COMPETITIVE ASSESSMENT OF THE U.S. FORGING INDUSTRY

Report to the President on Investigation No. 332-216 Under Section 332 of the Trade Act of 1930, as Amended

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PREFACE

On June 28, 1985, the United States International Trade Commission instituted investigation No. 332-216, Competitive Assessment of the U.S. Forging Industry. The investigation, conducted under section 332(g) of the Tariff Act of 1930, is in response to a request from the United States Trade Representative, at the direction of the President (app. A). This study examines the competitive position of the U.S. forging industry in domestic and world markets. The study also includes an overview of the U.S. forging industry, together with a detailed analysis of selected key products 1/ that are important to the U.S. forging industry and are representative of major segments of the industry in terms of the manufacturing process, import competition, marketing, and its financial condition.

Notice of this investigation was given by posting copies of the notice at the Office of the Secretary, U.S. International Trade Commission, Washington, DC, and by publishing the notice in the Federal Register (50 F.R. 28293 and 50 F.R. 32777) (app. B).

A public hearing in connection with this investigation was held in the Commission's hearing room on January 21, 1986, and testimony was received from U.S. producers and foreign producers of forged products (app. C).

In the course of this investigation, the Commission compiled data and information from questionnaires received from 136 producers, 56 importers, and 68 purchasers of forged products. The questionnaires were mailed to all known producers, importers, and purchasers of the products covered in the study. This listing was derived from previous Commission investigations, the Forging Industry Association, Custom's Importer File, and individual firms in the forging industry. U.S. producers responding to the questionnaires accounted for over 70 percent of total industry shipments 2/ during 1981-84. In addition, data provided by producers in the nine selected products represented an estimated 40 to 90 percent of their respective industry shipments. The Commission also received questionnaire responses from most major importers and purchasers of all forged products. Actual data as reported by respondents are used throughout the report; however, shipments, exports, and imports in the nine individual product categories were projected to the industry universe based upon discussions with domestic and foreign industry sources, data supplied in response to Commission questionnaires, and available Census data. Finally, information was gathered from various public and private sources, from U.S. embassies and consulates, and from interviews with both domestic and foreign producers, importers, and purchasers of forged products, as well as from public data gathered in other Commission studies.

1/ The products covered include forged steel crankshafts, forged steel connecting rods, forged steel undercarriage components, forged steel axles and spindles, steering arms and knuckles, forged steel valves and valve bodies, forged steel fittings and flanges, forged steel transmission parts, forged steel hooks, shackles, loadbinders, and other attachments, and forged metal turbine rotor and generator components.

2/ Total industry shipments compiled from official statistics of the U.S. Department of Commerce.

The information and analysis in this report are for the purpose of this report only. Nothing in this report should be construed to indicate how the Commission would find in an investigation conducted under other statutory authority covering the same or similar matter.

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EXECUTIVE SUMMARY

The U.S. forging industry is composed of some 400 forges, which produce a variety of ferrous and nonferrous forgings for aerospace, automotive, power generation and marine equipment, and many other applications. The manufacture of forgings involves processes that shape, refine, and improve the mechanical properties of metals by subjecting them to impact or pressure. This study assesses trends from the perspective of the steel, aluminum, and other forged products (e.g., titanium) segments of the industry, followed by a detailed analysis of nine key products.

While the use of forged products is widespread, the health of the industry is most closely related to conditions in the automotive, construction, agricultural, and aerospace markets. In recent years, the industry has faced a contraction in demand and an erosion of its competitive position in domestic and foreign markets. Given the diversity of products produced and the fact that many forgings are traded as components of engines and other assemblies, the industry has not been able to assess the level of import penetration in the U.S. market accurately.

This report examines the competitive position of the U.S. forging industry and its foreign competitors on a country-by-country and product-by-product basis. The assessment, which is based on questionnaire responses by producers, importers, and purchasers of forged products, and Commission staff interviews with both domestic and foreign industry officials, examines industry structural factors and product characteristics which are generally considered to provide the basis of market leadership. There were 15 significant areas of cost, technology, marketing, and government involvement included in the structural assessment (see tables 29 and 30, pages 44 and 45); whereas 11 product-associated criteria, ranging from price/exchange rates, tooling costs, and engineering assistance to delivery time, supplier relationships, and performance features were considered (see tables 79 and 80, pages 103 and 104). Statistical highlights are presented in table A. The principal findings of this study are summarized below:

World Market

- Production in 10 major countries of ferrous and nonferrous drop forgings, which represent about 70 to 80 percent of the forgings manufactured in most major producing countries, declined by 12 percent during 1981-82 from 4.4 to 3.9 million tons. After a further decline in 1983, production is believed to have increased in 1984 as worldwide industrial activity recovered from the recession; production in 1984, however, was probably still significantly below the 1981 level.

Table A.—Profile of the U.S. forging industry, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August— 1984	January-August— 1985	Absolute change, 1984 from 1981	Percentage change, 1984 from 1981
Net sales:								
Total—million dollars—	4,402	3,517	2,797	3,175	2,136	2,078	-1,227	-27.9
Industry coverage—percent—	73.7	73.5	66.5	1/ 71.8	1/ 71.7	1/ 72.7	-1.9	2/
Operating profits million dollars—	440	227	176	187	136	81	-253	-57.5
Ratio of net profit to net sales—percent—	10.0	6.5	6.3	5.9	6.4	3.9	-4.0	2/
Capital expenditures, domestic:								
Total—million dollars—	234	241	124	111	68	73	-123	-52.6
Ratio of domestic capital expenditures to total net sales—percent—	5.3	6.9	4.4	3.5	3.2	3.5	-1.8	2/
Research and development:								
Total—million dollars—	65	41	107	64	30	48	-1	-1.5
Ratio of research and development to total net sales—percent—	1.5	1.2	3.8	2.0	1.4	2.3	+0.5	2/
Capacity utilization—do—	56.2	40.5	39.9	48.6	41.6	38.1	-7.6	2/
Employment:								
Total—number—	52,137	42,820	38,570	40,287	40,189	39,845	-11,850	-22.7
Production workers—do—	38,264	32,831	28,853	30,118	28,116	27,201	-8,146	-21.3
Market data on selected key products: 3/								
Shipments—million dollars—	2,185	1,840	1,759	1,974	1,363	1,286	-211	-9.7
Exports—do—	101	79	69	79	47	69	-22	-21.8
Ratio of exports to shipments percent—	4.6	4.3	3.9	4.0	3.4	5.4	-0.6	2/
Imports—million dollars—	386	340	363	607	410	454	+221	+57.3
Consumption—do—	2,470	2,101	2,053	2,502	1,726	1,671	+32	+1.3
Trade balance—do—	-285	-261	-294	-528	-363	-385	-243	-85.3
Imports to consumption ratio percent—	15.6	16.2	17.7	24.3	23.8	27.2	+8.7	2/

1/ Estimated by the staff of the U.S. International Trade Commission.
2/ Not applicable.
3/ Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission. Key products include forged steel crankshafts, forged steel connecting rods, forged steel undercarriage components, forged steel axles and spindles, steering arms and knuckles, certain forged steel valves and valve bodies, forged steel fittings and flanges, forged steel transmission parts, forged steel hooks, shackles, loadbinders, and other attachments, and forged metal turbine rotor and generator components.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission, except as noted.

- Japan is one the world's largest producers of these forgings, accounting for 1.4 million tons or 37 percent of identified world production in 1982. The United States and West Germany are also major producers, accounting for 17 and 20 percent, respectively, of 1982 production. Other principal world producers include the Soviet Union, reputed by industry sources 1/ to be the world's largest producer (no production data are available), the Republic of Korea (Korea), Brazil, Italy, and the United Kingdom.

U.S. Market and the Domestic Industry

- During 1981-84, the U.S. economy outperformed the market for forgings. While the U.S. Gross National Product (GNP) increased by 25 percent (and the durable goods component of GNP by 24 percent), consumption of the nine forged products profiled in this study increased overall by 1 percent to an estimated $2.5 billion. Markets for the products not specifically profiled in this study are believed to have experienced a more limited degree of turnaround as growth in industrial machinery demand, which is relatively more important for the other products, lagged behind that of the automotive and related industries. The overall increase in consumption is largely attributable to the recovery in the automotive and construction markets.

- Improvement in market conditions was not matched by domestic shipments, which fell overall by 18 percent to $3.1 billion (shipments of profiled products fell by 10 percent). The decline in shipments contributed to weakened financial conditions in the domestic industry. The ratio of net profits to sales fell from 9.9 to 5.9 percent during 1981-84, while capital expenditures and research and development spending fell from 6.8 to 5.5 percent of sales.

- Financial performance differed markedly, however, among major types of forgings and their end markets. In 1984, the return on sales of forged steel products, which are shipped principally to the automotive and bus and truck industries (which experienced increasing returns on sales during 1981-84), was 3.8 percent. The return on aluminum forgings (which are shipped principally to the aerospace industry) was a negative 1.2 percent, far below those of the automotive and aerospace industries. Throughout the period these two forged products segments were far outperformed by the higher-valued "other" forgings (such as titanium and nickel-based superalloys), which are used primarily in aerospace applications. The return on sales in this segment was 16.3 percent in 1984, down from a period high of 22.1 percent in 1983, but still several times higher than that of its major market, the aerospace industry.

1/ Interviews with domestic forgers by USITC staff, December 1985.

- Reported capacity by the steel sector declined by 3 percent during 1981-84 to 3.1 million tons of product, whereas capacity in the aluminum and other forged products sectors increased by 17 and 15 percent, respectively, in anticipation of growing demand in the aerospace and defense-related industries by four forges located in California. Reported production declined by 15 percent to 1.6 million tons during 1981-84. Industry employment of production workers fell by 21 percent to 30,118 workers during 1981-84, reflecting both improved productivity and production declines.

Imports

- Imports of the nine forged products profiled in the study increased by 57 percent during 1981-84 to $607 million, which is more than double the 24-percent increase experienced by the United States in imports of durable goods and services. This resulted in an increase in import penetration from 15.6 to 24.3 percent. Import penetration was highest in crankshafts (55 percent in 1984) and fittings and flanges (44 percent), and lowest in turbine rotors (9 percent) and axles and spindles, steering arms and knuckles (15 percent) (see table 47, pages 75-77).

Industry Structural Factors of Competition

- Raw materials and labor costs are the two largest cost components in the forging industry. To the extent that foreign forging industries are similar to the U.S. industry in terms of use of these two inputs, it would appear that U.S. producers are at a significant cost disadvantage in these two areas. The recent decline in the dollar, however, has undoubtedly narrowed the disadvantage.

- With respect to raw materials, U.S. producers account for substantial shares of the U.S. market for steel, aluminum, and other metals, such as titanium. It would appear that foreign prices of steel and titanium have been substantially below domestic prices (ranging from 20 to 36 percent for steel (1985 prices) and 36 to 58 percent for titanium (1983 prices)), while a relatively small premium may have been paid for aluminum. These three metals account for about 40 percent, 30 to 35 percent, and 45 to 55 percent of typical steel, aluminum, and titanium forgings, respectively.

- With regard to labor, labor costs account for over 29 percent of forged steel costs and over 25 percent of forged nonferrous costs (based on the U.S. input-output model). Wage rates in the industry exceeded those for all U.S. manufacturing by about 60 percent in each of the years during 1981-84, when the rates rose from $14.73 to $15.67 per hour. Data suggest that total foreign labor costs (i.e., including benefits) were 10 to 87 percent below U.S. costs in 1983. All other things equal, these lower labor costs would translate into foreign production cost advantages of 3 to 25 percent for steel and 3 to 22 percent for nonferrous forgings.

- Technology is an important factor affecting competitiveness in the forging industry. Discussions with forging officials suggest that current technological developments in the aerospace sector, such as precision or near-net-shape forging, could represent the leading technological edge for the forging industry as a whole. Although U.S. forgers appear to be somewhat ahead of the rest of the world in aerospace forging technology, they are, at best, about equal in other forging sectors.

- The same technology is available to both U.S. and foreign forgers, but some domestic and foreign forgers believe that many U.S. forgers are not utilizing much of the more modern equipment. This reflects the U.S. industry's inability to generate profits sufficient to fund increased investment in plant and equipment. One of the most important technological developments in recent years has been the incorporation of computer-aided design and manufacturing processes (CAD-CAM). The expense of CAD-CAM processes has limited its implementation thus far to the larger domestic and foreign forgers.

- U.S. producers, when evaluating their competitive position on a product-by-product basis, indicated that marketing factors such as distribution and market response were comparable factors among both U.S. and foreign industries in only four segments out of nine. One explanation for these results could be that foreign producers are increasingly warehousing their products without charge at locations close to U.S. purchasers. U.S. producers also indicated that foreign industries have an advantage in raw materials, capital, and labor costs (see above references) and in most government-related factors such as nontariff barriers and research and development support.

- On a country-by-country basis, U.S. producers generally rated domestic and foreign producers of forged products as comparable overall. The producers indicated that although many foreign industries allegedly benefited from government involvement (that is, the existence of subsidies, higher tariff levels, and nontariff barriers to imports), the U.S. and foreign industries were considered comparable with respect to production technology and foreign government regulations which increase costs. U.S. producers considered themselves at a disadvantage when competing with the Japanese forging industry, particularly in the areas of cost-related factors and government involvement. U.S. producers assessed themselves as on an equal footing with the other foreign industries (Taiwan, Korea, Brazil, West Germany, Italy, and Canada) principally because of marketing factors, production technology, and fuel costs.

Product-Related Factors of Competition

- On a product-by-product basis, U.S. producers and importers of forged products agreed that foreign producers were at an advantage in the U.S. market in seven product categories. Domestic producers considered both the U.S. and foreign industries as equally competitive in two product lines--forged steel hooks, shackles, loadbinders, and other attachments; and metal turbine rotor and generator components--whereas U.S. importers judged the foreign producers as having the competitive advantage in hooks and domestic producers, an advantage in rotors. The advantages accorded foreign-produced forgings by both U.S. producers and importers were concentrated in cost areas, such as pricing, favorable exchange rates, and the cost of tooling and dies. Of these items, price was cited by purchasers as the most important factor influencing their foreign purchases. The principal factor influencing U.S. purchasers' decisions to buy domestic forgings was their shorter delivery time.

o On a country-by-country basis, U.S. producers accorded all foreign producers (Taiwan, Japan, Korea, Brazil, West Germany, Italy, the United Kingdom, and Canada) as having an overall competitive advantage in the U.S. market, with importers following suit in all but two cases. In these two instances, domestic forgers were considered to be equally competitive with the United Kingdom and as having an overall advantage over Canadian forgers.

o With respect to U.S. exports of forged products, U.S. producers exporting to foreign markets indicated that all eight countries evaluated had a competitive advantage in foreign markets, principally because of price-related factors such as lower prices, cost of tooling/dies, and favorable terms of sale and exchange rates.

o With respect to barriers to U.S. exports, U.S. producers of forged products cited 22 different quantitative restrictions, nontariff charges, and government regulations and standards as placing them at a disadvantage in principal foreign markets. Respondents most frequently cited: (a) exchange and other monetary controls; (b) foreign government subsidies and other aids to industry; (c) local content requirements, and (d) foreign government laws and practices that discourage imports. The countries most frequently alleged to be involved in such restrictive practices include the United Kingdom, Canada, France, Japan, and Mexico.

Implications of the Forging Industry's Competitive Position

The U.S. industry

o U.S. producers of forged products are responding to competitive conditions in U.S. and foreign markets by lowering prices, initiating cost-reduction programs, and reducing production. These actions could lead to an eventual streamlining of the U.S. industry, wherein a few large, highly automated firms dominate high volume work, certain medium-sized forges focus on specialized work, and a number of small firms survive as jobbers. These firms would likely need to become more assertive in the application of new technology and the innovation of product design to remain competitive--thereby altering the largely reactive nature of the industry. Furthermore, the U.S. industry is facing increased competition from European and other foreign competitors, some of whom have increased production capacity and targeted the U.S. market as part of a deliberate marketing strategy. Foreign exchange rates, however, will likely be an important factor affecting the degree and speed at which import competition intensifies or abates. The significant decline in the value of the dollar in recent months, for example, has undoubtedly narrowed cost disadvantages in certain areas, putting the industry on a more cost competitive basis with major foreign suppliers.

- In addition to direct import competition, the U.S. forging industry faces challenges in other areas which could have implications for the industry. For example, U.S. purchasers have changed sourcing patterns to enhance their market position. The automotive and construction machinery industries have begun to import finished assemblies incorporating forgings in order to become more price competitive with imports of finished products (such as automobiles). Moreover, the forging industry is facing increased competition from cast products; substitution is expected to increase in the automotive sector as advances are made in casting and ceramics.

- The aerospace sector, which has been fortified by increased defense equipment expenditures, remains a stabilizing influence in the industry, particularly for the aluminum and other forged products sectors. Research and development expenditures for a variety of new manufacturing methods, new materials, and a broadening of end-use applications improve the outlook for continuing changes in products and production techniques.

- In summary, the outlook for the U.S. industry is dominated by the general level of U.S. economic activity and by prospects for the automotive and aerospace industries in particular. Fluctuating sales of domestic autos, increased production in the United States by foreign automotive firms, and intensifying competition from substitute materials and imports of complete forged components and autos incorporating forged articles leave the near-term outlook for sales to the automotive market uncertain.

Related industries and the U.S. economy

- Only a few industries are significantly affected by changes in the output of forgings. The supplying industries most affected by changes in the output of forgings are iron and ferroalloy ores mining and electrometallurgical products. No other industries directly or indirectly supply more than 4 percent of their own industry output to the makers of forgings. This implies that no others besides those listed above would experience more than a 2-percent drop in production if the output of forgings were reduced by one-half.

- Output of forgings in the United States amounts to less than 0.1 percent of GNP. Under these circumstances any reduction in U.S. production of forgings caused by increased imports would have a very small impact on overall U.S. production.

OVERVIEW OF THE U.S. FORGING INDUSTRY

Industry Structure

There are three principal markets for domestically made forged products: (1) small to medium sized, low-value forgings produced primarily for the motor vehicle, construction, agricultural, and manufacturing markets; (2) large, relatively low-value forgings produced for the shipbuilding, rail, and heavy industrial markets; and (3) high-value forgings manufactured for the aerospace and power-generating equipment sector. 1/ Although there is some overlap in these three sectors and there are additional products/markets that the forging industry supplies, these three market segments represent the vast majority of the uses for forged products. The principal raw material utilized to produce small to large low-value forgings is steel; whereas aerospace and power-generating equipment forgings use mostly aluminum, titanium, or other lightweight, more exotic metals in the manufacturing process.

The principal products forged for the motor vehicle, agricultural, and construction industries are crankshafts and connecting rods for internal combustion engines; gears, shifter forks and levers, shafts, and other parts for manual and automatic transmissions; and suspension parts, such as knuckles and steering arms. Other principal low-value forgings used by U.S. industry include steel valves and valve bodies; steel fittings and flanges; hooks, shackles, loadbinders, and other lifting or material-handling attachments; and forged hand tools such as large wrenches and hammers. In addition to crankshafts, connecting rods, and transmission and suspension parts, the construction industry also uses forged steel undercarriage components in crawler-mounted tractors. The parts of a crawler tractor that are normally forged are rollers, links, and segments. Most heavy forgings consist of very large crankshafts and connecting rods used in large marine, locomotive, ordnance, and industrial internal-combustion engines. Forgings for the third market segment consist mostly of parts for turbine engines and airframe and landing gear assemblies for aircraft and main rotor shafts for power-generation equipment.

The production processes utilized by the forging industry in producing low-value forgings (using steel as the principal raw material) and high-value products (using more expensive metals, such as aluminum and titanium) are quite similar. For example, aerospace turbines, automotive crankshafts, and crawler-mounted undercarriage components may be produced in the same forging facility since the same hammers or presses are often used to manufacture all three products. Although the independent production processes are similar in many respects, the practice of many forging companies is to specialize in low- or high-value forgings and produce each in separate plant facilities since each is a separate market.

1/ A typical motor-vehicle forged part would have a value of less than $1 per pound, while most forgings used by the aerospace industry would be valued at over $10 per pound.

An important factor affecting both domestic and foreign forgers is the increased competition from the casting (or foundry) industry. 1/ Many mechanical components such as certain types of crankshafts and transmission parts were formerly forged, but due to improvements in casting technology during the last 5 to 10 years and their generally lower cost, these parts are now cast. A representative of a large Italian forging operation stated that the firm lost a major contract in 1984 for a six-cylinder forged crankshaft and expects to lose the contract for a large forged, eight-cylinder crankshaft within the next 2 to 5 years when the engine manufacturer will change to a cast crankshaft. 2/ In addition to competition from the casting industry, representatives of the largest crankshaft manufacturer in West Germany predict that ceramics and plastics could become strong competitors of the forging industry but practical applications for most ceramic and plastic components are 10 to 20 years in the future. 3/

Since a major percentage of total shipments of forged products are used by the motor vehicle and aerospace industries, the trends in production, shipments, sales, and profits (or loss) tend to follow economic developments in these two industries. Because some forgers specialize in only one market segment (for example, automotive, construction, or aerospace), each may follow a somewhat different pattern. For example, forgers that specialized in automotive forgings in the early 1980's were affected by the decrease in demand for autos, trucks, and buses; but forgers that produced primarily for the aerospace industry were able to capitalize on the rapid defense build-up during the period 1980-84. Also, European Community (EC) forgers were not affected by the slowdown in EC demand for heavy-truck forgings nearly as much as U.S. heavy-truck forgers, because a much higher percentage of EC heavy trucks and corresponding forgings were exported worldwide. 4/ Since the U.S. truck producers export few heavy trucks and components (except to Canada), U.S. forgers supplying the domestic truck industry were more heavily impacted.

Manufacturing Process

The manufacture of forged products is a process whereby metal is shaped under impact or pressure to produce a desired shape with improved mechanical properties. This process is carried out by several basic forging methods (all of which are fundamentally related to hammering and pressing); the choice of method is determined by the quantity of parts to be produced, the characteristics of the material, and the configuration to be formed.

After forging stock (typically bars and billets) arrives at the forge plant, a sample is often sent to the laboratory for examination to ensure proper grain structure, fiber formation, and cleanliness. Stock is then cut

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1/ This information was conveyed to the USITC staff repeatedly by both domestic and foreign forgers and industry association officials.

2/ Interview with the general manager of Teksid, Hot and Cold Forging Division, Turin, Italy, Nov. 26, 1985.

3/ Interview with officials of Gerlach Werke GMBH, Homburg, SAAR, West Germany, Nov. 18, 1985.

4/ Interview with officials of the Industrial Association of German Forges, Nov. 19, 1985.

to lengths of 6 to 8 feet by either shearing or cutting by power hacksaws, automatic circular sawing machines, band saws or abrasive wheel cutoff machines.

Although there have been new developments in cold forging, materials to be forged are typically heated to temperature ranges conducive to shaping. Principal methods of heating stock include electric or fuel-fired furnaces, electrical induction or resistance processes, or by special gas burning techniques; the choice of method is often determined by factors such as the forging temperature required for a particular material and the availability of various fuels. 1/

A new set of dies is typically released after die proofs of the final impression have been approved by the customer and the forging engineer. An operations sheet is then issued which describes the sequence of forging operations to be used, recommended stock size, number of pieces on the initial order, and target dates for production. The dies are then installed, heated, and forged with a sample piece of stock. The piece is inspected and checked for defects; if no corrections are necessary, production begins.

In a typical sequence, stock is delivered from the furnace where preliminary hot working proportions the metal. Using the operation of the hammer as an illustration, the stock is hot worked in successive blows, thus forcing the workpiece to flow into and fill the blocking impressions in the dies. Flash is produced and appears as flat, unformed metal around the edge of the product. The exact shape of each product is obtained by the impact of several additional blows of the hammer that force the stock to completely fill every part of the finishing impression. Finally, the flash is removed from the forging with trim dies in a mechanical press or by sawing and grinding.

Depending on customer requirements, many impression die forgings produced by hot forging methods are heat treated after completion of final forging operations and before machining and end use. The range of heat treating facilities includes equipment for normalizing, annealing, hardening with either water or oil quench, and tempering.

As a result of the high temperatures required for forging and heat treating, forgings produced from most materials acquire a thin coating of scale; it is generally necessary to remove scale before further processing is performed (e.g., machining, plating, painting or coating). Cleaning is typically accomplished by blast cleaning, tumbling, and pickling.

After heat treating and cleaning, finishing operations (e.g., coining, and straightening) are performed cold and consist primarily of minor dimensional corrections. Coining is performed in a press whereby extremely close tolerances can be met; manual or mechanized straightening corrects the warping that can occur during trimming, heat treating, cleaning, or handling operations. Finally, the forging is given a final inspection and prepared for shipment.

1/ Interview with Gerlach-Werke GMBH, Homburg, West Germany, Nov. 18, 1985.

Hammer and press forging

Over the years, forging hammers have been the most widely used type of equipment for impression die forging. The three basic types of forging hammers operate on the same basic principle- a heavy ram containing the upper die is raised and is driven or allowed to fall on the workpiece which is placed on the bottom die. These hammers are classified by the method used to raise the ram, i.e., board hammers, air-lift hammers, and steam hammers. Other types include counterblow hammers and helve and trip hammers.

Forging presses comprise the second type of basic forging equipment employed in impression die forging and are classified according to the means used to deliver energy to the workpiece. Mechanical forging presses provide a fixed stroke; hydraulic presses have a variable stroke that can be adjusted to selected speeds, pressures, and dwell times. In contrast to the hammer, the material is typically struck only once in a die impression, thus the design of each impression is critical, and operator skill is less important. 1/

Impression die forging

Impression die forging accounts for the bulk of commercial forging production. In a simple illustration of impression die forging, a round or rectangular workpiece is placed in a lower die, where it is formed into the desired shape as the top and bottom dies are brought together. At the same time, a small portion of material begins to flow outside the die impressions, forming flash. The flash cools quickly and presents resistance to the forming process, thus aiding the flow of the material into parts of the impressions previously unfilled.

Although the terms are often used interchangeably, the method known as closed die forging is a special form of impression die forging that does not depend on the formation of flash to fill the die completely. In closed die forging, the material is shaped in a cavity with virtually no escape of excess material. Closed die forging is very demanding with respect to die design- i.e., since pressing is typically completed in one stroke, careful control of workpiece volume is necessary to achieve complete filling without creating abnormal pressures in the dies from overfilling. In addition, another potential problem is the trapping of gas and lubricant, thus die vents are often necessary to prevent excessive pressure buildup.

Open die forging

Open die forging is differentiated from impression die and closed die forging in that the material is never completely confined as it is being formed by the dies. The open die process is typically associated with large parts such as shafts, sleeves, and disks; however, weights of parts can range from 5 to 100,000 pounds.

1/ Interview with Jung and Sohn, Halver, West Germany, Nov. 20, 1985.

Open die forgings are produced on flat dies, round swaging dies, and V dies; materials range from carbon, alloy, stainless, and tool steels to aluminum, titanium, and nickel-based alloys. As the workpiece is hammered or pressed, it is manipulated between the lower and upper dies until hot working forces the metal to final forged dimensions. Because this is not a precise process, the skill of the forging master in changing the positioning of the workpiece is very important; furthermore, the workpiece often cools below its hot-working temperature and must be reheated several times before final forged dimensions are achieved.

The workpiece then moves to heat treating and rough machining. At this time, it is important to establish accurate centers for mounting large items in the lathe; i.e., the as-forged shape is never perfectly round nor entirely straight, hence, precise lathe centers aid in achieving accurate, final, rough-machined dimensions.

Precision forging

Precision die forgings are distinguished from other forgings principally by their more detailed geometric features and closer dimensional tolerances. These types of products are most commonly manufactured from light metals, such as aluminum and titanium (e.g., for aerospace applications) in which weight, strength, and special design are important factors as well as price and delivery.

Precision forging produces a finished part that requires little or no preheating, descaling, lubrication, or machining. These advantages must be evaluated with respect to the relative economies of additional operations and tooling, thus precision forging is typically limited to high-quality applications.

Cold forging

Cold forging involves either impression die forging or closed die forging with lubricant and circular dies at room temperature. Carbon and standard alloy steels are most frequently used; parts are generally symmetrical and typically under 25 pounds in weight.

Cold forging efficiently uses raw materials by producing precision shapes that require few finishing operations. Closed die impressions and extrusion-type metal flow yield close-tolerance components; furthermore, production rates are very high with long die life.

Ring rolling

Seamless rolled rings are produced in numerous cross-sectional shapes, ranging from several inches to over 20 feet in diameter. Rings can range in weight from one pound to over 20,000 pounds. Rolled rings are typically used in gears, couplings, rotor spacers, and components for pressure vessels and valves.

Seamless rolled rings are produced on different equipment, which is often modified by individual producers to meet customer specifications. Manufacture of a rolled ring requires the production by means of a press or hammer of a doughnut-shaped forging from a cut-to-weight billet. The pancaked stock is then prepunched and preformed, punched and restruck, then placed over the idler roll of the rolling mill. By applying pressure to the wall as the ring rotates, the outside diameter and inside diameter are gradually expanded.

Production Technology

Aerospace

Discussions with forging industry officials suggest that current technological developments in the aersospace sector could represent the leading technological edge for the future of the forging industry as a whole. In general, the greatest advances have been in the areas of materials and precision forging processes. The aerospace forging industry, noted to be at the forefront of high technology applications 1/, is widely considered to be free from import competition because of this technological superiority. Aerospace forging technology, based on information obtained from domestic and foreign forging industry officials, is discussed below.

Currently, forgings are utilized in three main areas of an aircraft: the engine; the landing gear; and the fuselage and tail assembly. These are areas in which a high degree of metal strength and reliability are necessary for the aircraft's operation. In an engine, the critical rotating parts are always forged, including the turbine, rotor, rings, and certain disks, shafts and blades. The fuel nozzle supports and hot-gas manifolds are also forged, because of the need for high temperature resistance. Landing gear manufacturers indicate that every major member of an airplane's landing gear system is made from forged steel because of the need for strength and durability. The main structural portions of the fuselage and tail assembly utilize forgings for wing and engine attachment and support, as well as for control surface fittings. Additionally, a large number of parts for missiles and expendable and reuseable launch vehicles require forged components. Precise product specifications are common characteristics of all of the aerospace forgings described in this section.

Industry sources indicate that some of the machinery used by the aircraft forging industry is almost 30 years old, with many of the heavy presses built under Department of Defense contracts in the 1950's being used to produce many of these forgings. Recently, however, additional heavy presses have been added to expand the capacity to produce large, conventionally forged aircraft parts. Improved forging presses, utilizing advanced CAD/CAM processes, have

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1/ Statement of Richard Steele, Ladish Company, at the public hearing, Jan. 21, 1986, p. 44.

been installed by only a few forgers. 1/ New machinery to accomodate the exotic materials and "superalloys" utilized by this industry sector have also been installed. Electronic feedback mechanisms are being used, to a limited extent, to provide more precise control of presses, rolling mills, and other forming equipment. 2/

Raw materials utilized by the aerospace forging industry must be of "aircraft quality" and procedures in the manufacture of the forged components must be closely controlled in order to meet rigid aeronautical requirements. 3/ Aluminum, titanium, steel, or combinations thereof comprise most of the materials used in aircraft forgings. These parts, when used in static applications, are normally conventionally forged, using either cold or hot dies. In aircraft engine applications, because of the high temperatures involved and the need for strength and oxidation resistance, "superalloys" and powdered metals are commonly used for rotating parts. The term "superalloy" is generally used in reference to a complex, solid-state nickel- or iron-based alloy, further strengthened by a precipitation-hardening process. These alloys include the INCO (International Nickel Company) series, Astroloy, Waspaloy, Merle 76, and the Rene series of alloys. In 1981, approximately 10 percent of an aircraft engine's weight was accounted for by superalloys. However, superalloys represent almost 70 percent of the weight of the new high-thrust engines currently under development. 4/ Intense interest from the forging industry has also accelerated the production timetable for light-weight aluminum-lithium alloys to be forged for aerospace applications. 5/

Because of the use of aerospace strategic metals and their cost, isothermal and near isothermal forging processes are frequently utilized to manufacture aircraft engine parts. Industry sources indicate that in isothermal forging, the die is heated to the same temperature as the material to be formed and the processing is very slowly performed in a positive pressure chamber, with an inert gas (usually argon or nitrogen), or in a vacuum. The vacuum or inert gas atmosphere is necessary because the refractory metal dies needed to forge some aerospace alloys would oxidize rapidly in a normal atmosphere. This method allows a very precise (near net) forging to be produced, as the heat loss during processing is reduced, which improves the plastic deformation of the material during forming, resulting in very little unacceptable material that must be machined off. 6/ Near

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1/ "Forging Industry Pushes Improved Productivity Across a Wide Front: Through Partial Automation, Materials Improvements, Die-Making Gains and Better Process Controls," Forging Industry Association News Release, Jan. 29, 1986.

2/ "Six Technical Trends In Forging Reflect Industry's Continuing Stress on Improvements, Cost-Cutting Production Techniques and New Materials Development," Forging Industry Association News Release, Dec. 4, 1984.

3/ Forging Industry Association and the American Society for Metals, <u>Forging Handbook</u>, 1985, p. 275.

4/ Data provided by the Forging Industry Association, January 1986.

5/ Op. cit., Forging Industry Association News Release, Dec. 4, 1984.

6/ John McKeough, "Forging Savings," <u>American Metal Market - Aerospace Metals & Machines</u>, Mar. 15, 1982, and statement of Paul Haussman, Wyman-Gordon Corp., at the public hearing, Jan. 21, 1986, p. 41.

isothermal forging, sometimes referred to as hot die forging, is a process in which the die system is heated to within approximately 200 degrees (Fareinheit) of the material temperature. The forging process is then performed in atmospheric conditions, using nickel-based alloy dies. 1/ Isothermal and near-isothermal forgings offer several advantages over conventional forgings, including substantial materials savings and reduced machining costs, as well as reduced forging pressures and, in many cases, the replacement of multiple die operations with a single die. 2/ Impression die forging is the method most commonly used for nonengine aerospace forgings. Conventionally forged aircraft parts are characterized by excellent tensile strength and ductility but only modest fracture toughness. 3/ It is important to note, however, that industry officials assert that the material and forging methods used for airframe and engine parts vary considerably, depending on the aerospace manufacturer and the end use. Often, a combination of materials and/or processes is used to obtain the necessary grain structure and forging strength.

Advanced machinery for material processing has also been utilized for aerospace forgings. Hot isostatic pressing (HIP) is one of the newer superalloy powder consolidation processes. The powder metal is placed inside the HIP facility, heated, and subjected to pressure, which consolidates the powder. For some applications, hot isostatically pressed and heated parts can be used "as is." However, most often the HIP facility is utilized to produce superalloy powder preform shapes for subsequent hot die or isothermal forging. 4/

In recent years, efforts directed toward advanced and more cost-effective techniques for forging aerospace components have focused on precision or near net shape forgings. Advancements in state-of-the-art near net shape technology, sponsored by the Air Force Materials Laboratory and MANTECH programs, have resulted in significant product improvements. 5/ These advanced processes require expensive die materials, equipment, and preforms. Computer simulation has also recently been used to reduce costs and improve efficiency. This simulation allows the process designer to modify the die and preform geometry on the computer in order to obtain the desired metal flow (before the dies and preforms are prepared), and also lowers manufacturing costs and shortens lead times. 6/

1/ Ibid.

2/ "Forging Materials: Titanium Alloys," Forging Topics, 1979, p. 7.

3/ Ibid.

4/ "Forging Materials: Superalloys Powder Metals," Forging Topics, 1981, p. 10.

5/ Sanjay N. Shah and John McKeough, "Status of Near Net Shape Forging For Major Aerospace Applications," Technical paper for the American Society of Manufacturing Engineers, presented at the Near Net Shapes-I Conference, September 1982.

6/ S.I. Oh, J.J. Park, S. Kobayashi, and T. Altan, "Application of FEM Modeling to Simulate Metal Flow in Forging A Titanium Alloy Engine Disk," technical paper for the American Society of Mechanical Engineers, 1983, p. 1.

In some cases, large investment castings have replaced forgings in aerospace structural parts. Castings are now challenging wrought items in such areas as jet engine compressor shroud rings and vanes, and in selected rotating disc applications. 1/ Industry sources note that as casting techniques are improved, resulting in more consistent quality, a larger amount of aircraft assemblies will be made from castings to reduce cost. Cast structures are expected to be used in primary aircraft structural applications in 5 years and could replace 30 percent of current aircraft forging applications in 10 years. 2/ Also, the increased usage of composites (kevlar, graphite-expoxy, and glass-fibre reinforced plastics) and diffusion bonding, in order to reduce weight and increase fuel efficiency, have led to a minor decrease in metal forgings in secondary structural applications. However, because of the complex nature of airframe and engine design, and the long lead times involved, these substitutions have occurred only to a small extent. 3/ Industry sources note that in areas where there is a critical need for strength, durability, and/or high temperature resistance, there are few current substitutes for forgings. In this regard, research is being performed in the use of ceramics. In February 1986, the National Bureau of Standards, in cooperation with the U.S. Energy Department and research organizations in West Germany and Sweden, is developing an international consensus on standardized ceramic material for advanced engine hot sections. 4/ Industry sources indicate, however, that this technology is believed to be at least a decade away from commercial application.

Other sectors

The basic technology in all forging sectors other than aerospace has changed little in the last decade. This applies not only to the U.S. forging industry, but also to forging industries throughout the world. For example, many of the hammers currently in use are over 20-years old, yet the productivity levels of these hammers are, for certain forgings, just as high as newer hammers or presses less than 2-years old.

Although presses are more productive than hammers on most higher volume forgings, the basic technology of a press has also changed little during the last decade. For example, a forge shop may use a press to produce a large number of crankshafts for an original equipment diesel engine manufacturer, but as a result of the very large investment needed for a new press, the shop will utilize an older hammer to produce low volume forgings for the same customer.

1/ Edward Argo, "Castings Now Challenge Wrought Aerospace Items," American Metal Market, Sept. 5, 1985.

2/ Harry E. Chandler, "Emerging Trends in Aerospace Materials and Processes," Metal Progress, April 1984, pp. 23-24.

3/ The Analytic Sciences Corp., for the Federal Emergency Management Agency, Cost Effective Options to Enhance U.S. Industries Mobilization Potential, Sept. 28, 1984, pp. 5-39.

4/ "Industry Observer," Aviation Week & Space Technology, Feb. 3, 1986, p. 13.

Most of the improvements in forging technologies have not been the hammers or presses themselves but improvements in raw materials, die making, material handling, computer-aided processing, and other auxiliary equipment and processes. One of the most significant technology developments in worldwide forging operations during the last 5 to 10 years has been the incorporation of computer-aided-design and -manufacturing (CAD-CAM) processes. 1/ According to discussions with U.S. and European forging companies, CAD-CAM is now only being used principally by the largest forgers. During the Commission's hearing, a representative of the domestic industry testified that CAD/CAM is currently widespread throughout his company and that there is great interest within the industry. As a result of heavy startup costs, however, CAD/CAM is currently limited to the larger forgers, as the cost of entry is a major barrier for some of the smaller companies.

Computer-aided-design systems have been used principally to aid in the design and production of the dies used in the hammers and presses in both the United States and in foreign countries. One of the major expenses of the forging process is the cost of tooling and designing dies. 2/ Formerly, a die design would require days or weeks to develop, and would also require a series of drawings by the designer. With the new system, a designer can use a computer which projects the image on a screen and make minor design alterations in minutes instead of days. Thus, the forger can not only decrease the cost of developing a new die, but also respond to customer requests for new dies or minor changes to the old dies much more rapidly.

Robots are used almost exclusively for material handling in forging plants. For example, many workers who previously manually moved large forgings, such as truck crankshafts from a preform operation to a press and then to a trimming press, have been replaced by robots. Therefore, it appears that robots are currently used only in large forge shops that produce limited products in high volumes. Robots, like presses, often cannot be justified when there are low production runs of many divergent size products.

The use of micro-alloyed steel has been a major development in raw material technology. Micro-alloyed steels are carbon steels with low content of vanadium, niob, or nitrogen. 3/ By using micro-alloyed steel, a forging is not required to be heat-treated after it cools, but is subject to controlled cooling directly out of the press. This results in increased mechanical properties and fatigue strength to a level that formerly could be achieved only with additional heat treating. Micro-alloyed steel was developed in Europe and is used very little in the United States. This type of steel is used rather extensively by some European forgers because their customers request it, but according to one U.S. forger, very few U.S. customers request it. 4/ The principal reason for not using micro-alloyed steel in the United

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1/ Hearing before the U.S. International Trade Commission, Jan. 21, 1986, pp. 46-47.

2/ Posthearing brief submitted by Justin M. McCarthy, Manager of Marketing, Unit Drop Forge Company, Jan. 24, 1986, p. 2.

3/ Publication from Gerlach-Werke GMBH, Homburg (SAAR), West Germany.

4/ Hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 55.

States appears to be its very high cost to the forgers. This additional cost would have to be passed on to the customers, thus any savings realized by not heat treating the forging would be more than offset by the higher material costs. 1/

Some of the other developments in the forging sector that have affected technology are flashless preforms, near-net shape, and precision forging. All of these techniques have the ultimate goal of reducing the amount of final machining of the forged product. The closer a rough forging is to the final shape used by the ultimate consumer, the less additional work, such as machining and polishing, needs to be done. Since these processes are labor intensive, it is to the benefit of the high-labor cost countries to forge the product as close as possible to the final shape. Based on conversations with both large and small forgers located in Europe, it appears as though both European and Japanese forgers have an advantage over domestic forgers in producing near-net shape or precision forgings in the low-value area. 2/

In addition to the previously mentioned developments, the U.S. and foreign forging industries are both using statistical process/quality control methods, the latest numerically controlled machinery, and conducting various types of studies regarding new material usuage. In joint efforts with material suppliers, U.S. forgers are currently studying ladle metallurgy, desulfurization, inclusion-shape control, and rare earth addition. 3/ In Europe, energy costs are relatively high, and forgers there have worked to reduce energy usuage by using zone induction heating and furnaces with automated control of the temperature and gas mixture. Many European forgers now use mostly induction heating equipment, but they also heat-treat using formerly wasted forging heat and utilize reciprocative or regenerative heat recovery methods.

The World Market

International demand for all forged products is dependent on the level of business activity in transportation, construction, and other industrial sectors. The economic downturn of these industries during 1982-83 adversely affected the level of output of the world's forging manufacturers.

Drop-forging 4/ production in 10 major countries reflected the significant impact of the recession, particularly in the United States. Drop-forging production declined by 12 percent (544,600 tons) in 1982 to 3.9 million tons, the greatest portion (308,200 tons) of which was absorbed by the U.S. industry (table 1). World drop-forging production is believed to have resumed an upward trend in 1984 as a result of the economic recovery experienced by many end markets, but probably never attained the 1981

1/ Ibid.
2/ Interviews with foreign forgers by USITC staff, November 1985.
3/ Post hearing brief submitted by the Forging Industry Association, Jan. 29, 1986, p. 8.
4/ Drop-hammer manufacturing method.

production level. Drop- forging production is believed to account for 70 to 80 percent of total forgings production in most major producing countries.

Japan is one of the leading world producers of ferrous and nonferrous drop forgings, with 1.5 and 1.4 million tons of production in 1981 and 1982, respectively, representing 35 and 37 percent, respectively, of reported world production. Japanese drop forging production is believed to have risen slightly in 1984.

The United States is also a major world producer of drop forgings, producing 867,900 tons in 1984. The recession of 1982-83 appears to have affected the U.S. forging industry to a greater extent than those of the other countries exhibited in figure 1, since U.S. production of drop forgings declined by 35 percent during 1981-83 to 612,200 tons compared with a range of 1 to 25 percent for other producing countries.

West German production of drop forgings fell by 8 percent during 1981-83 to 727,700 short tons before increasing in 1984 to an estimated 743,000 tons. West Germany was the third largest producer of drop forgings in 1984. Other principal world producers include the Soviet Union, reputed to be the world's largest producer (no production data are available), Korea, Brazil, Italy, and the United Kingdom.

Comparable data for other segments of the world forging industry, such as open die production, are not available. As indicated earlier, the other segments of the industry are believed to represent only 20 to 30 percent of world production.

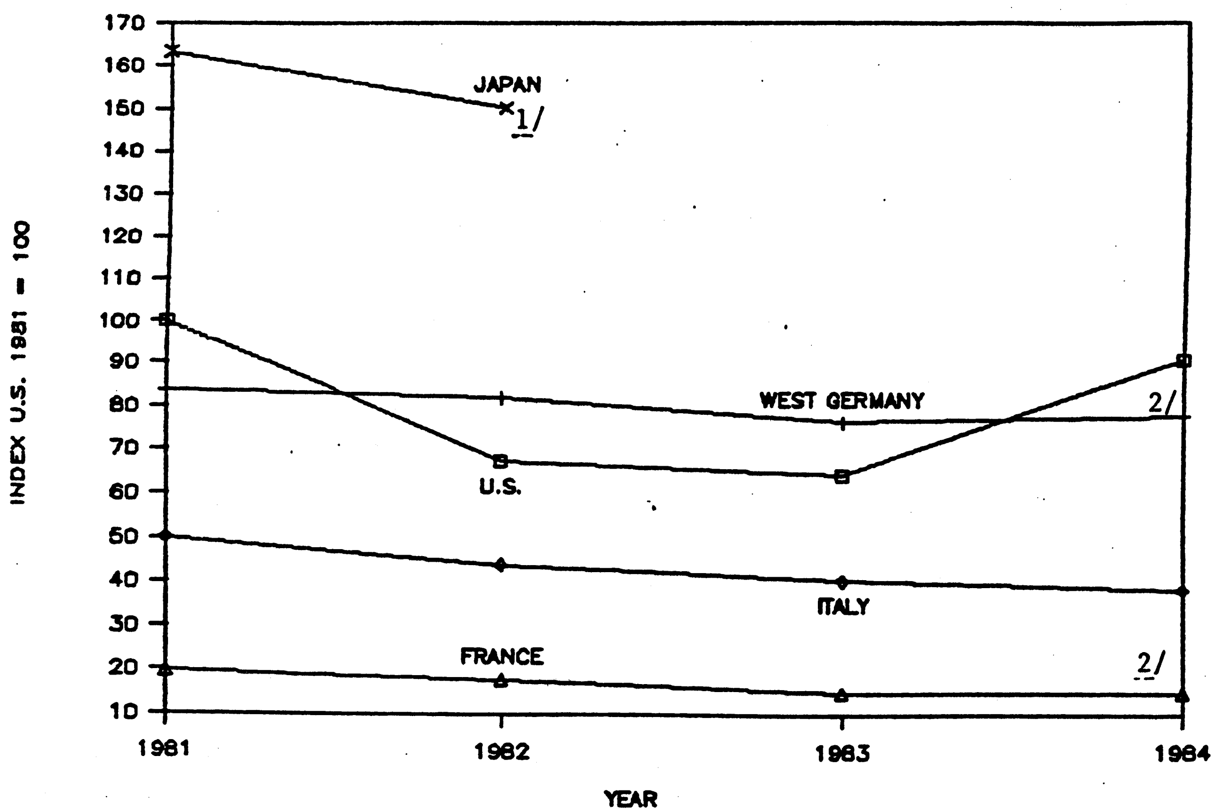
Table 1.--Drop forgings: Production by specified countries, 1981-84

Country	1981	1982	1983	1984
	1,000 tons			
Belgium	15.5	15.6	1/	1/
Brazil	45.7	34.2	35.7	56.1
France	187.9	169.1	141.3	2/ 141.3
Italy	472.5	415.8	384.7	365.4
Japan	1,547.0	1,423.0	1/	1/
Spain	107.8	121.6	1/	1/
Sweden	63.7	57.6	63.0	1/
United Kingdom	237.3	219.8	222.7	1/
United States	947.4	639.2	612.2	867.9
West Germany	793.0	777.3	727.7	2/ 743.0
Total	4,417.8	3,873.2	1/	1/

1/ Not available.
2/ Estimated.

