, the licensed product is defined by utilization of the patent, and it is a stated intention not to use the patent after the expiration of the license granted. (See, e.g., Qume-Fujitsu_ Settlement Agreement, CX 209, 11(b), 3; see also FF 365-371, 375).

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To make an explicit finding herein that each of the settled respondents has engaged in an unfair act, would potentially negate a negotiated term in several of these settlement agreements, all of which have been approved by the Commission. However, the terms of these agreements implicitly, if not explicitlyr-concede infringement of the suit patent, and importation of the accused product, or in effect the commission of an unfair act. (FF 364-375)., Thus, whereas an independent determination of infringement could undermine the terms of these agreements, the contents of these agreements provide "some indication that an 'unfair act' has occurred." Food Slicers II, 219 U.S.P.Q. at 184. Under these circumstances, and in view of my findings that the suit patent is valid and infringed by the remaining respondents, there appears to be little risk of erroneously aggregating the imports of respondents who have not engaged in an unfair act.

For the foregoing reasons, I find that under the facts of this case, the aggregate imports of the settled respondents from Rotary Wheels I and Rotary Wheels II are relevant to consideration of the effect or tendency to substantially injure the domestic industry.

2. Segmentation of the rotary wheel market

Determination of the effect or tendency to substantially injure the domestic industry in this case is a complicated matter, in large part due to the rapid evolution of the relevant market, and the myriad of often conflicting opinions as to the forces that are affecting this evolution as well as to the direction that the market is headed.[12/] In spite of the

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12/ In this connection, I note that both complainant and respondents presented expert economic testimony at the hearing. Complainant'foxpert was
(Footnote continued to page 268)

apparent contradictions which pervade this issue, the emerging market trends, which are described with a reasonable degree.of consistency by various sources in the record, provide a basis for the determination of this issue, as discussed hereinafter.

The central proposition relied on by respondents and staff in support of their contention that there has been no injury to the domestic industry is that the United States market for rotary wheel printing devices is characterized by a high end and a low end. It is further alleged that because Qume competes in the high end of the market and respondents compete in the low end, there is no competition between Qume and respondents, thus, any injury suffered by Qume is not caused by respondents. The evidence of record establishes that Qume markets rotary wheel printers ranging in speed from 20-75 cps. (FF 23, 24, 286, 289). The low speed printers currently sold by

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(Footnote continued from page 267)
Mr. Lloyd Oliver, President of Glassman-Oliver Economic Consultants, Inc. Mr. Oliver is an economic consultant who provides consultant services to government and business primarily dealing with economic efficiency of firms and industries, and the effects on competition of mergers, various trade practices and governmental regulations. (CX 169, Oliver W.S.) Respondents' expert was Mr. Thomas Billadeau, Vice President, Gartner Group, Inc. Mr. Billadeau is an expert in the field of office automation who provides product specification, review and analysis to many major office automation vendors. (RXE 134, Billadeau, W.S.).

Although Mr. Billadeau is no doubt a qualified expert in the field of. office automation, his testimony in this investigation has been found to be of marginal value due to its foundation in generalities, its lack of focus on unique factors specific to this case, and the inability to ascertain the factual basis underlying the opinions expressed. (See RXE 134, Billadeau W.S.; Billadeau, Tr. 2176-2318). By contrast, Mr. Oliver's testimony took specific account of the parties to this investigation and the factors peculiar to the market defined under Section 337. (See CX 169, Oliver W.S.; Oliver, Tr. 486-563). In addition, the background information which Mr. Oliver used to formulate his opinion appears in this record, for the limited purpose of indicating the basis for his opinion (unless otherwise received for all purposes). This has allowed an evaluation of the validity of the conclusions reached by Mr. Oliver as well as of their applicability to this investigation in light of other evidence on the record. Asa result, Mr. Oliver's testimony has been found to be more probative of the economic issues presented in 2&is case.

Qume, i.e., the LetterPro 20 and Virgo, are both manufactured outside of the United States. (FF 24, 289, 290, 311-318). -The rotary wheel printers and typewriters marketed by the remaining respondents in this investigation range in speed from 10-20 cps. (FF 25-28).

Market segmentation has been defined in various ways on this record. One, method of dividing the market that appears to be generally utilized in the industry is by speed. Mr. Billadeau has utilized a four-tiered division of 0-20 cps, 20-30 cps, 31-60 cps, and 61-plus, in which the strongest segments are the 0-20 cps and 31-60 cps markets. (RXE 134, Billadeau W.S., at 2-3). Some Dataquest documents that segment the market by speed have used the same speed divisions, or relatively close variations, such as 0-25 cps, 26-60 cps, and 61-plus. (Cf. CX 1092, 1116).[13/] Certain Qume documents suggest a

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13/ In connection with certain Dataquest documents and other documents that were received into evidence for the limited puZpose of demonstrating the basis of Mr. Oliver's expert opinion, Order No. 55, issued January 9, 1985, was an order to show cause why certain exhibits should not be received into evidence without limitation. All parties responded to this order. In addition, Qume filed a motion for leave to reply to respondents' and staff's responses to this order. (Motion Docket No. 185-83). Leave to reply is hereby granted.

Of the documents included in Order No. 55, respondents and staff do not object to the receipt of CX 350, 352, 354, 363, 364, 1138, 1174, 1175, and 1177. Accordingly, each of these documents is received in evidence without limitation. Although CX 1141 was not covered by Order No. 55, it falls into the same category as CX 1138, and also is referenced in Nakajima's answers to the Commission investigative attorney's interrogatories as Bates Nos. 00651-53. (SX 26). In view of the status of this document as a business record of Nakajima, the Commission should have access to this relevant information. Therefore, CX 1141 is also received in evidence without limitation.