Source: Data collected at the 11th International Drop Forging Congress, the 1984 Euroforge Presidents' Meeting, the Forging Industry Association, and a report from the U.S. Consulate, Sao Paulo, January 1986, except as noted.

Figure 1.--All forged products: Indexes of world production of drop forgings, by specified countries, 1981-84



1/ Data for 1983-84 are not available.
2/ Estimated.

Source: Data collected at the 11th International Drop Forging Congress, the 1984 Euroforge Presidents' Meeting, and the Forging Industry Association.

The U.S. Industry and Major Foreign Competitors

United States

The U.S. forging industry consists of approximately 400 to 450 forges, approximately 15 percent of which produce nonferrous forgings, according to the 1982 Census of Manufactures. These forges are concentrated in the heavy industrial Great Lakes region and California, with a secondary concentration in the South Central States. Ohio, Illinois, and Michigan accounted for 38 percent of all steel forging establishments in 1982 and are believed to have maintained a comparable share through 1985. California accounted for 41 percent of all nonferrous forging establishments in the comparable period. Employment in the industry totaled about 50,000 workers in 1982 and is believed to have declined since that time because of plant closures (see app. D) and production cutbacks. Two steel companies are known to have closed 3 forges during 1981-85; most steel companies which operated forges closed these plants prior to 1981. Company mergers, cross investments, and joint ventures within the forging industry during the period were minimal. Nearly 60 percent of the domestic forgers employed more than 20 workers. Industry shipments amounted to about $4.0 billion in 1982, 73 percent of which represented ferrous forgings.

Approximately half of the total forgers employ the hot impression die manufacturing method; another 40 companies are primarily cold impression die forgers. Open die manufacturers number about 80 to 100 companies, and rolled ring forgers total about 25 firms. These firms produce a wide variety of products, ranging in size from small desk calculator parts weighing less than an ounce to large structural components weighing many tons.

Forges generally fall into two categories: production plants, which manufacture large quantities of a limited range of forgings; and job shops, which concentrate production on a number of small orders. Commercial (or custom) plants then sell their customized forgings to others, whereas captive plants manufacture for their company's internal needs. Most captive producers manufacture forgings for the automotive industry.

Production, capacity, and employment.--Despite the recovery in the automotive and construction markets, overall production has not increased proportionally. U.S. production of forged products reported by questionnaire respondents declined during 1982-83 from the previous year's level before resuming growth rates ranging between 23 and 26 percent in all sectors in 1984 (table 2). The decline was most pronounced in the steel sector, where production dropped by 31 percent, compared with 26- and 21-percent declines in the aluminum and other products sectors, respectively. Production levels through the first eight months of 1985 reflected continued growth for aluminum forgings whereas forged steel and other products are lagging the August 1984 benchmarks.

According to questionnaire respondents, original equipment manufacturers, such as those in the construction equipment and machine tool industries, have increased their purchases of imported rough and finished forgings and assemblies, have lost market share to imported merchandise, have not sustained export market growth, or have moved manufacturing facilities abroad, all to the detriment of domestic ferrous and nonferrous forgers seeking to reestablish their prerecession production and profitability levels. Although the Commission was unable to gather specific information concerning the magnitude of offset transactions (a range of industrial and commercial

Table 2.--U.S. forging industry: U.S. producers' practical capacity, production, and capacity utilization, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August 1984	January-August 1985
	Practical capacity					
Forged steel products short tons--	3,178,356	3,087,343	3,071,485	3,097,361	2,458,501	2,508,767
Forged aluminum products 1,000 pounds--	60,743	60,959	64,446	71,054	57,366	59,142
Other forged products 1,000 pounds--	100,134	102,974	106,112	114,959	81,908	87,129
All forged products short tons--	3,258,795	3,169,310	3,156,764	3,190,368	2,528,138	2,581,903
	Production					
Forged steel products short tons--	1,779,294	1,244,429	1,220,287	1,501,365	1,019,609	951,718
Forged aluminum products 1,000 pounds--	34,791	26,402	25,909	32,553	20,567	24,745
Other forged products 1,000 pounds--	67,929	54,340	53,966	67,611	41,807	40,969
All forged products short tons--	1,830,654	1,284,800	1,260,225	1,551,447	1,050,796	984,575

Table 2.--U.S. forging industry: U.S. producers' practical capacity, production, and capacity utilization, 1981-84, January-August 1984, and January-August 1985--Continued

Item	1981	1982	1983	1984	January-August 1984	January-August 1985
	Capacity utilization					
Forged steel products percent--	56.0	40.3	39.7	48.5	41.5	37.9
Forged aluminum products percent--	57.3	43.3	40.2	45.8	35.9	41.8
Other forged products percent--	67.8	52.8	50.9	58.8	51.0	47.0
All forged products percent--	56.2	40.5	39.9	48.6	41.6	38.1

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

practices generally tied to the purchase of military-related exports), respondents indicate that forgers producing for the U.S. aerospace industry have encountered difficulties involving such arrangements. In addition, whereas forgings for the U.S. defense industry generally have been domestically procured, increasing levels of foreign purchases have occurred under dual sourcing procedures.

Reported practical capacity for forged steel products remained stable during 1981-84 at about 3.1 million short tons. Reported capacity for aluminum and other forged products rose by 17 and 15 percent, respectively, during the period to 71.1 and 115.0 million pounds in 1984. Two California forgers in each of these sectors expanded capacity during 1983-84 in anticipation of increased demand, particularly from the aerospace and defense-related industries. During 1981-84 operating rates declined in all three product sectors as production fell and/or capacity expanded while production experienced no net growth (table 2). Forged aluminum products is the only segment that demonstrated a utilization rate during the first 8 months of 1985 higher than that of 1984.

Paralleling the production decline experienced by these producers during the economic downturn of 1982-83, the level of employment in the forging establishments of all questionnaire respondents fell by 26 percent to 38,570 workers during 1981-83, before rising slightly to 40,287 workers in 1984 (table 3). Production and related workers accounted for 73 to 77 percent of total employees reported during the period and showed a 25-percent reduction during 1981-83 before increasing to 30,118 workers in 1984. Principally as a result of this significant employment decline and improved productivity in all three sectors, man-hours worked and wages paid fell to their lowest levels of the period in 1983 and increased only slightly in 1984, when direct and indirect labor costs accounted for about 27 percent of net sales. 1/ Average hourly wage rates (excluding benefits) rose overall by 6 percent to $15.67 in 1984.

Financial experience of U.S. producers.--Reflecting both the production downturn and reported suppressed or lowered prices for these products, total net sales of reporting producers of forged products declined by 36 percent during 1981-83 to $2.8 billion, before rising to $3.2 billion in 1984 (table 4). Approximately 85 percent of net sales in 1984 amounted to the cost of goods sold. Of this total, net materials cost amounted to 34 percent; labor cost, 27 percent; and other costs (such as maintenance and repair, fixed expenses, and supervisors' salaries), 25 percent, with a net inventory loss of 1 percent. 2/ The respondents experienced declining profits during 1981-83, falling 60 percent to $176.4 million in 1983, before rising slightly to $187.3 million in 1984. Net operating profits declined annually during the period, from 10.0 percent of net sales in 1981 to 5.9 percent in 1984, and 3.9 percent during January-August 1985.

While the industry was profitable overall during 1981-84, the three sectors differed markedly in their financial status. Reflecting the significant losses recorded by two major domestic aluminum forgers, the aluminum sector recorded the only losses of the U.S. forging industry during 1982-84. Contrary to the other industry segments, which continued to exhibit declining profit ratios, the net profit to sales ratio for the aluminum products sector rose in January-August 1985 to 1.6 percent.

Reflecting the specialized nature of other forged products, their more stable customer base, and the ability to sustain price increases, this segment remained the most profitable during 1981-84, with the highest net operating ratios in the industry (16.3 to 22.1 percent of net sales). The steel sector operated at a profit ranging between 2.6 and 8.2 percent during the period.

The fortunes of the forging industry did not necessarily mirror that of their primary markets (table 5). The other forged products sector recorded profitability several times higher than the aerospace industry, its major market. The return on aluminum forgings, however, was far below those of the aerospace and automotive industries. The return on sales of steel forgings fluctuated during the period, while the automotive industry increased its returns each year and the construction equipment sector suffered continued losses.

1/ Posthearing brief, Forging Industry Association, Jan. 29, 1986, p. 6.
2/ Posthearing brief, Forging Industry Association, Jan. 29, 1986, Exhibit C.

Table 3.—U.S. forging industry: Average number of employees and production and related workers employed in the forging industry, man-hours worked, wages paid, and productivity, by types of forge, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August—	
					1984	1985
Steel:						
Number of employees and wages paid:						
Production and related workers	24,778	19,534	16,677	17,858	17,880	17,160
Man-hours worked 1,000 hours	51,035	37,866	33,541	37,030	25,080	24,319
Wages paid 1,000 dollars	771,408	679,814	586,460	590,742	399,001	401,929
Productivity—hours/ton	28.7	30.4	27.5	24.7	24.6	25.6
Aluminum:						
Number of employees and wages paid:						
Production and related workers	7,880	8,446	8,383	8,314	6,307	5,989
Man-hours worked 1,000 hours	3,183	2,279	2,189	2,688	1,765	1,893
Wages paid 1,000 dollars	44,495	31,652	32,198	39,373	25,878	28,465
Productivity—hours/1,000 pounds	9.1	8.6	8.4	8.3	8.6	7.7
Other:						
Number of employees and wages paid:						
Production and related workers	5,606	4,851	3,793	3,946	3,929	4,052
Man-hours worked 1,000 hours	10,715	9,110	6,927	7,770	5,158	5,451
Wages paid 1,000 dollars	140,597	128,378	98,894	114,002	75,787	81,333
Productivity—hours/1,000 pounds	15.8	16.8	12.8	11.5	12.3	13.3
Total:						
Number of employees and wages paid:						
All persons	52,137	42,820	38,570	40,287	40,189	39,845
Production and related workers	38,264	32,831	28,853	30,118	28,116	27,201
Man-hours worked 1,000 hours	64,933	49,255	42,657	47,488	32,003	31,663
Wages paid 1,000 dollars	956,500	839,844	717,552	744,117	500,666	511,727
Productivity—hours/ton	35.5	38.3	33.8	30.6	30.5	32.2

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 4.—U.S. forging industry: U.S. producers' net sales and net operating profit or (loss) on their operations producing forged products, by types of forge, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August— 1984	January-August— 1985
Forged steel products:						
Net sales——1,000 dollars—	3,206,471	2,507,092	2,087,318	2,430,480	1,637,157	1,559,454
Net profit or (loss) 1,000 dollars—	262,187	64,586	54,095	93,180	76,481	31,441
Ratio of net profit or (loss) to net sales percent—	8.2	2.6	2.6	3.8	4.7	2.0
Firms reporting losses number—	15	39	40	32	32	39
Forged aluminum products:						
Net sales——1,000 dollars—	264,172	216,931	128,502	155,279	99,966	113,893
Net profit or (loss) 1,000 dollars—	8,345	(3,368)	(5,994)	(1,891)	(2,121)	1,824
Ratio of net profit or (loss) to net sales percent—	3.2	(1.6)	(4.7)	(1.2)	(2.1)	1.6
Firms reporting losses number—	4	5	6	6	6	4
Other forged products:						
Net sales——1,000 dollars—	931,228	792,769	580,734	589,370	399,059	404,401
Net profit or (loss) 1,000 dollars—	169,960	165,880	128,267	95,983	62,031	47,413
Ratio of net profit or (loss) to net sales percent—	18.3	20.9	22.1	16.3	15.5	11.7
Firms reporting losses number—	4	4	5	6	4	5
Total:						
Net sales——1,000 dollars—	4,401,871	3,516,792	2,796,554	3,175,129	2,136,182	2,077,748
Net profit or (loss) 1,000 dollars—	440,492	227,098	176,368	187,272	136,391	80,678
Ratio of net profit or (loss) to net sales percent—	10.0	6.5	6.3	5.9	6.4	3.9
Firms reporting losses number—	18	41	44	35	33	41

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 5.--U.S. aerospace, 1/ automotive, 2/, construction equipment, and forging industries: Ratio of net operating profit or (loss) to net sales, 1981-84

Item	1981	1982	1983	1984
Ratio of net profit or (loss) to net sales:				
Aerospace----------percent--:	4.4	3.3	3.5	4.1
Automotive------------do----:	(1.2)	0.3	4.5	6.1
Construction equipment-----------do----:	7.6	(3.1)	(6.7)	(6.8)
Forgings--------------do----:	10.0	6.5	6.3	5.9
Forged steel products percent--:	8.2	2.6	2.6	3.8
Forged aluminum products percent--:	3.2	(1.6)	(4.7)	(1.2)
Other forged products percent--:	18.3	20.9	22.1	16.3

1/ Includes aircraft and spacecraft only.
2/ Data for worldwide operations.
3/ Estimated by the staff of the U.S. International Trade Commission.

Source: Data supplied from Automotive News, the Aerospace Industries Association of America, Standard and Poor's, and data submitted in response to the questionnaires of the U.S. International Trade Commission.

Capital expenditures and research and development expenditures.--Respondents indicated that funds for capital expenditures, particularly in the steel sector, were lacking or unjustifiable because of the decline in production, earnings, and product prices, and the unfavorable outlook for increased market share and business. As a result, capital expenditures on domestic facilities by U.S. producers during 1981-84 fell by 53 percent to $110.5 million, 3.5 percent of net sales (table 6).

Capital expenditures in the aluminum sector fluctuated between $2.7 million in 1983 (2.1 percent of net sales) and $18.3 million (6.9 percent) in 1981, representing the lowest percentages of net sales of all sectors during 1982-84. In both the steel and other forged products segments, expenditures peaked in 1982 at 7.1 percent of net sales before falling to period lows of 3.5 and 3.6 percent, respectively, in 1984. All sectors of the industry increased investments in capital expenditures during January-August 1984/85, with increases ranging from 9 percent for the aluminum sector to 29 percent for other forged products.

Research and development expenditures have also suffered from declining industry profitability and an uncertain economic future. Research and development expenditures for all forging sectors fluctuated during 1981-84 between a low of $41.0 million (1.2 percent of net sales) in 1982 to a peak of

Table 6.—U.S. forging industry: U.S. producers' capital expenditures on domestic facilities, by types of forge, 1981-84, January-August 1984, and January-August 1985

(In thousands of dollars)

Item	1981	1982	1983	1984	January-August— 1984	January-August— 1985
Facilities in the United States:						
Forged steel products	179,986	178,665	85,846	85,361	54,249	55,940
Forged aluminum products	18,338	6,410	2,710	3,918	2,614	2,838
Other forged products	35,418	56,198	35,569	21,250	11,020	14,244
Total	233,742	241,273	124,125	110,529	67,883	73,022

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

$106.7 million (3.8 percent) in 1983 (table 7). The aluminum sector invested less than one percent of their net sales in research and development during each year of the period, whereas the other forged products sector dedicated increasing percentages of its net sales to this effort. Investment in research and development by the steel sector fluctuated between 0.8 and 4.2 percent of net sales during 1981-84. Respondents indicated that efforts are being made to develop new materials, such as aluminum-lithium alloys and metal-matrix composites; to improve manufacturing processes with precision or near-net-shape forging, powder metallurgy, and CAD/CAM; and to develop new manufacturing techniques, in such areas as metalworking, flash reduction, and welding.

Table 7.--U.S. forging industry: U.S. producers' research and development expenditures, by types of forge, 1981-84, January-August 1984, and January-August 1985

(In thousands of dollars)

Type	1981	1982	1983	1984	January-August--	
					1984	1985
Steel	45,664	20,021	87,011	43,713	15,487	32,273
Aluminum	430	790	661	1,124	646	894
Other	18,773	20,189	18,996	19,148	13,605	14,401
Total	64,867	41,000	106,668	63,985	29,738	47,568

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers' shipments and exports.--The quantity of U.S. producers' shipments of forged steel products declined by 13 percent, from 1.6 million tons in 1981 to 1.4 million tons in 1984, and the quantity of U.S. producers' shipments of forged aluminum products and other forged products declined 2 percent and 10 percent, respectively, during 1981-84 to 31.2 million pounds and 56.4 million pounds in 1984. The decline in shipments of certain nonferrous products was less severe than the decline in ferrous products as a result of the increase in defense expenditures (e.g., aerospace) in recent years. The value of U.S. producers' shipments of all forged products decreased by 18 percent from $3.8 billion in 1981 to $3.1 billion in 1984 as shown in table 8; shipments generally paralleled developments in the U.S. market during the period. Unit values for forged steel products, forged aluminum products, and other forged products fluctuated downward during 1981-84, peaking at $1.00, $5.05, and $14.22 per pound, respectively, in 1982.

Exports of U.S.-produced products accounted for between 4 and 5 percent of domestic shipments during 1981-84. During 1982-84, exports were affected by the high value of the U.S. dollar relative to other foreign currencies and the worldwide economic recession. The value of exports of forged products fell by 42 percent from $183.0 million in 1981 to $106.5 million in 1983, then

Table 8.—U.S. forging industry: U.S. producers' domestic shipments, by type of forge, 1981-84, January-August 1984, and January-August 1985

Type	1981	1982	1983	1984	January-August— 1984	January-August— 1985
	Quantity					
Forged steel products short tons	1,628,233	1,163,233	1,142,951	1,421,407	963,312	890,839
Forged aluminum products 1,000 pounds	31,659	25,307	26,107	31,178	19,863	24,168
Other forged products 1,000 pounds	62,531	50,406	47,847	56,438	37,850	36,198
	Value					
Forged steel products 1,000 dollars	2,880,385	2,320,807	2,086,082	2,426,380	1,636,000	1,550,111
Forged aluminum products 1,000 dollars	156,588	127,919	120,515	148,140	94,232	108,205
Other forged products 1,000 dollars	769,054	716,918	558,924	564,672	385,785	370,535
Total do	3,806,027	3,165,644	2,765,521	3,139,192	2,116,017	2,028,851
	Unit value					
Forged steel products per pound	$0.88	$1.00	$0.91	$0.85	$0.85	$0.87
Forged aluminum products per pound	4.95	5.05	4.62	4.75	4.74	4.48
Other forged products per pound	12.30	14.22	11.68	10.01	10.19	10.24

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

increased to $119.3 million in 1984 (table 9). Exports of forged steel products accounted for an increasing share of total exports of all forged products during 1981-84.

Major foreign competitors

Major foreign competitors of the U.S. forging industry are Canada, Italy, Japan, the United Kingdom, and West Germany. In recent years, however, competition has increased from Brazil and Korea, as well as other newly industrialized countries hoping to increase sales to the U.S. market. Many forges in developed countries have seen their domestic markets shrink because of a contraction in demand and product substitution, hence, many have had to look to foreign markets to meet capacity utilization goals. This phenomenon has increased import penetration within Europe as well as in the U.S. market.

Brazil.--The establishment of the Brazilian forging industry in the late 1950's coincided with the growth of the Brazilian motor vehicle industry, on which the Brazilian forging industry is greatly dependent. Many of these original forges were the joint ventures of Brazilian nationals and European or American companies. Currently, about 20 percent of the 54 known Brazilian forges have some degree of foreign ownership; one forge is state owned.

Total annual capacity of the Brazilian forging industry during 1981-84 ranged between 325,000 to 350,000 short tons, with utilization rates fluctuating between a low of 53 percent in 1983 and a peak of 90 percent in 1981. Production of the Brazilian industry, which is dominated by closed die forgings used predominantly in the motor vehicle industry, fell 41 percent during 1981-83 to 179,147 metric tons before rising 60 percent to 285,850

Table 9.—U.S. forging industry: U.S. producers' export shipments, by types of forge, 1981-84, January-August 1984, and January-August 1985

Type	1981	1982	1983	1984	January-August—	
					1984	1985
Forged steel products 1,000 dollars—	93,602	78,828	63,392	71,294	45,106	49,056
Forged aluminum products 1,000 dollars—	7,871	6,922	6,432	7,892	6,128	4,560
Other forged products 1,000 dollars—	81,564	40,939	36,725	40,138	21,965	38,515
Total do—	183,037	126,689	106,549	119,324	73,199	92,131

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

metric tons in 1984 (table 10) and over an estimated 300,000 metric tons in 1985. The 1981-83 decline in production largely reflects the fortunes of the Brazilian motor-vehicle industry. The 1984 turnaround in forgings production coincided with the upswing in business and industrial activities in Brazil.

Table 10.--Brazilian forging industry: Production of open die, closed die, and other forged products, 1981-84 and January-June 1985

(In metric tons)

Item	1981	1982	1983	1984	January-June 1985
Open die	38,047	51,371	31,394	52,531	28,000
Closed die	220,450	157,496	123,772	204,182	106,414
Other	45,304	38,298	23,981	29,137	14,011
Total	303,801	247,165	179,147	285,850	148,425

Source: U.S. Department of State telegram, U.S. Consulate, Sao Paulo, January 1986.

Conservative estimates of production for three specific forged metal products--crankshafts, connecting rods, and axles--are supplied in table 11.

Table 11.--Brazilian forging industry: Production of crankshafts, connecting rods, and axles, 1980-84

(In units)

Product	1980	1981	1982	1983	1984
Crankshafts	230,000	212,000	190,000	152,000	202,000
Connecting rods	5,223,974	3,583,508	3,909,008	4,005,381	3,916,360
Axles	1,453,972	955,632	972,684	985,359	988,418

Source: U.S. Department of State telegram, U.S. Consulate, Sao Paulo, January 1986.

Average employment in this industry declined during the recession but reached record levels during January-June 1985, as shown in the following tabulation:

Year	Employment (number)
1981	17,557
1982	15,034
1983	14,532
1984	19,568
January-June 1985	21,112

Hourly wages for production and related workers in January 1986 ranged from 14,600 cruzeiros ($1.27) to 42,481 cruzeiros ($3.69), depending upon an employee's seniority, job description, labor contract, and other factors. According to Brazilian industry sources, these wages are among the best in the country. The Brazilian industry recently experienced a 53-day strike by certain metal workers in the second quarter of 1985. This labor unrest is expected to continue in 1986 in the form of strikes and work-to-rule actions. Despite rising hourly wage rates partially attributable to these labor activities, low labor costs still constitute the largest single comparative advantage of the Brazilian industry.

The Brazilian forging industry has traditionally been profitable although profit margins have declined during economic downturns. Price controls enacted by the Brazilian Government to combat inflation reportedly restrained such profits, which averaged about 5 percent of sales in 1985 for the larger firms connected to the auto industry. Industry sources indicate that this profit margin, although greater than those of previous years, makes additional investment in research and development and capital expenditures difficult to justify.

About 5 percent of the total sales of Brazilian forges are dedicated to research and development expenditures, with larger firms investing as much as 10 percent. Brazilian industry sources indicate that the Brazilian motor-vehicle industry's reliance on American and European designs lessens the need for high levels of research and development expenditures. Plants are considered to be state-of-the-art and receptive to incorporation of new technologies.

The recession also affected the Brazilian industry's ability to implement capital improvements, many of which were cancelled or postponed. Although market conditions rebounded during 1984-85, industry investment in new plant and equipment has stalled for four primary reasons: (1) capacity underutilization in several of the past five years; (2) low returns on investment; (3) uncertainties over the durability of the economic recovery; and (4) the use of artificial exchange rates by the Government which make long-term planning for overseas marketing difficult.

The United States was Brazil's leading export market for forged products in 1984, followed by Algeria. Brazilian exports of forged products, which are not separately classified in Brazilian export statistics, are estimated to have accounted for about 15.5 percent (44,300 metric tons) of Brazilian production in 1984. The Brazilian export effort has benefited in recent years from the Brazilian Government's competitive exchange-rate policy, reduced domestic demand during 1981-83 (which encouraged expansion to overseas markets), and price controls on domestic sales.

Brazilian exports to the United States fell by an estimated 24 percent during the recession to 19,711 metric tons ($26.5 million) in 1983 before increasing to 31,520 metric tons ($40.1 million) in 1984 (table 12). Exports through June 1985 totaled 15,501 metric tons ($17.0 million) and were expected to equal total-year-1984 exports by yearend 1985.

Unfinished forged products (largely closed die) accounted for about 60 percent of exports to the United States during 1981-84, except for the year 1982 when these products represented 51 percent of the total. During January-June 1985, these exports accounted for 68 percent of total Brazilian exports of forged products. As shown in table 12, these forgings are generally of lower value than comparable finished forgings as a result of the lower level of labor and finishing procedures required.

The Brazilian industry's prosperity can be partially attributed to its insulation from foreign competition. The principal instrument of this policy is the law of similars, which bans the importation of manufactured goods that are "similar" to items that are, or could be, produced in Brazil. This is especially stringent for purchases made by the public sector, which is, in effect, required to "Buy National."

Although the national and regional governments provide many export/ marketing incentives and subsidy programs, the 54 Brazilian forges, all of which are eligible for these plans, do not directly participate in any of these programs. In addition to the law of similars, other import restrictions implemented by the Brazilian Government include: (1) foreign financing of imports valued over $100,000; (2) taxing financial operations of firms that purchase foreign exchange for purposes of importing goods and services; (3) import ceilings for purchases made by private and public companies; (4) priority treatment of import program applications from firms with BEFIEX 1/ contracts or other export promotion or energy substitution programs; and (5) a minimum tariff of 37 percent applied to most forged products.

1/ See the section on foreign government programs affecting competition in the U.S. market for a discussion of the BEFEIX program.

Table 12.--Brazilian forging industry: Exports of forged products to the United States, 1981-84 and January-June 1985

Product	1981	1982	1983	1984	January-June-- 1985
	Quantity (metric tons)				
Unfinished forged products:					
Open die	0	0	0	0	0
Closed die	15,035	10,628	11,665	19,237	10,478
Other	680	467	0	0	0
Total	15,715	11,095	11,665	19,237	10,478
Finished forged products:					
Open die	1,983	4,009	2,401	3,945	1,767
Closed die	2,341	1,425	1,581	2,638	629
Other	6,012	5,234	4,064	5,700	2,627
Total	10,336	10,668	8,046	12,283	5,023
All forged products:					
Open die	1,983	4,009	2,401	3,945	1,767
Closed die	17,376	12,053	13,246	21,875	11,107
Other	6,692	5,701	4,064	5,700	2,627
Total	26,051	21,763	19,711	31,520	15,501
	Value (1,000 dollars)				
Unfinished forged products:					
Open die	-	-	-	-	-
Closed die	21,766	16,431	17,033	25,708	12,844
Other	946	463	-	-	-
Total	22,712	16,894	17,033	25,708	12,844
Finished forged products:					
Open die	1,553	3,828	1,329	2,124	927
Closed die	6,594	5,729	5,417	8,502	1,397
Other	7,067	4,951	2,682	3,758	1,829
Total	15,214	14,508	9,428	14,384	4,153
All forged products:					
Open die	1,553	3,828	1,329	2,124	927
Closed die	28,360	22,160	22,450	34,210	14,241
Other	8,013	5,414	2,682	3,758	1,829
Total	37,926	31,402	26,461	40,092	16,997

Table 12.--Brazilian forging industry: Exports of forged products to the United States, 1981-84 and January-June 1985--Continued

Product	1981	1982	1983	1984	January-June-- 1985
	Unit value (per metric ton)				
Unfinished forged products:					
Open die	-	-	-	-	-
Closed die	$1,448	$1,546	$1,460	$1,336	$1,226
Other	1,391	991	-	-	-
Average	1,445	1,523	1,460	1,336	1,226
Finished forged products:					
Open die	783	955	554	538	525
Closed die	2,817	4,020	3,426	3,223	2,221
Other	1,175	946	660	659	696
Average	1,472	1,360	1,172	1,171	827
All forged products:					
Open die	783	955	554	538	525
Closed die	1,632	1,839	1,695	1,564	1,282
Other	1,197	950	660	659	696
Average	1,456	1,443	1,342	1,272	1,097

Source: U.S. Department of State telegram, U.S. Consulate, Sao Paulo, January 1986.

In many instances, such as a pre-approved drawback arrangement, import restraints can be avoided. Under this arrangement, an imported forging would be allowed if it were to be incorporated into a higher value assembly to be exported.

Canada.--The Canadian forging industry consists of about 40 firms. Excluding captive automotive forge plants, Canadian forges tend to be somewhat smaller than their U.S. counterparts. About 10 percent of all forging operations in Canada are under United States ownership; it is estimated that these operations account for approximately 40 percent of total Canadian output. 1/

Canadian production of forged products totaled $312.2 million in 1984. Canadian exports to the United States reached $137.9 million in 1984, accounting for 44 percent of total Canadian sales. The bulk of these exports were automotive ($92.0 million), defense and aerospace, and agricultural products (table 13).

1/ Prehearing brief, Canada Forgings Inc., p. 5.

Table 13.--Forged metal products: Canadian exports to the United States, by type of market, 1984

Item	1984
	1,000 dollars
Automotive	92,029
Agriculture	828
Defense/aerospace	9,931
Other	35,136
Total	137,924

Source: Canada Forgings Inc.

A large number of Canadian forging workers belong to unions affiliated with United States parent organizations. Much of the equipment used by Canadian forgers is manufactured by U.S. companies; certain Canadian forges also purchase raw material from United States sources, as well as services such as machining, repair, die sinking, and computer technology. 1/

France.--The French forging industry is made up of over 70 firms, most of which are relatively small, family-owned companies. During 1980-84, no forge plants opened, two closed down, five were taken over by other French forging firms, and eight remained idle.

Production capacity for the French forging industry totaled 450,000 tons in 1984; production declined by 20 percent to 204,448 tons ($358.8 million) during 1981-84 (table 14). During 1984, the automobile industry accounted for 33.7 percent of drop-forged production (chiefly connecting rods, steering knuckles, and crankshafts), and agricultural machinery and tractors accounted for 12.5 percent of the volume of drop-forged production (table 15). Nearly 10,000 workers were employed in the entire French industry during 1981-84; these workers averaged about $87 million in wages and fringe benefits during 1982-84.

1/ Ibid, p. 6.

Table 14.--Forged metal products: French capacity, production, and employment, 1981-84

Item	1981	1982	1983	1984
Capacity------------------------tons--	1/	1/	400,000	450,000
Production:				
Quantity----------------------do----	254,175	232,682	199,174	204,448
Value---------------million dollars--	626.1	557.3	415.4	358.8
Employment:				
Number----------------------------------	10,934	10,452	9,729	8,778
Wages and benefits million dollars--	1/	103	86	72

1/ Not available.

Source: Compiled from statistics of the French Association for Drop Forging and Forging.

Table 15.--Drop-forged products: French shipments, by types of market, 1981-84

(Percent)

Type	1981	1982	1983	1984
Automobiles----------------------------	31.8	31.6	32.7	33.7
Transmission parts---------------------	6.6	6.7	7.9	8.0
Agricultural machinery and tractors----	10.4	11.0	12.0	12.5
Valves---------------------------------	7.2	6.8	4.8	4.9
Other markets--------------------------	44.0	43.9	42.6	40.9

Source: Compiled from statistics of the French Association for Drop Forging and Forging.

During 1981-84, French exports of drop-forged products declined 6 percent to 32,453 tons ($40.4 million) in 1984 (table 16). According to France's Trade Association for Drop Forging and Forging, France exported 5,694 tons to the U.S. market in 1984. 1/ Most of these exports are in the form of raw subassemblies, which are imported and machined by U.S. subcontractors to the automobile industry. 2/ French production of open-die products declined by 22 percent during 1981-84 to 21,137 tons ($65.7) in 1984; exports of these products decreased by 41 percent to 2,212 tons ($16.2 million) in 1984 (table 17). Although the industry does not receive direct Government assistance, the Government is nevertheless present in this sector through nationalized industry

1/ Interview with the French Association for Drop Forging and Forging, Paris, France, Nov. 21, 1985.

2/ Ibid.

(both upstream with the Usinor and Sacilor steel mills and downstream with the Renault automobile firm).

Table 16.--Drop-forged products: French production, exports, and employment, 1981-84

Item	1981	1982	1983	1984
Production (including exports):				
Quantity------------------------tons--:	187,922	169,109	141,263	142,633
Value----------------million dollars--:	347.8	306.7	240.1	205.7
Exports:				
Quantity------------------------tons--:	34,522	30,294	25,956	32,453
Value----------------million dollars--:	54.6	47.9	38.6	40.4
Employment:				
Workers----------------------number--:	7,534	7,143	6,465	5,738

Source: Compiled from statistics of the French Association for Drop Forging and Forging.

Table 17.--Open die forged products: French production and exports, 1981-84

Item	1981	1982	1983	1984
Production (including exports):				
Quantity------------------------tons--:	26,960	24,783	19,239	21,137
Value----------------million dollars--:	126.3	102.7	68.5	65.7
Exports:				
Quantity------------------------tons--:	3,752	2,625	2,077	2,212
Value----------------million dollars--:	28.1	19.9	13.7	16.2

Source: Compiled from statistics of the French Association for Drop Forging and Forging.

Italy.--The forging industry in Italy consists of about 120 firms whose combined annual capacity was about 450,000 tons in 1984. The Italian industry is believed to be the second largest in Europe, employing about 10,200 workers.

Italian production of drop-forged products declined by 34 percent from 556,000 tons in 1980 to 365,350 tons in 1984 (table 18). Capital expenditures and research and development expenditures for the industry averaged about 5 percent of sales during 1980-84. In general, the larger Italian firms are attempting to automate manufacturing processes, while less competitive companies are attempting to maintain market share by diversifying into product areas having higher value added components. 1/

1/ Interview with Teksid, Turin, Italy, Nov. 26, 1985.

Almost all Government assistance to the forging industry is related to helping firms reduce their work force. 1/ For firms in difficulty, the primary source of Government assistance is unemployment compensation for laid-off workers and early retirement for workers 50 years or older.

Table 18.--Drop-forged products: Italian production, 1980-84

Item	1980	1981	1982	1983	1984
Production (short tons)--	556,000	472,500	415,850	384,650	365,350

Source: Report from the U.S. Consulate, Milan, Italy, January 1986.

Japan.--The Japanese forging industry is made up of nearly 700 firms, most of which are relatively small companies. About eight of these forgers are raw steel producers; the remaining firms produce steel or aluminum forgings from purchased mill products.

Japanese shipments of forged products decreased 1 percent from $1.69 billion in 1980 to $1.67 billion in 1983 (table 19). Nearly 18,000 workers were employed in the Japanese industry between 1980 and 1983. These workers were paid an annual salary of approximately $275 million, with annual average earnings per worker of $15,400 during the period.

Table 19.--Forged metal products: Japanese shipments and employment, 1980-83

Item	1980	1981	1982	1983
Shipments:				
Value---------------million dollars--	1,685	1,921	1,606	1,665
Employment:				
Workers-----------------------number--	17,669	18,602	17,166	17,989
Earnings--------------1,000 dollars--	259,018	298,273	249,121	293,227
Average annual cash earnings per regular worker------------dollars--	$14,659	$16,034	$14,512	$16,300

Source: Report from the U.S. Embassy, Tokyo, Japan, December 1985.

1/ Interview with Italian Government officials, Rome, Italy, Nov. 25, 1985.

The Commission was not able to identify any nontariff barriers affecting the entry of foreign forged products into the Japanese market. Certain Japanese forging companies with 300 or fewer regular employees are eligible for various Government assistance programs available for all small businesses. These programs include: (1) low interest loans for expansion and improvement of facilities and operating funds; (2) certain interest-free loans to companies with less than 100 employees to enable them to finance half of the cost of new equipment for modernization; (3) certain Government credit guarantees; (4) limited tax relief; (5) subsidies or low interest loans for the practical application of technological innovations; and (6) Government procurement assistance; i.e., alloting an annually-determined share of total procurement contracts of Government entities to small companies.

Republic of Korea.--The forging industry in Korea consists of over 200 companies. Statistically, these firms are classified in three basic categories: (1) manufacturers of hammered or pressed forged steel products produced from steel ingots and semifinished steel products; (2) manufacturers of forged steel products from plates and blocks; and (3) all manufacturers (including forgers) of components and parts solely for motor vehicles.

There were about 15 manufacturers of hammered or pressed forged steel products produced from ingots during 1980-83 (table 20). These firms' shipments increased 87 percent from $29 million in 1980 to $54 million in 1983. Employment increased to nearly 2,000 workers with wages totaling $7.6 million in 1983; research and development expenditures reached $844,000 during the same year.

Table 20.--Certain hammered or pressed forged steel products: Korean production, shipments, tangible fixed assets, research and development expenditures, and employment, 1980-83

Item	1980	1981	1982	1983
Production--------------1,000 dollars--:	29,791	37,562	42,240	55,713
Shipments-------------------------do----:	28,954	37,258	39,323	54,084
Tangible fixed assets------------do----:	18,967	34,687	35,199	40,611
Research and development expenditures 1,000 dollars--:	1/	1/	1/	844
Employment:				
Workers-----------------------number--:	505	1,474	1,260	1,799
Wages-----------------1,000 dollars--:	1,837	5,201	5,147	7,559

1/ Not available.

Source: Report from the U.S. Embassy, Seoul, December 1985.

There were 192 producers of metal stamped and pressed products (i.e., bottle caps, medical appliances, machine parts, ash trays, cookingware, furniture parts, domestic utensils, and helmets) during 1983. Shipments reached $136 million, and employment totaled nearly 8,000 workers with wages reaching $21.3 million in 1983.

Spain.--The forging industry in Spain consists of about 22 companies. Two of these firms are also large steelmakers employing a combined 6,000 workers; 11 are medium-sized firms with nearly 3,000 employees and revenues of $93 million in 1984. Automotive parts reportedly represent less than 50 percent of production; Spanish firms report a capacity utilization rate of 70 percent. Annual wages paid to Spanish forging production workers totaled about $6,000 in 1984; in addition, forgers contribute about 35 percent of payroll to social security.

Spanish exports of forged steel propeller shafts and certain crankshafts increased by 23 percent, from 2,567 tons ($5.7 million) in 1983 to 3,169 tons ($7.9 million) in 1984 (table 21). Imports of these products increased by 6

Table 21.--Forged steel propeller shafts and certain crankshafts: Spanish exports and imports, 1983-84

Item	1983	1984
	Quantity (short tons)	
Forged steel propeller shafts:		
Exports	1,777	1,666
Imports	97	114
Certain forged steel crankshafts:		
Exports	790	1,503
Imports	141.35	138.33
	Value (million dollars)	
Forged steel propeller shafts:		
Exports	2.3	1.8
Imports	0.77	0.58
Certain forged steel crankshafts:		
Exports	3.391	6.093
Imports	1.60	1.13

Source: Report from the U.S. Embassy, Barcelona, Spain, December 1985.

percent, from 238 tons ($2.4 million) in 1983 to 252 tons ($1.7 million) in 1984.

No nontariff barriers concerning steel automotive parts are reported to exist in Spain; in fact, car manufacturers are permitted periodically to import certain parts (e.g., complete gearboxes and engines) duty free. Local requirements imposed on car manufacturers have been reduced to 60 percent (i.e., car manufacturers are permitted to import components for a value equivalent to 40 percent of the final value of the vehicle) and are scheduled to be eliminated within 4 years.

Two Spanish industrial vehicle forges were granted funds totaling $5.4 million and official loans totaling $12.1 million during 1980-85. These benefits were granted under the reindustrialization plan of the Government of Spain and are targeted at reducing company losses and increasing productivity of these firms to 48 and 55 tons per worker per year in 1985, up from 29 and 35 tons per worker per year in 1982.

Sweden.--The Swedish forging industry is made up of about 17 companies, most of which are relatively small firms. Swedish forges produce a variety of products, including crankshafts, steering spindles, valves and valve bodies, and aircraft components (table 22). During 1980-84, four new firms began production, and no plant closures were reported.

Capacity in the Swedish industry averaged about 94,000 tons during 1980-84. Hourly earnings for production workers averaged about $6.41 during 1984; fringe benefits (i.e., employer contributions by law and collective agreement as a percentage of gross wages) amounted to 42 percent in 1984.

Table 22.--Swedish forging industry: Swedish firms, capacity, and products produced

Firm	Capacity	Products produced
	Short tons	
Bacho Verktyg	2,535	Shift forks, rocker arms, and front wheel spindles
Bergs Smide AB	1,323	Automotive products
Bulten AB	3,307	Upset-forged, die-forged and automatically forged fixing devices
Bultsmide I Tanum AB	441	Special and standard fixing devices
Bofors AB	276	Crankshafts, front axles, and aerospace products
Componenta Kilsta AB	35,000	Crankshafts, front-axle beams, steering spindles, and aircraft components
Dalaverken Produktions	2,866	Wear parts, shafts, and gear wheels
Hejarsmide AB	772	Drop forgings
Hults Bruk	386	Handtools
Hoeganaes AB	22	Iron Power products
Igelfors Bruks AB	2,756	Shift forks and steering arms
Necks Verkstaeder	6,614	Automotive and general engineering industries
Pressmetall AB	331	Precision forgings
Robema Verkstads AB	1,102	Die-forged and upset-die forged products
Tors Hammare AB	1,102	Handtools
Wirsbo Bruks AB	15,432	Gear-wheel and crown-wheel forgings
Volvo Komponenter AB	17,634	Heavy-plate components

Source: Report from the U.S. Embassy, Stockholm, Sweden, December 1985.

United Kingdom.--The forging industry in the United Kingdom consists of over 50 companies. Shipments of forged, pressed, and stamped products declined 19 percent during 1981-84 to $1.6 billion in 1984 (table 23). Apparent consumption declined 2 percent to $1.5 billion during 1983-84, and exports and imports increased to $66.2 million and $56.9 million, respectively, during the period. Employment fell 15 percent, from 34,000 workers in 1981 to 29,000 workers in 1984.

Table 23.--United Kingdom forging, pressing, and stamping industry: United Kingdom shipments, exports, imports, apparent consumption, and employment, 1981-84, January-June 1984, and January-June 1985

Item	1981	1982	1983	1984	January-June--	
					1984	1985
Shipments--1,000 dollars--	1,914,087	1,747,725	1,587,792	1,555,674	752,410	958,686
Exports-----do----	1/	1/	63,240	66,153	1/	32,967
Imports-----do----	1/	1/	49,335	56,908	1/	36,128
Apparent consumption-----1,000 dollars--	1/	1/	1,573,887	1,546,429	1/	961,847
Ratio of imports to consumption percent--	1/	1/	3.1	3.7	1/	3.8
Employment number----------	34,000	1/	29,200	29,000	29,300	2/ 27,900

1/ Not available.
2/ January-March 1985.

Source: Business Monitor.

The fortunes of the British forging industry are tied to those of its major customers--the British vehicle assemblers. Although shipments to the largest end-user sector, commercial vehicles, fell slightly by 0.1 percent during 1983-84, there was a notable 8.5 percent decline in shipments to the second largest end-user sector, cars and light vans (table 24). In contrast, increases were recorded in shipments to end-user markets for tractors (wheeled), aircraft, and agricultural machinery. Direct exports of forgings increased by 5.8 percent and accounted for a record proportion (15.1 percent) of total shipments during 1984.

Table 24.--United Kingdom drop-forging industry: United Kingdom shipments, by markets, 1983-84

End-user market	1983	1984	1983	1984
	Quantity (short tons)		Share of total shipments 1/	
Cars and light vans	57,157	52,322	23.3	21.3
Commercial vehicles	57,920	57,865	23.6	23.5
Tractors (wheeled)	31,593	34,034	12.9	13.8
Earth moving (tractor crawler)	8,007	8,811	3.3	3.6
Mechanical handling and engineering	1,631	2,044	.7	.8
Miscellaneous mobile	8,260	8,046	3.4	3.3
Agricultural machinery	2,157	3,149	.9	1.3
Mining	8,498	4,819	3.5	2.0
Railways	1,760	1,882	.7	.8
Industrial engines	2,302	2,266	.9	.9
Pipeline	3,711	3,123	1.5	1.3
Aircraft	2,355	3,506	1.0	1.4
Mechanical engineering	8,728	8,932	3.6	3.6
Government sector	899	1,381	.4	.6
Other	15,419	16,851	6.3	6.8
Direct exports	35,107	37,157	14.3	15.1
Total shipments	245,504	246,187	100.0	100.0

1/ Because of rounding, totals may not add to 100.

Source: Estimated from statistics of the British Forging Industry Association.

West Germany.--The forging industry in West Germany consists of about 160 firms; about half of these companies employ less than 50 workers. West German production of drop-forged products trended downward, from 793,000 tons in 1981 to an estimated 743,000 tons in 1984 (table 25). Production increased 7.1 percent during January-June 1985 as compared with January-June 1984; sales increased 10 percent over the same periods. West German forgers cited subcontractors for the automotive industry and passenger-car manufacturers as the two largest customers for their products (table 26).

Table 25.--Drop-forged products: West German production, 1981-84

(In thousands of short tons)

Item	1981	1982	1983	1984
Production	793.0	777.3	727.7	1/ 743.0

1/ Estimated.

Source: Data collected at the 11th International Drop Forging Congress.

Table 26.--Forged products: West German shipments, by types of industrial customers, 1984

Item	1984
	(Percent)
Subcontractors for the automotive industry	21.1
Passenger car manufacturers	19.3
Truck manufacturers	18.1
Machinery	9.4
Farm-vehicles	5.6
Special-purpose vehicles (construction vehicles, cranes, forklifts, etc.)	8.1
Mining industry	2.5
Railroads	2.0
Two-wheel vehicle manufacturing	0.3
Shipbuilding industry	0.4
Aircraft industry	0.1
Others (fittings-, tool-industry, construction, replacement parts)	13.1

Source: Industrial Association of German Forges.

West German exports reached approximately 106,000 tons during January-September 1985; automotive parts accounted for the bulk of these exports (table 27). West German exports to the United States totaled about 35,000 tons annually during 1984 and 1985, reportedly accounting for less than 5 percent of U.S. consumption. 1/ Sweden, France, the United Kingdom, and Belgium and Luxembourg were other major markets for West German exports (table 28).

1/ Interview with officials of the Industrial Association of German Forges, Hagen, West Germany, Nov. 20, 1985.

Table 27.--Drop-forged products: West German exports, by types of products, January-September 1985

Item	January-September 1985
	Short tons
Unworked articles	25,422
Worked articles	4,321
Crankshafts	22,500
Machinery parts	3,208
Axles, wheels, locomotives	1,742
Buffer, hooks	726
Nondriving automotive axles	19,247
Other automotive parts	28,615
Total	105,781

Source: Estimated from statistics provided by the Industrial Association of German Forges.

Table 28.--Drop-forged products: West German exports, by markets, January-September 1985

Market	January-September 1985
France	12,946
Belgium and Luxembourg	10,133
Netherlands	5,265
Italy	3,923
United Kingdom	11,840
Sweden	14,008
Switzerland	2,594
Austria	5,647
Soviet Union	795
United States	28,347
Iran	501
Total	95,999

Source: Estimated from statistics provided by the Industrial Association of German Forges.

West German forges have invested in: (1) modernization through automation; (2) measuring technology to achieve higher accuracy; and (3) rationalization of production and distribution in general. 1/ West German industry representatives predict a future emphasis on lighter forgings, noting that many ferrous forgings will be too heavy for future applications. 2/

1/ Prehearing brief, Industrial Association of German Forges, p. 5.

2/ Interview with officials of the Industrial Association of German Forges, Hagen, West Germany, Nov. 19, 1985.

Structural Factors of Competition Between U.S. and Foreign Industries

According to U.S. producers responding to the Commission's questionnaire, the United States' overall competitive position in industry structural comparisons with its major foreign competitors is the same for six of the nine product areas examined (table 29). The United States maintains a comparable position or a greater competitive advantage with major foreign industries in production technology, fuel cost, and marketing ability, particularly in providing after-sale services to its customers. However, foreign industries have a competitive advantage in lower raw material, capital, and labor costs, as well as alleged government subsidies, higher tariff levels, and nontariff barriers on imports of forgings.

In a country-by-country comparison, U.S. manufacturers perceived themselves nearly on an equal footing with all principal foreign industries except Japan (table 30). Although many foreign industries allegedly benefited from government involvement (that is, the existence of subsidies, higher tariff levels, and nontariff barriers to imports) and lower raw materials, capital, and labor costs, U.S. and foreign producers were considered comparable with respect to production technology, marketing, fuel costs, and foreign government regulations which increase costs.

Although exceptions to these structural-factor assessments may be cited by U.S. producers for individual product areas or foreign competitors as discussed in subsequent analyses of nine key products, these conclusions are based on the aggregate responses to the Commission's questionnaire. Specific information on competitive positions of specific types of forging producers is discussed in each of the product sections of the report.

U.S. and foreign government regulations that increase costs

The U.S. forging industry is affected by most major environmental and workplace safety regulatory laws. The primary Federal agency responsible for environmental regulations and enforcement is the Environmental Protection Agency (EPA), which monitors the forging industry in air and water pollution control and hazardous substance and solid waste disposal requirements. The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) enforces regulations that affect forgers in the areas of worker safety and health, noise, and carbon monoxide and other emissions. In addition to Federal environmental and safety regulations, forgers are subject to State and local regulations which may conflict with or exceed Federal standards.

Over half the U.S. producers who responded to Commission questionnaires cited Government environmental and safety regulations as adversely affecting the competitive position of the U.S. forging industry. Industry sources claim that since the standards are not as stringent in many foreign countries, especially the newly industrialized countries, such as Taiwan, Korea, and

Table 29.—U.S. forging industry: U.S. producers' competitive assessment of structural factors of competition for the U.S. industry and foreign industries, 1/ by product categories, 1984-85

Item	Forged steel crankshafts	Forged steel connecting rods	Forged steel undercarriage components	Forged steel: axles and spindles, steering arms and knuckles	Forged steel valves and valve bodies	Forged steel fittings and flanges	Forged steel transmission parts	Forged steel hooks, shackles, load-binders, and other attachments	Forged metal turbine rotor and generator components
Overall competitive advantage	F	F	F	F	F	F	F	F	F
Fuel cost	D	D	F	F	F	F	F	D	F
Raw materials cost	F	F	F	F	F	F	F	F	F
Capital:									
Cost	F	F	F	F	F	F	F	F	F
Ability of industry profits to attract funds	F	F	F	F	F	F	F	F	F
Labor cost	F	F	F	F	F	F	F	F	F
Production technology	S	S	S	S	S	S	S	S	S
Marketing:									
Channels of distribution	S	D	S	S	D	D	S	S	S
Responsiveness to orders	D	D	S	S	D	D	S	S	S
After-sale service capabilities	D	D	S	S	D	D	D	D	D
Government involvement:									
Subsidies	F	F	F	F	F	F	F	F	F
Research and development	F	F	F	F	F	F	F	F	F
Tariff levels on imports	F	F	F	F	F	F	F	F	F
Nontariff barriers to imports	F	F	F	F	F	F	F	F	F
U.S. Government regulations which increase costs	F	F	F	F	F	F	F	F	F
Foreign government regulations which increase costs	F	S	F	F	S	S	S	S	S

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

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Table 30.—U.S. forging industry: U.S. producers' competitive assessment of structural factors of competition for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Taiwan	Japan	Korea	Brazil	West Germany	Italy	Canada
Overall competitive advantage	S	F	S	S	S	S	S
Fuel cost	S	S	S	S	S	S	S
Raw materials cost	F	F	F	F	F	F	F
Capital:							
Cost	F	F	F	F	F	F	S
Ability of industry profits to attract funds	S	F	F	F	S	F	S
Labor cost	F	F	F	F	F	F	F
Production technology	S	S	S	S	S	S	S
Marketing:							
Channels of distribution	S	S	S	S	S	S	S
Responsiveness to orders	D	S	S	S	S	D	S
After-sale service capabilities	D	D	S	S	S	D	S
Government involvement:							
Subsidies	F	F	F	F	F	F	F
Research and development assistance	S	F	S	F	S	S	S
Tariff levels on imports	F	F	F	F	S	F	F
Nontariff barriers to imports	F	F	F	F	F	F	F
U.S. Government regulations which increase costs	S	F	S	S	F	F	F
Foreign government regulations which increase costs	S	S	S	S	S	S	F

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Brazil, the importers are able to pass the savings on to U.S. forging purchasers in lower prices or use the capital not spent on compliance with environmental laws for further investment in more modern facilities.

Foreign government programs affecting competition in the U.S. market

Although the Commission was unable to gather specific information concerning alleged foreign government subsidies, there are various types of assistance that foreign governments give to their domestic forging industries. Few, if any, however, are targeted specifically at the forging industry. Some of the assistance is directed at the individual country's steel industry and reaches the forging and casting industries because of the direct relationship between the two industries. For example, the countries that belong to the EC receive specific financial aid for retraining from the European Coal and Steel Commission (ECSC). All EC countries contribute to this fund, and when a plant is closed or some of the workers are permanently laid off, money may be drawn from the fund for retraining, severance payments, or even for early retirement benefits. 1/ Many programs also have been developed to create employment, aid in research and development, promote exports and/or impede imports, and provide other financial benefits and incentives for all domestic industries. Some of the more prominent foreign government incentives and benefits are discussed below.

Brazil.--Following World War II, Brazil began importing a large volume of industrial products, causing a severe balance-of-trade problem in the early 1950's. 2/ In 1952, Brazil banned imports of automotive parts, including forgings and castings, where local sources were available. Brazil then furthered the promotion of the domestic automotive industry in the late 1950's by including domestic content requirements and vehicle production schedules, as well as by creating the Executive Group for the Automotive Industry (GEIA). 3/

Another major Brazilian program is the Fiscal Benefits for Special Exports Program (BEFIEX). BEFIEX is a program whereby individual companies may receive substantial tax benefits and duty reductions by agreeing to export a predetermined value of production. These programs, which generally run about 10 years, allow import duty and industrial-product-tax reductions of 70 to 80 percent on machinery and capital-goods imports and 50 percent on imports of components, raw materials, and intermediate goods. Complete exemptions may be available for companies with favorable balance of payments figures year to year. 4/ This program helped to maintain steadily increasing export volumes even during the 1981 recession, and its importance has risen as Brazil's international debt crisis has deepened.

1/ Staff interviews with officials of the Italian and British Governments.
2/ Knut Mober, Richard Feast, "Brazilians Are Export Experts, "Automotive News, Jan. 21, 1985.
3/ Ibid.
4/ Department of State Airgram, Aug. 31, 1984.

Italy.--During November 1983, the U.S. Department of Commerce determined that certain benefits that constitute subsidies were provided to manufacturers, producers, or exporters in Italy of semifinished forged undercarriage components. The Department found that subsidies were being provided under "rebates of indirect taxes."

The stated purpose of Italian Law 639 was to rebate customs duties and certain indirect taxes upon the export of products containing certain raw materials. The law set forth the value of the rebate for iron and steel in lire per kilogram.

The Department determined that the rebate of indirect taxes provided to the Italian exporter under Italian Law 639 confers an export subsidy. The Department calculated a net subsidy in the amount of 1.37 percent ad valorem.

Korea.--Imports into Korea require an import license issued by one of the country's foreign exchange banks. In general, applications for import licenses are approved automatically unless the item is restricted under Korea's Annual Trade Plan. The Annual Trade Plan is a negative-list system to control imports. Under the plan, imports of restricted items may be approved if recommended by the appropriate ministry or trade association. 1/

Also, the motor-vehicle-parts industry (which includes forgings) has been heavily protected behind high tariff barriers and fostered by a protected domestic market and given financial and technical help. In addition, little Government support has been lent to joint ventures with foreign firms. These policies have yielded a parts industry composed of many small manufacturers producing limited, low technology product lines. 2/

Mexico.--Mexico has attempted to create an automobile and related parts supplier industry through Government intervention since 1962. 3/ Various auto decrees have been issued by Mexico since 1962 that require a certain Mexican content level in autos, trucks, and buses assembled by motor-vehicle manufacturers operating in Mexico. These decrees have caused the establishment of parts manufacturing facilities, including forging operations, by either domestically owned and controlled companies or facilities owned jointly by Mexican and foreign firms. 4/

In addition to local content requirements, the later decrees have mandated import-export ratios. The 1972 decree established a schedule whereby all auto-parts imports for use in production would have to be offset by exports on a dollar-for-dollar basis by 1979. 5/

1/ Report from the U.S. Embassy, Seoul, Korea, June 1984.
2/ "Korean Auto Industry Gears Up For Exports," Department of State Airgram, May 9, 1984.
3/ "Mexico: Set for a Decade of Growth," Automotive Industries, March 1982, p. 48.
4/ Ibid.
5/ Jack H. Parkinson, "The Automotive Industry Decree: Tooling Up For More Exports," Business Mexico, 1978.

Fuel cost

The cost of fuel (energy) accounts for approximately 2 to 10 percent of the value of forging production costs, according to U.S. industry sources. Natural gas is the predominant fuel used, accounting for about one-half of the energy use (on the basis of BTu consumption). Gas is used by the manufacturer to operate a variety of furnaces used in the pre-forging heating of stock, and in post-forging heat treatment of the final product. Electricity, which accounts for about 40 percent of energy use, is used by the manufacturer in the pre-forging heating of furnaces by the electrical induction or resistance process, and in the operation of machinery and equipment. Light fuel oil (which accounts for the balance of energy use) is used to operate various furnaces used in the pre-forging heating of stock.

To determine a comparative cost estimate of key energy sources used in forging operations in various countries, a common reference point must first be established. Although natural gas is purchased in therms, light fuel oil in gallons, and electricity in kilowatt hours (K.W. hrs.), these energy sources can be equated to millions of British thermal units (mil Btu), as shown in the following tabulation: 1/

Fuel	Natural gas	Light fuel oil	Electricity
Units-----------	Therm	Gallons	K.W. hr.
Btu/unit---------	100,000	140,000	3413
Units/mil Btu---	10	7.14	293

Process heating accounts for the largest portion of energy in a forging plant. Using the above data and certain assumptions about fuel efficiencies, consumption, rates, and equipment, the following comparative set of energy costs can be developed for heating steel billets to 2,200 F for a forging operation:

Assumptions:
Fossil furnace = 17% efficiency or 4 mil Btu/ton
Electric induction = 50% efficiency or 1.365 mil Btu/ton
(400 K.W. hrs./ton)
Oil = Average 7 gal./mil Btu 1/
Costs:
Oil at 4 mil Btu/ton and $0.88/gallon = $24.64/ton
Gas at 4 mil Btu/ton and $0.41/therm = $16.40/ton
Electricity at 400 K.W. hrs./ton and $0.05/K.W. hr. = $20.00 ton

1/ Ibid.

1/ Energy and Engineering Bulletin, Forging Industry Association, vol. 8, No. 1, February 1985, p. 1.

The United States held a cost advantage over many foreign competitors in energy prices during 1981. By 1984, however, the advantage had narrowed or disappeared due in large part to the effect of the rapid appreciation of the dollar or relative prices (table 31). Assuming energy use to be consistent throughout the forging industries worldwide, the disparity between U.S. and foreign prices in 1984 would translate into an advantage of up to 3 percent for U.S. producers with the United States at a disadvantage with respect to two countries, Canada and the United Kingdom (table 32).

Table 31.—Energy prices: Prices (including taxes) to industrial users in selected countries, 1981-84

Year	United States	Canada	Japan	France	Italy	Sweden	United Kingdom	West Germany
	Light fuel oil (in U.S. cents per gallon)							
1981	108	75	132	119	108	127	112	106
1982	106	90	137	116	116	133	106	109
1983	89	100	138	110	120	114	95	94
1984	88	102	133	114	116	113	86	89
	Electricity (in U.S. cents per kilowatt hour)							
1981	4.2	2.1	10.0	4.4	2.6	3.4	5.5	5.2
1982	4.9	2.4	9.1	4.1	2.5	2.9	5.1	5.3
1983	5.0	2.5	9.5	4.0	2.7	2.5	4.4	5.1
1984	5.0	2.6	9.1	4.2	1/	2.7	3.9	4.7
	Natural gas (in U.S. cents per 100 cubic feet/therm)							
1981	3.1	2.3	11.6	4.5	4.6	2/	4.1	3.9
1982	3.7	2.7	10.5	4.5	5.0	2/	3.8	4.9
1983	4.3	3.0	10.4	4.2	4.5	2/	3.4	4.5
1984	4.1	2.8	10.6	4.0	1/	2/	3.3	4.8

1/ Not available.
2/ No appreciable consumption at the national level.

Source: U.S. Department of Energy, Energy Information Administration, International Energy Prices, 1980-84, August 1985, pp. 44-57.

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Table 32.--U.S. energy cost advantage or (disadvantage), 1984

Country	Fuel oil, natural gas, and electricity	
	(Dollars per ton)	(Percent of total cost of production) 1/
Canada	($10.88)	(0.64)
Japan	55.00	3.24
France	3.68	0.22
Italy 2/	0.28	0.16
United Kingdom	(8.16)	(0.48)
West Germany	1.88	0.11

1/ Based on U.S. Department of Commerce, Census of Manufactures, 1977 forging input-output model.
2/ Comparison of 1983 costs.

Raw materials

The principal raw materials used in the production of forgings include steel, aluminum, and a wide variety of other materials, including titanium. The selection of a grade or form of metal for a forging operation is dependent on the physical and mechanical properties desired. Machinability, strength, and fatigue resistance of the raw material, response to heat treatment, and corrosion resistance are attributes of the finished product which must be considered. While U.S. producers could have a significant cost disadvantage with respect to steel and titanium, the recent decline in the dollar has undoubtedly narrowed this disadvantage significantly.

Steel.--The world steel market has, in recent years, become a buyers' market with steel often selling below list price. U.S. steel prices are generally above foreign prices, largely reflecting higher U.S. steelmaking costs. A comparison of domestic and foreign composite steel prices per short ton indicates that the U.S. price has exceeded that of Japan, West Germany, the United Kingdom, and France in the respective home markets during 1981-84. During January-March 1985, the prices of imports ranged from 20 percent (Japan) to 36 percent (France) below U.S. prices. 1/ As most of U.S. consumption is met by domestic production (i.e., approximately 75 percent), the cost of domestic steel would tend to put U.S. forgers at a disadvantage. According to industry sources, steel accounts for approximately 40 percent of the cost of production of a typical forging. Exclusive use of domestic steel, for example, would result in a foreign cost advantage of 8 to 14 percent.

Aluminum.--Aluminum represents approximately 30 to 35 percent of the cost of production of a typical aluminum forging, according to industry sources. While aluminum is traded on both the London Metal Exchange (LME) and the New York Commodity Exchange (COMEX), the world price is generally pegged to the

1/ Paine Webber: World Steel Dynamics, The Steel Strategist, table 3 September 1985.

LME. The U.S. aluminum price is generally above that of the LME or COMEX, as indicated below:

	1985 average price
London Metal Exchange-------------	47.85¢/lb.
COMEX-----------------------------	46.45¢/lb.
U.S. producer transaction price---	49.00¢/lb.

U.S. aluminum forgers, some of which are owned by the major aluminum producers, are most likely to buy their raw materials from U.S. aluminum producers, despite slightly higher transaction prices. This is due to various factors including market proximity, quantity discounting, reliability, financing arrangements, customization, and long-standing business connections. This tends to suggest that U.S. forgers may have a slight initial raw materials competitive disadvantage against foreign competitors.

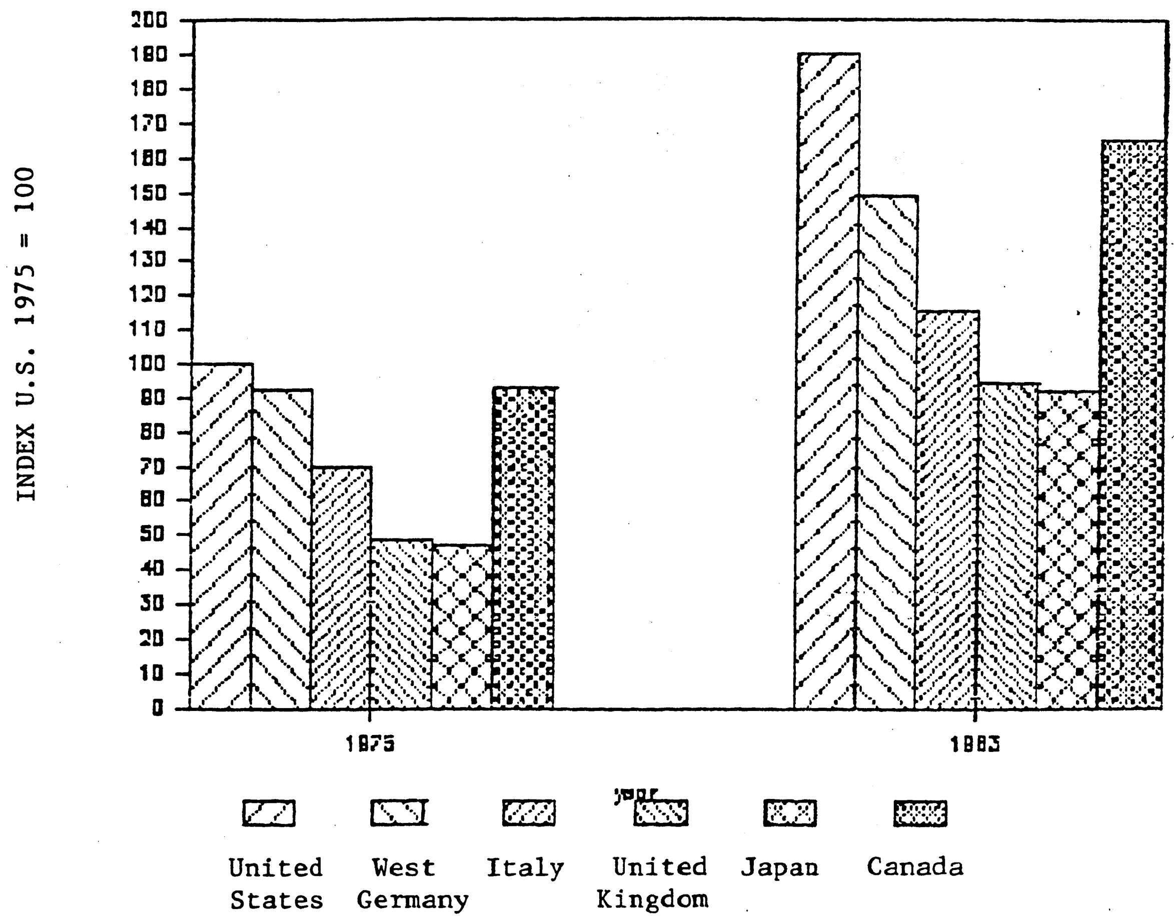
Titanium.--According to industry sources, the cost of titanium represents approximately 45 to 55 percent of the total cost of a typical titanium forging. Prices for the metal are not based on commodity exchanges; rather they are established by producers. As a result, they can vary from company to company and country to country. Data collected in a 1983 Commission investigation suggest that foreign titanium prices (as measured by U.S. import prices) are lower than U.S. prices. The report on the investigation shows that the prices of imports during 1983 ranged from 58 percent (imports from the U.S.S.R.) to 36 percent (imports from Japan) below U.S. prices. 1/ As most of U.S. consumption is met by domestic production (i.e., approximately 72 percent), the premium paid for domestic material would tend to put U.S. forgers at a competitive disadvantage. Exclusive use of U.S.-produced titanium, for example, would translate into a foreign production cost advantage of 16 to 32 percent (based on the 1983 titanium price comparisons).

Labor

Hourly compensation costs paid to production workers in fabricated metal products manufacturing in the United States are higher than those paid to workers in other major producing countries. Table 33 shows data on hourly compensation costs for U.S. production workers in fabricated metal products manufacturing compared with those of workers in major producing countries. Although the figures include compensation for the broad category, fabricated metal products manufacturing, they are believed to be indicative of the differences in compensation costs for the steel forging industry. Although information is not available for all countries during 1984, data indicate that compensation paid in the various producing countries ranged from 11 percent (for Korea) of the U.S. compensation level of $12.96 per hour to 69 percent (for West Germany). As shown in figure 2, the disparity between U.S. hourly

1/ U.S. Bureau of Mines, 1985 Mineral Commodity Summaries, p. 166; Titanium Sponge from Japan and the United Kingdom (Final) (investigation Nos. 731-TA-161 and 162), USITC Publication 1600, p. A-36.

Figure 2.--Fabricated metal products manufacturing: Hourly compensation costs for production workers, by specified countries, 1975 and 1983



Source: Compiled from unpublished data of the U.S. Department of Labor, Bureau of Labor Statistics.

compensation costs and those of the other countries indexed grew during 1975-83. Hourly compensation costs for all manufacturing during

Table 33.--Fabricated metal products manufacturing: Hourly compensation costs for production workers, by specified countries, 1981-84 1/

Country	1981	1982	1983 2/	1984 2/
United States	$11.06	$12.01	$12.53	$12.96
Canada	9.55	10.39	10.87	3/
Japan	6.16	5.75	6.10	6.31
West Germany	9.98	9.84	9.80	9.00
Italy	7.45	7.27	7.59	3/
Sweden	11.47	9.83	8.61	3/
France	7.89	7.73	7.61	7.15
United Kingdom	6.80	6.61	6.21	5.73
Spain	5.90	5.59	4.81	3/
Korea	1.17	1.24	1.29	1.41
Brazil	2.23	2.64	1.77	3/

1/ Hourly compensation is defined as all payments made directly to the worker, including bonuses and overtime, and employer contributions to legally required insurance programs and contractual and private benefit plans.

2/ Estimated.

3/ Not available.

Source: Compiled from unpublished data of the U.S. Department of Labor, Bureau of Labor Statistics.

1984 were generally higher than such costs for fabricated metal products manufacturing for Japan, West Germany, France, and the United Kingdom; compensation for all manufacturing was lower for the United States and Korea (table 34).

Table 34.--All manufacturing: Hourly compensation costs for production workers, by specified countries, 1981-85 1/

Country	1981	1982	1983	1984 2/	1985 2/
United States	$10.79	$11.52	$12.04	$12.59	$13.09
Canada	9.31	10.16	10.92	11.00	10.76
Japan	6.18	5.70	6.12	6.35	6.64
West Germany	10.53	10.38	10.33	9.55	9.75
Italy	7.39	7.37	7.74	7.52	7.67
Sweden	11.80	10.07	8.89	9.17	9.68
France	8.15	8.01	7.92	7.48	7.69
United Kingdom	7.13	6.76	6.26	5.85	6.06
Spain	5.60	5.35	4.64	4.58	4.87
Korea	1.17	1.25	1.30	1.36	1.38
Brazil	1.90	2.16	1.46	1.23	1.27

1/ Hourly compensation is defined as all payments made directly to the worker, including bonuses and overtime, and employer contributions to legally required insurance programs and contractual and private benefit plans.
2/ Estimated.

Source: Compiled from unpublished data of the U.S. Department of Labor, Bureau of Labor Statistics.

Marketing

Domestic forgers distribute their products directly to original-equipment producers, such as the major motor vehicle or aerospace producers; to component suppliers, such as independent engine or transmission suppliers that sell directly to producers of the complete product; or to companies that machine or further finish the rough forging, who in turn sell the finished forging to suppliers or producers. In the replacement market (that segment of the parts market that distributes new parts that replace worn or damaged original parts) U.S. forgers sell to the ultimate consumer if the forger has the capability to finish the forging (i.e., machine or heat treat) or to a company that does the finishing.

The U.S. captive manufacturers, such as producers of forged undercarriage parts for crawler tractors or crankshafts for diesel engines, sell directly to subsidiaries of the parent company. In addition, they will sell forgings for replacement use to distributors that sell and service their products. Most captive forgers are operated as individual profit centers and must compete with domestic and offshore forgers as well.

Foreign forging manufacturers follow the same general distribution channels as U.S. forgers, selling directly to original-equipment manufacturers, as in the case of forgers that import crankshafts, or through a U.S. sales representative. The U.S. sales representative is a subsidiary of the foreign producer, or it may utilize an unaffiliated U.S. distributor to market its products. However, some of the larger foreign forgers have now established not only their own affiliated U.S. importer, but also distribution points, or warehouses, located close to some of their major customers. According to domestic forgers, many of these foreign firms are willing to not only warehouse the forgings at no additional cost to the customer, but also are giving 90 to 120 day payment deferrals. 1/ Thus, the importers of forgings not only offer better service (shorter delivery time and less inventory at the customer's plant) but are also offering lower prices due to longer payment deferrals and even lower initial prices. U.S. forgers have claimed that the importers have taken many high-volume steel forgings markets away from domestic forgers due to the above practices and that, in some instances, the importers' initial price quote for a forging is almost as low as the U.S. forgers raw material cost alone. 2/

Technology

Although U.S. forgers are more advanced than the rest of the world in the area of aerospace forging technology, when examining all domestic forgers they are, at best, about equal in other forging sectors. Both domestic and foreign forgers admit that the same technology is available to them, but some domestic forgers and U.S. purchasers of imported forgings believe that the U.S. industry (especially small-to-medium size forgers) are not utilizing much of the more modern equipment. 3/ This reflects the U.S. industry's inability to generate profits sufficient to fund increased investment in plant and equipment. State-of-the-art hammers and presses are produced in the United States, Europe, and Japan, and U.S.-built presses are used in both Europe and Japan.

There is the perception by observers both outside and inside the forging industry that presses are superior to hammers. Based on conversations with domestic and European forgers and forging associations, there is a general consensus that presses are superior to hammers when there is a high-volume run, but the additional expenditure for a press cannot normally be justified for low-volume runs, which require frequent die changes. The larger forgers in Europe and Japan are believed to use presses more extensively than do U.S. forgers.

Transportation

Most forgings in both the United States and foreign countries are shipped to customers by truck, although some high-volume forgings, such as crankshafts,

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1/ Prehearing statement submitted to the U.S. International Trade Commission by Paul J. Hausmann, Vice President-General Manager, Wyman-Gordon Company, Jan. 21, 1986, p. 12.

2/ Hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 49.

3/ Based on statements submitted in response to questionnaires of the U.S. International Trade Commission.

are occasionally shipped to original-equipment manufacturers by rail. Based on information received from U.S. forgers, the predominant mode of transportation for forgings is truck and the general marketing area is greater than 200 miles from the production plant for most forgings (table 35).

Table 35.--U.S. forging industry: Predominant modes of transportation, general marketing area, and average transportation costs 1/

Item	Forged steel products	Forged aluminum products	Other forged products
Predominant mode(s) of transportation:			
Truck------------------number--:	119	21	25
Rail--------------------do----:	5	1	0
Other-------------------do----:	3	1	2
General marketing area (radius):			
Up to 100 miles---------number--:	20	1	1
101-200 miles-----------do----:	21	2	2
201-500 miles-----------do----:	46	2	5
Over 500 miles----------do----:	76	17	22
Average transportation costs (as percentage of sales):			
0-5 percent------------number--:	100	16	19
6-10 percent-------------do----:	15	0	0
11-15 percent------------do----:	1	0	0

1/ Data include responses of 163 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Domestic forgers appear to maintain a competitive advantage over offshore forgers such as West Germany and Japan. On a cost basis, transportation accounted for 5 percent or less of the delivered cost of steel forgings 86 percent of the time and 100 percent in the case of both aluminum and other forged products (table 35). In contrast, an analysis of official U.S. trade statistics for 1985 indicates that the insurance and freight component of shipping crankshafts for use in compression-ignition automotive engines (a representative sample of steel forgings) from Japan to the United States averaged about 5.5 percent of the delivered, c.i.f., value of the merchandise. 1/

1/ Based on 1985 Japanese imports of TSUSA item 660.7113 into the United States.

Exchange rates

The real depreciation of the currencies of the major forgings supplying countries has made them more competitive relative to U.S. producers of forgings. This is illustrated by quarterly data reported by the International Monetary Fund indicate that from January 1981 to September 1985, the nominal values of the Japanese yen, West German mark, Canadian dollar, Italian lira, U.K. pound, Korean won, and Brazilian cruzeiro generally depreciated relative to the U.S. dollar by 13.8 percent, 26.8 percent, 12.2 percent, 49.2 percent, 1/ 40.4 percent, 24.5 percent, and 99 percent respectively (tables 36 and 37) 2/. When differing inflation rates in the United States and the other countries are taken into account, as in the "real" exchange rate indices of tables 36 and 37, more accurate indicators of international purchasing power are obtained. 3/ These indices show virtually no change relative to the U.S. dollar in the "real" exchange rate for the Canadian dollar, and a depreciation of between 20 percent and 30 percent for all of the others.

The U.S. dollar reached a high against Japanese and European currencies in the first quarter of 1985 in both nominal and real terms. The dollar has declined in nominal terms since that time, especially since September 1985, when the United States, Japan, and several European countries launched a concerted effort to lower the value of the U.S. dollar. By January 29, 1986, the currencies of Japan, West Germany, Italy, and the United Kingdom appreciated 33, 36, 24, and 26 percent, respectively, relative to the U.S. dollar over first quarter 1985 nominal values.

If this effort to bring down the dollar's value is successful, the competitive advantage that foreign producers have enjoyed as a result of the high value of the dollar will be lessened and should make imports higher priced in the U.S. market and U.S. products more price competitive in export markets.

1/ January 1981 to June 1985.

2/ International Financial Statistics, April 1984 and December 1985.

3/ The percentage change in the international purchasing power of each currency from the reference period January-March 1981 provides an indication of the maximum amount that a foreign producer or its agent can reduce its dollar prices of foreign products in the U.S. market without reducing its profits, assuming it has no dollar-denominated costs or contracts. A foreign producer, however, may choose to increase its profits by not reducing its dollar prices or by reducing its dollar prices by less than the depreciation would allow. Within specific industries, such as the forging industry, the proportion of foreign producers' costs attributable to imports of raw materials and energy from the United States or from countries whose currencies are linked to the dollar would vary by specific product and producer.

Table 36.—Exchange rates 1/: Nominal-exchange-rate equivalents of the Japanese yen, the West German mark, the Canadian dollar, and the Italian lira, in U.S. dollars, real-exchange-rate equivalents, and producer price indicators in the United States, Japan, West Germany, Canada, and Italy 2/ indexed by quarters, January 1981–September 1985

(January-March 1981 = 100)

Period	U.S. producer price index	Japan			West Germany			Canada			Italy		
		Producer price index	Nominal-exchange-rate index	Real-exchange-rate index 3/	Producer price index	Nominal-exchange-rate index	Real-exchange-rate index 3/	Producer price index	Nominal-exchange-rate index	Real-exchange rate index 3/	Producer price index	Nominal-exchange-rate index	Real-exchange-rate index 3/
			US$ per Jyen			US$ per Dm			US$ per Can$			US$ per ITR	
1981:													
Jan.-Mar—	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Apr.-June-	102.2	101.1	93.5	92.4	102.5	91.7	91.9	102.2	99.6	99.6	105.1	88.3	90.8
July-Sept-	102.9	102.4	88.7	88.2	104.7	85.8	87.3	104.4	98.5	99.9	108.9	82.4	87.3
Oct.-Dec—	102.8	102.1	91.5	90.9	106.2	93.0	96.1	105.7	100.2	103.0	113.2	83.7	92.2
1982:													
Jan.-Mar—	103.7	102.5	88.1	87.0	108.1	88.9	92.6	107.2	98.7	102.0	116.8	79.4	89.4
Apr.-June-	103.8	102.8	84.2	83.3	109.1	87.7	92.2	109.3	95.9	100.9	119.2	75.9	87.2
July-Sept-	104.4	103.8	79.4	79.0	110.1	84.1	88.7	110.1	95.5	100.8	123.1	71.9	84.8
Oct.-Dec—	104.4	103.7	79.2	78.6	110.5	83.4	88.3	110.5	96.9	102.6	127.2	69.8	85.0
1983:													
Jan.-Mar—	104.5	101.7	87.2	84.9	110.2	86.7	91.4	111.2	97.3	103.5	129.2	71.6	88.6
Apr.-June-	104.8	100.7	86.6	83.2	110.5	84.0	88.6	112.9	97.0	104.5	131.3	67.8	85.0
July-Sept-	105.8	100.9	84.8	80.9	111.4	79.0	83.1	113.8	96.8	104.2	134.3	63.6	80.8
Oct.-Dec—	106.4	100.3	87.8	82.8	112.1	77.9	82.1	114.3	96.4	103.6	138.8	61.6	80.4
1984:													
Jan.-Mar—	107.5	100.4	89.0	83.1	113.1	77.2	81.3	116.2	95.1	102.8	143.2	60.2	80.3
Apr.-June-	108.2	100.5	89.5	83.2	114.0	77.0	81.1	117.6	92.3	100.3	146.4	59.8	80.9
July-Sept-	107.9	101.1	84.4	79.1	114.5	71.5	75.8	118.2	90.8	99.5	148.3	55.6	76.4
Oct.-Dec—	107.7	100.8	83.6	78.2	115.3	68.3	73.2	118.5	90.5	99.7	151.1	53.0	74.3
1985:													
Jan.-Mar—	107.5	101.2	79.8	75.1	116.5	64.1	69.5	119.7	88.2	98.3	155.1	49.5	71.4
Apr.-June-	107.6	100.5	82.0	76.6	117.0	67.6	73.5	120.6	87.2	97.7	158.6	50.8	74.9
July-Sept-	106.8	99.4	86.2	80.2	177.0	73.2	80.2	120.8	87.8	99.2			

1/ Exchange rates expressed in U.S. dollars per unit of foreign currency.

2/ Producer price indicators—intended to measure final product prices—are based on average quarterly indexes presented in line 63 of International Financial Statistics.

3/ The real value of a currency is the nominal value adjusted for the difference between inflation rates in the United States and the respective foreign country. Producer prices in the United States increased by 6.8 percent between January 1981–September 1985 compared with a 0.6-percent decrease in Japan, a 17.0 percent increase in West Germany, a 20.8 percent increase in Canada during that period, and a 58.6 percent increase in Italy in the period January 1981–June 1985.

Source: International Monetary Fund, International Financial Statistics, April 1984 and December 1985.

Note.—January-March 1981=100.

Table 37.—Exchange rates 1/: Nominal-exchange-rate equivalents of the United Kingdom pound, the Korean won, and the Brazilian cruzeiro in U.S. dollars, real-exchange-rate equivalents, and producer price indicators in the United States, United Kingdom, Korea, and Brazil, 2/ indexed by quarters, January 1981–September 1985

(January–March 1981 = 100)

Period	U.S. producer price index	United Kingdom: Producer price index	United Kingdom: Nominal-exchange-rate index	United Kingdom: Real-exchange-rate index 3/	Korea: Producer price index	Korea: Nominal-exchange-rate index	Korea: Real-exchange-rate index 3/	Brazil: Producer price index	Brazil: Nominal-exchange-rate index	Brazil: Real-exchange-rate index 3/
			—US$ per UKl—			—US$ per Kw—			—US$ per Bcr—	
1981:										
Jan.–Mar—	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Apr.–June—	102.2	103.3	90.1	91.0	105.8	98.0	101.4	119.7	84.4	98.8
July–Sept—	102.9	104.5	79.5	80.8	108.3	97.3	102.4	138.2	71.0	95.4
Oct.–Dec—	102.8	106.7	81.5	84.6	108.4	96.7	102.0	160.5	59.9	93.6
1982:										
Jan.–Mar—	103.7	109.5	80.0	84.4	110.0	94.0	99.6	188.4	51.3	93.3
Apr.–June—	103.8	111.2	77.0	82.5	110.4	91.6	97.4	227.5	44.2	96.8
July–Sept—	104.3	112.3	74.7	80.4	110.8	90.0	95.6	269.1	37.3	96.3
Oct.–Dec—	104.4	113.6	71.4	77.7	111.1	89.6	95.4	310.8	30.7	91.5
1983:										
Jan.–Mar—	104.5	115.2	66.3	73.2	111.6	88.6	94.6	388.0	21.7	80.5
Apr.–June—	104.8	117.5	67.3	75.5	110.7	86.7	91.6	512.9	14.9	72.8
July–Sept—	105.8	118.4	65.4	73.1	110.4	85.0	88.6	734.7	11.1	77.0
Oct.–Dec—	106.4	120.0	63.6	71.8	110.4	83.9	87.1	1035.5	8.2	79.5
1984:										
Jan.–Mar—	107.5	122.0	62.1	70.5	110.8	83.9	86.4	1365.1	6.2	78.8
Apr.–June—	108.2	124.9	60.5	69.8	111.1	83.6	85.8	1813.4	4.7	78.3
July–Sept—	107.9	125.6	56.2	65.4	112.1	82.3	85.5	2419.7	3.5	79.2
Oct.–Dec—	107.7	127.2	52.6	62.2	112.2	81.4	84.8	3381.5	2.6	81.4
1985:										
Jan.–Mar—	107.5	129.3	48.3	58.0	112.2	79.5	83.0	4660.3	1.9	81.6
Apr.–June—	107.6	131.9	54.4	66.7	112.3	77.0	80.3	5960.8	1.4	75.0
July–Sept—	106.8	132.6	59.6	74.0	112.5	75.5	79.6	7828.8	1.0	76.3

1/ Exchange rates expressed in U.S. dollars per unit of foreign currency.

2/ Producer price indicators—intended to measure final product prices—are based on average quarterly indexes presented in line 63 of International Financial Statistics.

3/ The real value of a currency is the nominal value adjusted for the difference between inflation rates in the United States and the respective foreign country. Producer prices in the United States increased by 6.8 percent between January 1981–September 1985 compared with a 32.6-percent increase in the United Kingdom, a 12.5-percent increase in Korea, and a 7728.8-percent increase in Brazil during the same period.

Source: International Monetary Fund, International Financial Statistics, April 1984 and December 1985

Note.—January–March 1981=100.

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Capital costs

U.S. producer responses to the Commission's questionnaire indicate a belief that foreign forgers face lower capital costs than do U.S. forgers. The measurement of capital costs is complex and the specific ways in which capital costs may be higher in the United States were not indicated in the questionnaires. According to domestic industry sources, 1/ however, the major concerns are with foreign government subsidized loans to foreign forgers and a lesser ability of U.S. firms to attract funds. The Commission does not have confirmation of any instances of foreign government capital subsidies, however, a representative of a U.S. forger testified that he knew of a specific instance of a loan to a foreign forger by its home government at a below market interest rate. 2/ With respect to the second issue, the ability of a firm to attract funds depends on the expected future profitability of that firm, and as such reflects the capital market's judgment about the most profitable use of resources.

Regarding interest rates themselves, capital is generally mobile internationally; therefore, costs of capital should be nearly the same across countries. A simple comparison of nominal interest rates among countries cannot establish convergence or divergence of international costs of capital for reasons mentioned below. Moreover, even if properly adjusted market rates are the same, individual firms may have differing costs of capital depending on government policies toward particular firms or industries and on the firm's particular circumstances.

Market interest rates will vary most noticeably across countries with respect to differing expected inflation rates. In table 38, nominal and "real" interest rates (i.e., adjusted for actual inflation) are shown for the United States and major industrialized countries supplying forgings. The table shows that U.S. rates, both on a "real" and nominal basis, were among the highest during 1984 and 1985. As expected, however, the spread between nominal and "real" rates is narrower in the case of the "real" rates.

Market rates will also vary across countries because of differing tax policies, perceived political risks, expectations of currency fluctuations, foreign exchange and international capital movement restrictions, etc. Costs of capital faced by individual firms will also depend on tax treatment of depreciation and new investment and property income, perceived riskiness of the firm and/or its industry, its ability to generate funds internally, and direct and indirect government subsidies, among other things.

1/ Interviews with domestic forgers by USITC staff, January 1986.

2/ Transcript of the hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 58.

Table 38.--Long-term government bond rates for specified countries, nominal and inflation adjusted, 1981-84, and October 1985

Item	1981	1982	1983	1984	October 1985
United States:					
Nominal rate 1/	13.7	12.9	11.4	12.5	10.7
Inflation rate 2/	10.4	6.2	3.2	4.3	3.4
"Real" rate 3/	3.3	6.7	8.2	8.2	7.3
Japan:					
Nominal rate	8.7	8.1	7.4	6.8	6.1
Inflation rate	4.9	2.6	1.8	2.3	2.3
"Real" rate	3.8	5.5	5.6	4.5	3.8
West Germany:					
Nominal rate	10.4	9.0	7.9	7.8	6.4
Inflation rate	6.3	5.3	3.3	2.4	2.1
"Real" rate	4.1	3.7	4.6	5.4	4.3
Canada:					
Nominal rate	15.2	14.3	11.8	12.8	10.8
Inflation rate	12.4	10.8	5.8	4.3	4.0
"Real" rate	2.8	3.5	6.0	8.4	6.8
Italy:					
Nominal rate	20.6	20.9	18.0	15.0	13.5
Inflation rate	17.8	16.5	14.7	10.8	9.1
"Real" rate	2.8	4.4	3.3	4.2	4.4
United Kingdom:					
Nominal rate	14.7	12.9	10.8	10.7	10.4
Inflation rate	11.9	8.6	4.6	5.0	6.2
"Real" rate	2.8	4.3	6.2	5.7	4.2
Summary:					
Mean nominal rate	13.9	13.0	11.2	10.9	9.7
Standard error	4.2	4.6	3.8	3.1	2.9
Mean "real" rate	3.3	4.7	5.7	6.1	5.1
Standard error	.57	1.2	1.6	1.8	1.5

1/ Average long-term government bond rate in period. Presented in line 61 of International Financial Statistics.

2/ Percentage change in index of consumer prices over corresponding period of previous year. Consumer price indices presented in line 64 of International Financial Statistics

3/ Long-term government bond rate minus inflation rate.

International Trade Barriers

U.S. producers of forged products reported that their ability to service foreign markets is restricted by a number of foreign trade barriers. Table 39 lists the trade barriers considered in the Commission's survey and illustrates those most often encountered by U.S. producers in foreign markets. Exchange controls, financial support by foreign governments, local content requirements, and laws and practices that discourage imports were the most frequently cited barriers during the period of the study.

Exchange and other monetary or financial controls were indicated by 43 percent of the respondents as being barriers to international trade. The principal countries indicated were the United Kingdom, Canada, France, Japan, and Mexico. Representatives of the French Forging Association and certain European producers stated that the value of foreign currencies relative to the value of the U.S. dollar is the major factor that has helped to make foreign-produced forged products more competitive. 1/ Exchange rate changes among selected U.S. trading partners are addressed earlier in the report.

Forty-two percent of respondents alleged that foreign forgers have a competitive advantage because of government subsidies that are targeted to facilitate exports (to third markets). Domestic industry representatives claim that foreign governments provide subsidies for the purpose of maintaining employment at home. 2/ Specific programs provided by foreign governments are discussed in the previous section of this report on structural factors of competition.

Of all respondents, 26 percent alleged that local content requirements affected trade; e.g., Spanish car manufacturers are only permitted to import components for a value equivalent to 40 percent of the final value of the vehicle.

Laws and practices that discourage imports were indicated by 20 percent of the respondents as being a barrier to international trade. The importation of products into Brazil is controlled by a Government agency; whereas imports into Korea and Taiwan require an import license issued by one of the country's foreign exchange banks.

1/ Interviews with France's Association for Drop Forging and Forging (Paris, France), Nov. 22, 1985, and Gruppo Bertoldo (Turin, Italy), Nov. 26, 1985.
2/ Hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 14.

Table 39.--U.S. forging industry: International trade barriers experienced by U.S. producers in foreign markets, by number of responses and share of total respondents, 1981-84

Category of Barriers	Number of respondents indicating barriers	Percent of total respondents
Quantitative restrictions and similar specific limitations:		
Licensing requirements	11	12
Quotas	-	-
Embargoes	-	-
Export restraints	4	4
Exchange and other monetary or financial controls	40	43
Minimum/maximum price regulations	1	1
Local content requirements	24	26
Restrictive business practices	13	14
Discriminatory bilateral agreements	10	11
Discriminatory sourcing	5	5
Other	20	22
Nontariff charges on imports:		
"Border" taxes	2	2
Port and statistical taxes, etc.	-	-
Nondiscriminatory use and excise taxes and registrations fees	2	2
Discriminatory excise taxes, government-controlled insurance, use taxes, and commodity taxes	3	3
Nondiscriminatory sales taxes	-	-
Discriminatory sales taxes	-	-
Other taxes and fees	-	-
Government participation in trade:		
Subsidies and other aids	39	42
State trading, government monopolies, and exclusive franchises	12	13
Laws and practices that discourage imports	19	20
Government procurement	1	1
Other	12	13
Standards:		
Health and safety standards	-	-
Product content requirements	-	-
Processing standards	1	1
Industrial standards	-	-
Requirement on weights and measures	-	-
Labeling and container requirements	-	-
Marking requirements	-	-
Packaging requirements	-	-
Trademark problems	-	-

Table 39.--U.S. forging industry: International trade barriers experienced by U.S. producers in foreign markets, by number of responses and share of total respondents, 1981-84--Continued

Category of Barriers	Number of respondents indicating barriers	Percent of total respondents
Customs procedures and administrative practices:		
Antidumping practices	-	-
Customs valuation	-	-
Consular formalities	-	-
Documentation requirements	3	3
Administrative difficulties	2	2
Merchandise classification problems	-	-
Regulations on samples, returned goods, and re-exports	-	-
Countervailing duties	2	2
Emergency action	-	-
Other	-	-
Discriminatory ocean freight rates		
Other	10	11

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

The U.S. Market

Domestic market profile

Respondents to the Commission's questionnaire indicated that an overwhelming majority of all forged products are sent to original equipment manufacturers for assembly components for automobiles, trucks and buses, aircraft, machinery, and other equipment (table 40). The secondary distribution channel for all forged products was machine shops, where rough forgings are machined and finished before their sale to other processors. Captive production, which does not enter normal marketing channels, accounts for a significant portion of total industry production, particularly for the automotive, truck and bus, and machinery markets.

Predominant end-use markets reported by questionnaire respondents varied by type of forging, reflecting the different physical characteristics of each particular material and the end-use market for which the forging is best suited. Forged steel products are principally shipped to the passenger car and truck and bus markets, which accounted for 59 percent of these shipments in 1984 (table 41). Steel forgings for defense-related equipment, which accounted for about 5 percent of shipments in 1984, were primarily shipped to the ordnance and aircraft parts markets.