With respect to several Dataquest documents, the Commission staff has stated a continuing objection on the basis of completeness of the document and/or unauthenticated handwriting. As with other documents that have been received, any handwriting that appears on these documents is specifically excluded. Respondents have also stated additional grounds for their objections to the receipt of these documents without limitation.

(Footnote continued to page 270)

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division of 12-20 cps, 20-35 cps, 35-55 cps, and 55-70 cps. (FF 449). Thus, broadly speaking, speed is a useful identification of the low, middle and high ranges of the market, and may be correlated to a limited extent with price, but the precise speed division is somewhat arbitrary. (Inc 169, Oliver W.S., at 15-17). —In short, the rated speed of a typewriter or printer, in and of itself, does not appear to be a primary factor in the choice of product purchased. (FF 431, 432).

A more useful market division that has been described on this record is based on function or end use. This segmentation identifies the market for typewriters and printers as the low end, consisting of portable and compacts,

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(Footnote continued from page 269)

Upon consideration of the arguments of respondents and staff concerning these documents, I overrule their objections, as appropriate, to CX 1036, 1050, 1076, 1092, 1109-1111, 1113, 1114, 1116-1118, 1122-1124, and 1128-1130, and receive these documents without limitation. These documents originated with Dataquest and provide useful background information about the relevant market, as well as compilations and market analyses. To the extent that some of these documents are incomplete, and certain terms may not be apparent from their context, the weight to be given to these documents must be correspondingly restricted, although their relevance is not thereby eliminated. However, certain terms mentioned in one document may be specifically defined in another. In addition, Mr. Oliver has provided certain definitions obtained from Dataquest documents in his testimony. Dataquest As an information source that is relied on in this industry. (Shires, Tr. 396-98; Billadeau, Tr. 2201-02, 2316-17; Ayling, Tr. 1335). The information and compilations provided by Dataquest are not a substitute for primary evidence on this record, and the extent of their use will be apparent in this initial determination. Nevertheless, these documents emanate from a reliable source and will provide the Commission with a useful framework for assessing the market setting relevant to this investigation.

CX 1126 and 1127 are incomplete documents which appear to be included in CX 1076. Accordingly, these two documents will not be received without limitation.

CX 1279 is a manufacturing agreement between Sharp and Diablo. It is a business record from the files of Sharp, and is self-explantory without the need for additional testimony. As a licensing agreement between a respondent in the investigation and a licensee of Qume under the '129 patent, it is relevant to the issues in this case and should be available to the Co1ssion without restriction. Accordingly, CX 1279 is received in evidence without limitation.

especially used by students; a second range of office grade machines capable of sustaining heavy use and having limited display and limited memory; a third range having greater memory and text editing ability; and the upper range consisting of full word and information processing capabilities. (FF 420; CX 1076). These four ranges may also be identified by use, in which the lowest range is for personal use, e.g., with **a personal** computer; **the second** range covers small business use, which uses low-end word processing **and small** business computers; the third segment covers medium size business which uses full function word processing and small business computers; **and the final segment, which consists of large business, utilizing dedicated, or cluster type** word processing. **(FF 449). Each of these four categories is characterized by lower cost and lower speed at the low end, and progressively increasing speed and cost at the high end. (FF 420, 449).**

Qume's traditional market, and the market where it maintains the greatest presence is the middle to high range. Its sales have been primarily directed to OEMs in the past, and it occupies a solid position in the market for dedicated, cluster-type word processing systems which utilize printers of speeds greater than 30 cps. (FF 421, 428).

Due to the rapid expansion of the market for microcomputers, the market for peripherals, i.e., printing devices, is also undergoing a transformation. (FF 421, 426, 427). The effect of this market shift is that there is a trend to decentralize word processing **and data processing systems and to** adopt stand alone systems. **(FF 427). The practical effect of this trend on the** printer market is that a stand alone system which utilities a single printing device will tend to have a lower usage **than a** centralized WP **system, and thus can** make use of a lower speed, lower cost, lower quality printer. (FF 431, 450).

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In addition, because the overall cost of the microcomputer is less than a large, centralized system, the printing device that accompanies the system must be commensurately low priced. (FF 426).

The significant growth in the market for microcomputers has been accompanied by rapid growth in the low-end segment of the printer market. (Fr 421, 426-428). Concurrently with this growth in this segment of the printer market, there has been a tremendous increase in competition in the United States market, particularly marked by the entry of new foreign manufacturers. (FF 376, 383, 421; see also, CX 169, Oliver W.S., at 28-30). All of the respondents remaining in this investigation market rotary wheel printing devices ranging in speed from 10-20 cps. (FF 25-28).

Qume has taken the position that there should be no breakdown in the market based on speed for purposes of determining injury -- i.e., the relevant market consists of a continuum of all printing devices ranging from 0-75 cps. (Shires, CX 166, at 3-4). At the opposite end of the spectrum, respondents contend that there is a high end and a low end of the market, and that, in terms of speed, complainant is exclusively in the high end, and respondents are exclusively in the low end. An appraisal of the record in this regard indicates that market realities lie somewhere in between these two extremes.

3. <u>Competition between rotary wheel printers and electronic typewriters</u>

There can be little doubt that a 12 cps rotary wheel typewriter does not compete in the same market as a 75 cps rotary wheel printer. Nevertheless, in the middle range between these two extremes there is evidence of competition between Qume and respondents. An important aspect in this assessment is consideration of the competition between rotary wheel typewriters and rotary wheel printer's.

Here again, the market for both of these products has been characterized by transformation and convergence. In the early phase of rotary wheel technology, a rotary wheel printer was typically used in a dedicated word processing system, commonly in a situation where a single printer would be controlled by a central processor, and would support several work stations. (FF 427). At that period in time, the predominant office typewriter was an electromechanical golf-ball type typewriter, such as the IBM Selectric. There was essentially no interchangeability of functions between a word processing system and an electric typewriter. (Shires, CX 166, at 4-5).

As the market has evolved, together with the emergence of microcomputers, word processing systems have become decentralized, utilizing lower speed, lower cost, lower duty printers. Concurrently, typewriters have adopted rotary wheel technology, as well as limited microcomputer technology, i.e., they also can have limited display and memory for storage and text editing purposes. (FF 411, 416). In addition, it is now possible to interface electronic typewriters, that is, to connect them with a personal computer or other such data source. (FF 404-414). When a typewriter is interfaced in. this fashion, the keyboard/printwheel response is superseded, and the printwheel is activated by the computer. In this configuration, the typewriter functions as a printer. (FF 411, 416).

Respondents and staff assert that, irrespective of interface capability, the differences between rotary wheel typewriters and rotary wheel printers prevent them from competing in the same market. In addition, respondents challenge Qume's assertion that all of the typewriters remaining in this investigatiom_can be interfaced.

Respondents have detailed the functions performed by a typewriter that cannot be performed by a printer, standing alone. (See RXE 133, Ayling W.S., at 8-12). That a typewriter functions differently than a printer when it is being used as a typewriter is not seriously disputed. (FF 416). However, this fact does not dispose of the issue of competition between printers and interfaceable typewriters.

It is established that certain models of rotary wheel typewriters manufactured by *each* of respondents Nakajima, Sharp, Adler and Tows are interfaceable. Some of these models have external ports or built-in interfaces, and/or interfaces manufactured by the respondent. (FF 385, 388, 390, 391, 394-399, 401, 455). Other models can be interfaced with interfaces manufactured by third parties. (FF 404-410). Although Sharp and Adler assert that the number of interfaces actually sold by them his been small, there are several third parties who have sold a significant number of interfaces, in addition to those actually sold by Sharp, Adler and Nakajima. (FF 385, 494, 405, 408, 410). In addition, Towa's R2 typewriter/printer can be turned into a printer with a switch on the machine. (FF 401). The newer models of typewriters are increasingly manufactured with an external port to facilitate interfaceability. (FF 390, 397-398, 407). Tte'ability to interface these typewriters so that they will operate as printers is a feature promoted by Sharp and Adler in their advertisements, and, it is felt that this interface capability is' a necessary feature for these typewriters to be competitive in the market. (FF 407, 412, 414, 415).

Respondents' rotary wheel typewriters range in speed from about 10-20 cps and vary in price according to features available, such as the number of pitches, automatic features, and amount of memory. (FF 25-28, 388, 391-398). Depending on features, and therefore, price, these typewriters are directed either to the low end, personal use market, or the small and medium sized office markets, which require a certain amount of text editing functions. (FF 420). Although an electronic typewriter may be interfaceable, it is not designed for sustained use as a printer. (Ayling, RXE 133, at 11; Ayling, Tr. 1322; Shires, Tr. 458-59).

The low-speed printer is also directed to the low-end personal computer market, as well as the small and medium sized office markets. (FF 449). The consumer attraction to this printer is low cost. Since this segment of the market is price conscious, the buyer in this segment is willing to sacrifice a measure of reliability and features for lower cost. (FF 431, 432). In this market, the primary usage is low duty, thus high speed is not a necessity. (FF 450).

From the foregoing facts, it is apparent that low-speed printers and a wide range of electronic typewriters are capable of serving the word processing and text editing needs 'of the low and middle range of the market for printing devices. In this market an interfaceable typewriter can accommodate the typical low duty printing requirements, plus offer features over and above those available from printers alone. (FF 411, 416). Thus, although a consumer in this market who is seeking the features of a conventional typewriter in addition to interface capability will very likely not purchase a low speed printer, a consumer in the market for a low speed printer may alternatively purchase a rotary wheel typewriter due to its multifunctionality.

Accordingly, I find that rotary wheel printers and rotary wheel typewriters are competitive in the low and middle range of the market, or in about the 0-30 cps segment. (FF 420, 449).

4. Qume's presence in different segments of the market

It is clear that Qume established itself early on in the high end of the printer market, where it remains a dominant force, selling primarily to OEMs. (FF 421, 428). Currently, the printers manufactured domestically by Qume and sold to OEMs and distributors range in speed from about 35-55 cps and are priced from about . (FP 378, 381). At present, Qume's only low speed printers are the LetterPro 20 and the Virgo, which has a rated speed of 25 cps. Both machines are manufactured abroad. (FF 24, 289, 312 318). Qume does not manufacture typewriters, and its models of printers that were sold at one time with a keyboard have been discontinued. (FF 23).