The principal end-market for aluminum forgings in 1984 was aircraft parts with 42 percent of the total. Secondary markets were trucks and buses (22 percent) and industrial machinery (12 percent). About 39 percent of forged aluminum product shipments for defense-equipment use went to the aircraft parts and ordnance markets, which accounted for nearly all shipments (94 percent).

Table 40.--U.S. forging industry: U.S. producers' shipments by channel of distribution for reporting forges, by types of forge, 1984

Channel of distribution	Percent of shipments 1/		
	Steel	Aluminum	Other
Machine shops	11	4	14
Distributors	4	1	9
Original-equipment manufacturers	79	96	74
Other	6	2/	3
Total	100	100	100

1/ Because of rounding, figures may not add to 100.
2/ Less than 0.5 percent.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Markets for other forged products were primarily aircraft engines, plumbing fixtures, and aircraft parts, accounting for 61 percent of respondents' shipments in 1984. Approximately 24 percent of total shipments were defense-related; 79 percent of these shipments were purchased by the aerospace sector for aircraft engines and parts in 1984.

Table 41.--U.S. forging industry: U.S. producers' shipments by type of markets for reporting forges, by types of forges, 1984

Market	Percent of shipments 1/					
	Steel		Aluminum		Other	
	Total	Defense only	Total	Defense only	Total	Defense only
Passenger cars	29	2/	5	0	1	0
Trucks and buses	30	9	22	0	1	0
Aircraft engines	1	9	2	1	25	39
Aircraft parts (except engines) including missiles	1	14	42	70	14	40
Off-highway equipment (construction, mining, and material handling)	9	5	2/	0	1	0
Ordnance (except missiles)	2	24	10	24	1	4
Marine equipment	1	6	1	1	1	1
Plumbing fixtures, valves, and fittings	2	2	1	2/	22	2
Oil field machinery and equipment	3	0	2/	0	2/	0
Railroad equipment	2	0	1	0	1	0
Farm machinery and equipment	3	0	0	0	1	0
Industrial machinery	6	4	12	0	13	2/
Other (incl. bearings and gears)	10	26	4	3	18	15
Total	100	100	100	100	100	100

1/ Because of rounding, figures may not add to 100.
2/ Less than 0.5 percent.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Forgings and the business cycle.--The forging industry, like any durable goods related industry, is heavily affected by the business cycle. As can be seen in table 42, output in the forging industry is more volatile than output in the general economy (gross national product-GNP). In years of above normal growth in real (constant dollar) GNP, growth in forgings production tends to be higher than real GNP growth. In years of below-normal real GNP growth, forgings output tends to be very low or negative. This pattern is more evident in the production of iron and steel forgings. The military buildup and withdrawal in Vietnam had a large effect on heavily aerospace-related nonferrous forgings production. This war-related bubble masks somewhat the basic business cycle pattern in nonferrous forgings, but elements of the pattern can be seen, especially since the end of direct American involvement in Vietnam.

Recession-peak-to-trough drops in iron and steel forgings production have been 17.6 percent in 1970-71, 5.6 percent in 1975, 9.0 percent in 1980, and 41.9 percent in 1981-83. This compares with drops in net investment in producers' durable equipment during the same periods of 17.6 percent, 48.9 percent, 31.9 percent, and 57.5 percent, respectively. It should be noted that in the first full year (1983) of the most recent recovery, while real GNP rose 3.7 percent, and net investment in producers' durable equipment rose 7.1 percent, output of iron and steel forgings fell 18.7 percent, the second largest (next to 1982) drop in iron and steel forgings production over the time period covered. Comparable data on forgings production for 1984 have not been published.

Table 42.--Forgings, annual value of shipments of U.S. producers, in current and constant (1972) dollars, 1/ 1963-83

Year	Iron and steel forgings 2/			Nonferrous forgings			GNP, percent change from previous year, constant dollars
	Current dollars	Constant (1972) dollars	Percentage change from previous year, constant dollars	Current dollars	Constant (1972) dollars	Percentage change from previous year, constant dollars	
1963	1,075.6	1,500.8	-	198.4	276.8	-	-
1964	1,234.4	1,696.3	13.0	214.9	295.3	6.7	5.3
1965	1,364.8	1,835.4	8.4	236.7	318.6	7.9	6.0
1966	1,506.7	1,962.9	6.9	334.1	435.3	36.6	6.0
1967	1,550.7	1,961.4	-.1	348.1	440.3	1.1	2.7
1968	1,617.4	1,959.5	-.1	320.7	388.5	-11.8	4.6
1969	1,738.4	2,003.0	2.2	350.5	403.8	3.9	2.8
1970	1,561.9	1,707.9	-14.7	320.8	350.8	-13.1	-.2
1971	1,584.4	1,650.2	-3.4	301.6	314.1	-10.5	3.4
1972	1,838.7	1,838.7	11.4	280.8	280.8	-10.6	5.7
1973	2,202.5	2,082.7	13.3	370.4	350.3	24.8	5.8
1974	2,732.1	2,374.1	14.0	466.0	404.9	15.6	-.6
1975	2,818.5	2,240.6	-5.6	511.3	406.5	.4	-1.2
1976	3,122.1	2,359.2	5.3	508.6	384.3	-5.5	5.4
1977	3,349.2	2,391.4	1.4	540.4	385.9	.4	5.5
1978	3,852.2	2,561.0	7.1	681.9	453.3	17.5	5.0
1979	4,262.4	2,608.2	1.8	863.8	528.6	16.6	2.8
1980	4,234.4	2,373.3	-9.0	1,107.9	621.0	17.5	-.3
1981	4,717.7	2,411.9	1.6	1,254.9	641.6	3.3	2.5
1982	3,571.2	1,722.1	-28.6	1,210.9	583.9	-9.0	-2.1
1983	3,016.8	1,400.9	-18.7	1,187.3	551.4	-5.6	3.7

1/ Forgings production deflated using Gross National Product (GNP) implicit deflator, 1972=100.
2/ Includes forgings produced in steel mills.

Source: U.S. Department of Commerce, Census of Manufactures, Annual Survey of Manufactures.

Developments in the aerospace market.--The aerospace industry consumed approximately 13 percent of U.S. shipments of steel forgings, 78 percent of aluminum forgings, and 59 percent of other metallic forgings in 1984. 1/ Aerospace forgings must conform to aircraft quality standards, being produced under closely controlled melting and fabrication practices to minimize nonmetallic inclusions and surface and internal flaws. The difficult-to-fabricate materials required for aircraft applications often demand slow or controlled forging techniques or even a combination of several processes. These requirements have prompted the U.S. forging industry to continually develop and improve its understanding of the materials and technologies involved in this market. Because the aerospace manufacturers' demands have become increasingly detailed and exact, this segment of the forging market has evolved into a high-tech science utilizing advanced materials and forging processes. 2/

In the materials area, new alloys of aluminum, titanium, and steel have been developed and incorporated into aerospace forgings. There has also been an important increase in the total weight of forged superalloys in aircraft applications, particularly engines. Additionally, advanced materials melting techniques, including specially designed and controlled thermomechanical processes, are being used to develop and produce alloys with superior mechanical and microstructural properties. 3/

In conjunction with improvements in materials, advanced hot die and isothermal forging processes have contributed to achieve improved shape formation at a moderate cost. Larger, specially equipped presses are also advancing conventional forging technology. However, the use of hot die and isothermal forging processes are expected to further expand the use of new alloys for aerospace applications. Also, very close tolerance forgings in some moderately large aircraft parts have also been developed using these forging techniques. 4/ Although these two processes require special dies and controlled conditions, industry sources note that they offer a large number of advantages, including forging to closer tolerances and reduced machining costs. Industry sources indicate that isothermal forgings will be growing at the expense of conventional aerospace forgings, possibly resulting in 10 to 20 percent of total aircraft applications in the next 5 years. 5/

Industry officials indicate that aerospace manufacturers are the main area for which forged components are isothermically produced. As noted earlier, this method of production dictates specialized machinery and environments that are expensive to acquire and/or install. The aircraft industry's need for precision components, and their use of exotic, lightweight

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1/ Data received in response to questionnaires of the U.S. International Trade Commission.

2/ Forging Industry Association and the American Society for Metals, Forging Handbook, 1985, p. 1 and 24.

3/ Ibid, p. 134.

4/ Forging Industry Association and the American Society for Metals, Forging Handbook, 1985, pp. 1 and 24.

5/ Harry Chandler, "Emerging Trends In Aerospace Materials and Processes," Metal Progress, April 1984, p. 28.

alloys, has justified the use of the more costly isothermal forging process. The costs associated with high technology forgings are expected to decrease as the usage of this process expands, according to industry sources. Currently, however, the expense associated with isothermal forging significantly limits its application in areas other than aerospace.

Aerospace forgings is one of the few segments of the U.S. forging industry that is not facing a large degree of import competition. The primary reason that imports of aerospace forgings have faced little import competition is that the U.S. industry is much more technologically advanced than the foreign aerospace forging industry. In addition, many of the forgings produced for aerospace use, as well as other defense related products, are subject to the Buy American Act. This Act states that certain products purchased by the U.S. military must be produced by domestic manufacturers.

Industry sources indicate that there are approximately 14 major foreign firms, located in 8 countries, that produce aerospace forgings for incorporation in either the airframe or the engine (table 43). Discussions with domestic producers and purchasers of aerospace forgings indicate that, for the most part, foreign-made products are not competitive with U.S. produced forgings. Most foreign suppliers, while often selling at lower prices, are not believed to be technically proficient or do not have adequate production capabilities when compared with the U.S. industry. Three firms, located in the United Kingdom, France, and Israel, were noted to be somewhat competitive in conventional forgings. In the other forging areas, most specifically isothermal forgings, foreign manufacturers do not yet have the experience to supplant the established marketing relationships U.S. aerospace forging companies have with airframe and engine manufacturers. 1/

1/ Statement of Paul Haussman, Wyman-Gordon Corp., at the public hearing, Jan. 21, 1986, p. 44.

Table 43.--Aerospace forgings: Major foreign producers, by countries, 1985

Firm	Country
Cameron Iron Works 1/	Scotland
Daniel Dunn Caster	Great Britain
Smith Clayton	Great Britain
HDA	Great Britain
DEW	West Germany
Thyssen	West Germany
VEW	Austria
Forgeal	France
C3F Co.	France
Aubert DuVal	France
Carmel	Israel
Kobelco	Japan
Daido	Japan
S.I.T. 2/	Italy

1/ This firm is a subsidiary of a U.S. producer.
2/ Currently not in production; was expected to reopen in January 1986.

Source: Compiled from discussions with industry officials, December 1985.

U.S. consumption and trade

U.S. consumption of representative forged products, 1/ shipments of which accounted for nearly 50 percent of total industry shipments, declined from $2.5 billion in 1981 to $2.1 billion in 1982 and 1983, before rising to $2.5 billion in 1984 (table 44). Weak demand in the automotive, agriculture, construction, and oilfield markets caused the decline in consumption during 1982-83; however, domestic shipments rose in 1984, largely attributable to the recovery in the automotive and construction markets.

1/ The products covered include forged steel crankshafts, forged steel connecting rods, forged steel undercarriage components, forged steel axles and spindles, steering arms and knuckles, forged steel valves and valve bodies, forged steel fittings and flanges, forged steel transmission parts, forged steel hooks, shackles, loadbinders, and other attachments, and forged metal turbine rotor and generator components.

Table 44.--Certain forged products: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1981-84, January-August 1984, and January-August 1985

Year	Domestic shipments	Exports	Imports	Apparent consumption	Ratio (percent) of imports to consumption
	Value (1,000 dollars)				
1981	2,185,783	100,562	386,171	2,471,392	15.6
1982	1,839,933	79,390	339,857	2,100,400	16.2
1983	1,758,824	69,240	362,597	2,052,181	17.7
1984	1,973,519	79,238	606,686	2,500,967	24.3
January-August:					
1984	1,363,496	46,607	409,749	1,726,638	23.7
1985	1,286,371	69,141	454,361	1,671,591	27.2

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission and from official statistics of the U.S. Department of Commerce.

The reported value of U.S. exports and imports followed different patterns during 1981-84. The value of exports trended downward from $100.6 million in 1981 to $79.2 million in 1984, with exports of forged steel products accounting for an increasing share of the total. The value of imports of selected forged products declined by 6 percent during 1981-83 to $362.6 million in 1983 before rising by 67 percent to $606.7 million in 1984. As a share of apparent consumption, the value of imports increased from 15.6 percent in 1981 to 24.3 percent in 1984 and 27.2 percent during January-August 1985.

Imports by U.S. producers.--Imports by U.S. producers of all forged products rose by 88 percent to $56.3 million during 1981-84 (table 45), with imports of forged steel products more than doubling during the period. No imports of forged alumimum products were recorded. Imports as a share of shipments increased slightly during the period. U.S. producers reported lower prices, favorable foreign exchange rates, and price-related factors, such as the cost of tooling and terms of sale, as the principal reasons for their imports (table 46).

Table 45.--U.S. forging industry: U.S. producers' imports, 1981-84, January-August 1984, and January-August 1985

(In thousands of dollars)

Item	1981	1982	1983	1984	January-August	
					1984	1985
Forged steel products	21,474	21,773	24,096	47,358	29,768	31,864
Forged aluminum products	-	-	-	-	-	-
Other forged products	8,500	8,600	8,000	8,981	5,481	3,587
Total	29,974	30,373	32,096	56,339	35,249	35,451

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 46.--U.S. forging industry: U.S. producers' ranking of product-related factors that were the principal reasons for their imports, 1981-84

Reason for importing	Ranking 1/		
	Steel	Aluminum	Other
Lower purchase price (delivered)	1	-	1
Cost of tooling/dies	3	-	3
Shorter delivery time	7	-	-
Engineering/technical assistance	6	-	-
Favorable terms of sale	6	-	3
Favorable product guarantees	-	-	-
Favorable exchange rates	2	-	1
Historical supplier relationship	3	-	-
Product performance features:			
Superior design	8	-	-
Quality	3		
More durable	-	-	-
Other	-	-	3

1/ Ranking numbers range from 1 to 8, number 1 indicating the most important reason for importing and number 8 indicating the least important reason for importing.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table 47 displays domestic consumption and trade data for the nine products covered in the report. Further discussion of these data is included in the individual product write-ups (I-VIII).

Table 47.—Certain forged products: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-Aug— 1984	January-Aug— 1985	Percentage change, 1984 from 1981
Forged steel crankshafts:							
Producers' shipments million dollars—	154	65	60	96	66	46	-37.7
Exports—do—	10	13	5	5	2	1	-50.0
Imports—do—	108	63	76	111	72	69	+2.8
Apparent consumption million dollars—	251	115	131	202	136	114	-19.5
Ratio of imports to consumption percent—	43.0	54.4	58.1	55.1	52.8	60.7	+28.1
Forged steel connecting rods:							
Producers' shipments million dollars—	62	48	57	69	49	50	+11.3
Exports—do—	2	2	7	9	6	6	+350.0
Imports—do—	17	14	15	28	19	20	+64.7
Apparent consumption million dollars—	77	60	65	88	61	64	+14.3
Ratio of imports to consumption percent—	22.4	23.6	23.7	31.5	30.7	31.8	+40.6
Forged steel undercarriage components:							
Producers' shipments million dollars—	167	143	162	190	136	120	+13.8
Exports—do—	9	10	13	16	10	16	+77.8
Imports—do—	31	60	60	101	76	83	+225.8
Apparent consumption million dollars—	186	194	210	275	202	187	+46.3
Ratio of imports to consumption percent—	14	31	29	37	38	44	+164.3

See footnotes at end of table.

Table 47.—Certain forged products: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1981-84, January-August 1984, and January-August 1985—Continued

Item	1981	1982	1983	1984	January-Aug— 1984	January-Aug— 1985	Percentage change, 1984 from 1981
Forged steel axles and spindles, steering arms and knuckles:							
Producers' shipments million dollars—	391	373	486	557	384	380	+42.5
Exports—do—	7	5	9	15	11	11	+114.3
Imports—do—	38	27	46	99	66	86	+160.5
Apparent consumption million dollars—	422	396	523	640	439	455	+51.7
Ratio of imports to consumption percent—	9.1	6.9	8.8	15.4	15.1	18.9	+69.2
Certain forged steel valves and valve forgings:							
Producers' shipments million dollars—	144	117	55	59	40	40	-59.0
Exports—do—	17	12	10	6	4	5	-64.7
Imports—do—	13	13	9	10	7	7	-23.1
Apparent consumption million dollars—	140	119	53	63	43	42	-55.0
Ratio of imports to consumption percent—	9.0	11.0	16.7	16.2	15.6	17.5	+80.0
Forged steel fittings and flanges:							
Producers' shipments million dollars—	315	244	149	155	106	105	-50.8
Exports—do—	7	5	5	2	1	1	-71.4
Imports—do—	88	67	61	118	77	94	+34.1
Apparent consumption million dollars—	399	305	205	271	182	198	-31.7
Ratio of imports to consumption percent—	22.2	21.8	29.9	43.5	42.1	47.6	+95.9

See footnotes at end of table.

Table 47.—Certain forged products: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1981-84, January-August 1984, and January-August 1985—Continued

Item	1981	1982	1983	1984	January-Aug— 1984	January-Aug— 1985	Percentage change, 1984 from 1981
Forged steel transmission parts:							
Producers' shipments million dollars—	379	264	295	362	253	215	-4.5
Exports———do———	1	1	2/	2/	2/	2/	1/
Imports———do———	46	31	45	67	43	41	+45.7
Apparent consumption million dollars—	424	294	340	430	296	256	+1.4
Ratio of imports to consumption percent—	10.9	10.5	13.3	15.7	14.6	16.1	44.0
Forged steel hooks, shackles, and loadbinders:							
Producers' shipments million dollars—	73	55	55	66	46	42	-9.6
Exports———do———	3	2	2	2	2	1	-33 3
Imports———do———	10	20	17	34	25	12	+240.0
Apparent consumption million dollars—	80	73	70	98	69	53	+22.5
Ratio of imports to consumption percent—	12.1	27.5	24.4	34.3	36.2	22.5	+183.5
Forged metal turbine rotor and generator components:							
Producers' shipments million dollars—	502	530	441	418	284	288	-16.7
Exports———do———	44	30	18	23	11	27	-47.7
Imports———do———	35	45	32	39	24	41	+11.4
Apparent consumption million dollars—	493	545	454	435	298	302	-11.8
Ratio of imports to consumption percent—	7.2	8.2	7.0	9.0	8.2	13.5	+25.0

1/ Insufficient data.
2/ Less than $500,000.

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

Note.—Because of rounding, totals may not add to the figures shown.

Competitive Assessment of Product-Related Factors of Competition in the U.S. Market

U.S. forgers and importers were requested, through the Commission's questionnaires, to provide an overall assessment of how effectively domestic and foreign products competed in the U.S. market. Importers accorded an overall advantage to foreign producers in all but one product category, turbine rotor and generator components (table 48). Domestic forgers concurred in all but two instances, turbine rotor and generator components, and hooks, shackles, and loadbinders. In these two instances, domestic and foreign forgers were viewed as equally competitive. On a country-by-country basis, U.S. producers accorded all foreign producers an overall competitive advantage, with importers following suit in all but two instances, Canada and the United Kingdom. In these two instances, domestic forgers were rated as having a competitive advantage over Canadian forgers and as equally competitive with forgers in the United Kingdom (table 49).

The advantages accorded foreign producers by U.S. producers and importers were concentrated in cost areas, such as pricing, favorable exchange rates, and cost of tooling and dies. Of these items, price was cited by purchasers as the single most important factor influencing their decisions to purchase foreign forgings, followed by the cost of tooling and dies, favorable exchange rates, which is price-related, and product quality (table 50). Decisions by purchasers to buy domestic forgings, on the other hand, were influenced most by shorter delivery time, reliability of supplier, the technical assistance provided by U.S. firms, and product quality.

Table 48.—U.S. forging industry: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-produced forged products in the U.S. market, 1/ and the principal factors (x) underlying overall competitive advantages, by product categories, 1984-85

Item	Forged steel crankshafts		Forged steel connecting rods		Forged steel under-carriage components		Forged steel axles and spindles, steering arms and knuckles		Forged steel valves and valve bodies		Forged steel fittings and flanges		Forged steel transmission parts	
	P	I	P	I	P	I	P	I	P	I	P	I	P	I
Overall competitive advantage	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Principal factors:														
Lower purchase price (delivered)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cost of tooling/dies	X		X		X	X	X	X	X	X	X		X	X
Shorter delivery time										X				
Engineering/technical assistance		X		X										
Favorable terms of sale	X					X			X					
Favorable product guarantees														
Favorable exchange rates		X	X		X	X	X		X		X	X	X	X
Reliability of supplier				X						X				
Product performance features:														
Superior design														
Quality		X		X		X								
More durable														

Item	Forged steel hooks, shackles, and loadbinders		Forged metal turbine rotor and generator components	
	P	I	P	I
Overall competitive advantage	S	F	S	D
Principal factors:				
Lower purchase price (delivered)		X		X
Cost of tooling/dies		X		
Shorter delivery time				X
Engineering/technical assistance				
Favorable terms of sala				
Favorable product guarantees				
Favorable exchange rates		X		
Historical supplier relationship				X
Product performance features:				
Superior design				
Quality		X		
More durable				

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same. X = over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

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Table 49.—U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made forged products in the U.S. market, 1/ by major foreign sources, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Taiwan		Japan		Korea		Brazil		West Germany		Italy		United Kingdom		Canada	
	P	I	P	I	P	I	P	I	P	I	P	I	P	I	P	I
Overall competitive advantage	F	F	F	F	F	F	F	F	F	F	F	F	F	S	F	D
Principal factors:																
Lower purchase price (delivered)	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Cost of tooling/dies	X	X	X	X	X	X	X		X	X	X	X	X		X	
Shorter delivery time																
Engineering/technical assistance										X						
Favorable terms of sale							X				X		X		X	
Favorable product guarantees																
Favorable exchange rates	X	X	X		X	X	X	X	X	X	X	X	X		X	
Reliability of supplier						X				X						
Product performance features:																
Superior design																
Quality				X		X				X						
More durable																

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same. X = over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

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Table 50.--U.S. forging industry: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984

Reason for purchase	U.S.-produced forgings	Foreign-made forgings
Lower purchase price (delivered)	5	1
Cost of tooling/dies	6	2
Shorter delivery time	1	10
Engineering/technical assistance	3	6
Favorable terms of sale	11	11
Favorable product guarantees	8	8
Favorable exchange rates	10	3
Reliability of supplier	2	5
Product performance features:		
Superior design	7	7
Quality	4	4
More durable	9	9

1/ Ranking numbers range from 1 to 11, number 1 indicating the most important reason for purchase and number 11 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Pricing.--In order to develop insights into the nature of the price competitiveness of U.S. and foreign forgers, the Commission requested purchasers to supply information which would enable price comparisons for like products in each of the nine industries profiled. The Commission recognizes that there are many conceptual and practical problems associated with developing such a series, and that the results may not necessarily indicate overall advantages or disadvantages for domestic and foreign firms. Specifications, shipment sizes, credit terms, destinations, and transportation costs, for example, cannot often be matched, yet these factors are important to an accurate evaluation. In the final analysis, the data supplied by purchasers were too fragmentary to permit meaningful comparisons.

During the investigation, though, certain information on pricing was provided through written and oral testimony. Although these data are too limited to be representative of the industry, they relate specific experiences of forge purchasers and U.S. producers during the study period that provide insights to pricing concerns raised by the industry, and so we have included them. One U.S. producer that competed internationally during the 1970's indicated that its price competitiveness in large forgings has deteriorated during the 1980's. 1/ In 1982, foreign prices were 25 to 30 percent below those of the domestic firm; in a recent instance a foreign forger had quoted a price 69 percent lower than the domestic forger. Another U.S. producer

1/ Transcript of the hearing before the U.S. International Trade Commission, Jan. 21, 1986, pp. 21-22.

discussed price developments in the crankshaft market. 1/ Its bids of $199 and $175 for 1985 and 1987 production, respectively, had been undercut by foreign producers with winning bids that had fallen from $185 for 1985 production, to $175 and $125 in the two following years. The significant discounts on imported merchandise reported by U.S. producers was confirmed by a U.S. purchaser that indicated that it was able to purchase foreign forgings at a delivered price 50 to 70 percent less than the delivered price for U.S. forgings. 2/

Information on pricing was also developed during the course of investigations conducted by the Commission on certain forged undercarriage components from Italy and certain steel valves from Japan. In the undercarriage components investigation, quarterly prices paid for imported merchandise from Italy consistently reflected margins of underselling during January 1981-September 1983; the margins ranged from 3.1 to 31.8 percent for semifinished links, and from 8.5 to 24.3 percent for semifinished rollers. 3/ In the investigation on valves, imports from Japan were characterized as generally lower priced than domestically produced valves during January 1982-March 1984, with imported valves from other countries tending to be lower priced than Japanese products. 4/ The margins of underselling of Japanese products ranged from 1 to 35 percent. 5/ 6/

Finally, petitions filed in January 1986 by the U.S. Butt-Weld Pipe Fittings Committee alleging injury, or threat thereof, due to sales of certain finished carbon steel butt-weld pipe fittings from Japan, Brazil, and Taiwan at less than fair value indicate that prices of certain foreign fittings from the countries were 8 to 47 percent below those of U.S. producers during the second quarter of 1985. 7/

Other factors.--As indicated by both producers and importers, the advantages accorded foreign producers go beyond the issue of competitive pricing. Foreign producers were given an across-the-board advantage, for example, with respect to the cost of tooling and dies. Such costs, which can

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1/ Transcript of the hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 26.

2/ Prehearing brief, Caterpillar Tractor Co., p. 3.

3/ Certain Forged Undercarriage Components from Italy (investigation No. 701-TA-201), USITC Publication 1465, pp. 10-12 and A-31.

4/ Certain Steel Valves and Certain Parts Thereof from Japan (investigation No. 731-TA-145), USTIC Publication 1556, pp. A-60 to A-65.

5/ Margins of overselling, by as much as 60 percent, were also detected.

6/ The preliminary investigation cited a margin of underselling as high as 39.8 percent during April-June 1981 (see Certain Steel Valves and Certain Parts Thereof from Japan (investigation No. 731-TA-145), USITC Publication 1446, p. A-25).

7/ Petition before the U.S. Department of Commerce and the U.S. International Trade Commission in the matter of Certain Finished Carbon Steel Butt-Weld Pipe Fittings from Japan, p. 18, and Petition Before the U.S. Department of Commerce and the U.S. International Trade Commission in the Matter of Certain Finished Carbon Steel Butt-Weld Pipe Fittings from Taiwan, p. 22.

constitute considerable up-front expenditures, are often borne by purchasers. In some instances, it was alleged, foreign firms offer free tooling or rebates of tooling charges on higher volume orders to assist in making sales. Other methods allegedly used by foreign producers to assist in making sales of forged products include favorable sales terms, such as financing and extended payment terms, forgings on consignment for lengthy periods of time, pre-paid freight, warehousing close to customers, and providing better engineered or closer product tolerances.

Competitive Assessment of Product-Related Factors of Competition in Foreign Markets

The level of U.S. exports of all forged products, which accounted for 4 to 6 percent of producers' shipments during 1981-84, is adversely affected by their higher price compared with that of most foreign-produced products. U.S. exporters of forged products that responded to the Commission's questionnaire evaluated their competitive position in foreign markets with eight foreign countries, as shown in table 51. All foreign countries included in the evaluation were considered to have an overall competitive advantage over U.S. producers in foreign markets. The principal factors for these advantages were lower purchase prices, cost of tooling and dies, and favorable sales terms and exchange rates.

Table 51.—U.S. forging industry: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made forgings in foreign markets, 1/ by major U.S. export markets, and the principal factors (X) underlying overall competitive advantages, 1981-84

Item	Taiwan	Japan	Korea	Brazil	West Germany	Italy	United Kingdom	Canada
Overall competitive advantage	F	F	F	F	F	F	F	F
Principal factors:								
Lower purchase price (delivered)	X	X	X	X	X	X	X	X
Cost of tooling/dies	X	X	X	X	X	X	X	X
Shorter delivery time						X	X	
Engineering/technical assistance								
Favorable terms of sale	X	X	X	X		X	X	X
Favorable product guarantees								
Favorable exchange rates	X	X	X		X	X		X
Reliability of supplier								
Product performance features:								
Superior design								
Quality								
More durable								

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; and S = Competitive position the same. X = over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. Producers' Responses to Import Competition

U.S. producers, in response to increased import competition in their U.S. markets, have taken a number of actions (table 52). The most common response was reducing prices. Evidence of such reductions can be detected in the investigation conducted by the Commission on forged steel valves and forged undercarriage components. In the case of valves, data collected by the Commission indicate that prices received by U.S. producers generally declined during 1982 and 1983. 1/ The report on the preliminary investigation shows that prices of carbon steel wedge gate valves increased from $350 per piece during January-March 1981 to $399 in the following 3-month period before declining irregularly to $193 per piece in the final July-September 1983 period. The price of stainless steel wedge gates also declined during the period, but by a smaller margin (i.e., 16 percent (peak-to-trough) versus 52 percent). With respect to undercarriage components, the Commission report on the investigation indicates that the weighted average price received by domestic producers for semifinished rollers increased during October-December 1981, but that prices declined during the first two quarters of 1982 and showed little changes in the following quarters (through July-September 1983). 2/ Information on price reductions were also presented in the petitions filed by U.S. producers of butt-weld pipe fittings in January 1986. The petitions indicate that domestic producers' prices of four types of fittings fell from 21.9 to 24.3 percent from the first quarter of 1983 to the second quarter of 1985. 3/

Pricing data compiled by the Bureau of Labor Statistics may also provide insights into the extent to which prices have declined. 4/ Such data indicate that prices of iron and steel forgings in December 1985 were 2.3 percent below those prevailing in December 1983 (when the current pricing series was established). During the same time period prices of nonferrous forgings increased 4.1 percent, which is somewhat higher than the 3.7-percent increase registered in the prices of all finished goods. The largest increase occurred in prices of hot impression aluminum forgings (up 12.3 percent), while the sharpest declines occurred in prices of hot impression titanium forgings and open die steel forgings (down 8.2 and 6.2 percent, respectively). 5/

In addition to lowering prices, other responses to import competition included cost reduction efforts, improving quality of the products, cutting back production, and reducing or dropping plans to expand capacity. Interviews with foreign forgers revealed that foreign industries generally

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1/ Certain Steel Valves and Certain Parts Thereof from Japan (Preliminary) (investigation No. 731-TA-145), USITC Publication 1446, p. A-26.

2/ Certain Forged Undercarriage Components from Italy (Final) (investigation No. 701-TA-201), USITC Publication 1465, pp. 10-12.

3/ Petition before the U.S. Department of Commerce and the U.S. International Trade Commission in the Matter of Certain Finished Carbon Steel Butt-Weld Pipe Fittings from Taiwan, p. 22.

4/ See U.S. Deparment of Labor, Bureau of Labor Statistics, Producer Price Indexes Data for December 1985.

5/ Certain grades (or subcategories) of hot impression and open die steel forgings exhibited greater price declines.

Table 52.—Forging industry: Frequency of responses by U.S. producers indicating responses to increased competition from foreign-made forgings, 1981-84

Nature of response	Forged steel crankshafts	Forged steel undercarriage components	Forged steel: steering arms and knuckles, axles, and spindles	Forged steel valves and valve forgings	Forged steel fittings and flanges	Forged steel transmission parts	Forged steel hooks, shackles, and loadbinders	Forged metal turbine rotor and generator components
Took no or few actions because your firm:								
Had already shifted production to more advanced type of forgings	3	0	1	3	5	0	1	1
Had already shifted production to other lines of forgings	1	0	0	4	5	0	3	1
Lacked capital funds to counter foreign competition	1	2	5	6	3	12	4	3
Took the following actions:								
Lowered prices or suppressed price increases to maintain market share	15	19	27	31	29	15	15	13
Reduced or dropped plans to expand capacity	5	9	10	14	12	8	5	5
Cut back production	9	13	12	20	16	19	10	8
Closed production lines or manufacturing	6	8	5	10	7	4	3	4
Shifted to more advanced types of forgings	3	4	7	5	5	0	4	4
Implemented cost-reduction efforts	14	17	29	30	28	19	15	11
Improved quality of the products	12	13	22	22	18	15	9	9
Imported	0	2	3	2	5	4	1	0
Opened a plant to manufacture abroad	1	0	0	0	0	0	0	1
Other	0	0	0	0	0	0	0	0

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

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have responded to competitive pressures in much the same manner as the U.S. industry. Opening a plant to manufacture abroad was the least selected option by U.S. producers.

Certain U.S. producers took no actions or few actions, principally because of a lack of capital funds to counter foreign competition.

Implications of the Forging Industry's Competitive Position

U.S. forging industry

Forging as a manufacturing process affords many advantages over other types of metal forming with respect to ensuring component strength and reliability. Recent developments in forging technology, such as the forging of previously "unforgeable" materials, have significantly expanded the range of properties and potential applications available from forgings. Despite these favorable trends, and although demand increased in the U.S. market during 1984-85 compared with 1982-83, industry representatives are neither anticipating a return to the boom years of 1979-80 nor a significant decline in the import share of U.S. consumption.

The uncertain outlook for demand is a function of several variables, including developments in major consuming industries in the United States, which are themselves confronting challenges in the import area. For example, U.S. automotive industry suppliers are becoming increasingly international in scope as U.S. automakers continue to seek lower cost sources of supply in order to remain competitive with foreign vehicle manufacturers. In addition, forgings are increasingly traded as components of engines and other complete assemblies. Although questionnaire responses from U.S. purchasers did not provide sufficient data to assess the magnitude of this trend, field discussions with both foreign and domestic industry sources suggest that the importation of finished assemblies represent lost production for U.S. forges.

In addition, challenges posed by competition from alternative materials such as cast metals, plastics, and ceramics also affects demand for forgings. Both domestic and foreign forgers have experienced increased competition from cast products. U.S. passenger automobiles now almost exclusively contain lower-priced cast crankshafts, while advances are currently being made in cast crankshafts for certain diesel engines. In addition, competition is expected from ceramics and plastics for automotive applications before the year 2000.

Foreign producers of forged products were consistently cited by U.S. producers, importers, and purchasers as having competitive advantages in many competitive factors, from lower prices to certain product-performance features. In fact, certain U.S. purchasers claim to have purchased foreign forgings at a delivered price 50-70 percent less than the delivered price of U.S.-produced forgings. 1/ In addition, foreign producers claim to have

1/ Prehearing brief, Caterpillar Tractor Co., p. 3.

improved product quality in recent years and allege that U.S. producers have invested a smaller portion of earnings toward upgrading plant and equipment. 1/

Other foreign representatives, however, claim that increased import competition is due to the price differentials caused by exchange rates; thus, should the dollar continue to fall relative to major trading partner currencies, U.S. producers will become more price competitive and regain market share. 2/ Another factor in the current price disparity between domestic and foreign forged products may be foreign government subsidies or aid to its industries. For example, France, Italy, and the United Kingdom all have state-owned steel mills, while these governments are also involved downstream with certain automotive firms. U.S. industry sources allege that a foreign producer received an interest-free loan to construct a new forging facility and that the loan was only to be repaid when the company became profitable. 3/

The total estimated value of imports as a percentage of U.S. consumption rose steadily from 16 percent in 1981 to 24 percent in 1984. However, certain individual forged products have experienced much higher levels of import penetration, ranging from 30 percent to 55 percent. Import penetration is likely to continue growing in certain areas, most notably forged steel fittings and flanges, forged steel crankshafts, forged steel hooks, and forged steel undercarriage parts, principally because of the lower labor costs and price-related advantages which were identified with foreign-made products. Because production of many catalog items (typically higher-volume products wherein price is the prime purchase consideration) does not require sophisticated manufacturing processes, further competition is likely to develop from countries not currently supplying the U.S. market.

Foreign industry sources claim that responsive delivery and postdelivery support, and providing better engineered or closer product tolerances (to reduce customer machining and finishing costs) are important elements in their success in the U.S. market. 4/ 5/ Certain domestic purchasers of forged products have adopted a "just-in-time" delivery system in order to reduce the cost of maintaining costly inventories. Hence, by maintaining warehouses close to their customers and providing more customized technical services, foreign producers claim that they have been better able to meet the needs of their U.S. customers. 6/

Some of the largest European forges have increased capacity in recent years, thus many medium-sized European firms have faced increased competition in their home markets and are also targeting the U.S. market as part of a

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1/ Interviews with the Industrial Association of German Forges (Hagen, West Germany) and Kampwerk (Plettenberg, West Germany), Nov. 20, 1985.

2/ Interview with the French Association for Drop Forging and Forging, Paris, France, Nov. 21, 1985.

3/ Hearing before the U.S. International Trade Commission, January 21, 1986, p. 58.

4/ Post hearing brief, Sumitomo Metal Industries, Ltd., p. 2.

5/ Prehearing brief, Caterpillar Tractor Co., p. 3.

6/ Post hearing brief, Sumitomo Metal Industries, Ltd. p. 2.

deliberate marketing strategy. In addition, many of the large European firms either own, are owned by, or are part of a steelmaker. Beyond raw material prices, this is an important factor in the future application of precision forging wherein geometrical and surface tolerances are crucial. Foreign industry sources claim that integrated steel manufacturers have an advantage because they can systematically control the quality of the forged product throughout the steelmaking process. 1/ U.S. producers allege that integrated foreign producers are able to take advantage of low transfer pricing arrangements to engage in diversionary dumping. 2/

The widespread use of microalloyed steels by certain European forges has reduced costs by omitting heat treatment, straightening, and stress relieving operations. 3/ Domestic producers state that foreign steel suppliers have quoted prices for microalloyed steel that are much higher than the prices quoted for other raw steel, thus offsetting the benefits of not heat treating. These producers add that the U.S. steel industry is working on catching up in the production of microalloyed steel. 4/

U.S. producers dispute claims that the U.S. forging industry is technologically inferior to its foreign counterparts. 5/ Many large U.S. firms have incorporated CAD/CAM, while other domestic firms are employing statistical process/quality control methods, conducting research into materials, applying techniques to produce net and near-net shapes, and utilizing robots and other automatic materials handling systems. 6/

In response to increased import competition, U.S. producers have reduced production, lowered prices, and cut employment; thus, without the ability to generate profits, they are left with little to fund investment and research and development. The future of the industry could be one of increasing concentration and stratification with the potential loss of a number of small- to medium-sized firms. The industry structure could include a few large, highly automated forges dealing in high-volume work, some medium-sized specialists, and a number of small jobbing firms. Most important, the forges that survive must actively develop new uses for forgings, because product designs planned by customers will increasingly have more options for alternative materials and manufacturing processes.

Any restructuring of the U.S. industry could include further reductions in certain product lines (the number of producers of undercarriage parts, fittings and flanges, and crankshafts has already declined significantly). Firms could incorporate new equipment (e.g., new heat-treating and machining applications) and switch from gas and oil to electric power--which yields less scale, more even heating, and a better surface finish.

1/ Post hearing brief, Sumitomo Metal Industries, Ltd., p. 3.
2/ Hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 26.
3/ Interview with Gerlach-Werke GMBH, Homburg, West Germany, Nov. 18, 1985.
4/ Hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 55.
5/ Posthearing brief, Forging Industry Association, p. 7.
6/ Ibid, pp. 7-8.

It has been suggested that U.S. forgers could move production operations offshore in order to cut labor costs and reduce the burden of environmental compliance requirements. In fact, certain foreign industry sources believe that a significant share of U.S. imports of forgings are produced by foreign forges that are owned in part or in whole by U.S. companies. 1/ However, U.S. industry representatives deny knowledge of such operations. 2/

Two important areas remain open for possible diversification: (1) cold forging and (2) powder metal forging. Cold forging requires less raw material (there is no trimming operation), is more automated, and yields a better surface finish. In powder metal forging, shaped objects can be produced from powders by compaction (using only the precise volume of material required). Both cold forging and powder metal forging are expected to have increasing application in a number of automotive products.

Although data indicate that the relatively few forgers producing certain nonferrous forged products achieved return on sales averages of nearly 20 percent during 1981-84, it is not expected that other U.S. producers will attempt to expand into this area. Industry sources indicate that a very high return on sales is necessary to maintain market share in a segment in which technology is continuously changing and in which die-making is critical in order to reduce expensive scrap. In addition, most of these forgings are aerospace products, some of which were helped by recent increases in defense expenditures as well as Buy-American provisions in defense procurement contracts.

Related industries

The U.S. input-output accounts for 1977 provide the basis to look at industries most likely to be affected by changes in the competitive position of the U.S. forging industry. Data reveal that only a few industries are significantly affected by changes in the output of forgings; however, the U.S. industry has experienced considerable change since 1977, thus the picture presented should be considered suggestive.

In table 53, major direct inputs to forging industry sectors are shown, along with forging industry sector expenditures on these inputs as a fraction of the value of forging industry sector output. Figures in this table can also be viewed as showing the distribution of industry input costs. For the iron and steel forgings industry, the major expenditures for direct inputs were for the output of blast furnaces and steel mills, compensation of employees, and profit-type income, net interest, and capital consumption allowances. As percentages of the total value of iron and steel forgings industry output, these amount to 34.7 percent, 28.8 percent, and 10.9 percent, respectively. Expenditures on all other inputs amounted to less than 10

1/ Interview with officials of the Industrial Association of German Forges, Hagen, West Germany, Nov. 20, 1986.
2/ Hearing before the U.S. International Trade Commission, Jan. 21, 1986, p. 32.

percent of the value of iron and steel forgings industry output. Input values exceeding 1 percent of the value of output are listed in table 53.

For the nonferrous forgings industry, the major expenditures for direct inputs were for compensation of employees, primary aluminum, nonferrous rolling and drawing, n.e.c., and profit-type income, net interest, and capital consumption allowances. As percentages of the total value of nonferrous forgings industry output, these amount to 25.0 percent, 11.0 percent, 11.0 percent, and 16.9 percent, respectively. Expenditures on all other inputs amounted to less than 10 percent of the value of nonferrous forgings industry output. Input values exceeding 1 percent of the value of output are listed in table 53.

Table 53.--Major commodities used directly by the forging industry (major direct inputs), 1977

Input-output account No.	Commodities used	Value of input relative to total forging industry sector output: Iron and steel forgings	Value of input relative to total forging industry sector output: Nonferrous forgings
		Percent	
12.0201	Maintenance and repair of other nonfarm buildings.	1.8	-
32.04	Miscellaneous plastics products	-	1.9
37.0101	Blast furnaces and steel mills	34.7	3.6
37.03	Iron and steel forgings	1.1	-
38.04	Primary aluminum	-	11.0
38.07	Copper rolling and drawing	-	2.5
38.08	Aluminum rolling and drawing	-	3.7
38.09	Nonferrous rolling and drawing n.e.c	1.6	11.0
42.0402	Metal coating and allied services	-	3.0
47.03	Special dies and tools and machine tool acc	2.1	1.9
65.03	Motor freight transportation and warehousing	-	1.7
68.01	Electric services (utilities)	1.4	1.5
68.02	Gas production and distribution (utilities)	2.2	1.5
69.01	Wholesale trade	3.7	1.6
88.0	Compensation of employees	28.8	25.0
89.0	Indirect business taxes	-	1.1
90.0	Profit-type income, net interest, and capital consumption allowed	10.9	16.9

Source: U.S. Department of Commerce, U.S. input-output accounts.

In table 54, major industries affected by changes in the output of forgings are presented, along with the percentage of each industry's output that is directly and indirectly used to make forgings. Output from these industries is used directly to make forgings and as intermediate input for industry output used directly to make forgings. Major industries affected by changes in the output of iron and steel forgings and the percentages of each industry's output used to make forgings are as follows: blast furnaces and steel mills, 3.7 percent; iron and steel forgings, 93.1 percent; iron and ferroalloy ores mining, 5.8 percent; and electrometallurgical products, 4.2 percent.

Major industries affected by changes in the output of nonferrous forgings and the percentages of each industry's output used to make forgings are as follows: iron and steel forgings, 3.4 percent; and nonferrous forgings, 88.9 percent.

Consider the following examples to aid in interpreting this table. If output of iron and steel forgings were to drop 10 percent, output of the iron and ferroalloy ores mining industry would drop .58 percent, and output of the iron and steel forging industry would drop 9.31 percent. The reason output in the iron and steel forging industry would drop less than the output of iron and steel forgings is that the forging industry as defined does not produce all forgings (e.g., the blast furnace and steel mill industry produces about 13 percent of iron and steel forgings).

Table 54.--Major industries affected (directly and indirectly) by changes in U.S. output of forgings, 1977

Input-output account No.	Industries	Industry output used to make forgings: Iron and steel forgings	Industry output used to make forgings: Non-ferrous forgings
		Percent	
5	Iron and ferroalloy ores mining	5.8	0.3
37.0101	Blast furnaces and steel mills	3.7	0.2
37.0102	Electrometallurgical products	4.2	0.2
37.0104	Cold finishing of steel shapes	2.7	0.2
37.0105	Steel pipes and tubes	2.7	0.2
37.03	Iron and steel forgings	93.1	3.4
37.0401	Metal heat treating	2.3	0.2
37.0402	Primary metal products, n.e.c.	2.2	0.2
38.03	Primary zinc	1.8	0.6
38.05	Primary nonferrous metals, n.e.c.	2.0	1.2
38.09	Nonferrous rolling and drawing, n.e.c.	1.9	1.8
38.14	Nonferrous forgings	9.5	88.9
42.0402	Metal coating and allied services	1.4	0.9
45.03	Oil field machinery	2.1	-

Source: Derived from U.S. Department of Commerce, U.S. input-output accounts.

U.S. economy

Output of forgings in the United States amounts to less than .1 percent of GNP. Under these circumstances any reduction in U.S. production of forgings caused by increased imports of forgings would have a very small impact on overall U.S. production. For example, if the increase in the forgings import penetration ratio of 8.7% reported in table A, p. vi, were equal to the reduction in U.S. production of forgings caused by increased imports, this reduction would be less than .01% (one one hundredth of a percent) of GNP.

Overview of Selected Forged Products

The key products analyzed in the following write-ups were selected for their importance to the U.S. forging industry (representing nearly one-half of the value of industry shipments) and their representativeness of the major industry segments in terms of manufacturing process, import competition, marketing, and financial condition.

As shown in tables 55 and 56, all product lines experienced a loss of market share to increased imports, a larger trade deficit, and lower employment levels during 1981-84. The product lines most severely impacted during this period were valves and valve forgings and fittings and flanges, which suffered net losses in 1984 as import competition increased and the recovery of its major end market--oilfield machinery and equipment--lagged other end markets. Most product lines associated with the automotive and truck and bus markets, with the exception of forged steel crankshafts, achieved 1984 shipment levels near or above their 1981 performances. Forged steel crankshafts, however, experienced the highest level of import penetration and the lowest shipment index of the automotive-related forgings in 1984.