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Respondents portray Qume as something of•a dinosaur in the industry, remaining at the high end of the market, and failing to enter the low end, growth segment of the market. Thus the issue to be decided is whether Qume's presence in-the low end of the market only with imported printers „is an indication that there is no low end segment of the domestic industry, or whether this condition itself is the result of injury caused by respondents. Developments at Qume during 1982-1983 are illuminating of this issue.

a. Injury to Qume in the low-speed segment of the market

In 1982, Qume entered into a contract with Raytheon for a low speed printer. Qume modified a Sprint 8/35, and developed the Sprint 8/20. This low speed printer was manufactured by Qume in Puerto Rico in 1983. The number of printers contracted for was not produced, and the contract was not carried out because Raytheon decided not to get into the word processing business.

C The original contract price of

by January 1984. (FF 287). Qume has not.manufactured the Sprint 8/20 since 1983, and it has not offered to sell this printer to any other customer because, at the prevailing market price for low speed printers, Qume cannot make a profit on the Sprint 8/20. (FF 288).

In November 1983, Qume developed a plan to manufacture another low speed printer called the Virgo. (FF 311). Several prototypes of this machine were manufactured at San Jose earlier in 1983, and the initial manufacturing location was intended to be Puerto Rico, as indicated in Qume's contract with

purchaser for this printer. (FF 314, 315, 384). Due to the trend of eroding prices for its printers, in January 1984 Qume shut down its

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manufacturing operations in San Jose and expanded its printer production at Qume Caribe in Puerto Rico. (FF 277, 433). .Upon evaluation of the cost of manufacturing the Virgo in Puerto Rico and the sales price of the product, Qume determined that it could not be manufactured profitably **in Puerto Rico, and plans were made to switch production to Taiwan. (FF 314, 384). It** is clear that Qume's cost of labor and **materials is much lower in Puerto Rico than in San Jose, and is even lower in Taiwan than in Puerto Rico. (FF 423, 424).**

This collection of factors demonstrates that in the emerging low end of the daisywheel printer market, which is the fastest growing market segment and one of the most populated by products of foreign manufacture, it is no longer possible for Qume to compete successfully with a domestically produced printei because of the disparity of production costs between the United States and the Far East, in particular. (FF 376, 378-380, 385, 387-389, 400, 423, 424). At the relevant time period, during 1983, when Qume was just entering the low end of the market with a domestically produced printer, there was an influx of new entrants into the market, predominantly from Japan, and there was a prevailing trend of price reduction. (FF 265-275, 287-288, 363-375, 376-377, 387, 389, 393, 400). Qume's response to this situation was to have a printer manufactured for it by Tohoku-Ricoh while it developed the Virgo printer in Taiwan. (FF 289, 290, 311-318).

The evidence is clear that the primary competition faced by Qume in this low speed segment of the market was from foreign imports. The primary participants in the market include virtually every respondent named_in_Rotarv, _ Wheels I and Rotary Wheels II during a time period when the respondents in both of these investigations were importing or beginning to import into the

United States, and before the majority of these imports were licensed. (Cf. FF 265-275, 376, 383).

This scenario corresponds very closely to the situation found by the C.A.F.C. to...exist in Bally/Midway, 219 U.S.P.Q. 97. As in Bally/Midway, market developments during the pendency of the investigation, in this case from March 1983 to November 1984, have had the effect of destroying the domestic industry in the low end segment of the market. This sequence of events should not, however, lead to the finding that the domestic industry does not exist. As noted by the C.A.F.C. in Bally/Midway, a finding that a domestic industry does not exist in these circumstances would "vitiate the statutory proscription of unfair practices 'the ... effect of which is to destroy ...' a domestic industry." The effect of this interpretation would 134 that:

> If the effect of the unfair practices have been to injure seriously the affected business during the administrative proceeding ... the importation would violate section 337(c). If, however, the infringers were so effective that they succeeded in capturing all of complainant's business and therefore destroyed the relevant 'industry,' then there would be no violation .... The result would be that the infringing importers whose unfair practices were most effective, i.e., those who succeeded in destroying their American competition, would be treated more favorably than those whose unfair practices were less successful. It is most unlikely that Congress, which enacted section 337 to 'prevent every type and form of unfair practice' ... intended the statute to have such a bizarre effect. (Citation omitted.)

219 U.S.P.Q. at 100. The fact that the remedy available under Section 337 is prospective in nature and may not be able to revive a domestic industry that has met its demise does nothing to change this outcome, inasmuch as the focus of inquiry at this stage of the investigation is strictly on the existence of a violation of Section 337. Id. at 101.

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Respondents point to the lack of any proof. of a direct link between the effect of imports by the remaining respondents and the injury to Qume which resulted in its moving its low end operations offshore. In the circumstances of this market, it is not the presence of one single respondent, or even a small group, which has had the effect of creating a climate of intense competition and price erosion. Although the volume of imports by the remaining respondents is significant, it is but a small part of the total market picture. (FF 265-275, 376).

The remaining respondents represent imports from essentially four manufacturers. This is in contrast to the total volume of imports from 17 respondents in Rotary Wheels I and Rotary Wheels II together. It is only by aggregating the total volume of imports from all respondents that a realistic market picture emerges. Food Slicers II, 219 U.S.P.Q. at 183-84. This picture indicates that Qume is but one participant in a populous market in which the products emanate from lower production cost locations than Qume can duplicate in the United States or Puerto Rico. In this competitive climate, Qume is unable to set its prices for low speed printers produced in the United States at a profitable level and still compete effectively. See Reclosable Plastic Bags, 192 U.S.P.Q. at 680. For the foregoing reasons, I find that the effect of the respondents' unfair acts in the aggregate has been to destroy the domestic industry represented by Qume in the low-end, or under 30 cps, segment of the daisywheel market.