Table 55.—Certain forged products: Selected industry indicators and indices, 1981

Item	Forged steel crankshafts	Forged steel connecting rods	Forged steel undercarriage components	Forged steel axles and spindles, steering arms and knuckles	Certain forged steel valves and valve forgings	Forged steel fittings and flanges	Forged steel transmission parts	Forged steel hooks, shackles, loadbinders, and other attachments	Forged metal turbine rotor and generator components
Shipments million dollars	153.7	61.6	166.9	390.7	143.9	315.4	379.1	72.7	501.7
Shipment index (1981=100)	100	100	100	100	100	100	100	100	100
Sales index (1981=100)	100	100	100	100	100	100	100	100	100
Employment of production and related workers index (1981=100)	100	100	100	100	100	100	100	100	100
Average hourly wages	$13.05	$11.42	$16.38	$12.64	$11.21	$11.28	$12.58	$11.57	$13.60
Ratio of net profit (loss) to net sales percent	15.5	7.3	11.0	4.0	9.0	9.7	8.6	5.7	19.9
Profit index (1981=100)	100	100	100	100	100	100	100	100	100
Capacity utilization percent	49.7	49.8	44.0	60.9	66.9	58.0	72.0	72.4	39.0
Ratio of imports to apparent consumption percent	43.0	22.4	16.3	9.1	9.0	22.2	10.9	12.1	7.2
Ratio of exports to shipments—percent	6.8	3.2	5.6	1.7	11.7	2.2	1/	3.8	8.8
Trade balance million dollars	-97.6	-15.3	-21.4	-31.6	4.2	-81.3	-44.8	-6.9	9.0

1/ Less than 0.5 percent.

Source: Calculated from data submitted in response to questionnaires of the U.S. International Trade Commission.

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Table 56.—Certain forged products: Selected industry indicators and indices, 1984

Item	Forged steel crankshafts	Forged steel connecting rods	Forged steel undercarriage components	Forged steel axles and spindles, steering arms and knuckles	Certain forged steel valves and valve forgings	Forged steel fittings and flanges	Forged steel transmission parts	Forged steel hooks, shackles, loadbinders, and other attachments	Forged metal turbine rotor and generator components
Shipments million dollars	96.1	69.5	190.4	556.5	58.5	155.4	362.4	66.3	418.4
Shipment index (1981=100)	62.5	112.8	114.1	142.4	40.7	49.3	95.6	91.2	83.4
Sales index (1981=100)	65.3	125.5	125.2	141.0	41.8	57.8	92.1	88.8	78.7
Employment of production and related workers index (1981=100)	58.6	94.1	92.3	94.9	43.0	39.2	88.1	71.1	66.1
Average hourly wages	$15.04	$15.66	$17.52	$15.32	$12.53	$12.32	$12.62	$13.54	$15.52
Ratio of net profit (loss) to net sales percent	6.9	8.1	19.0	5.0	(20.4)	(1.2)	6.7	10.6	15.2
Profit index (1981=100)	29.2	138.6	221.9	175.4	-95.3	-7.4	71.2	165.6	60.3
Capacity utilization percent	42.8	86.2	51.0	83.8	22.7	17.0	75.7	64.8	26.0
Ratio of imports to apparent consumption percent	55.1	31.5	36.6	15.4	16.2	43.5	15.7	34.3	9.0
Ratio of exports to shipments—percent	5.6	13.5	8.5	2.7	10.2	1.5	1/	3.4	5.4
Trade balance million dollars	-106.1	-18.3	-84.3	-83.9	-4.2	-115.6	-67.1	-31.2	-16.6

1/ Less than 0.5 percent.

Source: Calculated from data submitted in response to questionnaires of the U.S. International Trade Commission.

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I. FORGED STEEL CRANKSHAFTS AND CONNECTING RODS

Description and Uses

The crankshaft and connecting rod assembly performs two primary functions within an internal-combustion engine. During the power stroke of a 2- or 4-cycle engine, the piston is driven downward from its top dead center (TDC) position within the cylinder. The connecting rod, attached to the piston at its upper end and the crankshaft at its lower, transfers this downstroke motion to the crankshaft (fig. I-1). The crankshaft consists of a series of throws and counterweights (fig. I-2). The connecting rod secures to the pin bearing located within a throw and the pin bearing rotates about the crankshaft in a planetary manner. Thus, during the power stroke, the connecting rod and crankshaft transform the linear motion of a piston into rotary motion that is then transmitted from the crankshaft to the transmission (see sec. VI on transmission parts). As the crankshaft completes each revolution, the piston is forced back towards TDC, performing the assembly's second major function by compressing the air/fuel mixture within the engine cylinder. This compression enhances fuel mixture combustion and the power of the subsequent downstroke. The crankshaft bearings are positioned so that the one or more pistons in the power stroke reciprocally drive the remaining piston or pistons through the compression stroke. This relationship becomes more important in diesel engines, where high compression ratios are required to raise fuel mixture temperatures near the ignition point.

Steel crankshafts and connecting rods are normally cast or forged. Foundries generally produce lower cost cast pieces; however, these parts lack the strength of forged components. Higher stress applications generally require forged parts. The high compression ratios required for diesel fuel ignition usually require forged crankshafts and connecting rods. Therefore, heavy-duty use engines represent the most significant market for forged steel crankshafts and connecting rods. This market includes Class 6, 7, and 8 trucks, construction and agricultural machinery, locomotives, and ships. The secondary market for these forgings consists of some lighter duty diesel engine applications such as in passenger cars, pleasure boats, and power generators.

Crankshafts and connecting rods are generally produced to customer specifications on a job-order basis. Purchaser contracts depend primarily on the ability to deliver satisfactory products for a minimum price. Domestic forgers must utilize the most efficient production methods not only to meet competition from foreign or other domestic forgers, but also to compete with castings producers. The foundry industry in the past has improved casting strength such that lighter crankshafts and connecting rods, including those for passenger car use, are now predominantly cast.

Production technology for crankshafts varies according to the size of the crankshaft being produced and, as with most forgings, the volume required. Low-volume runs of small crankshafts can be effectively produced using hammer forges since the cost benefits of advanced flexible manufacturing systems (FMS) are generally not significant for short production runs. However, FMS forging operations exhibit substantial productivity improvements in high-volume production.

Figure I-1.--Connecting rod within piston assembly.

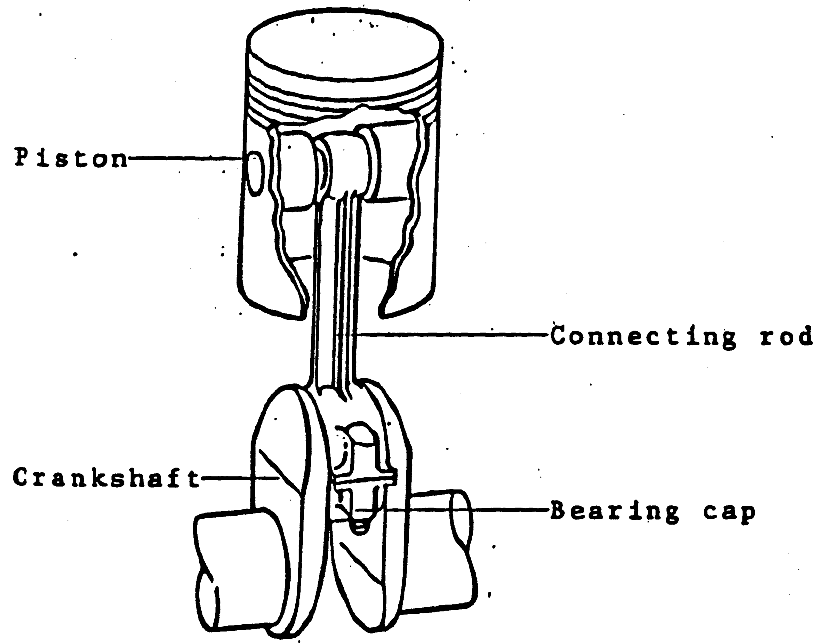
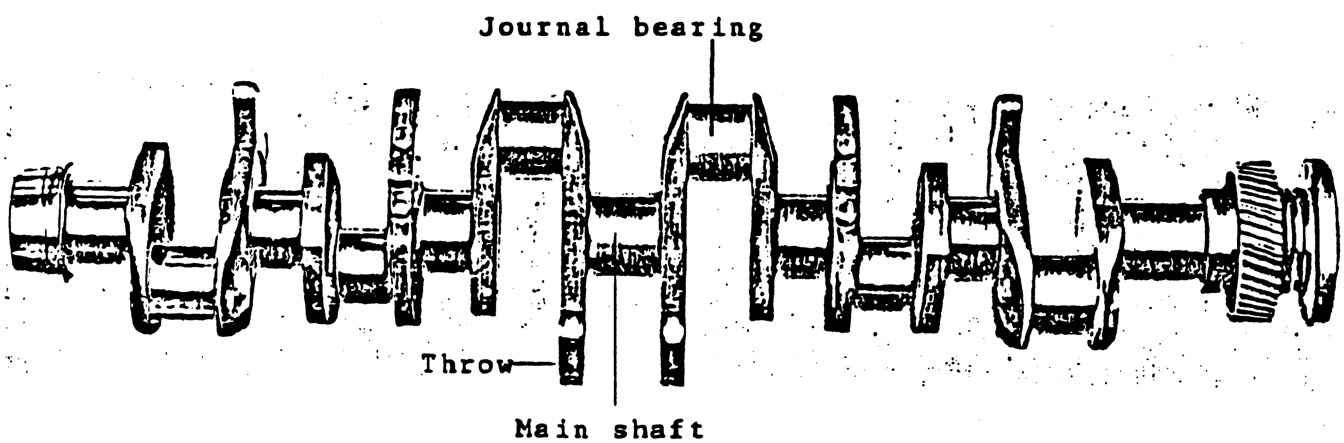


Figure I-2.--Crankshaft.



Source: Principles of Automotive Vehicles, Departments of the Army and Air Force, 1956.

In the more technologically advanced systems producing smaller crankshafts, a rectangular billet sheared from round-edged bar stock and induction-heated to about 2280 °F is conveyed to a forging press. A robot may be used to position the billet in a dieset for the initial strike. A second, and sometimes third, robot transfers the workpiece to a second dieset for further strikes. A fourth robot removes the forging from the press and places the piece on a conveyor that leads to the trimming and coining station. A fifth robot sometimes is used to position the forging for these operations. The forging then automatically proceeds to a collection bin. This system yields approximately 180 to 250 crankshafts per hour using a two-man crew, whereas nonautomated hammer forging would require 6 to 8 workers and would yield about 120 to 150 pieces per hour.

Larger crankshafts require manipulators to move the workpieces from the dieset. One of the most advanced large piece forging lines, located in Sweden, employs a five-zone induction heater that hot-shears a 26-foot long billet to required lengths. Automatic preforming prepares the billet for deformation. This deformation is achieved in a 16,000-ton mechanical eccentric press. Large crankshafts are forged with the throws facing the same direction. A manipulator transfers the workpiece to a hydraulic twisting unit that rotates the throws into their proper orientation. Flash removal occurs in a 1,250-ton mechanical press. In the United States, one advanced operation automatically loads presheared billets manually into the induction furnace. Close-tolerance forging dies yield a virtually flashless product. At both the Swedish and American facilities, an in-line cooling tunnel rotates the crankshafts as they hang vertically and are cooled at a controlled rate using air blowers.

The most advanced connecting rod facilities employ systems similar to that described for small crankshafts; however, preforming assumes a more important role. As seen in figure 1, a connecting rod consists of a shaft with a small bearing for the piston pin and a larger bearing for the crankshaft bearing or crankpin. The disparity between these two bearings makes preforming a necessity in order to avoid significant material losses to flash formation.

Moreover, the need for robotics to enhance efficiency is somewhat moderated for connecting rods that may be easily manipulated manually. Greater production efficiency improvements appear to be generated through the use of induction heaters and preformed billets in conjunction with mechanical presses. Smaller volume production, however, may be competitively produced using induction heating and preforms in conjunction with drop hammers.

Customs Treatment

U.S. tariff treatment

The Tariff Schedules of the United States (TSUS) classify crankshafts and connecting rods as parts of piston-type internal-combustion engines. Crankshaft and connecting rod imports for nondiesel engines fall under TSUS item 660.67 and are currently dutiable at 3.2 percent ad valorem, and parts imported for diesel engines are dutiable at 3.9 percent ad valorem under TSUS item 660.71. Under the terms of an automotive agreement between the United States and Canada, imports of these items produced in Canada and intended for use as original equipment on motor vehicles enter the United States duty free. Such imports for nondiesel and diesel engines are classified under TSUS items 660.68 and 660.82, respectively. Table I-1 summarizes these duty rates and future rates of duty under the Multilateral Trade Negotiations (MTN). An explanation of the various rates of duty is provided in app. E.

Foreign tariff treatment

The United States imports forged steel crankshafts and connecting rods primarily from Japan, West Germany, Brazil, and the United Kingdom. These countries classify their imports under the Customs Cooperation Council Nomenclature (CCCN) system using item 84.06. The duty rate for these items established by the European Community currently stands at 5.2 percent ad valorem. This tariff falls to 4.9 percent under the MTN in 1987. In 1984, Japan unilaterally eliminated its tariffs on these items. Brazil maintains a 70-percent ad valorem tariff on these items in addition to strict local-content laws that effectively prohibit imports. The following tabulation summarizes these duty rates.

Item No.	Description	Country	Present rate of duty
84.06	Parts of piston-type, internal-combustion engines for motor vehicles.	Japan	Free.
		West Germany	5.2% ad val.
		United Kingdom	5.2% ad val.
		Brazil	70% ad val.

Profile of the U.S. Industry and Major Foreign Competitors

United States

Overview.--Approximately 25 companies produce crankshafts and connecting rods in the United States. Crankshaft production for the most part requires larger capital investments than for most forged products, including connecting rods. Because of this relative sophistication, approximately 5 companies together account for more than two-thirds of total domestic production. Connecting rods, in contrast, may be readily produced through hammer as well as press forging. Connecting rod production is more evenly dispersed, with the top 10 companies together accounting for slightly less than 60 percent of total output.

Crankshaft production requires substantial deformation of bar stock to yield the intermediate forging with its small-diameter shaft relative to the length of the throws and distance between the shaft and bearings. Crankshaft forging, then, particularly of larger units, mandates sophisticated presses capable of achieving such deformation. Producers make the most efficient use

Table I-1.—Forged steel crankshafts and connecting rods for piston-type, internal combustion engines: U.S. rates of duty, by TSUS items, 1980-87

(Percent ad valorem)

TSUS item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rates of duty effective with respect to articles entered on or after Jan. 1—								Col. 2 rate of duty
			1980	1981	1982	1983	1984	1985	1986	1987	
660.67A	Parts of piston-type engines other than compression-ignition engines.	4%	3.9%	3.8%	3.7%	3.6%	3.4%	3.3%	3.2%	3.1%	35%.
660.71A	Parts of compression-ignition ~~piston-type engines~~.	5%	4.8%	4.7%	4.5%	4.4%	4.2%	4%	3.9%	3.7%	35%.

1/ The designation "A" indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP), and that all beneficiary developing countries are eligible for the GSP.
2/ Rate effective prior to Jan. 1, 1980.

of the machines in producing similarly demanding forgings, the high value of which will maximize investment returns. Thus, multiproduct forging at these facilities is generally limited.

Connecting rods, conducive to both hammer and press forging, and utilizing comparatively simple dies, require less specialized equipment. Therefore, connecting rod forgers generally exhibit greater flexibility in their production capabilities.

As indicated above, small crankshafts and connecting rods may utilize hammers or presses. In this regard, technological levels vary across a wide spectrum from 5- or 6-man crews working a slot furnace and drop hammer to 2- or 3-man crews manipulating an induction-heated preform through a press. The following tabulation highlights the age groups of most forging equipment: 1/

	Total machinery and and equipment (number)	
Age	Crankshaft	Connecting rod
0-2 years----------	7	7
3-4 years----------	21	12
5-9 years----------	46	51
10-19 years-------	34	136
20 years and over--	149	160

Production, capacity, and employment.--A high degree of cyclicality characterizes the heavy-duty segment of the motor-vehicle market. Hence, forged crankshaft and connecting rod producers show market shifts strongly and rapidly. In 1981, the construction equipment and heavy-duty truck markets, although rebounding somewhat, were still operating well below the high marks of previous cycles. High inventories among the vehicle makers as well as engine manufacturers also contributed to lower crankshaft and connecting rod demand. Thus, forgers of these products utilized only approximately 50 percent of available production capacity during 1981. On the basis of past market cycles, the heavy-duty industry expected continued market growth in 1982; however, both the construction equipment and heavy-duty truck markets declined sharply. This decline led to a 48-percent decrease in crankshaft production and concomitant drop in capacity utilization to 23 percent. Connecting rod forges, generally more flexible in their ability to switch capacity toward other products, reduced production by 21 percent and cut capacity such that the utilization rate actually rose to 59 percent. Both crankshaft and connecting rod production have substantially recovered from the low levels of 1982 in unit terms; however, a significant portion of the high-value construction equipment market has relocated overseas. Thus, although 1984 crankshaft production in unit terms shows a 4-percent increase over that in 1981, the nominal dollar value of 1984 production actually represents a 38-percent decrease from that in 1981. Crankshaft production was valued at

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

$164.5 million in 1981. 1/ The value of annual crankshaft production decreased from a low of $64.0 million in 1983 before recovering to $101.4 million in 1984. Similarly, 1984 connecting rod production in unit terms represented a 46-percent increase over that in 1981; however, 1984 production value fell to 23.2 percent below the 1981 figure. Connecting rod production was valued at $62.8 million in 1981, $47.6 million in 1982, recovered to $63.4 million in 1983, and finished 1984 valued at $77.4 million. 2/ Unit production appears to have benefited indirectly from deregulation of the trucking industry which has enhanced demand for Class 6-8 trucks; however, higher value business has been lost as construction and agricultural equipment production has moved increasingly offshore.

As will be discussed later, a majority of the forging industry's efforts to enhance competitiveness have been directed at productivity improvements. Thus, as declining production led to significant employment reductions, especially among crankshaft forgers, improved productivity has limited the extent to which the employment ranks have been refilled. Between 1981 and 1983, employment of production and related workers involved in forging crankshafts fell by 53 percent. Crankshaft-related employment in 1984 represented a 25-percent increase over that in 1983. Employment at connecting rod facilities fell sharpest in 1982, when employment dropped by 14 percent compared with the 1981 level. Although 1984 data indicate a 9-percent increase since 1982, 1984 employment is still down 6 percent from 1981. Wages during 1981-84 for the crankshaft and connecting rod forgers generally exceeded the average hourly wage for all forged products and for U.S. manufacturing establishments, as summarized below:

Year	Forgers producing steel crankshafts 1/	Forgers producing steel connecting rods 1/	All forged products 1/	All operating manufacturing establishments 2/
1981--	$13.05	$11.42	$14.73	$7.99
1982--	14.34	13.89	17.05	8.49
1983--	14.04	15.49	16.82	8.83
1984--	15.04	15.66	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.
2/ Compiled from official statistics of the U.S. Department of Labor.

Production, capacity, and employment statistics related to crankshafts and connecting rods are highlighted in table I-2 and table I-3.

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission, representing over 90 percent of the industry total.

2/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission, representing over 80 percent of the industry total.

Table I-2.--Forged steel crankshafts: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, and hourly wage rates, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August-- 1984	January-August-- 1985
Production and capacity:						
Production units--	1,132,392	593,118	785,561	1,178,544	706,164	802,074
Capacity----do----	2,279,647	2,576,079	2,464,124	2,754,017	2,102,196	2,289,828
Capacity utilization percent--	49.7	23.0	31.9	42.8	33.6	35.0
Employment of production and related workers:						
Number------------	1,708	1,286	800	1,001	960	901
Man-hours worked--	3,106,073	1,940,587	1,344,249	1,815,433	1,165,658	1,008,334
Wages 1,000 dollars--	40,530	27,832	18,868	27,298	16,873	14,201
Hourly wage rate--	$13.05	$14.34	$14.04	$15.04	$14.48	$14.08

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Financial data.--U.S. producers responding to the Commission's questionnaires reported that 1984 net sales of crankshafts amounted to $109.7 million and of forged connecting rods to $76.4 million (tables I-4 and I-5). The net profit margins for crankshafts and connecting rods were 6.9 and 8.1 percent, respectively, in 1984.

Table I-3.—Forged steel connecting rods: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, and hourly wage rates, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August— 1984	January-August— 1985
Production and capacity:						
Production units—	37,800,475	31,226,375	40,410,642	55,371,117	39,836,421	43,542,392
Capacity—do—	75,968,304	52,897,473	54,988,455	64,202,071	47,032,022	47,093,336
Capacity utilization percent—	49.8	59.0	73.5	86.2	84.7	92.5
Employment of production and related workers:						
Number—	740	636	659	696	640	683
Man-hours worked—	1,503,006	1,029,891	1,195,765	1,285,813	834,568	849,969
Wages 1,000 dollars—	17,163	14,309	18,518	20,137	13,497	15,264
Hourly wage rate dollars—	11.42	13.89	15.49	15.66	16.17	17.96

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table I-4.--Forged steel crankshafts: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Net sales------1,000 dollars--	167,952	82,072	72,218	109,665	74,156	52,529
Net profit or (loss)----do----	26,046	(8,273)	(2,986)	7,603	5,968	(2,358)
Ratio of net operating profit or (loss) to net sales percent--	15.5	(10.1)	(4.1)	6.9	8.0	(3.2)

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table I-5.--Forged steel connecting rods: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Net sales------1,000 dollars--	60,889	48,589	61,716	76,398	53,518	55,915
Net profit or (loss)----do----	4,438	3,093	8,531	6,153	4,498	3,031
Ratio of net operating profit or (loss) to net sales percent--	7.3	6.4	13.8	8.1	8.4	5.4

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

These margins, however, include forging facilities owned by large parent companies. These captive facilities benefit from other activities of the parent firm. In the case of crankshafts and connecting rods, facilities operated by the vehicle makers exhibited significantly higher profit margins than did the noncaptive firms. According to the Forging Industry Association (FIA), the total industry profit margin in 1984 was 1.4 percent. The largest forgers showed the best results with a 5.0-percent average margin. 1/ Both the Commission-compiled data and the FIA data clearly indicate poorer net earnings in 1984 than in 1981, with indications that 1985 performances will show a further erosion of profit margins. During 1981-84, crankshaft and connecting rod forgers spent $49.3 million on plant and equipment and research and development. The following tabulation summarizes these expenditures (in thousands of dollars):

1/ Prehearing brief submitted by the Forging Industry Association, Jan. 13, 1986, app. H.

Item	Crankshafts	Connecting rods
Capital expenditures--------	29,559	13,402
Research and development expenditures.	5,742	640

Major foreign competitors

The primary foreign competitors of U.S. forgers of crankshafts and connecting rods are located in West Germany, Japan, the United Kingdom, and Italy. Two major forging companies operate in West Germany and compete with U.S. firms. These companies together employ approximately 3,700 persons and produce a wide variety of forgings in addition to crankshafts and connecting rods. These facilities employ both drop hammers and counter-blow hammers in addition to forging presses. Efficiencies are augmented with preforming, trimming, hot-straightening, and hot sizing equipment. Both natural gas furnaces and induction heaters are available. The West German forgers belong to industrial groups highly integrated into steel production and engineering. Approximately 40 percent of production is exported to other European countries and elsewhere.

One major Japanese forging company competes with U.S. forgers. This company belongs to a major "keiretsu" commercial group with interests in steel production, banking, shipbuilding, export trading, and motor-vehicle production. Japan operates advanced press lines involving continuous induction heating and FMS-style press forging and trimming. U.S. producers indicate an emphasis by this company on high-volume business.

The United Kingdom hosts two large forging producers that compete significantly with the U.S. forging industry. One company is a division of a large British steel concern. The other firm is part of a highly diversified conglomerate with extensive ties into motor-vehicle parts distribution networks, including those in the United States. Both forgers operate in-house machining facilities in addition to hammer and press forges.

Three major Italian forgers compete in the crankshaft and connecting rod markets with U.S. companies. Two of these Italian firms are divisions of major Italian motor-vehicle companies, and the third supplies a large portion of its production to an Italian vehicle manufacturer. One of these companies is wholly owned by the Italian Government, and another has significant government participation. As such, Italian Government policies, including mandatory employment regulations, strongly influence the corporate and market strategies of these forging companies. The State holding company that controls portions of these companies also owns significant segments of Italian steel production.

Structural Factors of Competition Between U.S. and Foreign Industries

According to U.S. producers, Japan and West Germany enjoy the most significant structural competitive advantages over the United States (table I-6). Japan and West Germany, according to American forgers, benefit from lower raw-materials costs, lower capital costs, and lower labor costs.

Table I-6.--Forged steel crankshafts and connecting rods: U.S. producers' assessment of structural factors of competition for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Japan	West Germany
Overall competitive advantage	F	F
Fuel cost	S	D
Raw materials costs	F	F
Capital:		
Cost	F	F
Ability of industry profits to attract funds	S	S
Labor cost	F	F
Production technology	S	S
Marketing:		
Channels of distribution	S	S
Responsiveness to orders	S	D
After-sale service capabilities	D	D
Government involvement:		
Subsidies	F	F
Research and development assistance	F	S
Tariff levels on imports	F	S
Nontariff barriers to imports	F	S
U.S. Government regulations that increase costs	F	S
Foreign government regulations that increase costs	S	S

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Japan, however, allegedly receives additional aid through Government-related factors such as subsidies, research and development assistance, and tariff and nontariff policies. U.S. Government regulation not present in Japan also increase costs, according to U.S. producers. The U.S. producers responses appear to be based upon experiences with foreign competition in the United States. Several U.S. companies indicated that foreign producers have sold products at or below the raw materials costs common in the United States industry. The Commission, however, has found no indication of tariff barriers to crankshaft or connecting rod imports into Japan. On the contrary, Japan currently maintains no tariff on these imports. U.S. producers indicate a competitive advantage over foreign competitors in after-sale services.

The U.S. Market

Overview

The U.S. market for crankshafts and connecting rods followed similar patterns during 1981-84. Apparent U.S. consumption declined in 1982 before recovering during 1983-84 (table I-7 and table I-8). U.S. consumption of connecting rods in 1984 exceeded the 1981 figure by 14 percent; however, 1984 crankshaft consumption still lagged behind the 1981 level by nearly 20 percent.

Table I-7.--Forged steel crankshafts: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, and end-of-period inventories, 1981-84, January-August 1984, and January-August 1985

Period	Shipments	Exports	Imports	Apparent consumption	End of period inventories	Ratio of imports to consumption
	1,000 dollars					Percent
1981	153,713	10,450	108,068	251,331	33,909	43.0
1982	65,133	12,622	62,741	115,252	26,103	54.4
1983	59,539	4,503	76,261	131,297	22,736	58.1
1984	96,088	5,338	111,439	202,189	16,810	55.1
Jan.-Aug.--						
1984	65,912	1,611	71,937	136,238	22,739	52.8
1985	45,967	1,398	68,957	113,536	13,795	60.7

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table I-8.--Forged steel connecting rods: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, and end-of-period inventories, 1981-84, January-August 1984, and January-August 1985

Period	Shipments	Exports	Imports	Apparent consumption	End of period inventories	Ratio of imports to consumption
	1,000 dollars					Percent
1981	61,576	1,946	17,242	76,872	4,334	22.4
1982	47,950	1,770	14,265	60,445	3,705	23.6
1983	57,012	7,270	15,479	65,221	4,037	23.7
1984	69,485	9,356	27,648	87,777	4,425	31.5
Jan.-Aug.--						
1984	48,842	6,423	18,797	61,216	4,369	30.7
1985	50,087	6,198	20,446	64,335	3,962	31.8

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. imports

U.S. imports have substantially affected the crankshaft market. U.S. producers' shipments fell by 61 percent during 1981-83. Although recovering to a significant degree in 1984, shipments still were valued at 37 percent below the 1981 level. Imports, however, showed a 3-percent gain during 1981-84, indicating that a substantial percentage of the market's recovery has benefited imported crankshafts. Imports as a share of consumption rose from 43 percent in 1981 to over 55 percent in 1984. Data for January-August 1985 indicate a higher rate of decline in domestic shipments than import shipments, giving rise to expectations that import penetration will exceed 60 percent for the year.

The import share of the connecting rod market remained fairly steady during 1981-83. A 79-percent increase in U.S. connecting rod imports in 1984 boosted import penetration to over 31 percent from nearly 24 percent in 1983. This market share has held steady during January-August 1985.

As indicated in tables I-9 and I-10, U.S. forging producers and importers ship crankshafts and connecting rods almost exclusively to the original-equipment manufacturers (OEM). The OEM from the forging producers' and importers' viewpoint constitute engine manufacturers. These engines were destined in 1984 primarily for the heavy-duty motor-vehicle market, namely class 6-8 trucks and buses, as indicated in tables I-11 and I-12. A lesser market for producers of crankshafts was for marine engines, including outboard motors. Of significant note, importers shipped a much higher percentage of total shipments into the off-highway market than did U.S. producers. Growth of importer shipments in this area has accompanied the widespread internationalization of this market segment both in parts and vehicle production. In addition, the market distribution data indicate a greater latitude for connecting rod producers in that certain high performance gasoline

Table I-9.--Forged steel crankshafts: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution, 1984

Channel of distribution	Producers	Importers
Original equipment manufacturers	98	85
Machine shops/other fabricators	2	-
Distributors	-	2
All other	-	13
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table I-10.--Forged steel connecting rods: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution, 1984

Channel of distribution	Producers	Importers
Original equipment manufacturers	96	84
Machine shops/other fabricators	1	-
Distributors	3	13
All other	-	3
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table I-11.--Forged steel crankshafts: Percentage distribution of U.S. producers' and importers' shipments, by types of markets, 1984

Type of market	Producers	Importers
Passenger cars	2.2	0.1
Trucks and buses	41.0	67.3
Aircraft engines	.9	-
Aircraft parts (except engines) including missiles	-	-
Off-highway equipment (construction, mining and material handling)	9.5	5.9
Ordnance (except missiles)	1.7	0
Marine equipment	28.3	0
Plumbing fixtures, valves, and fittings	-	0
Oilfield machinery and equipment	3.4	0
Railroad equipment	.4	0
Farm machinery and equipment	3.6	9.0
Industrial machinery	5.3	13.1
Other	3.6	4.4
Total	100.0	100.0

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Note.--Because of rounding, figures may not add to the totals shown.

engines make use of forged rods. This permits rod forgers to be less dependent on the highly cyclical diesel engine markets.

Table I-12.--Forged steel connecting rods: U.S. producers' and importers' shipments, by type of market, 1984

(In percent)

Type of market	Share of shipments 1/	
	Producers	Importers
Passenger cars	46.7	5.4
Trucks and buses	38.2	76.2
Aircraft engines	0	0
Aircraft parts (except engines) including missiles	0	0
Off-highway equipment (construction, mining and material handling)	1.3	12.5
Ordnance (except missiles)	0	0
Marine equipment	5.8	0
Plumbing fixtures, valves, and fittings	0	0
Oil-field machinery and equipment	0	0
Railroad equipment	0.1	0
Farm machinery and equipment	6.6	0.5
Industrial machinery	0	5.4
Other	1.3	0
Total	100.0	100.0

1/ Totals may not add to 100 due to rounding.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Competitive Assessment of Product-Related Factors in the U.S. Market

According to U.S. producers and importers of crankshafts and connecting rods, the primary determinant in assessing competitive advantage in the U.S. market is the purchase price. Table I-13 highlights this assessment. Table I-14 corroborates this assessment from the purchasers' point of view. The single most important factor, in general, according to purchasers, in selecting a foreign crankshaft or connecting rod source is the delivered purchase price.

Purchasers, for the most part, select U.S. sources on the basis of more specialized requirements. Table I-14 indicates purchasing decisions in favor of the domestic product when technical assistance is necessary, when timely delivery is important, or when domestic quality exceeds that available from lower priced foreign sources.

Table I-13.--Forged steel crankshafts and connecting rods: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made products in the U.S. market, by major supplying countries, 1/ and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan		West Germany	
	P	I	P	I
Overall competitive advantage	F	F	F	S
Principal factors:				
Lower purchase price (delivered)	X	X	X	-
Cost of tooling/ dies	X	-	X	-
Shorter delivery time	-	-	-	-
Engineering/technical assistance	-	-	-	-
Favorable terms of sale	-	-	-	-
Favorable product guarantees	-	-	-	-
Favorable exchange rates	X	-	X	-
Reliability of supplier	-	X	-	-
Product performance features:				
Superior design	-	-	-	-
Quality	-	-	-	-
More durable	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers and advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table I-14.--Forged steel crankshafts and connecting rods: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984-85

Reason for purchase	U.S.-produced crankshafts and connecting rods	Foreign-made crankshafts and connecting rods
Lower purchase price (delivered)	5	1
Cost of tooling/dies	6	2
Shorter delivery time	1	9
Engineering/technical assistance	1	3
Favorable terms of sale	11	9
Favorable product guarantees	8	8
Favorable exchange rates	7	3
Reliability of supplier	3	6
Product performance features:		
Superior design	10	7
Quality	4	3
More durable	8	9

1/ Ranking numbers range from 1 to 11, number 1 indicating the most important reason for purchase and number 11 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers' responses to import competition in the U.S. market

The primacy of lower prices in the purchaser decision to select foreign crankshafts or connecting rods over domestic options and the assessments of both producers and importers underlining this fact are further corroborated by producers' responses to import competition in the U.S. market (table I-15). According to data submitted in response to producer questionnaires, U.S. forgers of crankshafts and connecting rods responded to competition by lowering prices or supressing price increases. To effect these pricing actions, U.S. producers implemented cost-reduction programs. The major thrust of these programs has been investment in more advanced production technologies, which significantly enhance materials usage, labor efficiency, and better quality of the finished products.

Competitive Assessment of Product-Related Factors in Foreign Markets

According to U.S. producers, the major foreign producers also enjoy an overall competitive advantage in foreign markets (table I-16). Again, respondents to the Commission's questionnaires indicated lower delivered

Table I-15.--Forged steel crankshafts and connecting rods: U.S. producers' responses to import competition in the U.S. market, 1981-84

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	3
Had already shifted production to other lines of forgings	1
Lacked capital funds to counter foreign competition	1
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	15
Reduced or dropped plans to expand capacity	5
Cut back production	9
Closed production lines or manufacturing	6
Shifted to more advanced types of forgings	3
Implemented cost-reduction efforts	14
Improved quality of the products	12
Imported	0
Opened a plant to manufacture abroad	1
Other	0

1/ Data include responses of 19 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

purchase price as being the major factor in this competitive situation. In addition, the three major supplier countries, Japan, West Germany, and the United Kingdom, all benefit from lower tooling and die costs.

As indicated earlier, a relatively small percentage of U.S. forging production is exported directly by producers. Thus, an insufficient data base was available from which to draw objective conclusions regarding producer responses to competition in foreign markets. Nonetheless, the available data was suggested that U.S. producers have reduced production costs and avoided price increases.

Table I-16.--Forged steel crankshafts and connecting rods: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in foreign markets, by major supplying countries, 1/ and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan	United Kingdom	West Germany
Principal factors:			
Overall competitive advantage	F	F	F
Lower purchase price (delivered)	X	X	X
Cost of tooling/ dies	X	X	X
Shorter delivery time	-	-	X
Engineering/technical assistance	-	-	-
Favorable terms of sale	-	-	X
Favorable product guarantees	-	-	-
Favorable exchange rates	X	X	-
Reliability of supplier	-	-	-
Product performance features:			
Superior design	-	-	-
Quality	-	-	-
More durable	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers and advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

II. FORGED STEEL UNDERCARRIAGE COMPONENTS

Description and Uses

Forged steel undercarriage components include a variety of parts that are contained within the supporting framework of crawler-mounted machinery (figure II-1) such as tractors, bulldozers, cranes, bucket loaders, and other similar earth-moving and material-handling equipment. When assembled as a unit, the undercarriage (figure II-3) is used to propel such vehicles. Forged undercarriage components include the following parts: rollers, links, and segments. The links are the connecting elements of the track chain that are interconnected through the use of pins and bushings (figures II-2 and II-4). Segments are cogged sections that fit onto the outside of a hub forming a sprocket wheel which drives the track assembly (figure II-5). Each crawler has two sprockets (one per side), which receive power from the penion shaft and transfer it to the track chain. As the sprocket rotates, its teeth engage the track chain and propel the crawler either forward or backward. The majority of sprockets and sprocket teeth are forged as a hub, however, sprockets can also be cast as a single unit. Rollers are revolving cylinders that contact the track assembly of the machine. They are often forged as two pieces (roller halves) and welded together in the center. The rollers may have either one or two flanges (figure II-6). Undercarriage components are sold as rough or semi-finished forgings, finished forgings ready for final assembly, and as assembled units; that is, as track chains, sprocket wheels, or roller assemblies (complete with the shaft, seals, and lubricants, ready to be mounted on the vehicle).

Manufacturing process

The forgers of these products use steel billets of varying lengths and widths, usually carbon or alloy steel containing boron, to produce links, rollers, and segments. Forgers attempt to obtain steel profiles that are closest to the finished product in order to reduce machining costs. In the forging operation, a chemical analysis is first performed to assure that the material meets the required specifications. The steel bars are then sheared to length by a mechanical or hydraulic shear and heated to a plastic state in an electric induction or gas furnace.

Links.--Mechanical presses or hammers are used to forge the hot steel into a link that is then trimmed by a hydraulic trim press while still hot. It is then cooled and cleaned by shot blast. Finishing operations begin with heat treating to bring the article to full hardness and the edge that contacts the track is further hardened through induction heating. The link is then drilled and bored. The links are coupled with pins and bushings to form the track chain. After assembly, the track chain is cleaned and painted.

Rollers.--For the production of rollers, the hot billet passes into a flanging or mechanical press in which it is flattened by an upsetter and

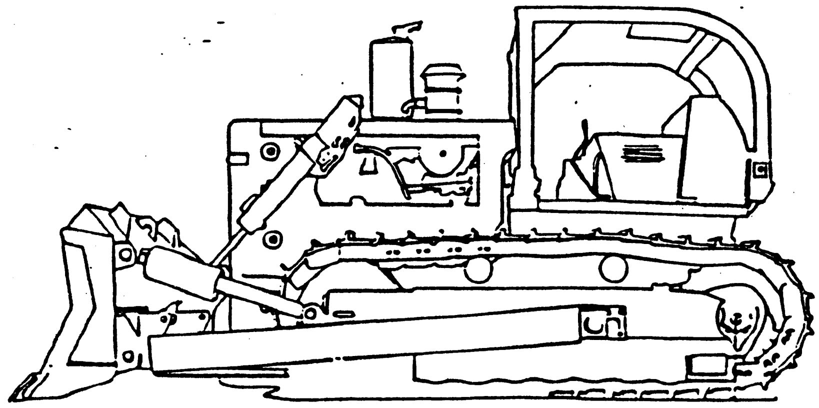


Figure 1 (above).-- A crawler-mounted machine

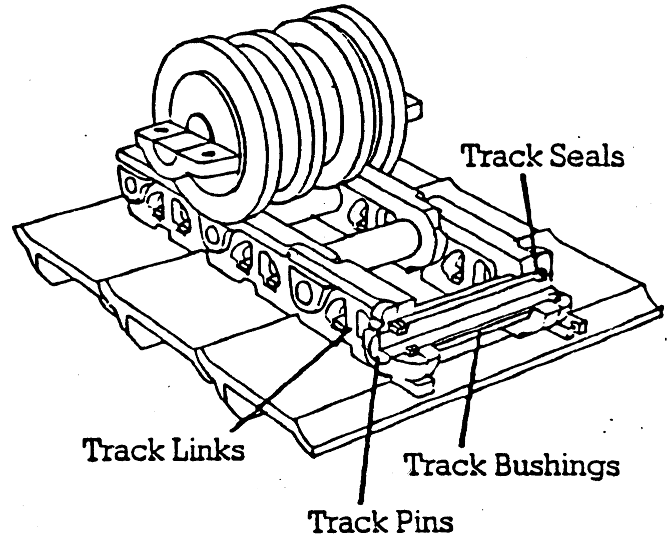


Figure 2 (above).--Track Chain Assembly

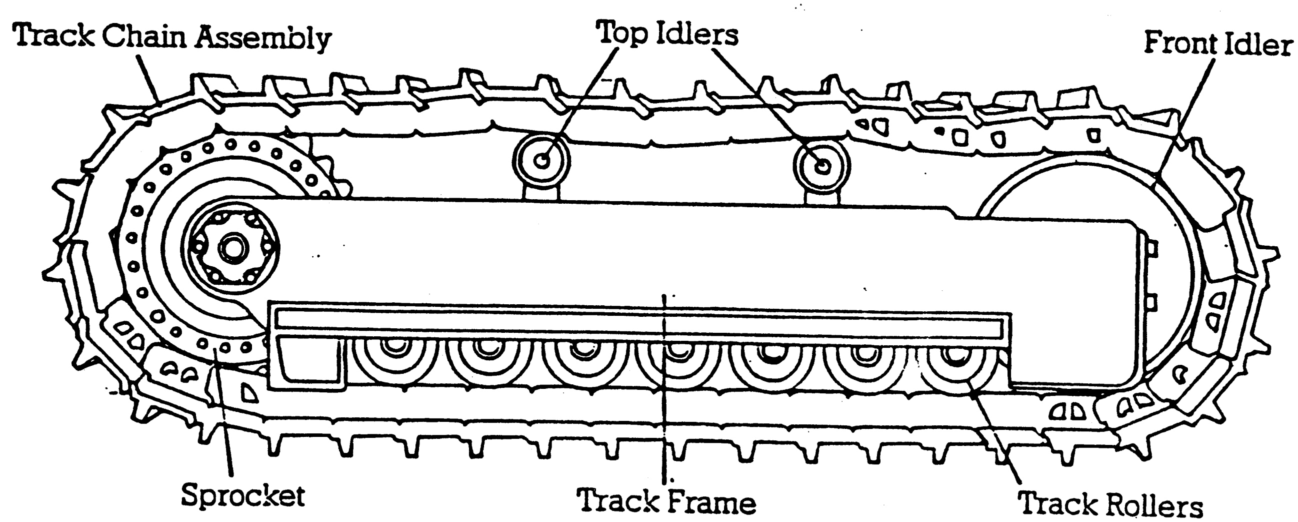


Figure 3 (above).--Undercarriage of a crawler-mounted machine

Source: Dresser Industries, Inc.

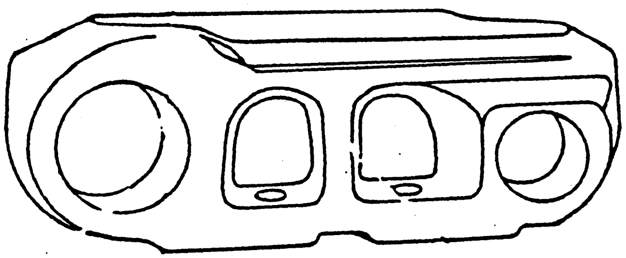


Figure 4 (above).--Link

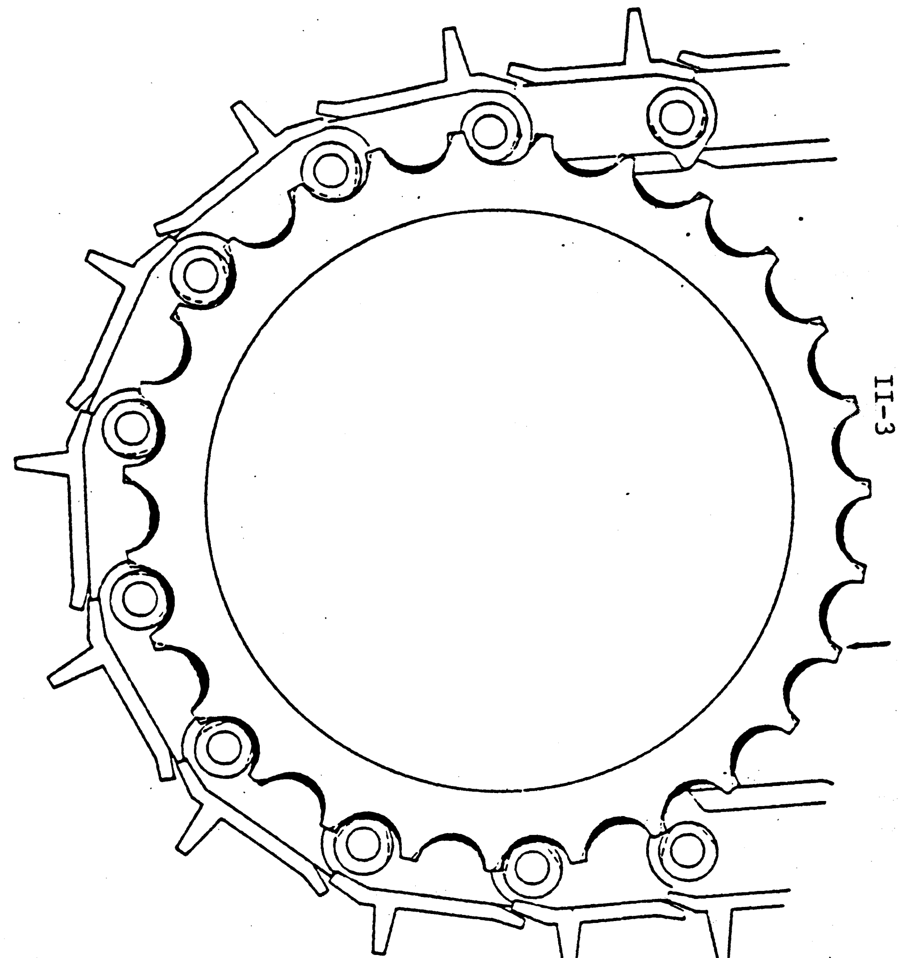


Figure 5 (above).-- Sprocket

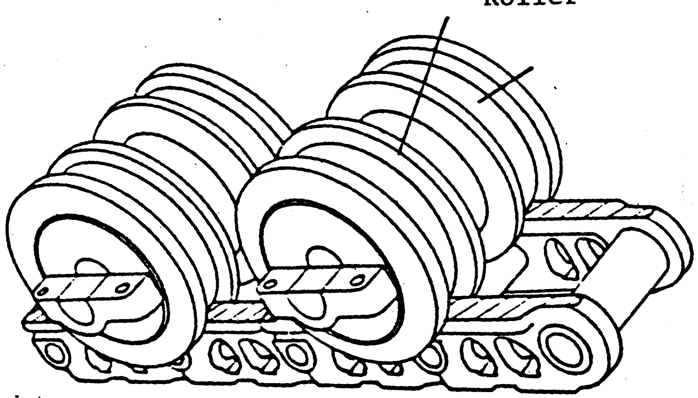


Figure 6 (above).--Roller Assembly

formed by blocking and finishing dies. The forging is trimmed of excess material by a hydraulic trim press, cooled, cleaned by shot blast, and inspected for quality.

Two methods are currently used in the United States for forging rollers: (1) the traditional method, whereby two roller halves are forged and then welded together, which requires an extensive amount of machining, especially for double-flange rollers, and (2) the Radonco process that produces a one-piece or two- or four-flange roller. The Radonco method significantly reduces production and labor costs as well as press time because it eliminates the need for additional trimming and machining.

The finishing operations on a roller are quite extensive. They begin with turning and boring operations. The outer diameter, flange, and seal are then faced and the roller is turned again and the welding diameter tested. 1/ The roller is heat treated and the flange induction hardened. The roller halves are welded together. 2/ The shaft is rebroached and the seal refaced. The retainer holes are drilled and tapped. The roller shell is then ready to be assembled. Assembly of the roller involves lubricating the roller and adding the shaft, seals, and seal retainers.