b. Injury to Qume in the middle and high segments of the market

Respondents suggest that any alleged injury to Qume is *in* reality the result of the development of the microcomputer market, and not attributable to

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respondents' actions. The evidence tends to indicate that the rapid expansion of the market for microcomputers has created and promoted **the explosive** growth **of *the* low** cost daisywheel printer market. (FF 421, **426). However, Qume's failure to compete in this newly-developing market with a domestically produced printer is directly attributable to the presence of a proliferation of low cost printers, emanating to a large extent from respondents and former respondents in <u>Rotary Wheels I</u> and <u>Rotary Wheels II.</u>**

It is also suggested by respondents that the effects on the domestic industry have been caused by alternative technologies. The evidence of record indicates that there are several printing technologies that play a role in the computer/word processor peripherals market, including impact, la$_{m}$ dot matrix, and nonimpact, <u>e.g.,</u> laser, ink jet, and thermal transfer, technologies. (FF 451, 452). Dot matrix technology has become a factor in the microcomputer market because of its relatively low cost, high speed and multifunctionality, especially graphics capability. In addition, advances in dot matrix technology have improved the quality of print that it is capable of producing. (FF 451). The nonimpact technologies are also starting to appear on the market, and hold promise for the ability to produce letter quality print. *(FF* 452).

In spite of the presence of these alternative technologies, the weight of evidence on this record indicates that there is an existing market that requires letter quality print that is still best and most cost effectively provided by daisywheel technology. Where letter quality print is required, the lower cost, graphics capability and speed of dot matrix printers do not overcome their inability to provide letter quality print. (FF 451). The remaining alternative technologies still appear to be new enough that they

have not become cost effective or demonstrated sufficient reliability to displace daisywheel technology. (FF 452). Thus, the market niche occupied by rotary wheel printing devices does not appear to be immediately threatened or currently impacted by alternative printing methods. Accordingly, the proper focus for this injury inquiry is on competition among daisywheel devices that utilize the '129 patent.

Qume asserts that the injury it has suffered as a result of respondents' importations has affected all of its domestic operations, irrespective of market segment. Analysis of the customary indicia of injury with respect to Qume's domestic operations to assess the existence of injury to its middle and high range printer products provides mixed results.

Proof of specific lost sales or lost customers is a classic method of establishing injury. In the present investigation, Qume can only prove the loss of sales or the direct competition for customers from respondents who were terminated from Rotary Wheels I, such as NEC, Ricoh, Silver Seiko or Brother. (FF 383, 447, 448). There has been no direct showing that the respondents remaining in this investigation have been the cause of specific lost sales or lost customers to Qume. As Qume has pointed out, this can be difficult to establish because Qume's OEM customers are competing more directly in the distribution market than Qume, and may not know or communicate to Qume to whom they may be losing sales. (FF 430). In any event, there is no proof of direct loss of sales by Qume to any one of the remaining respondents.

Qume also asserts that it has lost market share to the respondents. Although Mr. Oliver has provided an analysis of the shift in market share away

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from Qume and Diablo and to foreign importers, the defects in this market share analysis prevent me from accepting it as probative of this issue. (See CX 169, Oliver W.S. at 25-27, 32-33). Mr. Oliver's market share analysis is largely based on estimates, and may include market shares held by companies not within ..the scope of this investigation. In addition, no attempt is made to distinguish between different market segments. Since the evidence on this record shows that a large part of Qume's business is in the high end of the market, where respondents do not compete, it appears that in actuality what Ilas occurred as a result of respondents' imports is that Qume has retained a fairly stable market share in the upper end, but has failed in its attempt to establish itself in the newly emerging low end of the market with a domestically produced product. In addition, to the extent that Qume holds a percentage of the market in the low end segment by virtue of its sales of LetterPro or Virgo, this is not market share attributable to the domestic industry defined herein. Strictly speaking, in the newly emerging low end daisywheel market of under 30 cps, the domestic industry defined herein currently has no market share at all.

The evidence concerning declining sales, excess domestic capacity, price erosion arid declining profits is also somewhat mixed. The record indicates that Qume's unit sales of printers and total revenues have both increased, although at a slower rate of increase than it had experienced in earlier years. (FF 436). In its own stategic plans, Qume had forecast that the pattern of sales in the upper end of the market, i.e., its traditional stronghold, would peak in about 1984-1985, and the trend in the market would shift downward to lower cost printers. (FF 426, 428). Although this prediction may now be materializing, there is also evidence that Qume's OEM sales in the upper end of the market continue to be strong. (FP 442-446).

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The most convincing evidence of injury, outside the harm to Qume's domestic production of low end printers, lies in the areas of price erosion, declining profit margins and excess capacity affecting Qume's existing middle range printer operation. The record indicates that Qume's prices to both its OEM and distributor customers in its middle and low price ranges have been on, the decline. (FF 378-382, 437-438). These declining prices have shown up in a trend of reduced profit margins. (FF 439). 14/ In the face of declining prices from the respondents in this investigation, it is apparent that the intense competition from imported products in the low to middle range of this market is having the effect of reducing prices, as well as profit margins. (FF 387, 389, 437-439). In addition, the availability of low cost, low speed printers will tend to depess prices in the middle range, and also result in substitution of low cost printers for higher cost printers when price is a more significant factor than speed or other features. (CX 169, Oliver W.S. at 17-18). Finally, it is clear that the closure of Qume's San Jose manufacturing facility in January 1984 has resulted in excess domestic capacity. (FF 425, 433-435). This plant closure is evidently related to the shifting market trends caused by the influx of imports. In light of declining prices, and the significant difference in production costs between San Jose and Puerto Rico, Qume can only remain competitive in the market by reducing its production costs to the maximum extent. (FP 422-425).

14/ Qume has provided profit and loss figures for the past several years that suggest that (FF 439-441). These types of figures involve complex calculations and are particularly subject to manipulation. In view of the relatively scant testimony explaining these figures, it is difficult to arrive at a complete understanding of how the profit figures were reached. As a result, Qume's assertion that , caused by infringing imports, is not considered to be sufficiently reliable and probative, particularly in light of other financial data on this record.

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The foregoing indications of injury are the result of changes in the marketplace and the cumulative effect of import competition from respondents in both Rotary Wheels I and Rotary Wheels II. Based on the factors stated herein, I find that the cumulative effect of respondents' importations and sales in the United States of rotary wheel printers is to destroy or substantially injure the relevant domestic industry.

B. Tendency To Substantially Injure

when an assessment of the market in the presence of the accused imported product demonstrates relevant conditions or circumstances from which probable future injury can be inferred, a tendency to substantially injure the domestic industry has been shown. Certain Combination Locks, Inv. No. 337-TA-45, RD.at 24 (1979). Relevant conditions or circumstances may include foreign cost advantage and production capacity, ability of the imported product to undersell complainant's product, or substantial manufacturing capacity combined with the intention to penetrate the United States market. Certain Methods for Extruding Plastic Tubing, Inv. No. 337-TA-110, 218 U.S.P.Q. 348 (1982); Reclosable Plastic Bags, 192 U.S.P.Q. 674; Panty Hose, Tariff Commission Pub. No. 471 (1972). The legislative history of Section 337 indicates that "[w]here unfair methods and acts have resulted in conceivable loss of sales, a tendency to substantially injure such industry has been established." Trade Reform Act of 1973, Report of the House Comm. on Ways and Means, H. Rep. No. 93-571, 93d Cong., 1st Sess. at 78 (1973), citing In re Von Clem, 108 U.S.P.Q. 371 (C.C.P.A. 1955).

In the present case, in which the continued adverse effect on the domestic industry of all respondents' cumulative imports largely has been minimized by

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the conclusion of licensing agreements, in which Qume receives royalties on sales of the licensed imported rotary wheel printers and typewriters (FF 162)4 it is important to assess the impact of imports by the remaining respondents on the domestic industry. This inquiry is made complicated by the fact that in the market segment in which Qume's printers are most competitive with respondents' products -- i.e., the low speed, low cost segment of the market,. the products now sold by Qume, the LetterPro 20 and Virgo, are also imported. Nevertheless, for the reasons which follow, I find that certain imports of the remaining respondents do tend to substantially injure the domestic industry.

As is obvious from Qume's experience in moving its low speed printer production offshore, there is a significant cost advantage of manufacture in the Far East over the cost of manufacture in the United States, including Puerto Rico. IFF 423-424). The record indicates that the volume of imports of each of the remaining respondents is on the increase, and in some cases that production capacity for exportation to the United States has recently been expanded. (FF 265-275, 453-461).

Sharp, Triumph-Adler and Towa have established subsidiaries in the United States which handle importation and distribution and sale of their respective products. (FF 8, 10, 11). Nakajima and Towa also have several OEM customers in the United States which import and distribute their products. (FF 6, 386, 403). There does not appear to be any substantial dispute that each of the remaining manufacturing respondents has the capacity to manufacture and export a significant and increasing quantity of the accused products, and that each of the importing respondents has the ability to' sell the volume imported, and the intent to penetrate the United States market. (FF 453-461). Finally, in view of the significant presence of imported rotary wheel devices, which has

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contributed to an extremely competitive climate where prices continue to decline, it is apparent that the remaining respondents also have the ability to undersell a domestically produced product. (FF 287, 380-382, 385, 387-389, 393, 400, 437-438, 449).

Although the relevant conditions for a tendency to injure the domestic industry are present in this investigation, the finding of tendency to injure must be modified, and made more specific to take account of certain market realities. I have previously found that in a specific market segment, rotary wheel printers and rotary wheel typewriters which are interfaceable are competitive. See Injury, supra. However, a typewriter that cannot be interfaced to an external data source, and thus cannot function as a printer, is not competitive with a printer. It has not been shown on this record that the Nakajima AS 300, and AE 354 or the Sharp ZX 500 and ZX 505 models of rotary wheel typewriters are interfaceable. (FF 25, 26). In addition, Towa maintains that its R3 Excellence 55 electronic typewriter cannot be interfaced, and the contrary has not been proven. (FF 402). Accordingly, I find that these models of typewriter are not competitive with rotary wheel printers, and cannot be a cause of injury to the domestic industry.