Segments.--Mechanical presses or hammers are used to forge hot steel into segments that are then hot-trimmed by a hydraulic press. If a mechanical press is used, the segment is then hot-padded to bring the article to full hardness. If a hammer is utilized, the segment is cold-coined after it is trimmed. Finished segments are then welded together to form a sprocket. An alternative to forging segments is known as flame-cutting in which steel blooms are bent to shape using torches. The segments are then punched and heat treated.

Most U.S. forgers claim that there are no appreciable qualitative differences between imported and domestic forged undercarriage components. 3/ U.S. producers indicate that domestic sales have decreased not because they produce a product of inferior quality, but because they are unable to match the low prices of foreign imports. 4/

1/ When working with 2 roller halves.

2/ Ibid.

3/ Response to questionnaires of the U.S. International Trade Commission.

4/ At least one large purchaser of forged undercarriage components notes that although the lower price of imports has been a key factor in its decision to switch to imported forged products, there are qualitative differences between domestic- and foreign-forged undercarriage components as well. This U.S. purchaser claims that although U.S. forgers have attempted to produce higher quality forgings in the past couple of years, foreign forgings are generally superior to those produced domestically. Foreign suppliers are able to forge closer tolerances which reduces the weight of rough forgings and eliminates costly machinery operations. According to one purchaser, in certain product categories such as links, U.S. forgers are unable to produce large volumes of components of even-quality due to lack of modern technology. As such, the U.S. purchaser has upgraded its own gravity drop hammer operations in order to produce large volumes of links of standard size and shape.

Castings are sometimes used as a substitute for forged undercarriage components such as segments and sprockets. However, because of the need for durability and very heavy-duty, rugged application, these parts are usually forged.

Degree of automation

According to responses to questionnaires of the USITC, captive forging companies with large production runs are more likely to adopt modern forging techniques than smaller, independent forgers. 1/ U.S. forgers claim that their level of automation is comparable to that of forgers in Japan and Western Europe. A major U.S. purchaser disagrees, noting that until very recently U.S. forgers were using outdated equipment because they did not view technology and automation as being necessary. 2/ Among those automated techniques that are being employed by the larger sized U.S. forgers are the use of robots, smart conveyors and other modern materials-handling equipment that are used to transfer the hot forged pieces between stations of the forging operation. Programmable hammers and high-speed presses have been added to some forging shops, but many of the smaller independent companies with low levels of capital to invest, have been unable to pursue modern technological innovations and continue to follow traditional melting and heat-treating procedures that tend to be more labor intensive and less efficient.

Customs Treatment

U.S. tariff treatment

Links and rollers that are used in crawler-mounted machinery are classified under items 664.08, 692.34, and 692.35 (see table II-1). Item 664.08 includes construction and related machinery not specifically provided for elsewhere and parts of such machinery as well as parts for machinery classified in items 664.06 and 664.07. Item 692.35 includes other tractors and their parts not specifically provided for elsewhere.

The current column 1 rate of duty is 2.8 percent ad valorem for articles entered under TSUS item 664.08 and 2.6 percent ad valorem for those entered under item 692.35. The current rates represent the fifth annual reduction in a series of staged duty reductions negotiated during the Tokyo round of the MTN. The column 1 rate of duty prior to January 1, 1980, was 5.0 percent ad valorem for item 664.08 and 5.5 percent ad valorem under item 692.35. The current rates are scheduled to be reduced annually to 2.5 percent ad valorem under item 664.08 and to 2.2 percent ad valorem under item 692.35, effective January 1, 1987. Articles from all sources entered under item 692.34 are duty free.

The column 2 rates of duty for items 664.08 and 692.35 are 35 and 27.5 percent ad valorem, respectively. Articles imported from all designated beneficiary countries and entered under items 664.08 and 692.35 are eligible

1/ Response to questionnaires of the U.S. International Trade Commission.
2/ Written submission of Caterpillar Tractor Co., Jan. 8, 1986.

Table II-1.—Forged steel undercarriage components: U.S. rates of duty, by TSUS items

TSUS item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rates of duty effective with respect to articles entered on or after Jan. 1— 1980	1981	1982	1983	1984	1985	1986	1987	Col. 2 rate of dut
664.00	Other construction and mining machinery.	5% ad val.	4.7	4.4	4.1	3.8	3.4	3.1	2.8	2.5	35% ad
692.34	Agricultural tractors and parts—	Free	3/	3/	3/	3/	3/	3/	3/	3/	Free.
692.35A	Other tractors and parts—	5.5	5.1	4.7	4.3	3.9	3.4	3	2.6	2.2	27.5%.

1/ The designation "A" indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP), and that all beneficiary developing countries are eligible for the GSP.
2/ Rate effective prior to Jan. 1, 1980.
3/ Rate not modified in the Tokyo Round of Multilateral Trade Negotiations.

II-6

for duty-free treatment under the Generalized System of Preferences (GSP). The rate of duty on imports from least developed developing countries (LDDC's) is 2.5 percent ad valorem under item 664.08 and 2.2 percent ad valorem under item 692.35. As far as it can be determined, there are no significant imports of the articles covered by this investigation from designated beneficiary countries under the GSP or from any LDDC's.

Tractors suitable for agricultural use and parts thereof (TSUS item 692.34), which includes certain forged undercarriage components, enter the United States duty free regardless of country of importation. An explanation of the variius rates of duty is provided in app. E.

On May 24, 1983, the Department of Commerce, upon petition by the U.S. forging industry, initiated a countervailing duty investigation concerning certain forged undercarriage components from Italy. The Commission was informed of the Commerce Department's action and was required to make an injury determination. On June 13, 1983, the Commission determined that there was a reasonable indication that imports of semifinished forged undercarriage links and rollers were materially injuring or threatening to materially injure U.S. industries. On August 24, 1983, the Commerce Department issued a preliminary determination that the Government of Italy was providing subsidies to producers, manufacturers, and exporters of semifinished forged undercarriage components. The Commission instituted its final investigation on August 30, 1983 and on December 21, 1983, the Commission determined that domestic industries were materially injured by reason of imports from Italy of semifinished forged links and rollers for the undercarriages of crawler-mounted machinery. As a result of these findings, a countervailing duty equal to 1.37 percent ad valorem was assessed on semifinished forged undercarriage components from Italy, entered or withdrawn from warehouses for consumption after liquidation.

Foreign tariff treatment

The principal foreign markets for exports of forged undercarriage parts are the developed countries that utilize them in crawler-mounted machinery for construction projects and surface mining. During 1985, Canada, Mexico, and Australia were the leading destinations for U.S. exports for this type of machinery. The duty rate for parts of crawler-mounted machinery ranges from zero to 10 percent. Under the CCCN, which is used by most countries except the United States and Canada, forged undercarriage components, such as links, rollers, and segments are provided for in headings Nos. 84.23 and 87.06. These components are classified under Canadian tariff schedule No. 42700-6.

The present rate of duty for U.S. exports for these components entering the EC ranges between 6.6 to 8.2 percent ad valorem. The rate for parts of crawler-like machinery entering Canada is free. The tariff concessions made during the MTN are presented below:

Item No.	Description	Country	Present rate of duty
84.23AIC	Parts of construction and mining machines covered in 84.23.	EC	6.6% ad val.
87.06II	Parts for track-laying vehicles.	EC	8.2% ad val.
42700-6	Self-propelled crawler machines (bulldozers) and parts.	Canada	Free.

Profile of the U.S. Industry and Major Foreign Competitors

United States

Overview.--There are approximately 20 known domestic manufacturers of forged undercarriage components for crawler-mounted machinery. Only one company finishes and assembles its product. The remaining firms produce and ship semifinished forgings. Forgers of construction machinery components are located primarily in the Central and North Central States of Illinois, Wisconsin, Ohio, and Michigan. Most of these companies are multi-product forgers, producing undercarriage components as well as forgings for automobiles, agricultural equipment, and heavy duty trucks.

Production, capacity, and employment.--The production of forged-steel undercarriage components is closely tied to domestic and worldwide sales of crawler-mounted machinery. A workers' strike at one of the major construction-machinery manufacturers between 1982 and 1983 caused a drop in production for forged undercarriage components during those years. According to respondents to the Commission's questionnaire (representing over 75 percent of the industry total), U.S. production decreased from 117,508 units in 1981 to 76,518 units in 1982 before increasing by 78 percent to 135,913 units in 1984 (table II-2). During 1981 and 1982, production of forged components for construction machinery was adversely affected by a decline in the demand for crawler-mounted machinery, high interest rates, low levels of construction activity and a decline in the general economy. The demand for construction machinery was also affected by delays in new purchases caused by quantities of idle machinery on hand because of the recession, reduced spending on highway construction, reclamation projects, and water and sewer facilities. The rise in production in 1983 and 1984 was due mostly to an increase in construction activity, particularly housing starts, which increased the demand for earth-moving machinery.

Employment also fluctuated with U.S. demand, dropping from 1,640 workers in 1981 to 1,312 in 1982 and then increasing irregularly to 1,513 in 1984. Total man-hours worked decreased by 20 percent from approximately 2 million hours in 1981 to 1.6 million in 1982 before reaching a peak of 2.2 million hours in 1984.

Capacity utilization at forging facilities that produce forged undercarriage components decreased from 44 percent in 1981 to a low of 29 percent in 1982 before increasing to 51 percent in 1984. The low capacity

Table II-2.—Forged steel undercarriage components: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, hourly wage rates, and productivity, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August—	
					1984	1985
Production and capacity:						
Production short tons	117,508	76,518	97,984	135,913	92,265	81,261
Capacity do	267,406	268,160	268,517	267,713	234,222	256,432
Capacity utilization percent	44	29	36	51	39	32
Employment of production and related workers:						
Number	1,640	1,312	1,392	1,513	1,507	1,483
Man-hours worked	2,125,972	1,570,291	1,904,397	2,217,460	1,555,021	1,436,122
Wages 1,000 dollars	34,833	26,362	32,806	38,850	26,851	27,552
Hourly wage rate	$16	$17	$17	$18	$17	$19
Productivity man-hours/ton	18.1	20.5	19.4	16.3	16.9	17.7

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

utilization rates in 1982 and 1983 can be attributed to the lack of demand for crawler-mounted construction machinery and strikes at original equipment manufacturer (OEM) manufacturing facilities during 1982. The rise in capacity utilization rates between 1983 and 1984 was caused in large part by the recovery in construction activity that increased the demand for earth-moving machinery.

Productivity in the industry decreased by 10 percent compared with an increase of 16 percent in the overall level of production between 1981 and 1984.

During this period, the average hourly wage rate increased irregularly from $16 per hour in 1981 to $18 per hour in 1984. In 1984, wages for workers engaged in the production of forged undercarriage components exceeded the averages for all manufacturing and all forged products by 12 percent and 91 percent, respectively, as shown in the following tabulation:

	Forgers producing undercarriage components 1/	All forged products 1/	All operating U.S. manufacturing establishments 2/
1981-------	$16.38	$14.73	$7.99
1982-------	16.78	17.05	8.49
1983-------	17.22	16.82	8.83
1984-------	17.52	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.
2/ Compiled from official statistics of the U.S. Department of Labor.

Respondents to the Commission's questionnaire indicated that approximately 30 percent of total machinery and equipment used in the production of forged undercarriage components is from 0-9 years old while 70 percent is 10 years or older:

Age	Total machinery and equipment (number)
0-2 years-----------------	49
3-4 years-----------------	141
5-9 years-----------------	244
10-19 years---------------	479
20 years or older---------	604

These data reflect the high replacement costs of such items as electric furnaces, the overall labor intensive nature of the industry, and the limited production runs of many independent forging operations.

Financial data.--Net sales of U.S. producers of forged steel undercarriage components fluctuated during 1981-84, reaching a peak of $171 million in 1984 (table II-3). Profitability also varied, ranging from a low of 11 percent in

Table II-3.--Forged steel undercarriage components: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August-- 1984	January-August-- 1985
Net sales-------1,000 dollars--	136,280	126,200	148,925	170,605	114,781	108,729
Net profit or (loss)-----do----	14,538	18,557	29,704	32,262	23,270	19,703
Ratio of net operating profit or (loss) to net sales percent--	11	15	20	19	20	18

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

1981 to a high of 20 percent in 1983 and January-August 1984. Capital expenditures amounted to $26.0 million or only 4 percent of total net sales during the period 1981-1984. Research and development expenditures totaled $14 million during this same period.

Major foreign competitors

Japan, West Germany, and Italy were cited by respondents as being the major foreign suppliers of finished forged undercarriage components. West Germany is supplying two of the larger U.S. construction machinery producers with track links that are used on small crawler tractors. According to industry sources, Italy now supplies all production of the sprockets used in the United States. West Germany and Italy reportedly supply close to 30 percent of the domestic market for machined segments. Purchases of semifinished forged track links have shifted from U.S. producers to those of Great Britain because of increased purchasing overseas by the largest construction machinery producer. Korea is reported also to be emerging as a source of foreign competition.

Structural Factors of Competition Between U.S. and Foreign Industries

Japan, South Korea, Brazil, West Germany, and Italy were cited as being the main foreign competitors in the production of forged steel undercarriage components. U.S. producers indicate that foreign forgers generally enjoyed a competitive advantage in fuel costs, raw materials, capital, and labor (table II-4). According to domestic producers, foreign producers of forged steel undercarriage components also benefit from government assistance in the form of subsidies, research and development assistance, tariffs, and nontariff barriers to imports as well as government regulations that increase costs. However, U.S. producers view their level of production technology as being equal to that of the major competitors. (A discussion of these and other competitive factors is contained in the overview).

Table II-4.--Forged steel undercarriage components: U.S. producers' assessment of structural factors of competition for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Japan	Korea	Brazil	West Germany	Italy
Overall competitive advantage	F	F	F	F	F
Fuel cost	F	F	F	-	-
Raw materials costs	F	F	F	F	F
Capital:					
Cost	F	-	F	F	F
Ability of industry profits to attract funds	F	-	F	-	F
Labor cost	-	-	-	-	-
Production technology	S	-	S	S	S
Marketing:					
Channels of distribution	S	-	F	-	S
Responsiveness to orders	-	-	-	-	-
After-sale service capabilities	-	-	-	-	-
Government involvement:					
Subsidies	F	-	F	F	F
Research and development assistance	F		F		F
Tariff levels on imports	F	-	F	-	F
Nontariff barriers to imports	F	-	F	-	F
U.S. Government regulations which increase costs	F	-	-	-	F
Foreign government regulations which increase costs	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

According to questionnaire responses, domestic and foreign forgers utilize similar marketing techniques. However, because they do not have the ability to provide "local" or "as much service" to their customers, foreign forging companies attempt to compete in the lower cost, high-volume commercial market. Domestic forgers often employ salesmen, commissioned agents, and manufacturers' representatives to make direct contact with potential customers. A number of forgers have employed long-term purchaser-producer relationships with their major customers and do not actively market their products. This situation has changed somewhat in recent years as a result of some of the major producers shifting their production and purchases of forged undercarriage components from overseas. Aftermarket sales of these forged components by OEM's is very important because of the high replacement rate caused by the constant stress and frictions when the crawler-mounted machinery is in operation. The average service life of an undercarriage part is about 2,000 hours of operation.

The U.S. Market

Overview

Apparent U.S. consumption of forged construction machinery components rose irregularly between 1981 and 1984, closely following the demand for crawler-mounted construction machinery. As a result of the collapse in domestic and worldwide demand for construction machinery, U.S. shipments were depressed in 1982 and 1983, averaging about $152 million per year (table II-5). Between 1983 and 1984, shipments rose 17 percent from $162 million to $190 million. This trend reflects the pick-up in domestic building construction, public works, and surface mining during this period. Shipments declined 12 percent during January-September of 1985 compared with the corresponding period in 1984.

During 1981 and 1984, apparent U.S. consumption of forged construction machinery components rose from $188 million in 1981 to $275 million in 1984, an increase of 46 percent. The import share of apparent U.S. consumption rose from 16 percent in 1981 to 37 percent in 1984. During January-August 1985, the ratio of imports to consumption climbed to 44 percent compared with 38 percent during this period in 1984.

Forged undercarriage components are distributed primarily to OEM's and independent distributors. The OEM's usually purchase either rough forgings that must be machined, heat treated, and assembled before use or finished assemblies for use in the manufacture of the undercarriage for crawler-mounted machinery or for sale by distributors of spare parts. Independent distributors purchase only finished components for servicing crawler-mounted machinery in the aftermarket. According to questionnaire responses, more than 90 percent of both producers and importers shipments were of semifinished forgings destined for use in the manufacture of original equipment while the remainder of these shipments went to other channels of distribution (table II-6).

U.S. imports

Total imports of forged steel undercarriage components increased by 228 percent from $30.7 million in 1981 to $100.6 million in 1984. According to industry officials, the major sources of U.S. imports of forged construction machinery components during this period were Japan, West Germany, Italy, France, Korea, and Brazil. U.S. producers claim that these foreign competitors have been successful in gaining a larger share of the U.S. market

Table II-5.--Forged steel undercarriage components: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, and end-of-period inventories, 1981-84, January-August 1984, and January-August 1985

(Quantity in short tons; value in thousands of dollars)

Period	Shipments	Exports	Imports	Apparent consumption	End-of-period inventories	Ratio (percent) of imports to consumption
	Quantity					
1981	97,086	6,326	1/	1/	4,158	1/
1982	75,050	6,097	1/	1/	3,053	1/
1983	80,053	8,292	1/	1/	8,810	1/
1984	103,818	9,088	1/	1/	10,347	1/
Jan.-Aug.--						
1984	70,973	6,185	1/	1/	9,900	1/
1985	61,961	7,442	1/	1/	10,542	1/
	Value					
1981	166,946	9,315	30,737	188,368	13,435	16
1982	143,191	10,046	60,357	193,502	10,909	31
1983	162,269	12,742	60,378	209,905	11,386	29
1984	190,438	16,254	100,572	274,756	12,901	37
Jan.-Aug.--						
1984	135,573	10,164	76,430	201,839	11,410	38
1985	119,841	15,778	82,840	186,903	10,368	44

1/ Not available.

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table II-6.--Forged steel undercarriage components: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution, 1984

(In percent)

Channel of distribution	Producers	Importers
Orignial-equipment manufacturers	91	90
Machine shops/other fabricators	-	-
Distributors	-	-
Other	9	10
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

because of lower raw material costs, government subsidization, and the exchange rate differential between the dollar and other foreign currencies.

U.S. purchasers, however, note that part of the reason foreign forgers have been successful in gaining a foothold in the U.S. market is that they are able to supply forgings that are of superior quality compared with domestic forgings. In addition, foreign forging suppliers have been willing to establish warehouses near U.S. construction equipment manufacturers, reducing inventory costs for these producers.

Competitive Assessment of Product-Related Factors in the U.S. Market

U.S. producers indicated that foreign producers of forged steel undercarriage components have an overall competitive advantage in the U.S. market compared with domestic producers (table II-7). Importers reported similar findings. In general, both importers and producers judged major foreign manufacturers to have a competitive advantage in terms of lower delivered purchase prices, lower costs of tooling and dies, and favorable exchange rates. The principal factors which have contributed to the overall competitive advantage of the five major foreign sources (Japan, Korea, Brazil, West Germany, and Italy) are lower purchase price and favorable exchange rates. In addition, the cost of tooling and dies and favorable terms of sale were cited as being underlying reasons for the competitiveness of Brazil, West Germany, and Italy.

Importers assessed Japan and Italy as having an overall competitive advantage in the U.S. market. Importers judged Japanese forgings to be superior in terms of design and quality. In every case, importers assessed foreign forgers as having a competitive edge over domestic forgers of undercarriage components. Importers judged foreign forgings to be superior in terms of design and quality.

In response to the Commission's questionnaire, purchasers of forged steel undercarriage components indicated that the primary reason for purchasing domestic products was shorter delivery time (table II-8). Purchasers responded that engineering and technical assistance, historical supplier relationships, and favorable terms of sale were secondary reasons for purchasing domestic products. The major reasons for purchasing foreign-made forgings, according to questionnaire respondents, were lower purchase prices and costs of tooling/dies. At least one major U.S. purchaser claimed that it is not unusual for the delivered price of foreign forgings to be one-half that of comparable domestic forgings. As such, the purchaser has turned to foreign forging suppliers in order to reduce its own production costs and remain competitive with other suppliers of finished construction equipment worldwide. Foreign forgers are able to offer lower prices, according to industry sources, because of more modern equipment and technology. In addition, U.S. purchasers indicate that in certain instances domestic forgers are unwilling to produce forgings to closer tolerances as requested and to assure availability. 1/

1/ Written submission of Caterpillar Tractor Co., Jan. 8, 1986.

Table II-7.--Forged steel undercarriage components: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made products in the U.S. market, 1/ by major foreign sources, and the principal factors (X) underlying overall competitive advantage, 1984-85

Item	Japan		Korea		Brazil		West Germany		Italy	
	P	I	P	I	P	I	P	I	P	I
Overall competitive advantage	F	F	F	-	F	-	F	-	F	F
Principal factors:										
Lower purchase price (delivered)	X	-	X	-	X	-	X	-	X	X
Cost of tooling/ dies	-	-	-	-	X	-	X	-	-	X
Shorter delivery time	-	-	-	-	-	-	-	-	-	-
Engineering/technical assistance	-	-	-	-	-	-	-	-	-	-
Favorable terms of sale	-	-	-	-	X	-	-	-	X	X
Favorable product guarantees	-	-	-	-	-	-		-	-	-
Favorable exchange rates	X	-	X	-	X	-	X	-	X	X
Reliability of supplier	-	-	-	-	-	-	-	-	-	-
Product performance features:										
Superior design	-	X	-	-	-	-	-	-	-	-
Quality	-	X	-	-	-	-	-	-	-	-
More durable	-	-	-	-	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table II-8.--Forged steel undercarriage components: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984-85

Reason for purchase	U.S.-produced forged-steel undercarriage components	Foreign-made forged-steel undercarriage components
Lower purchase price (delivered)	5	1
Cost of tooling/dies	2	1
Shorter delivery time	1	4
Engineering/technical assistance	2	4
Favorable terms of sale	-	-
Favorable product guarantees	-	-
Favorable exchange rates	-	3
Reliability of supplier	2	4
Product performance features:		
Superior design	-	4
Quality	5	4
More durable	-	-

1/ Ranking numbers range from 1 to 5, number 1 indicating the most important reason for purchase and number 5 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers' responses to import competition in the U.S. market

In response to import competiton in the U.S. market, 95 percent of U.S. producers reported that they had lowered the prices of their products in order to maintain market share, and 85 percent indicated they had implemented cost-reduction measures (table II-9). Other significant actions taken in

Table II-9.--Forged steel undercarriage components: U.S. producers' responses to import competition in the U.S. market, 1981-84

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	-
Had already shifted production to other lines of forgings	-
Lacked capital funds to counter foreign competition	2
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	19
Reduced or dropped plans to expand capacity	9
Cut back production	13
Closed production lines or manufacturing	8
Shifted to more advanced types of forgings	4
Implemented cost-reduction efforts	17
Improved quality of the products	13
Imported	2
Opened a plant to manufacture abroad	-
Other	-

1/ Data include responses of 20 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

response to import competition included improving the quality of their product (65 percent of producers responding) and cutting back production (65 percent of producers responding). Two percent of respondents reported they lacked the capital funds required to counter foreign competition.

Competitive Assessment of Product-Related Factors in Foreign Markets

The major export markets for U.S.-produced forged construction machinery components during 1981-84 were Canada and Western Europe. U.S. exports of construction machinery components to these countries are directly dependent on the demand for crawler-mounted machinery. Exports of these components rose only 8 percent from $9.3 million in 1981 to $10 million in 1982. This slow growth was due to several factors including the relative strength of the dollar vis-a-vis foreign currencies making U.S. products comparatively more expensive in world markets, the uneven level of global economic recovery, and the high debt of developing nations and corresponding cutbacks in imports, all of which restrained growth of U.S. exports of construction machinery. In 1984, exports climbed to $16 million as a result of an increase in construction activity in the major U.S. export markets.

U.S. producers reported that Japan, West Germany, and Italy had a competitive advantage in foreign markets over U.S. producers (table II-10). The major factors cited by U.S. producers that have contributed to this competitive advantage include lower purchase prices and costs of tooling and dies. Favorable terms of sale and favorable exchange rates were reported to be underlying factors behind the competitiveness of Japan and Italy. In response to increased competition in their foreign markets, U.S. producers lowered or suppressed price increases, cut back production, or implemented cost-reduction efforts (95 percent of responses in each case) (table II-11). The second most frequent action taken by producers was to improve the quality of their product.

Table II-10.--Forged steel undercarriage components: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in foreign markets, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantage, 1984-85

Item	Japan	West Germany	Italy
Overall competitive advantage	F	F	F
Lower purchase price (delivered)	X	X	X
Cost of tooling/ dies	X	X	X
Shorter delivery time	-	-	-
Engineering/technical assistance	-	-	-
Favorable terms of sale	X	-	X
Favorable product guarantees	-	-	-
Favorable exchange rates	X	-	X
Reliability of supplier	-	-	-
Product performance features:			
Superior design	-	-	-
Quality	-	-	-
More durable	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table II-11.--Forged steel undercarriage components: U.S. producers' responses to increased competition in their foreign markets, 1981-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	
Had already shifted production to other lines of forgings	
Lacked capital funds to counter foreign competition	
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	4
Reduced or dropped plans to expand capacity	2
Cut back production	4
Closed production lines or manufacturing	1
Shifted to more advanced types of forgings	4
Implemented cost-reduction efforts	3
Improved quality of the products	
Imported	
Opened a plant to manufacture abroad	
All other	

1/ Data include responses of 5 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

III. FORGED STEEL AXLES AND SPINDLES, STEERING ARMS AND KNUCKLES

Description and Uses

Axle assemblies function primarily to support the weight of a vehicle while permitting the rotation of wheels attached to the axles, either independently of axle movement or as part of the vehicle's drive train. Hence, this analysis concerns three basic axle types: front axles, rear axles, and extrusion-type axles.

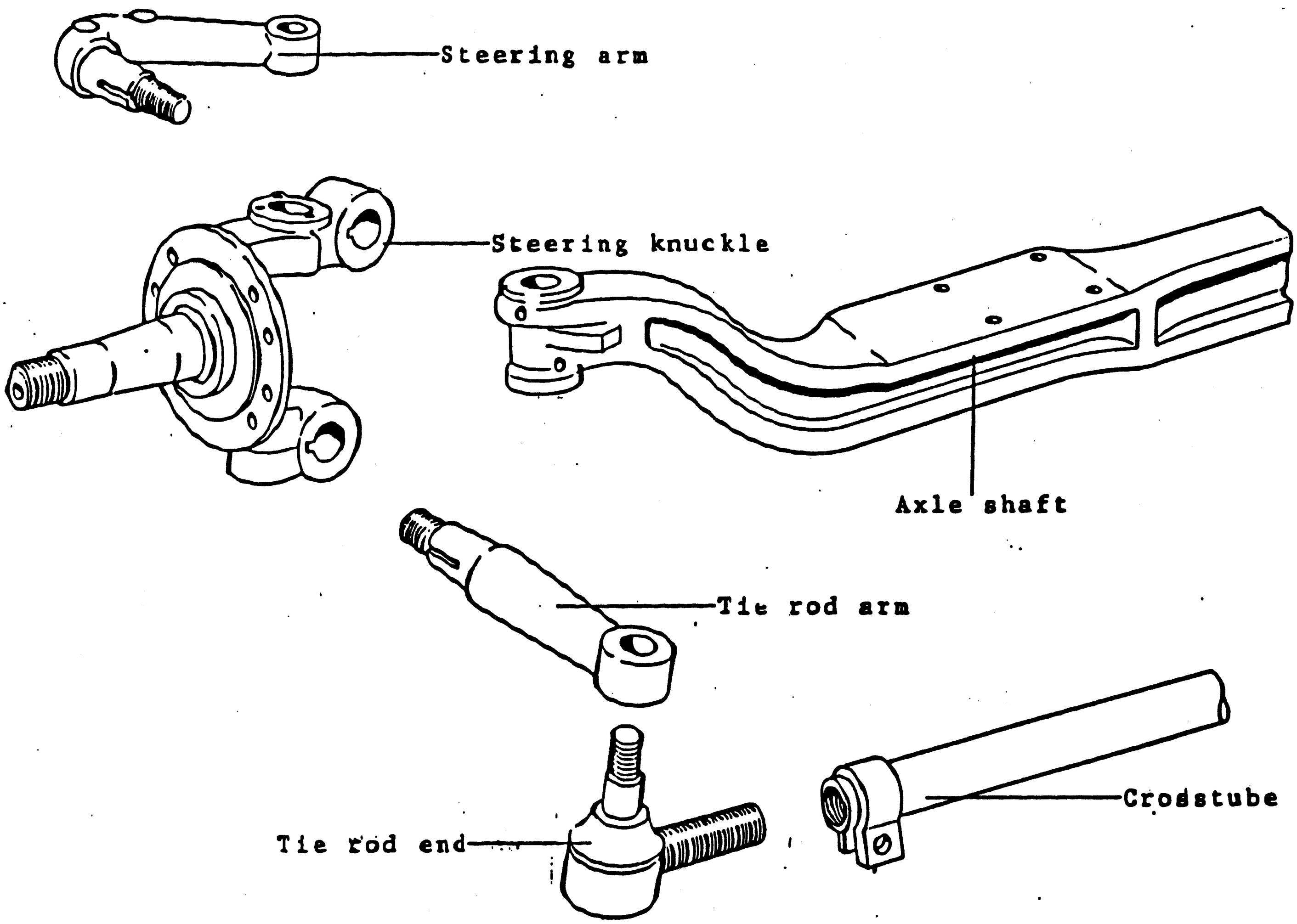
Front axles, for the purposes of this section, are designed to steer the vehicle and may, in the case of certain passenger cars and light trucks, be the driving axle. Front axles permit free and independent wheel rotation and control the direction of the vehicle. Front, nondriving axles incorporate five major forgings: the axle shaft, steering knuckle, steering arm, tie rod arm, and tie rod end. Wheels are mounted on hub and bearing assemblies that rotate freely about the steering knuckles, which act as spindles, and are secured to each end of the axle shaft by means of a kingpin. A steering arm attaches to the upper portion of the steering knuckle, and a tie-rod arm, to the lower. A rod connects the two tie-rod arms, using tie-rod ends, and the tie-rod assembly thus helps coordinate the steering movement of the wheels. Figure III-1 shows a portion of the front, nondriving axle. In some cases, steering knuckles and arms, tie rods and ends may form a single complex forging. Front-wheel-drive cars and trucks use more cast axle parts because these vehicles are intended for lighter use. However, most of these vehicles employ forged axles and spindles.

Rear axles within the context of this report consist of an axle shaft with integral spindles to which the wheel hub is fixed. A set of differential gears on the axle aid in transferring the rotary motion of the transmission-output shaft into actual rotation of the axle shaft and wheels, thus propelling the vehicle. These axles generally employ a forged shaft and a cast spindle. The spindle, which serves the same function as the tapered end of a knuckle, is welded onto the shaft by friction, i.e., the shaft is rotated at high speed and the spindle pressed onto the shaft thereby generating enough frictional heat to weld the spindle in place. The wheels and hub assembly are fixed to and rotate with the axle shaft.

Extrusion-type axles also incorporate integral spindles; however, these spindles are coldforged from tube stock. A forward extrusion process is used that creates the tapered spindle. The wheels and hub assemblies are mounted such that the wheels rotate freely and independently of one another.

Axles incorporating the preceding forged steel components are designed primarily for medium- and heavy-duty use. Class 6-8 trucks represent one of the largest markets for front and rear axles. Virtually all extrusion-type axles are used by trailer manufacturers. A large number of smaller axle forgings are used in passenger cars. Production of axles is concentrated among intermediate manufacturers rather than truck or trailer companies. Hence, the principal purchasers of forged steel axles and spindles, steering knuckles and steering arms are heavy-duty axle manufacturers.

Figure III-L--Forged steel axle, steering arm, steering knuckle, tie rod arm, tie rod end, and crosstube (not forged).



Source: Rockwell International Corp.

Customs Treatment

U.S. tariff treatment

Axles for motor vehicles are classified under TSUS items 692.32 and 692.33, certain motor-vehicle parts. The present rate of duty on these imports is 3.2 percent ad valorem for items imported under TSUS item 692.32 and zero for TSUS item 692.33. However, the duty on axle spindles imported under TSUS item 692.32 has been temporarily reduced. Imports of the axle spindles provided for under item 692.32 were dutiable at 2.3 percent in 1985, rising to 2.5 percent on January 1, 1986. 1/ The items covered by this TSUS item are eligible for both the GSP and Caribbean Basin Economic Recovery Act (CBERA) treatment. Presently, however, imports from Brazil, Mexico, and Taiwan exceed the competitive-need limits and are ineligible for this preferential treatment. Table III-1 summarizes tariff changes relating to axle imports. An explanation of the various rates of duty is provided in app. E.

Foreign tariff treatment

Axles and components thereof are classified in the CCCN under item number 87.06, motor-vehicle parts and accessories. The European Community established separate tariff levels for parts for use in the assembly of motor vehicles (CCCN item 87.06(A)) and for other parts (CCCN item 87.06(B)). Tariff levels of major exports markets are summarized below:

CCCN Item No.	Description	Country	Present rate of duty
87.06	Motor-vehicle parts and accessories	Brazil	70.0% ad val.
		Japan	Free
87.06(A)	Motor-vehicle parts for assembly use	West Germany	5.2% ad val.
		United Kingdom	5.2% ad val.
		Italy	5.2% ad val.
87.06(B)	Other motor-vehicle parts	West Germany	7.5% ad val.
		United Kingdom	7.5% ad val.
		Italy	7.5% ad val.

As part of efforts to reduce trade disputes with other countries, Japan unilaterally accelerated tariff reductions on these items to the present duty-free level in 1984. Brazil, in addition to high tariff levels, promoted the uses of locally manufactured components through investment incentives and domestic content requirements. In 1952, Brazil banned imports of automotive products for which local sources were available. Brazil further promoted

1/ This schedule resulted from a 201 case in which Japan requested a lower tariff on axle spindles as compensation for a tariff increase on porcelain-on-steel cookware.

Table III-1.--Forged steel axles and spindles, steering arms and knuckles: U.S. rates of duty, by TSUS items

TSUS(A) item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rates of duty effective with respect to articles entered on or after Jan. 1--								Col. 2 rate of duty
			1980	1981	1982	1983	1984	1985	1986	1987	
692.3207A*	Axle spindles 3/	4/	5/	5/	5/	5/	2.4%	2.3%	2.5%	2.6%	25%.
692.3295A* (pt)	Certain motor-vehicle parts	4%	3.9%	3.8%	3.7%	3.6%	3.4%	3.3%	3.2%	3.1%	25%.
692.3390(pt)	If Canadian article and original motor-vehicle equipment.	Free	4/	4/	4/	4/	4/	4/	4/	4/	5/

1/ The designation "A*" indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP), and that certain of these countries, specified in general headnote 3(c) of the *Tariff Schedules of the United States Annotated*, are not eligible.

2/ Rate effective prior to Jan. 1, 1980.

3/ Duty on axle spindles temporarily reduced pursuant to trade-agreements legislation.

4/ Rate not negotiated in the Tokyo round of the Multilateral Trade Negotiations.

5/ Not applicable.

exports through the Fiscal Benefits for Special Exports, which permits exceptions to import and tariff requirements on the basis of corporate-level export performance.

Profile of the U.S. Industry

United States

Overview.--During 1985, 30 companies accounted for virtually all axle forgings produced in the United States. About three-fourths of these companies operated facilities in the Upper Midwest region of the United States, including Ohio, Indiana, Illinois, Missouri, and Michigan. Average production-related employment for all axle-forging producers through the first 8 months of 1985 amounted to an estimated 2,826 workers. With the exception of the axle shaft itself, axle forgings are generally small pieces produced without specialized forging equipment. Thus, most axle forgings are produced in multiproduct facilities.

The majority of these producers operate capital-intensive production lines. The use of robotics is not prevalent, although billets commonly will be automatically fed into induction heaters that feed heated billets into preforming machinery. The heated preforms will proceed out of preforming to a closed-die mechanical press. Using this system, crews of three to four workers will turn out approximately 180 pieces per hour. Axle shafts, on the other hand, follow production constraints similar to those of large crankshafts, in that large, more specialized presses are required. The sheer size of axle shafts precludes manual manipulation of billets and workpieces. Hence, while smaller axle forgings are commonly produced by independent forgers, axle shafts usually are produced at facilities associated with an axle assembly manufacturer. Similarly, extruded axles involve specialized cold-forging machinery, sometimes called "groteness" or "swedging" machinery. For the most part, only axle manufacturers enjoy the production scales sufficient to justify the investment. Given the different natures of axle-forging production, these forgers, as a whole, are significantly more capital intensive than noncaptive forgers. The following tabulation summarizes the approximate ages of forging equipment used in axle-part production:

Age	Total machinery and equipment
0-2	59
3-4	61
5-8	221
10-19	289
20 years or older	594

Production, capacity, and employment.--In quantitative terms, reported forged-axle-part production (representing more than 85 percent of the industry total) suffered a relatively mild decline in 1982 of about 13 percent from 1981 figures. During 1982, motor-vehicle production fell to its lowest level in the past 20 years, the construction and housing markets were depressed, constricting related machinery sales, and the overall economic recession, reflected in significantly lower shipments of a broad range of commodities, led to a decrease in heavy-duty-truck sales. These three markets account for more than 99 percent of axle-component sales. This 13-percent production decline also contributed to the erosion of capacity utilization, which fell to 54 percent in 1982 from 61 percent in 1981.

Production rose during 1983-84 in such a way that production in 1984 represented a 35-percent increase over 1981. Capacity utilization in 1984 rose to 84 percent compared with the 61-percent rate in 1981. This strong recovery parallels the rapid increase in U.S. automotive production and expansion of the transportation sector of the U.S. economy starting in 1983. Table III-2 shows production and capacity data for 1981-August 1985.

Parallel to the production decline in 1982, U.S. employment among axle-part forgers declined, as indicated in table III-2. When production increased following 1982, improved manufacturing methods limited the personnel requirements of these companies. Thus, although 1984 production stood 35 percent ahead of the 1981 level, 1984 employment remained 5 percent below the corresponding 1981 figure. Despite these data, total wages increased 5 percent between 1981 and 1984. The following tabulation summarizes average hourly wage changes during 1981-84:

	Forgers producing axles and spindles, steering arms, and knuckles 1/	All forged products 1/	All operating U.S. manufacturing establishments 2/
1981--------	$12.64	$14.73	$7.99
1982--------	13.69	17.05	8.49
1983--------	14.45	16.82	8.83
1984--------	15.32	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.
2/ Compiled from official statistics of the U.S. Department of Labor.

Financial data.--Annual net sales figures aggregated for all axle-part forgers approximate the trends of industry production discussed earlier. Net sales declined more than 4 percent in 1982 from 1981 before increasing during 1983-84 to a level nearly 48 percent higher than in 1982 (table III-3). The net profit margins, however, follow a significantly different pattern. Subsequent to the industry's poor profits during 1982, net profits showed a 257 percent increase in 1983.

This decline in net profits directly relates to increased competition from overseas in the U.S. markets both for parts and finished assemblies. During 1984, U.S. imports of forged steel axles and spindles, steering arms and knuckles jumped nearly 115 percent (see the section of this report titled "Structural Factors of Competition Between U.S. and Foreign Industry: The U.S. market"). U.S. automakers, facing strong competiton from Japanese small cars, have continued to require cost reductions from suppliers, and thus have

Table III-2.—Forged steel axles and spindles, steering arms and knuckles: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, hourly wage rates, and productivity, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August— 1984	January-August— 1985
Production and capacity:						
Production————units——	84,865,168	74,123,073	102,576,813	114,711,222	79,420,161	74,778,053
Capacity————do——	139,263,184	136,981,356	135,899,330	136,863,249	108,989,282	108,817,748
Capacity utilization percent——	60.9	54.1	75.5	83.8	72.9	68.7
Employment of production and related workers:						
Number————	3,113	2,520	2,618	2,953	2,929	2,826
Man-hours worked-hours——	6,741,508	5,320,472	5,971,606	6,939,486	4,828,321	4,535,663
Wages——1,000 dollars——	85,211	72,853	86,266	106,301	75,025	74,520
Productivity man-hours/ton——	12.64	13.69	14.45	15.32	15.54	16.43

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table III-3.--Forged steel axles and spindles, steering arms, and knuckles: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August	
					1984	1985
Net sales------1,000 dollars--	360,381	344,255	451,123	508,200	347,344	340,530
Net profit or (loss)----do----	14,408	9,474	33,780	25,274	20,698	9,482
Ratio of net operating profit or (loss) to net sales percent--	4.0	2.8	7.5	5.0	6.0	2.8

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

pushed prices down at the forger level. The ready availability of imported alternatives to domestic suppliers increased the pressure on U.S. producers to meet the price demands or risk the loss of business.

During 1981-84, U.S. producers of axle forgings also invested large amounts of money in capital improvements and in research and development. As a means of reducing research and development costs, the vehicle makers have begun shifting more of this burden upon larger suppliers. This joint product development has improved the automaker-supplier relationship by facilitating greater interaction earlier in the production process. Clearly, though, suppliers have had to increase R&D expenditures because of this change. The following tabulation shows the expenditures during 1981-84 (in thousands of dollars):

Item	Value
Capital expenditures------------	73,475
Research and development expenditures------------------	25,329

Also of importance in the decline of profit performance has been increasing inventory-carrying costs. The utilization of controlled-parts flow into vehicle assembly operations, called just-in-time (JIT) inventory control, has caused inventory bottlenecks to develop at supplier levels in some instances. Through JIT systems, vehicle makers substantially decreased their parts inventories, coordinating parts requirements for specified time periods with suppliers. Theoretically, suppliers may then plan production runs in advance to match the expected needs of their customers. Unfortunately, production delays at the vehicle assembly level can result in inventory backlogs at the supplier levels.

Structural Factors of Competition Between U.S. and Foreign Industries

On the basis of U.S. producers' responses to questionnaires of the U.S. International Commission, the structural factors of competition between U.S. and foreign industries favor the major foreign competitors. These factors are detailed in table III-4 for Japan, Brazil, West Germany, and Italy.

Table III-4.--Forged steel axles and spindles, steering arms, and knuckles: U.S. producers' assessment of structural factors of competition for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Japan	Brazil	West Germany	Italy
Overall competitive advantage	F	F	F	F
Fuel cost	S	S	S	S
Raw materials costs	F	F	F	F
Capital:				
Cost	F	F	S	F
Ability of industry profits to attract funds	F	S	S	S
Labor cost	F	F	F	F
Production technology	S	S	S	S
Marketing:				
Channels of distribution	S	S	S	S
Responsiveness to orders	S	S	S	S
After-sale service capabilities	S	S	S	S
Government involvement:				
Subsidies	F	F	F	F
Research and development assistance	F	S	S	S
Tariff levels on imports	F	S	S	S
Nontariff barriers to imports	F	S	S	F
U.S. Government regulations which increase costs	F	S	S	S
Foreign government regulations which increase costs	S	S	S	S

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers indicated that this overall foreign competitive advantage stems from lower costs for raw materials and labor as well as government assistance in the form of subsidies. Japan, according to the U.S. forging industry, has the strongest overall advantage, including a greater ability to raise capital and to protect itself from competition through tariff and nontariff barriers. According to the Japanese tariff schedules, however, Japan maintains no tariff on axle parts. Forging producers in Italy and Brazil also benefit from lower capital costs than their U.S. counterparts.

The U.S. Market

The U.S. market for axle forgings grew nearly 62 percent during 1982-84, following a 6-percent decline between 1981 and 1982 (table III-5). Preliminary data for 1985 indicate continued market expansion.

Table III-5.--Forged steel axles and spindles, steering arms and knuckles: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, and end-of-period inventories, 1981-84, January-August 1984, and January-August 1985

Period	Shipments	Exports	Imports	Apparent consumption	End-of-period inventories	Ratio of imports to consumption
	1,000 dollars					Percent
1981	390,703	6,651	38,217	422,269	18,653	9.1
1982	373,203	4,856	27,451	395,798	19,591	6.9
1983	485,712	9,241	46,055	522,526	22,845	8.8
1984	556,546	14,983	98,909	640,472	26,435	15.4
Jan.-Aug.--						
1984	383,737	10,746	66,283	439,274	27,821	15.1
1985	380,272	11,062	86,124	455,334	20,100	18.9

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

This market expansion has come directly from the recovery of motor-vehicle sales in the United States. As indicated in tables III-6 and III-7, axle forgings are sold almost exclusively to original equipment manufacturers (OEM) supplying the motor-vehicle assembly industry.

Domestically owned vehicle producers purchase forgings predominantly from U.S. sources. Thus, U.S. producers' shipments have increased steadily during 1982-84 as domestic-passenger-car production rose. During 1984, however, U.S. automakers and axle manufacturers found it necessary to increase foreign purchases of axle parts. Increased production of passenger cars by Japanese-affiliated companies led to a 115-percent increase in axle-forging imports during 1984. Further increases in this production has pushed the import share of the axle-forging market to 18.9 percent for January-August 1985

Table III-6.--Forged steel axles and spindles, steering arms and knuckles: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution, 1984

(In percent)

Channel of distribution	Producers	Importers
Original-equipment manufacturers	90	99
Machine shops/other fabricators	7	-
Distributors	3	1
All other	-	-
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table III-7.--Forged steel axles and spindles, steering arms, and knuckles: Percentage distribution of U.S. producers' and importers' shipments, by types of markets, 1984

(In percent)

Type of market	Producers	Importers
Passenger cars	58.1	51.8
Trucks and buses	40.6	45.8
Aircraft engines	-	-
Aircraft parts (except engines) including missiles	-	-
Off-highway equipment (construction, mining, and material handling)	0.8	1.7
Ordnance (except missiles)	-	0
Marine equipment	-	-
Plumbing fixtures, valves, and fittings	-	-
Oilfield machinery and equipment	-	-
Railroad equipment	0.2	-
Farm machinery and equipment	0.3	0.7
Industrial machinery	-	-
All other	-	-
Total	100.0	100.0

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

from the 8.8 percent level during 1983. Table III-8 summarizes U.S. forging producers' and importers' purchases of foreign-made axle forgings during 1981-84 and January-August of 1984 and 1985.

Table III-8.--Forged steel axles and spindles, steering arms and knuckles: U.S. producers' and importers' imports, and producers' share of total imports, 1981-84, January-August 1984, and January-August 1985

Period	U.S. producers	U.S. importers	Total	U.S. producers' share of total imports
		1,000 dollars		Percent
1981	2,332	35,885	38,217	6.1
1982	3,036	24,415	27,451	11.1
1983	3,402	42,653	46,055	7.4
1984	4,061	94,848	98,909	4.1
Jan.-Aug.:				
1984	2,307	63,976	66,283	3.5
1985	2,546	83,578	86,124	3.0

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

Competitive Assessment of Product-Related Factors in the U.S. Market

According to U.S. producers and importers of axle forgings, foreign-made products enjoy an overall competitive advantage over domestically produced forgings (table III-9). The major foreign competitors, Japan, Brazil, West Germany, and Italy generally sell their products in the United States at a lower delivered purchase price than domestic sources. U.S. producers indicated that lower tooling costs and favorable exchange rates contribute to this pricing advantage. In the cases of Brazil and Italy, producers have noted the use of favorable sales terms by importers, including extended payment plans at low or no interest rates and assumption of warehousing function thus eliminating the attendant inventory carrying costs. The use of domestic warehousing enables foreign competitors to participate in the JIT programs of domestic-vehicle makers.