The evidence also shows that Qume's low speed printers are in the high.end of the low end segment of the market in terms of speed and price. (FF 25-28, 289, 312, 379-380, 385, 393, 400, 449). Although many of respondents typewriters and printers are in a comparable segment of the market to Qume, several of the portable and compact models of typewriter are in the low end of the low end segment of the market both in terms of speed and price. These typewriters are directed to the student and home personal computer type of use, where price is a paramount consideration. (FF 420, 431, 432). Qume's

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market projections indicate that it **does not anticipate making significant** inroads in this segment of the **market, even with. its Virgo and LetterPro printers. (FF 449). Therefore, I find that respondents' compact and portable typewriters, which include Nakajima's AE 330, AE 335, AE 350, AE 354, and AE 355 models,--and Triumph-Adler's 310/410 and Satellite II/Alpha 2001 models, are not competitive with Qume's rotary wheel printers, and thus cannot be a cause of injury to the domestic industry.**

The remaining models of respondents' rotary wheel typewriters and printers are competitive with Qume's printers in the mid-range segment of the market, and have the tendency to injure the middle range segment of the domestic idustry, which now consists of Sprint series printers ranging from 30-55 cps. (FF 23, 278, 437-438). As noted previously in Injury, supra, this injury takes the form of price erosion in the low and middle segments of the market, as well as the possibility of lost sales by the middle segment of the market to the low end segment of the market. The models of respondents' rotary wheel typewriters and printers which fall into this latter category include Nakajima's AP 650 printer, Teletex' TTX 1014 printer (manufactured by Nakajima), Sharp's models ZX-400, ZX-410, and ZX-415 electronic typewiters, Triumph-Adler's 1005/5005, 1005/5005XL, 1010/5010, 1011/5011, 1020/5020, 1030/5030, 1030/5030K, 1035/5035, 1040/5040, and 1041/5041 models of rotary wheel typewriters, and Towa's RI Printext printer, and R2 Executive 77
typewriter/printer. (FF 25-28, 385, 387, 388, 390, 393-396, 400-401).

For the reasons stated herein, and based on the evidence of record, I find that the effect or tendency of respondents' unfair acts and unfair methods of competition is to destroy or substantially injure an efficiently and economically operated domestic industry. (FF 462).

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CONCLUSIONS OF. LAW

1. The Commission has jurisdiction over the subject matter of this investigation and the parties named in the Notice of Investigation. 19 U.S.C. S 1337(b).

2. U.S. Letters Patent 4,118,129 is valid and enforceable. 35 U.S.C. SS 282, 102, 103, 112.

3. U.S. Letters Patent 4,118,129 is not invalid or unenforceable by reason of fruad or inequitable conduct before the PTO.

4. The rotary wheel typewriters designated as models AS-300, AE-330, AE-335, AE-350, AE-354, and AE-355, and the rotary wheel printer designated model AP-650, exported to the United States by respondent Nakajima All Co. directly infringe claim 8 of the '129 patent. 35 U.S.C. S 271(a).

5. The rotary wheel printer imported from Nakajima and sold in the United States by respondent Teletex Communication Corp,designated TTX 1014, directly infringes claim 8 of the '129 patent. 35 U.S.C. S 271(a).

6. The rotary wheel typewriters manufactured and exported to the United States by Sharp Corp. and/or imported into or sold in the United States by Sharp Electronics Corp., identified as models ZX 400, ZX 410, ZX 415, ZX 500, ZX 505, and 210, directly infringe claims 1 and 8 of the '129 patent. 35 U.S.C. S 271(a).

7. The rotary wheel typewriters manufactured and exported to the United States by Triumph-Adler and imported into and sold in the United States by Adler-Royal, designated as models 1005/5005, 1010/5010, 1011/5011, 1020/5020, 1030/5030, 1035/5035, 1040/5040, 1041/5041., 310/410, and Satellite II/Alpha 2002, directly infringe claim 8 of the '129 patent. 35 U.S.C. S 271(a).

8. The rotary wheel typewriters and rotary wheel printers exported to the United States by Towa Sankiden Co., identified as the R1 Printext, R2 Executive 77, and R3 Excellence 55, directly infringe claim 8 of the '129 patent. 35 U.S.C. S 271(a).

9. Patent infringement is an unfair act or unfair method of competition under 19 U.S.C. S 1337(a). In re von Clem, 108 U.S.P.Q. 371 (C.C.P.A. 1955).

10. The relevant domestic industry consists of the domestic facilities of Qume Corp. and Qume Caribe in the United States and Puerto Rico during 1983 devoted to production of rotary wheel printers in accordance with the '129 patent.

11. The domestic industry does not include the relevant operations of Qume's licensees under the '129 patent, Xerox and IBM, who have not been shown to produce in accordance with the patent.

12. The relevant domestic industry effiOently and economically operated.

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13. The effect of respondent's unfair methods of competition and unfair acts is to destroy or substantially injure the relevant domestic industry.

14. The tendency of respondents' unfair methods of competition and unfair acts, particularly in the importation of rotary wheel printers, namely, the Nakajima AP-650 and the Towa R1 Printext, and rotary wheel typewriters having the capability of being interfaced, namely Sharp's Models ZX 400, ZX 410, and ZX 415, Triumph-Alder's models 1005/5005, 1010/5010, 1011/5011, 1020/5020, 1030/5030, 1035/5035, 1040/5040, and 1041/5041, and Towa's model R2 Executive 77, is to substantially injure the relevant domestic industry.

15. There is a violation of S 337. 19 U.S.C. S 1337(a).

<u>INITIAL DETERMINATION AND ORDER</u>

Based on the foregoing findings of fact, conclusions of law, the opinion and the record as a whole, and having considered all of the pleadings and arguments presented orally and in briefs, as well as proposed findings of fact and conclusions of law, it is the Administrative *Law* Judge's DETERMINATION that there is a violation of Section 337 in the unauthorized importation into the United States of the accused rotary wheel printing systems.

The Administrative Law Judge hereby CERTIFIES to the Commission this Initial Determination, together with the record of the hearing in this investigation consisting of the following:

1. The transcript of the hearing, with appropriate corrections as may hereafter be ordered by the Administrative Law Judge: and further,

2. The exhibits accepted into evidence in the course of the hearing, and the exhibit proferred by the Administrative Law Judge, as listed in the Appendix attached hereto.