U.S. purchasers, as shown in table III-10, consider the purchase price to be the single most important factor in selecting foreign-made axle forgings. Next in importance come exchange rate benefits, the stability of the supplier, and tooling costs.

U.S. producers' data indicate import increases have recently been less than increases in domestic purchases (table III-11). Much of the increase in 1984 and 1985 was due to increased outsourcing of axle forgings by U.S. automakers; some independent forgers have benefited from the decisions of automakers to concentrate more on vehicle assembly and move away from in-house production of selected components.

U.S. producers' responses to import competition in the U.S. market

As indicated above, delivered price appears to be the primary reason purchasers select foreign-made axle forgings. U.S. producers, as shown in

Table III-9.--Forged steel axles and spindles, steering arms and knuckles: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made products in the U.S. market, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan		Brazil		West Germany		Italy	
	P	I	P	I	P	I	P	I
Overall competitive advantage	F	F	F	F	F	S	F	S
Principal factors:								
Lower purchase price (delivered)	X	X	X	X	X	-	X	-
Cost of tooling/ dies	X	-	X	X	X	-	X	-
Shorter delivery time	-	-	-	-	-	-	-	-
Engineering/technical assistance	-	-	-	-	-	-	-	-
Favorable terms of sale	-	-	-	-	-	-	-	-
Favorable product guarantees	-	-	-	-	-	-	-	-
Favorable exchange rates	X	-	X	-	X	-	X	-
Reliability of supplier	-	-	-	-	-	-	-	-
Product performance features:								
Superior design	-	-	-	-	-	-	-	-
Quality	-	-	-	-	-	-	-	-
More durable	-	-	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table III-10.--Forged steel axles and spindles, steering arms, and knuckles: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984-85

Reason for purchase	U.S.-produced forged steel axles and spindles, steering arms, and knuckles	Foreign-made forged steel axles and spindles, steering arms, and knuckles
Lower purchase price (delivered)	4	1
Cost of tooling/dies	4	2
Shorter delivery time	1	6
Engineering/technical assistance	2	6
Favorable terms of sale	11	9
Favorable product guarantees	9	10
Favorable exchange rates	10	2
Reliability of supplier	2	2
Product performance features:		
Superior design	7	6
Quality	6	5
More durable	8	10

1/ Ranking numbers range from 1 to 11, number 1 indicating the most important reason for purchase and number 11 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table III-11.--Forged steel axles and spindles, steering arms and knuckles: Purchases of U.S.-produced and foreign-made forgings by U.S. purchasers, 1981-84, January-August 1984, and January-August 1985

Period	U.S.-produced	Foreign-made	Total	Share of U.S.-produced to total (percent)
	1,000 dollars			Percent
1981	147,591	36,107	183,698	80.3
1982	125,402	26,089	151,491	82.8
1983	129,701	40,323	170,024	76.3
1984	484,285	71,416	555,701	87.1
Jan.-Aug.:				
1984	297,011	71,310	368,321	80.6
1985	351,291	59,860	411,151	85.4

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

table III-12, have attempted to meet competiton by reducing production costs and improving product quality, thereby facilitating price reductions or, at least, avoiding price increases. A significant number of firms selected to reduce production either as a means to concentrate on specific axle-forging types or in order to reduce their dependence on the axle market. As mentioned earlier, multiproduct forgers producing axle parts possess the flexibility to switch to alternative products or markets, thus avoiding competition not only with imports, but also with the generally much stronger captive forging operations.

Table III-12.--Forged steel axles and spindles, steering arms, and knuckles: U.S. producers' responses to import competition in the U.S. market, 1981-84

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	1
Had already shifted production to other lines of forgings	0
Lacked capital funds to counter foreign competition	5
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	27
Reduced or dropped plans to expand capacity	10
Cut back production	12
Closed production lines or manufacturing	5
Shifted to more advanced types of forgings	7
Implemented cost-reduction efforts	29
Improved quality of the products	22
Imported	3
Opened a plant to manufacture abroad	0
Other	0

1/ Data include responses of 31 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Competitive Assessment of Product-Related Factors in Foreign Markets

U.S. producers of axle forgings indicated that foreign producers in the major supplying countries enjoy an overall competitive advantage (table III-13). These countries, Japan, Brazil, and West Germany all sell in foreign markets at prices generally below those prices offered by U.S. companies. In the case of Japan and West Germany, exchange rates, according to U.S. producers, play a significant role.

III-15

Table III-13.--Forged steel axles and spindles, steering arms and knuckles: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in foreign markets, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan	Brazil	West Germany
Overall competitive advantage	F	F	F
Principal factors:			
Lower purchase price (delivered)	X	X	X
Cost of tooling/ dies	-	-	X
Shorter delivery time	-	-	-
Engineering/technical assistance	-	-	-
Favorable terms of sale	X	X	-
Favorable product guarantees	-	-	-
Favorable exchange rates	X	-	X
Reliability of supplier	-	-	-
Product performance features:			
Superior design	-	-	-
Quality	-	-	-
More durable	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents desginated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers' responses to competition in foreign markets

A small number of axle-part forgers export to foreign markets. These companies have responded to the competitive situation overseas in the same manner as they have responded in the domestic market. All of these companies rely predominantly on domestic sales and thus are motivated primarily by domestic market competition. Table III-14 summarizes producer actions in foreign markets.

Table III-14.--Forged steel axles and spindles, steering arms and knuckles: U.S. producers' responses to increased competition in their foreign markets, 1981-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	1
Had already shifted production to other lines of forgings	0
Lacked capital funds to counter foreign competition	1
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	7
Reduced or dropped plans to expand capacity	3
Cut back production	5
Closed production lines or manufacturing	1
Shifted to more advanced types of forgings	0
Implemented cost-reduction efforts	7
Improved quality of the products	6
Imported	1
Opened a plant to manufacture abroad	0
Other	0

1/ Data include responses of 9 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

IV. CERTAIN VALVE FORGINGS AND FORGED STEEL VALVES

Description and Uses

A valve (the end product of a valve forging) is a mechanical device used for controlling the flow of solids, fluids, and gases through pipes or piping systems. The valve may simply start or stop the flow of these materials or may determine or adjust the quantity, pressure, time, or direction of the flow. Flow control is attained by moving a dish, wedge, plug, cylinder, or other flow-controlling element within the valve assembly to either open, close, or partially obstruct the passageway. Valves can range in size from only a fraction of an inch to more than 30 feet in diameter. They are used at pressures ranging from a vacuum to extremely high pressures and at temperatures from those of cryogenics to those of molten metal.

There are three general classes of valves: multiturn, quarter-turn, and self-actuated. Within each of these classes, there are several major types of valves (figure IV-1). Multiturn valves are valves in which the flow-control elements are moved from fully opened to fully closed by multiple rotations of the valve stem. Among the multiturn valves are gate, globe, angle, and pinch valves. Quarter-turn valves are valves in which the flow-controlling elements, such as the disc or gates, can be moved from fully open to fully closed with a 90-degree rotation of the valve stems. Among the quarter-turn valves are plug, ball, and butterfly valves. Self-actuated valves are valves in which the flow-control elements (usually held by a spring) are opened and closed by the flow or pressure of the fluid as it passes through the valve. Among the self-actuated valves are check and relief valves.

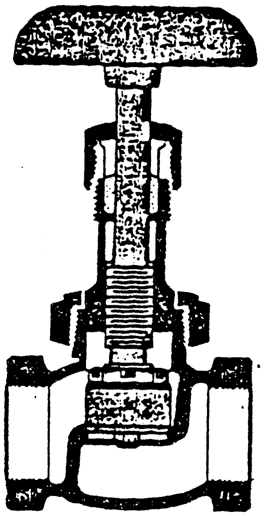
The valves included in this study may be manufactured from all grades of steel. The grades of steel are defined in the TSUS principally on the basis of their chromium content, as shown in the following tabulation (in percent, by weight):

Grade of steel	Chromium content	Carbon restrictions
Stainless steel	More than 11.5	Less than 1 percent.
Other than stainless steel:		
Alloy	0.20-11.5 inclusive 1/	None.
Carbon	0.20 or less	None.

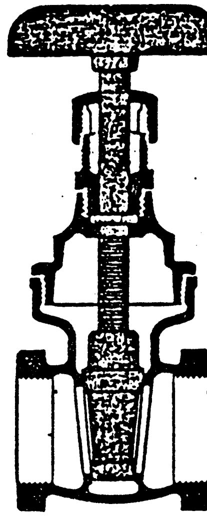
1/ Alloy grade may consist of over 1.65 percent of manganese, over 0.25 percent of phosphorus, over 0.35 percent of sulphur, over 0.60 percent of silicon, over 0.60 percent of copper, over 0.30 percent of aluminum, over 0.30 percent of cobalt, over 0.35 percent of lead, over 0.50 percent of nickel, over 0.30 percent of tungsten, or over 0.10 percent of any metallic element.

Forged steel valves are used primarily in piping systems in the petroleum-refining, petrochemical, electric-power-generation, marine, and pulp- and paper-manufacturing industries, as well as in the aerospace and nuclear power

Figure 1

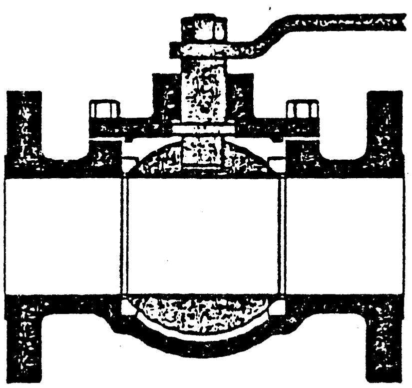


Globe Valve

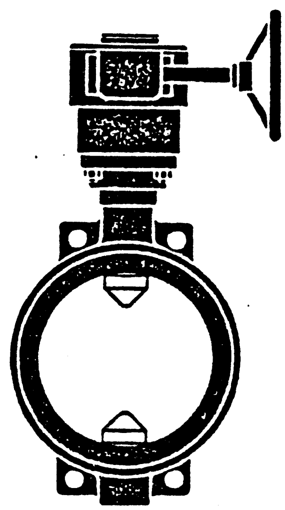


Gate Valve

Multiturn valves

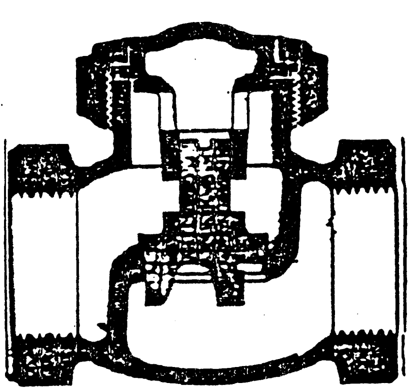


Ball Valve

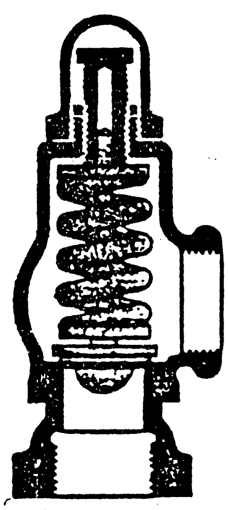


Butterfly Valve

Quarter-turn valves



Check Valve



Pressure Relief Valve

Self-actuated valves

Source: Valve Manufacturers Association.

industries. In selecting the grade of steel for its valves, the end user frequently has the option of choosing between a longer lasting, shorter lived, and more expensive high-alloy valve. Under varying conditions, a valve's life may range from only hours to many years. It may require service and maintenance after a single cycle or may operate trouble free for many thousands of cycles. The end users' choice of steel is likely to be determined by a combination of factors: the initial cost, the ability to withstand the desired temperature and pressure, the degree of corrosion resistance, and the ease with which a worn out valve can be replaced.

Valve specifications are determined by a number of U.S. organizations, including the American Society for Testing and Materials (ASTM), the American Petroleum Institute (API), and the American National Standards Institute (ANSI). Comparable foreign organizations in Japan, the United Kingdom, the U.S.S.R., and other countries have also developed standard specifications for steel valves that are compatible with U.S. standards and specifications.

Forged-steel valves imported from other countries and the domestically produced products are often interchangeable. Most, if not all, such valves are acceptable in quality and are produced to standards and specifications determined by a number of organizations, as mentioned above.

Most of the valves manufactured for pipes with outside diameters of 4 inches or less are produced from steel forgings, whereas valves manufactured with larger diameters are produced from steel castings. Cost is the primary reason for producing most large valves from castings. However, in some applications, especially in the aerospace and nuclear power industries, in which forged valves are specified for product liability and high structural integrity to avoid failure under stress and impact, forged valves can be made to accommodate pipes as large as 36 inches in diameter. Large valves, accommodating pipes that are 12 inches in diameter and above, are usually forged in two parts, then welded together.

The majority of the forging manufacturers of valves use the impression-die or the open-die method to produce steel valve forgings. These methods, as with most forging methods, with some variations, entail using hydraulic and mechanical presses and hammers to press heated steel billets between two dies. This force compels the hot and pliable metal to conform to the shape of the die. The flash (excess material around the forging) is removed immediately after the forging operation by a trimming press. Gas and induction heat treatments are used to bring the product to full hardness. In the forging operation, a chemical analysis is performed to assure that the materials meet the required specifications.

Generally, forging manufacturers do not provide for finishing operations other than cleaning the forgings by shot blast and trimming the flash. Finishing operations such as drilling, boring, facing, and milling are performed by the valve manufacturer who purchases the rough forgings. However, some of the larger automated forging companies as well as valve companies that operate their own forging facilities do the machining and assembling operations in-house.

IV-3

Despite the fact that some of the forging manufacturers have state-of-the-art equipment, such as computer-aided numerical control systems for machine operations and computer aided design systems for designing valves and dies, the manufacturing processes for producing valve forgings are still basically labor intensive. Most forging firms producing valves are jobber-type operations, and automation is generally limited because of the diversity of shipments and short production runs. Industry sources indicated that labor costs account for approximately 45 percent of total production cost. According to the 1982 Census of Manufactures, the ratio of payroll to value added by manufacture is 51 percent in the iron and steel forging industry (SIC 3462). However, the labor costs of valve manufacturers with in-house forging operations or forging manufacturers who use expensive high-alloy materials would be much less.

Customs Treatment

U.S. tariff treatment

Imported forged steel valves are classified under TSUS items 680.17 and 680.18 of the Tariff Schedules of the United States. Table IV-1 shows the staged reductions in the rates of duty as a result of the MTN for iron or steel valves. An explanation of the various rates of duty is provided in app. E.

On September 22, 1983, counsel for the Valve Manufacturers Association Fair Trade Council and 11 U.S. producers filed a petition with the U.S. International Trade Commission and the U.S. Department of Commerce alleging that an industry in the United States was materially injured by reason of imports from Japan of certain steel valves and certain parts thereof that were allegedly being sold at less than fair value (LTFV). Accordingly, effective September 22, 1983, the Commission instituted preliminary antidumping investigation No. 731-TA-143 (Preliminary) under section 731 of the Tariff Act of 1930. On the basis of information obtained in the investigation, the Commission determined on November 7, 1983, that there was a reasonable indication that industries in the United States were materially injured by LTFV imports from Japan of steel wedge gate, globe, and swing check valves and certain parts thereof 1/ (other than bellows seal valves and nonmachined valve bodies), provided for in item 680.17. The Commerce Department ruled in the second week of June 1984 that all steel gate and globe valves imported from Japan were being dumped in the United States at weighted-average dumping margins of 2.5 percent. On April 2, 1984, the Commission instituted a final investigation (inv. No. 731-TA-145 (Final)), and on July 23, 1984 under section 735(B) of the Tariff Act of 1930, determined that an industry in the United States was not materially injured by reason of imports of certain steel valves and parts thereof from Japan being sold at less than fair value. By virtue of the Commission's determination, no antidumping order was issued by the Department of Commerce against imports of certain steel valves and parts thereof from Japan.

1/ The term "certain parts" means "partially completed" valves. "Partially completed" valves in turn, are machine forged or cast bodies imported alone or together with one or more of the following parts: bonnet, stem, wedge, handle, and seat rings. Excluded from the definition are "rough," i.e., non-machined valve bodies, the above designated parts imported alone, and miscellaneous minor parts such as fasteners.

Table IV-1.—Certain forged steel valves: U.S. rates of duty, by TSUS items, 1980-87

TSUS item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rates of duty effective with respect to articles entered on or after Jan. 1—								Col. 2 rate of duty
			1980	1981	1982	1983	1984	1985	1986	1987	
680.17A	Taps, cocks, valves, and similar devices, used to control the flow of liquids, gases, or solids, all the foregoing and parts thereof, of iron or steel.	11% ad val.	11% ad val.	10.5% ad val.	10% ad val.	10% ad val.	9.5% ad val.	9% ad val.	8.5% ad val.	8% ad val.	45% ad val.
680.18	Taps, cocks, valves, and similar devices, . . . , if Canadian articles and original motor-vehicle equipment.	Free	3/	3/	3/	3/	3/	3/	3/	3/	4/

1/ The designation "A" indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP), and that all beneficiary developing countries are eligible for the GSP.
2/ Rate effective prior to Jan. 1, 1980.
3/ Rate not negotiated in the Tokyo round of Multilateral Trade Negotiations.
4/ Not applicable.

IV-5

The Department of the Treasury conducted two preliminary countervailing duty investigations concerning imports from Japan and Italy of valves and parts thereof. On August 23, 1979 (44 F.R. 49550), and October 24, 1979 (44 F.R. 61279), Treasury announced preliminary affirmative determinations concerning imports of such merchandise from Japan and Italy, respectively. The petitioners in these two investigations withdrew their petitions on January 31, 1980. Consequently, no final determinations were made in these investigations regarding injury or bounties or grants.

Workers in the valve industry have filed a number of petitions with the U.S. Department of Labor under the Trade Adjustment Assistance program for workers. The petitions alleged that the workers were being injured by increased imports. Since 1975, there have been 32 certifications, affecting 5,227 workers; 70 denials, affecting 5,598 workers; and 5 terminations, affecting 188 workers.

Foreign tariff treatment

Under the CCCN, which is used by most countries other than the United States and Canada, valves and parts thereof of iron and steel are classified under heading 84.61. Under the Canadian tariff system, these articles are provided for under 42700-1 and 44603-1. Foreign rates of duty applicable to imports of valves from the United States vary considerably from country to country. In the primary markets for U.S.-made valves (Canada, Korea, United Kingdom, Saudi Arabia, and Mexico), the rates of duty vary from 3 percent ad valorem to 40.0 percent ad valorem. The final rates negotiated under the MTN for Canada and the United Kingdom, scheduled to go into effect January 1, 1987, are 10.2 percent ad valorem and 4.6 percent ad valorem, respectively.

There is no negotiated rate for Korea, Mexico, and Saudi Arabia, since these countries have not acceded to the MTN agreements.

Item No.	Description	Country	Present rate of duty
44603-1	Taps, cocks, valves and parts thereof, of iron or steel	Canada	11.1% ad val.
84.61	Taps, cocks, valves and parts thereof, of iron or steel	EC	5.3% ad val.
		Korea	20.0% ad val., plus 10.0% surcharge.
		Mexico	40.0% ad val., plus 4.0% surcharge.
		Saudi Arabia	7.0% ad val.

Profile of the U.S. Industry

United States

Overview.--According to the 1982 Census of Manufactures, there were approximately 381 establishments in the United States that produce iron and steel forgings. About 50 of these establishments are estimated to be producing steel valve forgings; the top 25 establishments produce about

70 percent of total tonnage. The majority of these manufacturers are located in Illinois, Michigan, Ohio, Pennsylvania, and Texas.

The valve forging establishments generally operate on a job or order basis, producing rough and semifinished forgings for in-house use or for use as raw materials to forged steel valve manufacturers, which, in turn, produce primarily steel valves for industrial use. Forging plants manufacturing steel-valve forgings are generally multiproduct-line companies as a result of the competitive nature of the forge steel valve market. However, it is estimated the production of steel valve forgings represents 40 percent of the total production of valve forging manufacturers.

Production, capacity, and employment.--U.S. producers of steel valve forgings (representing about 70 percent of the industry total) reported decreasing production levels and decreasing capacity utilization from 1981-85 (table IV-2). Most manufacturers attribute this trend to the increasing imports as well as the slow economic recovery of major industries that use valves. The decline in expenditures of the major consumers (petroleum refining, petrochemical, power generation, and the pulp and paper industries) resulted in a decreased demand for steel valves.

Domestic production capacity for steel valve forgings rose 12 percent in 1982 over that in 1981 to 107,968 tons before declining to 95,826 tons in 1984. Most of the decrease during 1982-84 in domestic production capacity was attributable to plant consolidations and the substitution of other forged products for valve production. As a result of overall stagnant production capacity, coupled with the declining domestic production, domestic capacity utilization declined 44 percentage points during the 5-year period, dropping from 66.9 percent in 1981 to 22.7 percent in 1984. The average total employment reported by questionnaire respondents declined steadily from 1,564 persons in 1981 to 672 in 1984. Very little of this decline can be attributed to improvement in manufacturing, since most manufacturers have not significantly improved their production processes. Hourly wage rates increased irregularly during this period to $12.53 in 1984, compared to $15.69 for all forged products and $9.18 for all U.S. manufacturing establishments in 1984 as shown in the following tabulation:

	Forgers producing forged steel valves 1/	All forged products 1/	All operating U.S. manufacturing establishments 2/
1981----------	$11.21	$14.73	$7.99
1982----------	13.19	17.05	8.49
1983----------	11.79	16.82	8.83
1984----------	12.53	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.
2/ Compiled from official statistics of the U.S. Department of Labor.

Table IV-2.--Certain forged steel valves and valve forgings: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, and hourly wage rates, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Production and capacity:						
Production short tons--	64,666	46,747	19,713	21,790	16,196	14,409
Capacity----------do----	96,675	107,968	96,733	95,826	75,822	73,622
Capacity utilization percent--	66.9	43.3	20.4	22.7	21.4	19.6
Employment of production and related workers:						
Number------------------	1,564	1,134	614	672	689	682
Man-hours worked hours--	2,332,678	1,443,201	728,781	819,837	622,150	583,511
Wages---1,000 dollars--	26,148	19,030	8,589	10,275	7,568	7,415
Hourly wage rate--------	$11.21	$13.19	$11.79	$12.53	$12.16	$12.71

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

In response to Commission questionnaires on changes within the valve industry structure, four manufacturers reported plant closings during 1981-84. One company that closed at the end of 1984 reported that they could purchase the same steel forged products abroad at 30 to 40 percent below direct cost in the United States.

Respondents to the Commission's questionnaire reported only 6 percent of their machinery and equipment to be less than 5 years old and 53 percent of the machinery and equipment used in manufacturing facilities to be 20 years old or older. Questionnaire respondents reported that a lack of capital has kept them from purchasing more new manufacturing equipment:

Age	Total machinery and equipment (number)
0-2 years--------------------	37
3-4 years--------------------	31
5-9 years--------------------	86
10-19 years------------------	151
20 years or older------------	346

Financial data.--Net sales, as reported by respondents to the Commission's questionnaire, declined steadily during 1981-84 from $157 million in 1981 to $66 million in 1984 (table IV-3). The respondents reported a

Table IV-3.--Certain forged steel valves and valve forgings: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Net sales------1,000 dollars--	156,818	124,071	59,972	65,599	47,744	42,863
Net profit or (loss)----do----	14,044	9,564	(1,935)	(13,386)	(11,107)	(5,522)
Ratio of net operating profit or (loss) to net sales percent--	9.0	7.7	(3.2)	(20.4)	(23.3)	(12.9)

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

profit of $14 million in 1981 compared with a loss of $13 million in 1984. The ratio of net operating profit to sales ratio decreased from a positive 9.0 percent in 1981 to a negative 20.4 percent in 1984. Capital expenditures amounted to $60.3 million or 15 percent of total net sales during the period 1981-84. Research and development expenditures totaled $1.5 million during this same period.

Structural Factors of Competition Between U.S. and Foreign Industries

The competition in the U.S. market between domestically produced steel-valve forgings and those produced in foreign countries is influenced by various structural factors. U.S. producers responding to the Commission's questionnaire indicate that, with respect to all countries assessed, U.S. producers' competitive strengths lie mainly in responsiveness to orders and after-sale service capabilities. Foreign producers' competitive strengths, according to U.S. producer respondents, are concentrated in the availability and cost of capital and labor, foreign government involvement in the industry (subsidies, research and development assistance, nontariff barriers to imports), and U.S. Government regulations that increase costs (table IV-4).

Raw materials, energy, and technology

The availability and cost of energy and the application of production technology were judged by U.S. producers to be somewhat evenly balanced between the U.S. producers and their major competitors in the U.S. market. However, foreign producers were given the advantage in both availability and cost of raw materials. Some producers feel that this advantage is due to the overcapacity of raw materials in some competing countries, especially European countries where many forging companies are vertically integrated or are in some way affiliated with steel-producing companies.

Table IV-4.--Certain forged steel valves and valve forgings: U.S. producers' assessment of structural factors of competition for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Taiwan	Japan	Korea	Brazil	Germany	Italy
Overall competitive advantage	F	F	F	F	F	F
Fuel cost	S	F	S	F	S	S
Raw materials costs	F	F	F	F	F	F
Capital:						
Cost	S	F	F	F	F	F
Ability of industry profits to attract funds	S	F	F	F	F	F
Labor cost	F	F	F	F	F	F
Production technology	D	S	S	S	S	D
Marketing:						
Channels of distribution	D	D	S	D	S	D
Responsiveness to orders	D	D	S	D	D	D
After-sale service capabilities	D	D	S	D	D	D
Government involvement:						
Subsidies	F	F	F	F	F	F
Research and development assistance	F	F	S	F	S	F
Tariff levels on imports	F	F	F	F	F	F
Nontariff barriers to imports	F	F	F	F	F	F
U.S. Government regulations which increase costs	F	F	S	F	F	F
Foreign government regulations which increase costs	S	F	S	S	S	S

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Capital and labor

Foreign producers were given the advantage in both availability and cost of capital. U.S. producers have indicated that foreign producers generally have better access to low interest loans than U.S. producers and have somewhat more leverage than U.S. producers. 1/ These factors seem to contribute substantially to foreign firms' access to capital and their lower cost of capital, according to U.S. producers.

Marketing and Government involvement

Respondents indicated that U.S. producers have a clear advantage over most foreign competitors in marketing the product. This is primarily because of U.S. producers' long established channels of distribution and superior after-sale service capabilities, according to questionnaire respondents. In addition, the location of most domestic producers is in close proximity to major consumers giving them a competitive edge in lower transportation costs and in adjusting production schedules and delivery time. In response to the Commission's questionnaire, U.S. producers indicated that foreign producers generally have an overwhelming competitive advantage over U.S. producers in terms of government subsidies, tariff levels on imports, and U.S. Government regulations that increase costs. Some U.S. producers stated that capital that could be used for improving production processes has to be diverted to other areas to adhere to Environmental Protection Agency (EPA) and Occupational Safety and Health Agency (OSHA) regulations. 2/ Research and development assistance is another area in which U.S. producers indicated that foreign producers have an advantage.

The U.S. Market

Overview

Questionnaire data indicate that the market for forged steel valves and steel valve forgings declined 62 percent during 1981-83 before rebounding slightly in 1984 to $62.7 million (table IV-5). The overall 45 percent decline in 1984 over that in 1981 was principally due to economic conditions in the major consuming industries of forged valves. As stated previously, output in these end-users industries declined sharply in 1982 as a result of the worldwide economic recession. Demand for valves is dependent upon investment in new capital goods and the replacement of valves in existing piping systems. U.S. investment in capital goods was depressed in those industries using forged valves and did not recover as quickly as the general economy in 1983. Data from questionnaires show that despite the economic slow down during this period, the ratio of imports to consumption increased from 9.0 percent in 1981 to 16.2 percent in 1984; during January-August, the import ratio was 17.5 percent. Most U.S. producers indicated that they are being increasingly edged out of the standard valve market by lower priced imports and that the specialty valve market is not large enough to support the entire industry.

U.S. producers and importers vary in the method by which they distribute their products. Because U.S. manufacturers produce primarily valve forgings, nearly 79 percent of their forged steel shipments are to original equipment manufacturers, 16 percent are to distributors and the remaining 5 percent are to machine shops and others. In contrast, importers shipped only 56 percent

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1/ Information gathered in discussions with industry officials.
2/ Information obtained in discussions with industry executives.

Table IV-5.--Certain forged steel valves and steel valve forgings: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, and end-of-period inventories, 1981-84, January-August 1984, and January-August 1985

(Quantity in short tons; value in thousands of dollars)

Period	Shipments	Exports	Imports 1/	Apparent consumption	End-of-period inventories	Ratio (percent) of imports to consumption
	Quantity					
1981	62,813	9,560	2/	2/	11,983	2/
1982	45,443	5,156	2/	2/	9,800	2/
1983	16,625	2,959	2/	2/	5,112	2/
1984	18,792	1,822	2/	2/	3,134	2/
Jan.-Aug.--						
1984	13,911	1,179	2/	2/	2,837	2/
1985	12,499	2,007	2/	2/	1,744	2/
	Value					
1981	143,875	16,842	12,618	139,651	15,444	9.0
1982	117,430	11,704	13,089	118,815	18,940	11.0
1983	54,679	10,305	8,870	53,244	11,534	16.7
1984	58,531	5,967	10,176	62,740	9,515	16.2
Jan.-Aug.--						
1984	40,485	3,854	6,756	43,387	9,556	15.6
1985	39,789	5,414	7,305	41,680	7,109	17.5

1/ Partially estimated by the staff of the U.S. International Trade Commission.
2/ Not available.

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission, except as noted.

of their valves and valve forgings to original equipment manufacturers, 38 percent were shipped to distributors, and 6 percent were shipped to machine shops (table IV-6).

Shipments by U.S. producers and importers of valves were most concentrated (36 percent and 68 percent of total shipments, respectively) in products going to oil-field machinery and equipment producers. The second largest concentration of valve shipments by U.S. producers and importers (shipping 27 and 21 percent, respectively of their total shipments) went to the valve and fittings market (table IV-7). According to industry sources, transportation costs are estimated to account for about 2 to 5 percent of the selling price of forged steel valves and are not considered to be an important factor in the marketing of these products.

Table IV-6.--Certain forged steel valves and valve forgings: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution, 1984

(In percent)

Channel of distribution	Producers	Importers
Original-equipment manufacturers	79	56
Machine shops/other fabricators	3	6
Distributors	16	38
All other	2	-
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table IV-7.--Certain forged-steel valves and valve forgings: Percentage distribution of U.S. producers' and importers' shipments, by types of markets, 1984

(In percent)

Type of market	Producers	Importers
Passenger cars	-	-
Trucks and buses	-	-
Aircraft engines	-	-
Aircraft parts (except engines) including	-	-
missiles	10	-
Off-highway equipment (construction, mining and material handling)	24	2
Ordnance (except missiles)	-	-
Marine equipment	-	-
Plumbing fixtures, valves, and fittings	27	21
Oilfield machinery and equipment	36	68
Railroad equipment	-	-
Farm machinery and equipment	-	-
Industrial machinery	3	9
All other	-	-
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. imports

The principal sources for imports of these articles during 1981-84 were Japan, Taiwan, Canada, and Italy. Imports from all sources decreased significantly in 1983, primarily because demand from valve manufacturers and major end-user industries decreased.

Many U.S. producers of steel valve forgings indicated that downstream importing (the practice of foreign companies converting excess raw steel to valve forgings or finished valve assemblies for shipment to the U.S. market) is occurring and will continue as long as the United States imposes import restrictions on certain raw steel products. U.S. producers indicated that as a result of these import restrictions, they are forced to buy higher priced U.S.-produced raw materials while competing with imported steel forgings using lower priced foreign raw materials. They contend that this has had a major impact on the forged steel valve market.

U.S. producers of steel valve forgings who responded to the Commission's questionnaire reported that they did not import any steel valve forgings or finished valves during 1981-83 (table IV-8). However, one producer imported a small amount in 1984. U.S. producers of steel valve forgings are generally not importers primarily because they feel that they cannot monitor quality control from foreign sources, thus risking their reputation as quality producers.

Table IV-8.--Certain forged steel valves and valve forgings: U.S. producers' and importers' imports, and producers' share of total imports, 1981-84

Year	Producers	Importers 1/	U.S. producers' share of total imports
	1,000 dollars		Percent
1981	2/	12,618	2/
1982	2/	13,089	2/
1983	2/	8,870	2/
1984	***	10,176	***

1/ Partially estimated by the staff of the U.S. International Trade Commission.
2/ U.S. producers did not import during 1981-83.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission, except as noted.

U.S. exports

The major export markets for U.S.-produced forged steel valves and steel-valve castings are Canada, Saudi Arabia, and Korea. U.S.-produced steel valves imported by these countries are mainly specialty valves for use in the oil, petrochemical, and power generating industries. Worldwide expansion in major valve-consuming industries is expected to occur in the near future, thus providing strong export markets for U.S. products. 1/

Competitive Assessment of Product-Related Factors in the U.S. Market

In response to the Commission's questionnaire, U.S. producers indicated that imported steel valve forgings from Japan, Taiwan, Korea, Brazil, and

1/ U.S. Department of Commerce, U.S. Industrial Outlook 1984, p. 242.

Italy have an overall competitive advantage in the U.S. market when compared with domestically-produced steel-valve forgings (table IV-9). Generally, U.S. producers reported that the five major competitors had an advantage in lower delivered purchase price, cost of tooling and dies, and favorable exchange rates. Importers indicated in response to questionnaires that Japan had an overall competitive advantage, principally in the areas of lower prices, cost of tooling/dies, and favorable exchange rates.

Table IV-9.--Certain forged steel valves and valve forgings: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made products in the U.S. market, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan		Taiwan		Korea		Brazil		Italy	
	P	I	P	I	P	I	P	I	P	I
Overall competitive advantage	F	F	F	2/	F	2/	F	2/	F	2/
Principal factors:										
Lower purchase price (delivered)	X	X	X	-	X	-	X	-	X	-
Cost of tooling/dies	X	X	X	-	X	-	X	-	X	-
Shorter delivery time	-	-	-	-	-	-	-	-	-	-
Engineering/technical assistance	-	-	-	-	-	-	-	-	-	-
Favorable terms of sale	-	-	-	-	X	-	X	-	X	
Favoraable product guarantees	-	-	-	-	-	-	-	-	-	-
Favorable exchange rates	-	X	X	-	X	-	X	-	X	-
Reliability of supplier	-	-	-	-	-	-	-	-	-	-
Product performance features:										
Superior design	-	-	-	-	-	-	-	-	-	-
Quality	-	-	-	-	-	-	-	-	-	-
More durable	-	-	-	-	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

2/ Insufficient data.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

In response to the Commission's questionnaire, purchasers of forged-steel valves and valve forgings stated that shorter delivery time was the most important reason for their purchases of domestic products (table IV-10). Reliability of supplier and quality were given as purchasers' second most

Table IV-10.--Certain forged steel valves and valve forgings: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984-85

Reason for purchase	U.S.-produced forged steel valves and valve forgings	Foreign-made forged steel valves and valve forgings
Lower purchase price (delivered)	5	1
Cost of tooling/dies	-	3
Shorter delivery time	1	-
Engineering/technical assistance	4	-
Favorable terms of sale	-	-
Favorable product guarantees	5	-
Favorable exchange rates	-	3
Reliability of supplier	2	-
Product performance features:		
Superior design	5	3
Quality	2	2
More durable	-	6

1/ Ranking numbers range from 1 to 6, number 1 indicating the most important reason for purchase and number 6 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

important reason for buying U.S.-made valves and valve forgings. Purchasers indicated that lower delivered price was the primary reason for purchasing foreign products, and quality was given as second most important reasons for purchasing foreign-made valves and valve forgings.

Pricing considerations

U.S. purchasers of domestically made and foreign-made valves and valve forgings did not give specific price information on 2-inch, 600 PSI forged steel ball valves. The 2-inch ball valve, for most purchasers, is one of many valves and valve body forgings included in a purchase order, and prices are not normally broken down for specific products. Most purchasers indicated, however, that foreign-made valves and valve forgings are priced 30 to 70 percent below comparable U.S.-made products.

The cost of tooling and dies is generally higher in the United States than in foreign countries, primarily because of higher wages in the United States. Dies are made of steel by skilled craftsmen, and tooling is heavily dependent on labor. These higher costs increase the costs of finished products significantly. A number of producers indicated that higher labor costs in the U.S. forging manufacturing industries are the major reason for price differences between U.S.-made and foreign-made forging products.

Product performance features

In response to Commission questionnaires, U.S. producers and importers indicated that design characteristics of U.S.-made and foreign-made forged steel valves are basically the same, as valve manufacturers usually design valves to meet customers' specifications. The quality and durability of domestically produced and imported forged-steel valves and valve forgings were rated equal by importers responding to the Commission's questionnaire. U.S. producers' respondents, however, rated U.S.-made steel valve forgings as superior in quality and durability to imported products. U.S. producers are the major suppliers of specialty valves to the world markets. Consequently, the valves they produce must be of the highest quality to withstand the extreme temperatures and pressures of the piping systems that their customers use. Imported valves are primarily standard-type valves that are not used in special applications.

Market response

Both U.S. producers and importers indicated that delivery time for U.S.-made and imported forged valves and valve forgings was essentially the same. U.S. manufacturers and importers maintain inventories, and lead times on special orders are usually the same whether the order is with a U.S. producer or foreign producer. Availability was reported by importers and domestic producers to be the same. U.S. purchasers, however, reported that the availability of U.S.-produced products was significantly better than the availability of imported products. Purchasers reported that U.S. producers generally have standard and specialty valve capability, while importers primarily gave only standard valve capability.

U.S. producers' responses to import competition in the U.S. market

In response to import competition in the U.S. market, 21 percent of the U.S. producers reported that they had lowered prices or suppressed price increases to maintain market share (table IV-11). Other significant items taken in response to import competition included implementing cost-reduction efforts (20 percent of the respondents), improving the quality of their product (15 percent) and cut back production (14 percent of the respondents).

Competitive Assessment of Product-Related Factors in Foreign Markets

Without exception, U.S. producers responding to the Commission's questionnaire reported that foreign manufacturers have the overall competitive advantage in the foreign markets over U.S. producers (table IV-12). The major factors indicated by U.S. producers as the reasons for this overall competitive advantage were primarily lower delivered purchase price, cost of tooling and dies, and favorable exchange rates.

Table IV-11.--Certain forged steel valves and valve forgings: U.S. producers' responses to increased competition in the U.S. market, 1984-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	3
Had already shifted production to other lines of forgings	4
Lacked capital funds to counter foreign competition	6
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	31
Reduced or dropped plans to expand capacity	14
Cut back production	20
Closed production lines or manufacturing	10
Shifted to more advanced types of forgings	5
Implemented cost-reduction efforts	30
Improved quality of the products	22
Imported	2
Opened a plant manufacture abroad	-
All other	-

1/ Data include responses of 75 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table IV-12.--Certain forged steel valves and valve forgings: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in the foreign market, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Taiwan	Japan	Italy
Overall competitive advantage	F	F	F
Principal factors:			
Lower purchase price (delivered)	X	X	X
Cost of tooling/dies	X	X	X
Shorter delivery time	-	-	-
Engineering/technical assistance	-	-	-
Favorable terms of sale	-	-	X
Favorable product guarantees	-	X	-
Favorable exchange rates	-	-	X
Reliability of supplier	-	-	-
Product performance features:			
Superior design	-	-	-
Quality	-	-	-
More durable	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers' responses to competition in foreign markets

In response to increased competition in foreign markets, 18 percent of the U.S. producers reported lowering prices or suppressing price increases to maintain market share, and 18 percent reported cutting back production, while another 18 percent reported implementing cost-reduction efforts (table IV-13).

Table IV-13.--Certain forged steel valves and valve forgings: U.S. producers' responses to increased competition in their foreign markets, 1984-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	1
Had already shifted production to other lines of forgings	2
Lacked capital funds to counter foreign competition	2
Took the following actions:	
Lowered prices or suppressed price increased to maintain market share	7
Reduced or dropped plans to expand capacity	3
Cut back production	7
Closed production lines or manufacturing	3
Shifted to more advanced types of forgings	1
Implemented cost-reduction efforts	7
Improved quality of the products	4
Imported	1
Opened a plant manufacture abroad	-
Other	-

1/ Data include responses of 25 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

V. FORGED STEEL FITTINGS AND FLANGES

Description and Uses

Forged steel fittings, unions, and flanges are used in piping systems that convey gases or liquids in plumbing, heating, refrigeration, air-conditioning, automatic fire sprinkler, electrical conduit, irrigation, and process-piping systems for application in energy production, power generation, and manufacturing. Fittings and flanges are used to join pipes in straight lines, and to change or divide the flow of oil, water, gas or steam in commercial, residential or industrial piping systems. Structural uses include fences, guardrails, playground equipment, and scaffolding.

Forged fittings and flanges are made of carbon, alloy, or stainless steel. Fittings and flanges are formed and machined to exact specifications in sizes that range from 1/8 inch to 48 inches or more; wall thickness and inside diameter vary according to pressure class.

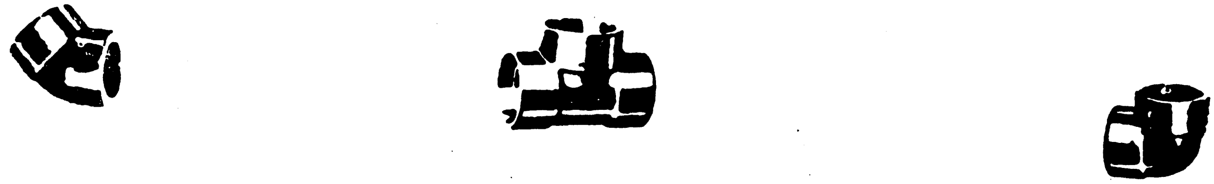
Principal configurations for fittings include tees, elbows, bends, Y's, crosses, and reducers; principal joining methods include welding, threading or mechanical coupling. Fittings are produced according to standards published by the American Society of Testing and Materials (ASTM), American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI), American Petroleum Institute (API), and Manufacturers Standardization Society (MSS). Examples of these products are shown on page V-2.

Customs Treatment

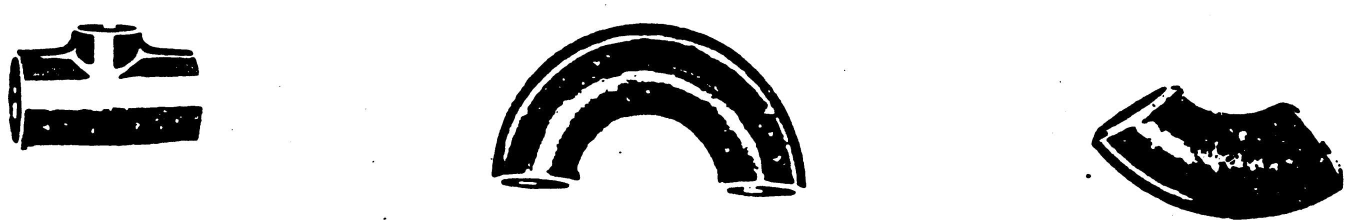
U.S. tariff treatment

Forged steel fittings and flanges are classified under items 606.71, 606.73, 610.84, 610.88, 610.89, 610.90, and 610.92 of the TSUS. Detailed tariff descriptions are shown in appendix E.

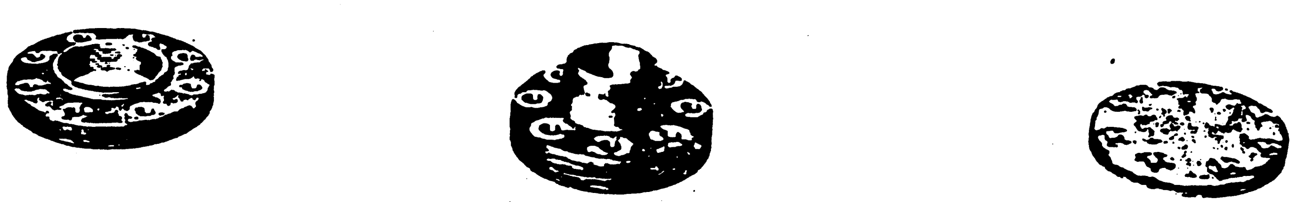
FORGED STEEL FITTINGS



BUTT WELDING FITTINGS



FORGED STEEL FLANGES



Source: Ladish Co.

Table V-1 provides the current and staged reductions in the rates of duty as a result of the MTN. Imports of forged steel fittings and flanges from designated beneficiary countries have been eligible for duty-free treatment under the GSP since January 1, 1976; however, Taiwan was graduated from GSP eligibility for TSUS item 610.88 on March 30, 1984.

On February 24, 1986, counsel for the U.S. Butt-Weld Pipe Fittings Committee filed a petition with the U.S. International Trade Commission and the U.S. Department of Commerce alleging that an industry in the United States is materially injured by reason of imports from Brazil, Japan, and Taiwan of certain butt-weld pipe fittings that are allegedly being sold at less than fair value. Accordingly, the Commission instituted preliminary Investigations Nos. 731-TA-308 through 310. The Commission will make a preliminary determination concerning these investigations during the week of March 30, 1986.

Foreign tariff treatment

Most of the major foreign sources of forged steel fittings and flanges use the Custom Cooperation Council Nomenclature (CCCN) System, which classifies these articles under item 73.20, "Tube and pipe fittings (e.g., joints, elbows, unions, and flanges), of iron or steel." The current rates of duty applicable to imports of forged steel fittings and flanges for major producing countries of these products are shown in the following tabulation:

Item No.	Description	Country	Present rate of duty
73.20	Tube and pipe fittings (e.g., joints, elbows, unions, and flanges) of iron or steel	Italy	6.8% ad val.
		Japan	4.9% ad val.
		Korea	20% ad val.
		West Germany	6.8% ad val.
		Taiwan	25% ad val.

In addition to the above duties, Korea and Taiwan maintain a system of import licensing for exports to their countries, according to the Department of Commerce. Canada classifies imports under its own tariff system, the Tariff Schedules of Canada, as follows:

Item No.	Description	Country	1986
40,000-1	Fittings and couplings of iron or steel n.o.p. for pipes and tubes; parts therefore alloy.	Canada	13.1% ad val.
40,000-2	Other		11.4% ad val.

Table V-1.—Forged steel fittings and flanges: U.S. rates of duty, by TSUS items

TSUS item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rate of duty effective with respect to articles entered on or after Jan. 1— 1980	1981	1982	1983	1984	1985	1986	1987	Col. 2 rate of duty
	Forgings of iron or steel, not machined, not tooled and not otherwise processed after forging:										
606.71A	Other than alloy iron or steel	6%	6%	6%	5.7%	5.4%	5.1%	4.8%	4.5%	4.2%	25%.
606.73A	Alloy iron or steel	8% + additional duties	8% + additional duties	8% + additional duties	7.3% + additional duties	6.7% + additional duties	6% + additional duties	5.3% + additional duties	4.7% + additional duties	4% + additional duties	33% + additional duties.
	Pipe and tube fittings of iron or steel:										
	Other fittings:										
	Other:										
610.84A	Flanges	11%	11%	11%	10.2%	9.4%	8.6%	7.8%	7%	6.2%	45%.
	Butt-weld-type fittings:										
	Under 14 inches (inside diameter):										
610.88A*	Other than alloy iron or steel	11%	11%	11%	10.2%	9.4%	8.6%	7.8%	7%	6.2%	45%.
610.89A	Alloy iron or steel	11%	11%	11%	10.2%	9.4%	8.6%	7.8%	7%	6.2%	45%.
610.90A	14 inches and over (inside diameter)	11%	11%	11%	10.2%	9.4%	8.6%	7.8%	7%	6.2%	45%.
610.92A	Other	11%	11%	11%	10.2%	9.4%	8.6%	7.8%	7%	6.2%	45%.