The pleadings of the parties are not certified, since they are already in the Commission's possession in accordance with Commission Rules of Practice and Procedure.

Further, it is ORDERED that:

I. In accordance with Rule 210.44(b), all material heretofore marked in camera for reasons of business, financial and marketing data found by the Administrative Law Judge to be cognizable as confidential business information under Rule 201.6(a) is to be given in camera treatment;

2. As provided herein, Motion 185-77, complainant's third motion to amend the complaint, is denied; Motion 185-80, respondents' motion to strike "Qume's Cross-Reference List Between QRFFs and RTFFs," is granted; Motion 185-81, respondents' motion to strike or disregard Qume's Rebuttal Findings of Fact (Technical), is denied; Motion 185-82, respondents' motion to strike complainant's findings pursuant to 19 C.F.R. 210.20(a)(5), 210.20(c)(1), and 210.20(c)(2), is denied, and Motion 185-83, complainant's motion for leave to reply to respondents' and staff's responses to Order No. 55, is granted;

3. The Secretary shall serve a public version of this Initial Determination upon all parties of record and the confidential version upon the Commission investigative attorney and all counsel of record who are signatories to the Protective Order issued by the Administrative Law Judge in this investigation.

4. Counsel for all parties shall indicate to the Administrative Law Judge those portions of this Initial Determination which contain confidential business information to be deleted from the Public Version of this Determination not later than February 25, 1985.

5. This Initial Determination shall become the determination of the Commission thirty (30) days after the service thereof, unless the Commission, within thirty (30) days after the date of filing of the Initial Determination shall have ordered review of the Initial Determination or certain issues therein, pu*suant to 19 C.F.R. 210.54(b) or 210.55 or by order shall have changed the effective date of this Initial Determination.

John J. Mathias
Judge Jo J. Mathias
Presidin Officer

Issued: February 15, 1985

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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE. OF CORRECTION

PATENT NO. : 4,118,129

DATED : October 3, 1978

INVENTORM: Willy J. Grundherr

It is certified that error appears in **the above-identified patent and that said Letters Patent** is hereby corrected as shown below:

Claim 8, line 51, "thre" should be --the--.

Claim 8, line 59, "fetching" should be --reading out--.

Claim 8, line 63, "fetched" should be --read out--.

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Twenty-seventh ***I*** **ay of** *November 1944*

Attest:

Ruth C. Mason

Attesting Officer

GERALD 1. MOSSINGHOFF

Commissioner of Perron end Tredemerks

CERTIFICATE OF SERVICE

I, Kenneth R. Mason, hereby certify that the attached INITIAL DETERMINATION (EUBLIC VERSION) was served upon Denise T. DiPersio, Esq., and upon the following parties via first class mail, and air mail where necessary, on March 1, 1985.

Kenn th R. Mason,Secretary
U.S International Trade Commission
701 E Street, N.W.
Washington, D.C.

FOR: COMPLAINANT OUME CORPORATION:

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RESPONDENTS

FOR: Triumph-Alder & Adler-Royal

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<u>SERVICE LIST</u> - page 2

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SERVICE LIST - page 3

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FOR: Telextex Communication Corp.

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Chief Counsel
U.S. Customs Service
1301 Constitution Ave., N.W.
Washington, D.C. 20229

OFFICE OF THE SECRETARY

UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C. 20436

March 1, 1985

Richard Abbey, Esq.
Chief Counsel
U.S. Customs Service
1301 Constitution Avenue, N.W.
Washington, D.C. 20229

Dear Mr. Abbey:

Enclosed is a copy of the nonconfidential version of an initial determination issued recently by a Commission administrative law judge in connection with

ITC Inv. No. 337-TA- 185

The Commission would appreciate receiving any written comments your agency cares to submit regarding this initial determination. Any such comments must be filed with the Secretary, U.S. International Trade Commission within 10 days of service of the initial determination. Should you have any questions regarding the initial determination, please contact Charles Nails.
Office of the General Counsel, U.S. International Trade Commission, telephone 523- 0375.

Sincerely yours,

Harold Sundstrom
Assistant Secretary/
Public and Consumer Affairs Officer

Enclosure

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OFFICE OF THE SECRETAR1

UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C. 20436

March 1, 1985

Mr. Charles S. Stark
Antitrust Division
U.S. Department of Justice
Room 7115, Main Justice
Pennsylvania Avenue & Tenth Street, N.W.
Washington, D.C. 20530

Dear Mr. Stark:

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Sincerely yours,

Harold Sundsttom
Assistant Secretary
Public and Consumer Affairs Officer

Enclosure

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UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C. 20436

March 1, 1985

Edward F. Glynn, Jr., Esq.
Assistant Director for International
Antritrust
Federal Trade Commission
Room 502-4, Logan Building
Washington, D.C. 20580

Dear Mr. **Glynn**:

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Sincerely yours,

Harold Sundstrom
Assistant Secretary
Public and Consumer Affairs Officer

Enclosure

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OFFICE OF THE SECRETARY

UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C. 20436

March 1, 1985

Darrel J. Grinstead, Esq.
Department of Health &
Human Services
Room 5362, North Building
330 Independence Avenue, S.W.
Washington, D.C. 20201

Dear Mr. Grinstead:

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Sincerely yours,

Harold Sundstrom
Assistant Secretary/
Public and Consumer Affairs Officer

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