1/ The designation "A" or "A*" indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP). "A" indicates that all beneficiary developing countries are eligible for the GSP. "A*" indicates that certain of these countries, specified in general headnote 3(c) of the *Tariff Schedules of the United States Annotated*, are not eligible.

2/ Rate effective prior to Jan. 1, 1980.

Profile of the U.S. Industry

Overview

There are approximately 50 forges in the United States that produce forged steel fittings and flanges; these forgers are concentrated in the upper Midwest United States. Fitting and flange producers often specialize in the production of these products and are considered to be relatively capital-intensive. U.S. producers responding to the Commission's questionnaire reported that a large share of their total machinery and equipment was 20-years old or older, and only a very small portion was less than 3 years old, as shown in the following tabulation:

Age	Total machinery and equipment
0-2 years--------------	15
3-4 years--------------	37
5-9 years--------------	93
10-19 years------------	104
20 years or older------	215

Domestic producers manufacture fittings and flanges utilizing both hammers and presses. Industry sources indicate that presses probably account for a large share of the newest equipment.

U.S. production, capacity, and employment

During 1981-84, capacity to produce forged steel fittings and flanges increased by 8 percent to 171,881 tons in 1984, and production (representing less than 80 percent of industry total) and employment declined by 67 percent and 61 percent, respectively (table V-2). The dramatic decline in production and employment took place during 1982-83, coinciding with the slowdown in the construction and oilfield markets. Capacity utilization ranged from a high of 58 percent in 1981 to a low of 17 percent during 1983-84. Industry representatives do not anticipate near-term recovery, a belief reflected in a capacity utilization rate of 16 percent during January-August 1985. According

Table V-2.--Forged steel fittings and flanges: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, and hourly wage rates, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Production and capacity:						
Production (short tons)--	91,820	57,221	27,132	29,990	20,605	20,310
Capacity-------do----	159,406	172,333	159,868	171,881	123,811	125,467
Capacity utilization percent--	58	33	17	17	17	16
Employment of production and related workers:						
Number----------------	2,327	1,827	1,035	912	908	893
Man-hours worked hours--	3,734,115	2,865,977	1,565,444	1,438,334	1,105,364	1,062,779
Wages 1,000 dollars--	42,129	34,349	20,103	17,718	11,768	11,743
Hourly wage rate-----	$11.28	$11.99	$12.84	$12.32	$10.65	11.05

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

to industry sources, worker productivity increased during the period as firms attempted to rationalize operations. Hourly wage rates fluctuated upward to about $12.32 during 1984, compared with $15.09 for all forged products and $9.18 for all U.S. manufacturing establishments as shown in the following tabulation:

	Forgers producing forged steel fittings and flanges 1/	All forged products 1/	All operating U.S. manufacturing establishments 2/
1981----------	$11.28	$14.73	$7.99
1982----------	11.99	17.05	8.49
1983----------	12.84	16.82	8.83
1984----------	12.32	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

2/ Compiled from official statistics of the U.S. Department of Labor.

Financial data

Net sales fluctuated downward during 1981-84, reaching a low point of $82.8 million in 1983 (table V-3). The ratio of net operating profit to net sales reflected the performance of the oil field and construction markets, dropping from 9.7 percent in 1981 to a negative 1.2 percent in 1984. During 1981-1984, capital expenditures as a share of net sales averaged about 4 percent; industry representatives indicated that the bulk of capital expenditures were incurred prior to the market contraction in 1983.

Table V-3.--Forged steel fittings and flanges: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Net sales--------1,000 dollars--	146,070	128,952	82,759	84,450	55,694	58,428
Net profit or (loss) do----	14,226	5,458	(1,413)	(1,049)	(1,531)	(720)
Ratio of net operating profit or (loss) to net sales---percent--	9.7	4.2	(1.7)	(1.2)	(2.7)	(1.2)

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Structural Factors of Competition Between U.S. and Foreign Industries

U.S. producers responding to Commission questionnaires generally expressed agreement on the factors that provide a competitive advantage to domestic and foreign forged steel fitting and flange producers (table V-4). Most respondents identified Italy and Japan as the principal foreign competitors; Taiwan, West Germany, Brazil, and Canada were also named as foreign manufacturers affecting the U.S. market.

The industry generally considered its strengths to be in certain areas of marketing (i.e., responsiveness to orders and after-sale service capabilities), whereas foreign producers were generally accorded an overwhelming advantage with respect to raw materials costs, capital, and labor costs as well as in most facets of foreign government involvement and U.S. Government regulations. A discussion of these competitive factors is contained in the overview. Chief among the policies of the U.S. Government noted by industry representatives as providing foreign competition with an advantage were costs associated with environmental protection and worker health and safety. In the area of production technology, there was little advantage indicated for either U.S. or foreign producers.

Table V-4.--Forged steel fittings and flanges: U.S. producers' assessment of structural factors of competition for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Brazil	Japan	Italy	Korea	Taiwan	West Germany
Overall competitive advantage	F	F	F	S	S	S
Fuel cost	S	S	F	S	S	S
Raw materials costs	F	F	F	F	F	F
Capital:						
Cost	F	F	F	F	F	F
Ability of industry profits to attract funds	F	F	F	F	S	S
Labor cost	F	F	F	F	F	F
Production technology	S	S	S	S	S	S
Marketing:						
Channels of distribution	F	S	S	S	D	S
Responsiveness to orders	D	D	D	D	D	S
After-sale service capabilities	D	D	D	D	D	S
Government involvement:						
Subsidies	F	F	F	F	F	F
Research and development assistance	F	F	S	S	F	S
Tariff levels on imports	F	F	F	S	F	F
Nontariff barriers to imports	F	F	F	F	F	F
U.S. Government regulations which increase costs	S	F	F	S	F	F
Foreign government regulations which increase costs	S	S	S	S	S	F

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

The U.S. Market

Overview

U.S. producers indicated that 61 percent of their shipments were sold to original equipment manufacturers, with the remaining shipments largely sold to distributors. Importers reported that 93 percent of their shipments went to end users and distributors (table V-5).

Table V-5.--Forged steel fittings and flanges: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution, 1984

(In percent)

Channel of distribution	Producers	Importers
Original-equipment manufacturers	61	7
Machine shops/other fabricators	7	-
Distributors	28	22
All other (end users)	4	71
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers indicated that 28 percent of their shipments were used in the plumbing fixtures, valves, and fittings market and 16 percent in the farm machinery and equipment market (table V-6). Importers shipped 70 percent of their products to the oilfield machinery and equipment market and 27 percent to the farm machinery and equipment market. Producers reported that 82 percent of their shipments for defense-equipment uses went to the ordnance (fuel storage and power plants and equipment) market (table V-7).

Table V-6.--Forged steel fittings and flanges: Percentage distribution of U.S. producers' and importers' shipments, by types of markets, 1984

Type of market	Producers	Importers
Passenger cars	2	-
Trucks and buses	1	2
Aircraft engines	1	-
Aircraft parts (except engines) including missiles	1	-
Off-highway equipment (construction, mining, and material handling)	9	1
Ordnance (except missiles)	3	-
Marine equipment	1	-
Plumbing fixtures, valves, and fittings	28	27
Oil-field machinery and equipment	2	70
Railroad equipment	1	-
Farm machinery and equipment	16	-
Industrial machinery	1	-
All other	36	-
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table V-7.--Forged steel fittings and flanges: Percentage distribution of U.S. producers' shipments for defense equipment uses, by types of markets, 1984

Type of market	Share of shipments
Passenger cars	-
Trucks and buses	-
Aircraft engines	-
Aircraft parts (except engines) including missiles	7
Off-highway equipment (construction, mining and material handling)	-
Ordnance (except missiles)	82
Marine equipment	7
Plumbing fixtures, valves, and fittings	4
Oilfield machinery and equipment	-
Railroad equipment	-
Farm machinery and equipment	-
Industrial machinery	-
All other	-
Total	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

The demand for forged steel fittings and flanges is directly influenced by demand in the oil patch and off-highway equipment markets; consequently, the contraction in demand in these markets during 1982-84 significantly affected the industry. During 1981-83, apparent consumption declined by 48 percent to $205.5 million in 1983, before rising to $271.0 million in 1984 (table V-8).

Table V-8.--Forged steel fittings and flanges: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, and end-of-period inventories, 1981-84, January-August 1984, and January-August 1985

Period	Domestic shipments	Exports	Imports	Apparent consumption	End-of-period inventories	Ratio of imports to consumption
	1,000 dollars					Percent
1981	315,365	6,836	88,127	396,656	46,509	22.2
1982	243,981	5,387	66,513	305,107	38,100	21.8
1983	148,633	4,610	61,430	205,453	26,753	29.9
1984	155,361	2,267	117,868	270,962	24,782	43.5
Jan.-Aug.--						
1984	106,249	1,152	76,731	181,828	24,509	42.1
1985	105,204	1,425	94,452	198,231	22,844	47.6

1/ Not available.

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

Imports increased their market share from 22 percent in 1981 to 44 percent in 1984, and exports as a share of domestic shipments declined from 2 to 1 percent.

U.S. imports

According to Commission questionnaire responses, U.S. imports of forged steel fittings and flanges increased by 61 percent during 1981-84 to $107.4 million in 1984 (table V-9). Japan, Italy, Taiwan, Canada, and West Germany accounted for the bulk of U.S. imports in 1984. Imports of forged steel fittings and flanges by U.S. producers * * * in 1984 (table V-9), representing * * * percent of total imports. Lower prices were cited as the principal reason for these purchases (table V-10).

Table V-9.--Forged steel fittings and flanges: U.S. producers' and importers' imports, 1981-84

(Quantity in short tons; value in thousands of dollars)

Year	Producers	Importers	Total	Producers' share (percent) of total imports
	Quantity			
1981	***	1/	1/	1/
1982	***	1/	1/	1/
1983	***	1/	1/	1/
1984	***	1/	1/	1/
	Value			
1981	***	66,840	***	***
1982	***	50,293	***	***
1983	***	46,174	***	***
1984	***	100,153	***	***

1/ Not available.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table V-10.--Forged steel fittings and flanges: U.S. producers' ranking of product-related factors that were the principal reasons for their imports, 1981-85

Reason for importing	Ranking 1/
Lower purchase price (delivered)	1
Cost of tooling/dies	2
Shorter delivery time	-
Engineering/technical assistance	6
Favorable terms of sale	6
Favorable product guarantees	-
Favorable exchange rates	2
Historical supplier relationship	2
Product performance features:	
Superior design	-
Quality	2
More durable	-
Other	-

1/ Ranking numbers range from 1 to 6, number 1 indicating the most important reason for importing and number 6 indicating the least important reason for importing.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

According to the American Pipe Fitting Association, there has been a marked increase in imports of custom, unfinished products in recent years. In contrast, most high-volume products are imported in an unfinished (i.e., not machined) condition.

Competitive Assessment of Product-Related Factors in the U.S. Market

U.S. producers and importers generally agree that foreign-made forged steel fittings and flanges have an overall competitive advantage because of lower purchase prices, costs of tooling, and favorable exchange rates (table V-11). U.S. purchasers also listed lower purchase prices as the most important reason for buying foreign-made forged steel fittings and flanges; U.S. buyers listed shorter delivery time and reliability of supplier as the principal reasons for purchasing domestically-produced products (table V-12).

Table V-11.--Forged steel fittings and flanges: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made products in the U.S. market, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Canada		Italy		Japan		West Germany		Taiwan	
	P	I	P	I	P	I	P	I	P	I
Overall competitive advantage	F	2/	F	F	F	F	F	2/	F	F
Principal factors:										
Lower purchase price (delivered)	X	-	X	X	X	X	X	-	X	X
Cost of tooling/dies	X	-	X	-	X	-	X	-	X	X
Shorter delivery time	-	-	-	-	-	-	-	-	-	-
Engineering/technical assistance	-	-	-	-	-	X	-	-	-	-
Favorable terms of sale	X	-	-	-	-	-	-	-	-	-
Favorable product guarantees	-	-	-	-	-	-	-	-	-	-
Favorable exchange rates	X	-	X	X	X	-	X	-	X	-
Reliability of supplier	-	-	-	-	-	-	-	-	-	-
Product performance features:										
Superior design	-	-	-	-	-	-	-	-	-	-
Quality	-	-	-	X	-	-	-	-	-	-
More durable	-	-	-	-	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same. X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

2/ Insufficient data.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table V-12.--Forged steel fittings and flanges: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984-85

Reason for purchase	U.S.-produced forged steel fittings and flanges	Foreign-made forged steel fittings and flanges
Lower purchase price (delivered)	6	1
Cost of tooling/dies	4	5
Shorter delivery time	1	-
Engineering/technical assistance	4	9
Favorable terms of sale	9	9
Favorable product guarantees	6	7
Favorable exchange rates	-	7
Reliability of supplier	2	2
Product performance features:		
Superior design	8	2
Quality	3	2
More durable	9	5

1/ Ranking numbers range from 1 to 9, number 1 indicating the most important reason for purchase and number 9 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

The purchasing trend of U.S. buyers responding to the Commission's questionnaires indicated an overall decline in value of domestic purchases and * * * in foreign purchases during 1981-84 (table V-13). There was a significant decline in purchases of U.S.-produced products during 1983, reflecting the downturn in the oil and construction markets.

Table V-13.--Forged-steel fittings and flanges: Purchases of U.S.-produced and foreign-made forgings by U.S. purchasers, 1981-84, January-August 1984, and January-August 1985

(Quantity in short tons; value in thousands of dollars)

Period	U.S.-produced	Foreign-made	Total	Share (percent) of U.S.-produced to total
	Quantity			
1981	354,266	***	***	***
1982	172,604	***	***	***
1983	97,527	***	***	***
1984	647,702	***	***	***
January-August--				
1984	585,568	***	***	***
1985	460,906	***	***	***
	Value			
1981	30,876	***	***	***
1982	41,083	***	***	***
1983	19,316	***	***	***
1984	26,095	***	***	***
January-August--				
1984	17,185	***	***	***
1985	17,816	***	***	***

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers' responses to import competition in the U.S. market

U.S. producers of forged steel fittings and flanges reported that the most common steps taken during 1981-84 in response to import competition in the U.S. market included lowering prices and costs (table V-14). These measures are consistent with producer assertions that suppression of prices caused lower profits in recent years and thwarted capital investment. Other steps taken by domestic producers included improving products, cutting back production, and reducing capacity.

Table V-14.--Forged steel fittings and flanges: U.S. producers' responses to import competition in the U.S. market, 1981-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	5
Had already shifted production to other lines of forgings	5
Lacked capital funds to counter foreign competition	3
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	29
Reduced or dropped plans to expand capacity	12
Cut back production	16
Closed production lines or manufacturing	7
Shifted to more advanced types of forgings	5
Implemented cost-reduction efforts	28
Improved quality of the products	18
Imported	5
Opened a plant to manufacture abroad	-
All other	-

1/ Data include responses of 35 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Competitive Assessment of Product-Related Factors in Foreign Markets

U.S. producers responding to the Commission's questionnaire assessed foreign producers as having an overall competitive advantage on the basis of prices, costs of tooling, and favorable exchange rates (table V-15). Moreover, the decline of the U.S. producers' competitive position is reflected by the steady decrease in U.S. exports during 1981-84.

Table V-15.--Forged steel fittings and flanges: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in foreign markets, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Canada	Italy	Japan	West Germany
Overall competitive advantage	F	F	F	F
Principal factors:				
Lower purchase price (delivered)	X	X	X	X
Cost of tooling/dies	-	X	X	X
Shorter delivery time	X	-	-	-
Engineering/technical assistance	-	-	-	-
Favorable terms of sale	-	X	-	-
Favorable product guarantees	-	-	-	-
Favorable exchange rates	X	X	X	X
Historical supplier relationship	-	-	-	-
Product performance features:				
Superior design	-	-	-	-
Quality	-	-	-	-
More durable	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same. X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.
2/ Insufficient data.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. producers' responses to increased competition in foreign markets

U.S. producers most commonly responded to increased competition in foreign markets by lowering prices, cutting back production, and implementing cost-reduction efforts (table V-16). Producers also reported that they attempted to improve product quality but lacked capital funds to counter foreign competition.

Table V-16.--Forged steel fittings and flanges: U.S. producers' responses to increased competition in their foreign markets, 1981-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	-
Had already shifted production to other lines of forgings	1
Lacked capital funds to counter foreign competition	3
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	9
Reduced or dropped plans to expand capacity	4
Cut back production	9
Closed production lines or manufacturing	3
Shifted to more advanced types of forgings	-
Implemented cost-reduction efforts	8
Improved quality of the products	4
Imported	2
Opened a plant to manufacture abroad	-
All other	1

1/ Data include responses of 11 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

VI. FORGED STEEL TRANSMISSION PARTS

Description and Uses

Several types of transmission designs are used in passenger cars, trucks, buses, agricultural equipment and construction equipment. To simplify the task of identifying the various forged components found in these transmissions and subsequently outlining their functions, this analysis will categorize transmissions as either manual or automatic systems. Both transmissions, in simple terms, transfer the rotation of an input shaft through to an output shaft. The input shaft receives its power directly from the rotating crankshaft in the engine. The output shaft's rotation is used to drive the power axle or axles of the vehicle through differential gearing arrangements incorporated into the axle assembly. The function of a transmission, then, is to translate the power of the engine and input shaft into rotation of the output shaft at a faster, slower, or identical speed or in the reverse direction of the input shaft. Thus, a vehicle may travel forward or in reverse and accelerate smoothly through a wide range of speeds. This transmission occurs through the use of two basic gear systems.

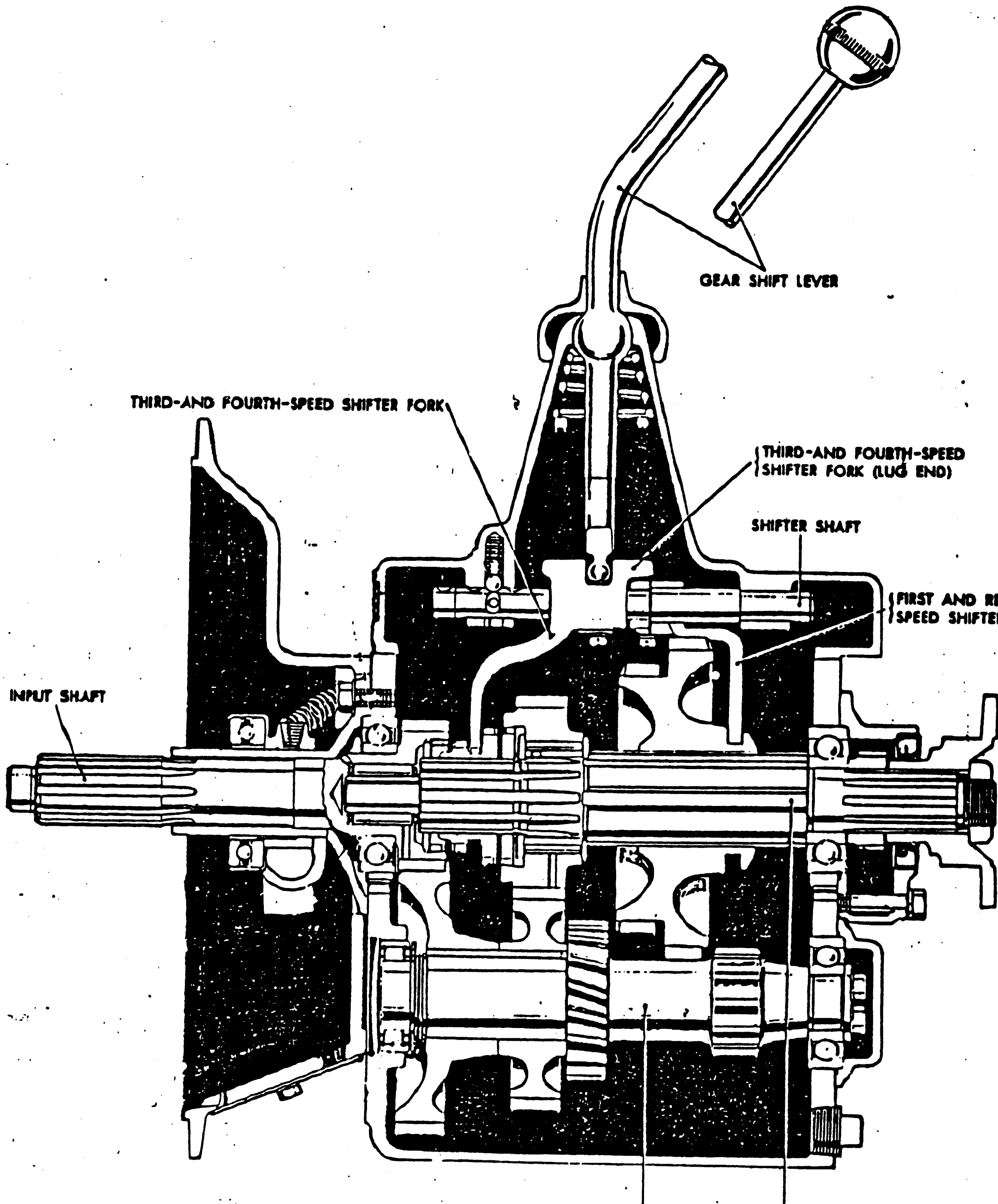
Figure VI-1 illustrates a manual transmission. In this arrangement, the rotation of the input shaft can be routed through a countershaft the gears of which then drive an output shaft, called the main shaft. The different sizes and positions of the gears enable the main shaft to rotate at different speeds and directions from the input shaft. The gears are moved into the desired positions by shifter forks attached to the driver-operated gear shift lever. The primary forged parts in this transmission are the shifter forks, the input, main, and countershafts, and the gears themselves.

Figure VI-2 shows the gearing arrangement of an automatic transmission. In this system, the output shaft may be driven using two gears, called pinions, that rotate about the main shaft. This arrangement is known as a planetary system because of the pinions' movement around the main shaft gears, called sun gears. Bands and clutches are engaged using oil pressure to control the movement of these gears. Both the gears and shafts are forged products.

Mechanical presses are used to forge steel transmission gears because of the high volumes usually required. A trimming operation punches the center hole of each gear, and the gears are forged without teeth. Producers use hot forging to produce shifter forks and levers. Preforming to near-net shape enhances efficiency.

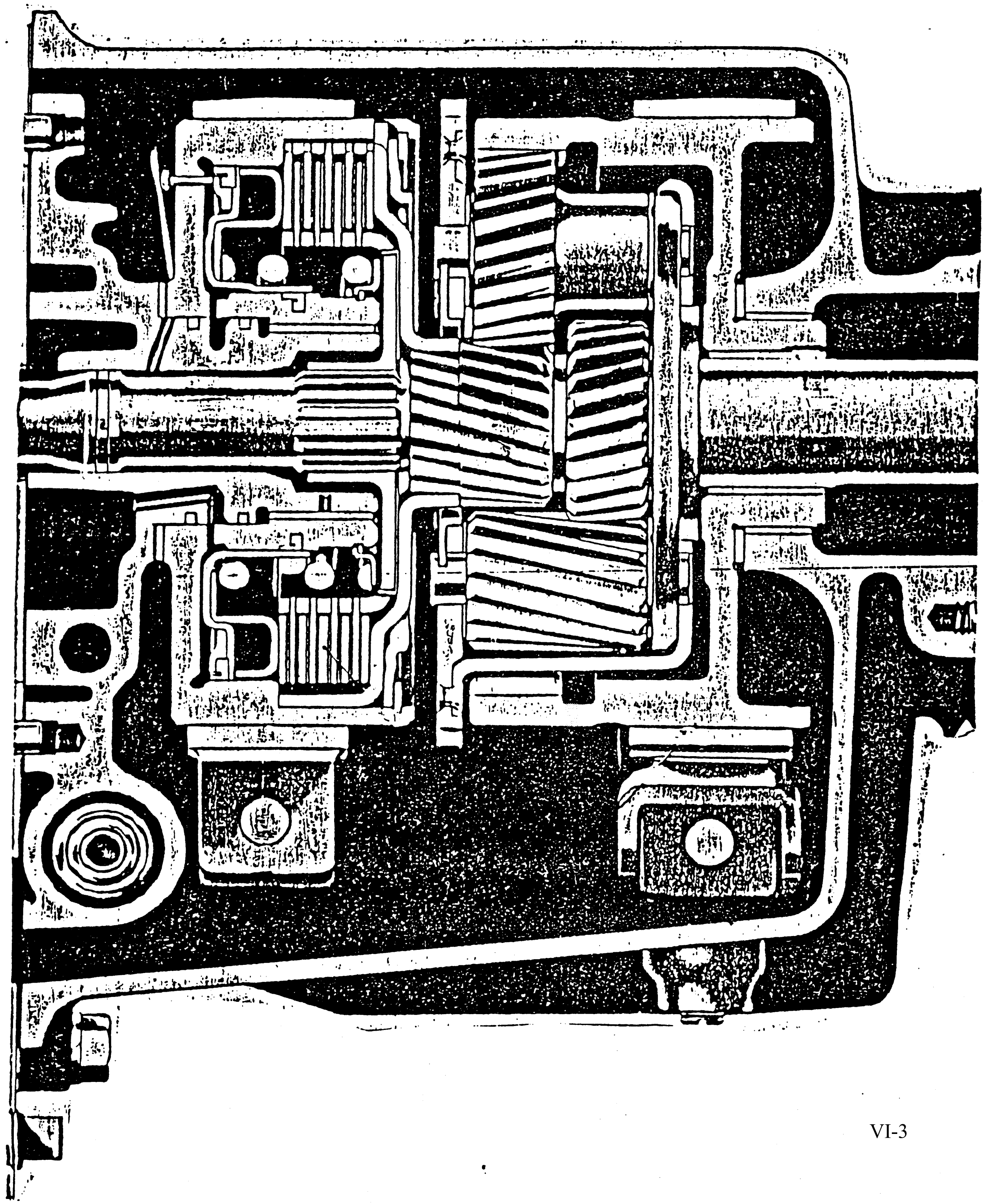
Transmission shafts, however, are forged using a cold-forming technique called splining. In the splining operation, rotating gears are pressed onto a steel shaft. As the shaft and gear rotate, the gear teeth press into the shaft thus creating splines along the shaft. The internal teeth of transmission gears used on the shaft mesh with these splines in the final assembly.

Figure VI-1.--Manual transmission (constant-mesh type), cross sectional view.



Source: Principles of Automotive Vehicles, Department of the Army and Air Force, 1956.

Figure VI-2.—Automatic transmission: view of planetary gear arrangement and shafts.



Source: Principles of Automotive Vehicles, Departments of the Army and Air Force, 1956.

Customs Treatment

U.S. tariff treatment

Motor-vehicle transmission parts are classified under TSUS items 692.32 abd 692.33, certain motor-vehicle parts. These parts are presently dutiable at 3.2 percent ad valorem (TSUS item 692.32) or zero if subject to APTA (table VI-1). These components are also eligible for duty-free treatment under the GSP and CBERA programs. Mexico, Brazil, and Taiwan currently exceed the GSP competitive need limits under this TSUS item and do not receive duty-free treatment. An explanation of the various rates of duty is provided in app. E.

Foreign tariff treatment

Motor-vehicle transmission parts are classified in the CCCN under item no. 87.06, motor-vehicle parts and accessories. The European Community has established separate tariff levels for parts for use in the assembly of motor vehicles (CCCN item no 87.06 (A)) and for other parts (CCCN item no. 87.06(B)). Tariff levels for Japan, West Germany, Italy, and Canada are summarized below:

Item No.	Description	Country	Present rate of duty
87.06	Motor-vehicle parts and accessories.	Japan	Free.
87.06(A)	Motor-vehicle parts for assembly use.	West Germany Italy	5.2% ad val.
87.06(B)	Other motor-vehicle parts.	West Germany Italy	7.5% ad val. 7.5% ad val.
95002-1	Motor-vehicle parts for use as original equipment.	Canada	Free.
43807-1	Other motor-vehicle parts.	Canada	8% ad val.

Japan unilaterally accelerated tariff reductions on these items to the present duty-free level in 1984.

Profile of the U.S. Industry

United States

<u>Overview</u>.--Approximately 40 companies currently produce transmission forgings in the United States, employing approximately 2,500 persons. Hot-forged components, as indicated earlier, can be produced on nonspecialized forging presses and hammers. Thus, the majority of gear blank, shift fork, and similar forging producers also turn out small forgings unrelated to transmissions. However, a significant portion of production is concentrated

VI-4

Table VI-1.--Forged steel transmission parts: U.S. rates of duty, by TSUS items, 1980-87

(Percent ad valorem)

TSUS item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rates of duty effective with respect to articles entered on or after Jan. 1--								Col. 2 rate of duty
			1980	1981	1982	1983	1984	1985	1986	1987	
692.32A*(pt.)	Certain motor-vehicle parts------	4%	3.9%	3.8%	3.7%	3.6%	3.4%	3.3%	3.2%	3.1%	25%.
692.33(pt.)	If Canadian article and original	Free	3/	3/	3/	3/	3/	3/	3/	3/	4/

1/ The designation A* indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP), and that certain of these countries, specified in general headnote 3(c) of the Tariff Schedules of the United States Annotated, are not eligible.
2/ Rate effective prior to Jan. 1, 1980.
3/ Rate not modified in the Tokyo round of the Multinational Trade Negotiations.
4/ Not applicable.

among about five forging operations owned by larger transmission builders. These captive forgers also operate the specialized equipment used for shaft splining. As with most forging facilities, the most efficient producers employ capital-intensive methods while limiting labor requirements. The following tabulation shows the approximate age and number of units of machinery and equipment used in transmission parts forging:

Age	Total machinery and equipment
1-2 years	53
3-4 years	74
5-9 years	166
10-19 years	130
20 years or older	377

Production, capacity, and employment.--As passenger car production declined in 1982 to less than 5 million units, transmission forging production also fell. In unit terms, 1982 transmission forging reported production (representing about 80 percent of the industry total) showed an 18-percent decrease from 1981. Spurred by the recovery of auto production in the United States and the higher demand for on-highway trucks caused in part by trucking industry deregulation, transmission forging production climbed 47 percent during 1982-84. At the same time, capacity utilization rates rose from an average of almost 55 percent in 1981 to just over 75 percent in 1984. Table VI-2 reviews these data and selected employment data analyzed below.

The labor force engaged in the production of transmission forgings experienced its largest reduction in 1982, when employment fell 21 percent. Employment fell again in 1983, this time by 3 percent. It should be noted that while employment fell during 1981-83, unit production rose 22 percent in 1983 when compared with 1982. These employment and production figures indicate significant productivity improvements. Current employments although slightly above the 1982 level, still is 9 percent below 1984. Wages, as shown in the following tabulation, have remained remarkably constant in light of other industrial averages:

	Forgers producing steel transmission parts 1/	All forged products 1/	All operating U.S. manufacturing establishments 2/
1981	$12.58	$14.73	$7.99
1982	12.25	17.05	8.49
1983	12.29	16.82	8.83
1984	12.62	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.
2/ Compiled from official statistics of the U.S. Department of Labor.

Financial data.--As indicated in table VI-3, net sales and net profit have followed a pattern similar to production. Following a decline in 1982, sales and profits have continued to increase. Data for the first 8 months of

Table VI-2.—Forged steel transmission parts: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, hourly wage rates, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August— 1984	January-August— 1985
Production and capacity:						
Production——units——	65,027,668	53,351,492	65,069,053	78,548,901	55,244,462	48,838,865
Capacity——do——	90,267,086	97,962,672	104,958,514	103,782,439	84,367,572	97,345,336
Capacity utilization percent——	72.0	54.5	62.0	75.7	65.5	50.2
Employment of production and related workers:						
Number——	2,339	1,841	1,784	2,060	2,089	1,897
Man-hours worked hours——	4,326,311	3,550,618	3,724,070	4,390,876	3,102,951	2,874,225
Wages——1,000 dollars——	54,438	43,508	45,752	55,400	39,175	39,253
Hourly wage rate——	$12.58	$12.25	$12.29	$12.62	$12.62	$13.66

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

1985, however, indicate an 18-percent decline in net sales in 1985 from 1984 and a decline in net profits of 77 percent. U.S. producers of transmission forgings will likely show a net profit margin for full year 1985 lower than that at any point during 1981-85:

Table VI-3.--Forged steel transmission parts: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Net sales--1,000 dollars--	279,472	192,649	214,876	257,326	179,087	147,409
Net profit or (loss) 1,000 dollars--	24,051	5,293	11,793	17,117	13,815	3,194
Ratio of net operating profit or (loss) to net sales----------percent--	8.6	2.7	5.5	6.7	7.7	2.2

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

As will be discussed later in this section, net profits have most likely declined, according to industry sources, because of price-reduction and cost-reduction programs designed to combat increased foreign competition in the U.S. market.

Structural Factors of Competition Between U.S. and Foreign Industries

According to U.S. producers of forged steel transmission parts, the major countries competing in the U.S. market enjoy an overall competitive advantage over domestic companies (table VI-4). These countries, Japan, Brazil, West Germany, and Italy derived their competitive advantage from lower costs for raw materials, labor, and capital. Moreover, U.S. producers indicated that these foreign governments provided economic assistance to their companies and protected their markets behind tariff and nontariff walls. (It should be noted that Japan does not maintain a tariff on transmission parts).

U.S. producers do, however, cite a competitive advantage over foreign companies in marketing areas. Particularly, U.S. producers are generally able to fill transmission forging orders faster than their foreign counterparts. Services after the sale also provide an advantage to domestic suppliers. Thus, the proximity of domestic producers to their customers appears to be the primary advantage these companies may utilize in competition with imports.

Table IV-4.--Forged steel transmission parts: U.S. producers' assessment of structural factors of competiton for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Japan	Brazil	West Germany	Italy
Overall competitive advantage	F	F	F	F
Fuel cost	F	S	D	S
Raw materials costs	F	F	F	F
Capital:				
Cost	F	F	F	F
Ability of industry profits to attract funds	F	F	F	F
Labor cost	F	F	F	F
Production technology	S	S	S	S
Marketing:				
Channels of distribution	S	S	S	S
Responsiveness to orders	D	D	S	D
After-sale service capabilities	D	D	D	D
Government involvement:				
Subsidies	F	F	F	F
Research and development assistance	F	F	S	S
Tariff levels on imports	F	F	F	F
Nontariff barriers to imports	F	F	F	F
U.S. Government regulations which increase costs	S	S	F	F
Foreign government regulations which increase costs	S	S	S	S

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

The U.S. Market

Overview

The U.S. market for forged transmission parts declined significantly in 1982 with apparent U.S. consumption falling by more than 44 percent when compared with 1981. Similarly, U.S. producers' shipments dropped over 30 percent in 1982. Although U.S. imports of these products also declined nearly 34 percent in 1982 when compared with 1981, imports by 1983 had recovered almost completely. Producers' shipments, on the other hand, were still well below 1981 levels. This disparity led to a gain in import penetration from 10.5 percent in 1982 to 13.3 percent in 1983. Imports rose again in 1984 by 49 percent, increasing their share of apparent consumption to 15.7 percent (table VI-5).

Table VI-5.--Forged steel transmission parts: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, and end-of-period inventories, 1981-84, January-August 1984, and January-August 1985

Period	Shipments	Exports	Imports	Apparent consumption	End-of-period inventories	Ratio of imports to consumption
	1,000 dollars					Percent
1981	379,090	1,492	46,249	423,847	7,413	10.9
1982	263,669	559	30,754	293,864	6,251	10.5
1983	295,364	338	45,140	340,166	7,055	13.3
1984	362,397	255	67,376	429,518	9,249	15.7
Jan.-Aug.--						
1984	252,614	191	43,267	295,690	9,827	14.6
1985	215,011	114	41,386	256,283	7,983	16.1

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

An examination of the markets for transmission parts, highlighted in table VI-6 and table VI-7, provides some insight into the channels of distribution and markets.

Table VI-6.--Forged transmission parts: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution

Channel of distribution	Producers	Importers
Original-equipment manufacturers	81	42
Machine ships/other fabricators	14	5
Distributors	1	51
All other	4	2
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VI-7.--Forged steel transmission parts: Percentage distribution of U.S. producers' and importers' shipments, by types of markets

Type of market	Producers	Importers
Passenger cars	46.8	47.3
Trucks and buses	44.9	41.5
Aircraft engine	-	-
Aircraft parts (except engines) including missiles	1.1	-
Off-highway equipment (construction, mining, and material handling)	2.7	4.6
Ordinance (except missiles)	0.1	-
Marine equipment	-	1.0
Plumbing fixtures, valves, and fittings	.1	-
Oilfield machinery and equipment	-	-
Railroad equipment	.1	-
Farm machinery and equipment	3.5	5.5
Industrial machinery	.2	-
Other	1.0	-
Total	100.0	100.0

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Although U.S. producers and importers sell forged transmission parts in the same markets, U.S. producers distribute their output predominantly through original equipment manufacturers (OEM), i.e., transmission manufacturers. Approximately half of all imports of transmission forging are sold to distributors. This would indicate that a significant portion of imports are being used by aftermarket-service channels for the maintenance of older vehicles. U.S. producers' shipments, on the other hand, are primarily destined for OEM's that produce primarily on-highway motor-vehicle transmissions. As both cars and trucks have been down-sized over the past 5 years, the transmissions in use have also become lighter and smaller. Thus, while unit production has recovered beyond 1981 levels, the unit value of this production has declined.

Another contributing factor to the recent strength of imports lies in the construction equipment and agricultural equipment markets. As shown in table VI-7, importers send a larger portion of total shipments into these markets than domestic companies. This disparity is likely to grow since several large manufacturers of construction and agricultural vehicles have chosen to increase off-shore production. This strengthens the domestic vehicle makers' ties with foreign parts sources and will also likely lead to the distribution of foreign-made vehicles through the domestic distribution network. Moreover, several foreign companies, including those from West Germany and Japan, have either purchased U.S. truck producers or begun truck exports to the United States. These vehicles will most likely require imported parts for production or repair and maintenance in the future. As noted above, imports are strongest in the aftermarket.

Lastly, two Japanese automakers currently produce cars and/or light trucks in the United States. Two new facilities are planned by other Japanese car companies. A joint venture between a U.S. and a Japanese auto company has begun operations with another venture planned between a different U.S. car maker and another Japanese firm. Thus, assuming foreign procurement in these cases, imports of smaller transmission forgings will likely continue to rise.

Competitive Assessment of Product-Related Factors of Competition in the U.S. Market

According to U.S. producers' and importers' assessments, the major countries supplying forged-steel transmission parts to the U.S. market have developed an overall competitive advantage rooted primarily in pricing. These countries, Japan, Korea, Brazil, West Germany, and Italy, all market these forgings at a lower delivered price. Producers also claim that these countries enjoy further product-related advantages in lower tooling costs and by offering special sales terms. In cases where importer responses were sufficient to make a determination, importers found no such advantage. Rather, in the case of Japan, importer responses to the Commission's questionnaire indicate higher product quality and supplier reliability as being significantly advantageous. Producers and importers agreed that Brazil benefitted from exchange rates of the dollar and cruzeiro during 1984-85. Table VI-8 summarizes the producers' and importers' responses.

U.S. purchasers also supported the importance of price in the selection of suppliers. Table VI-9 shows price to be the most important factor in choosing foreign-made transmission forgings and the second most important factor in selecting domestic products. Also important in the decision to purchase import parts were exchange-rate benefits and tooling costs. The purchase factors most important in selecting domestic sources included technical assistance and delivery time, indicating that producers have an advantage over imports in being nearer to their customers.

As shown in table VI-10, U.S. producers receive approximately 87 percent of U.S. purchaser orders for forged steel transmission parts. Imports, however, during 1981-84, have continued to take a growing share of this business. Given the importance of delivery time in selecting domestic sources, it is likely that the increasing sophistication of importers' distribution networks, particularly the rising use of U.S.-located warehousing facilities, will weaken the domestic advantage. Moreover, as discussed earlier, foreign investments in U.S. vehicle assembly operations and movement of some U.S. assembly operations to overseas locations will further bolster import shares.

<u>U.S. producers' responses to import competition in the U.S. market</u>

As noted in table VI-11, U.S. producers have responded to import competition by implementing major cost reduction programs, limiting price increases, and improving product quality where possible. The cost-reduction programs, in many instances, have included installation of advanced or more efficient forming and heating equipment. These highly capital intensive programs have cut into corporate profit margins, as mentioned previously. Further, several companies cut back on production, acknowledging significant over-capacity in the industry, exacerbated by new import competition.

Table VI-8.--Forged steel transmission parts: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made products in the U.S. market, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan		Korea		Brazil		West Germany		Italy	
	P	I	P	I	P	I	P	I	P	I
Overall competitive advantage	F	F	F	S	F	F	F	S	F	S
Principal factors:										
Lower purchase price (delivered)	X	X	X	-	X	X	X	-	X	-
Cost of tooling/ dies	X	-	-	-	X	-	X	-	X	-
Shorter delivery time	-	-	-	-	-	-	-	-	-	-
Engineering/technical assistance	-	-	-	-	-	-	-	-	-	-
Favorable terms of sale	-	-	-	-	X	-	-	-	X	-
Favorable product guarantees	-	-	-	-	-	-	-	-	-	-
Favorable exchange rates	X	-	X	-	X	X	X	-	X	-
Reliability of supplier	-	-	-	-	-	-	-	-	-	-
Product performance features:										
Superior design	-	-	-	-	-	-	-	-	-	-
Quality	-	X	-	-	-	-	-	-	-	-
More durable	-	-	-	-	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VI-9.--Forged steel transmission parts: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984-85

Reason for purchase	U.S.-produced forged steel transmission parts	Foreign-made forged steel transmission parts
Lower purchase price (delivered)	2	1
Cost of tooling/dies	4	3
Shorter delivery time	2	9
Engineering/technical assistance	1	4
Favorable terms of sale	10	8
Favorable product guarantees	8	9
Favorable exchange rates	10	2
Reliability of supplier	4	4
Product performance features:		
Superior design	7	7
Quality	6	4
More durable	8	9

1/ Ranking numbers range from 1 to 10, number 1 indicating the most important reason for purchase and number 10 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VI-10.--Forged steel transmission parts: Purchases of U.S.-produced and foreign-made forgings by U.S. purchasers, 1981-84, January-August 1984, and January-August 1985

Period	U.S.-produced	Foreign-made	Total	Share of U.S.-produced to total
	1,000 dollars			Percent
1981	196,083	23,795	219,878	89.2
1982	138,836	16,169	155,005	89.6
1983	158,034	23,485	181,519	87.1
1984	217,999	33,840	251,839	86.6
Jan.-Aug:				
1984	145,689	21,528	167,217	87.1
1985	127,981	19,859	147,590	86.7

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VI-11.--Forged steel transmission parts: U.S. producers' responses to import competition in the U.S. market, 1981-84

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	0
Had already shifted production to other lines of forgings	0
Lacked capital funds to counter foreign competition	12
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	15
Reduced or dropped plans to expand capacity	8
Cut back production	19
Closed production lines or manufacturing	4
Shifted to more advanced types of forgings	0
Implemented cost-reduction efforts	19
Improved quality of the products	15
Imported	4
Opened a plant to manufacture abroad	0
All other	0

1/ Data include responses of 40 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Competitive Assessment of Product-Related Factors in Foreign Markets

Table VI-12 summarizes producers' assessments of product-related factors for Japan and West Germany in foreign markets. These countries exhibited an overall competitive advantage over U.S. producers which stemmed primarily from lower delivered prices and favorable exchange rates for transmission forgings.

U.S. producers' responses to competition in foreign markets

Table VI-13 reviews the responses of U.S. producers to competition in their foreign markets. This table indicates a small percentage of producers competing overseas. These producers have avoided price increases and implemented cost reduction programs just as they did in the domestic market. However, the majority of these companies have also cut back production significantly. Most major foreign markets have suffered from underutilized production capacity similar to that of the United States.

Table VI-12.--Forged steel transmission parts: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in foreign markets, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan	West Germany
Overall competitive advantage	F	F
Principal factors:		
Lower purchase price (delivered)	X	X
Cost of tooling/dies	-	X
Shorter delivery time	-	-
Engineering/technical assistance	-	-
Favorable terms of sale	-	-
Favorable product guarantees	-	-
Favorable exchange rates	X	X
Reliability of supplier	-	-
Product performance features:		
Superior design	-	-
Quality	-	-
More durable	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VI-13.--Forged steel transmission parts: U.S. producers' responses to increased competition in their foreign markets, 1981-84

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	0
Had already shifted production to other lines of forgings	0
Lacked capital funds to counter foreign competition	4
Took the following actions:	
Lowered prices or suppressed price increases to maintain market share	6
Reduced or dropped plans to expand capacity	3
Cut back production	7
Closed production lines or manufacturing	1
Shifted to more advanced types of forgings	0
Implemented cost-reduction efforts	7
Improved quality of the products	5
Imported	1
Opened a plant to manufacture abroad	0
All other	0

1/ Data include responses of 40 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

VII. FORGED STEEL HOOKS, SHACKLES, LOADBINDERS, AND OTHER ATTACHMENTS

Description and Uses

The forged steel hooks, shackles, loadbinders, and other attachments included in this sector generally are components of an assembly that lifts, binds, or fastens heavy loads (figure VII-1). These articles are made of carbon, alloy, and stainless steels, and are manufactured in various sizes and strengths depending upon the load to be lifted or supported. Generally, the heavier the load the larger the hook or shackle. Because of the stress placed upon these articles and the standards that must be met as a result, substitute articles such as castings or ceramics are not suitable for such applications.

Hooks are manufactured in capacities of 3/4 ton through 300 tons, and shackles range between 1/3 ton through 150 ton capacities. Loadbinders, which attach to chains for tensioning, accommodate various chain sizes ranging from 3/16 to 5/8 inch. Examples of other attachments included in this sector are rope clips, links, and turnbuckles.

The basic production process involved in the manufacture of these forged articles is the impression die method. A bar of steel is cut into shorter lengths and heated by such means as electric-induction or gas. The heated bar is pressed between two dies of a hammer, forcing the steel to conform to the die design. The flash is then removed from the forging in a trimming process before being cleaned and treated. Secondary machining operations such as drilling, tapping, and boring are conducted before final inspection. Specifications for these forged steel hooks, shackles, and loadbinders are determined by a number of organizations, such as the American Society for Testing and Materials (ASTM).

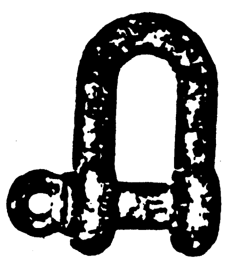
Customs Treatment

U.S. tariff treatment

Forged steel hooks, shackles, loadbinders, and other attachments are classified under TSUSA item 657.2590. Included within this category are other articles of iron or steel, not coated or plated with precious metal, such as stands for drills and terminals, handcuffs, office dividers, and other miscellaneous iron and steel articles. The rate of duty applicable to imports

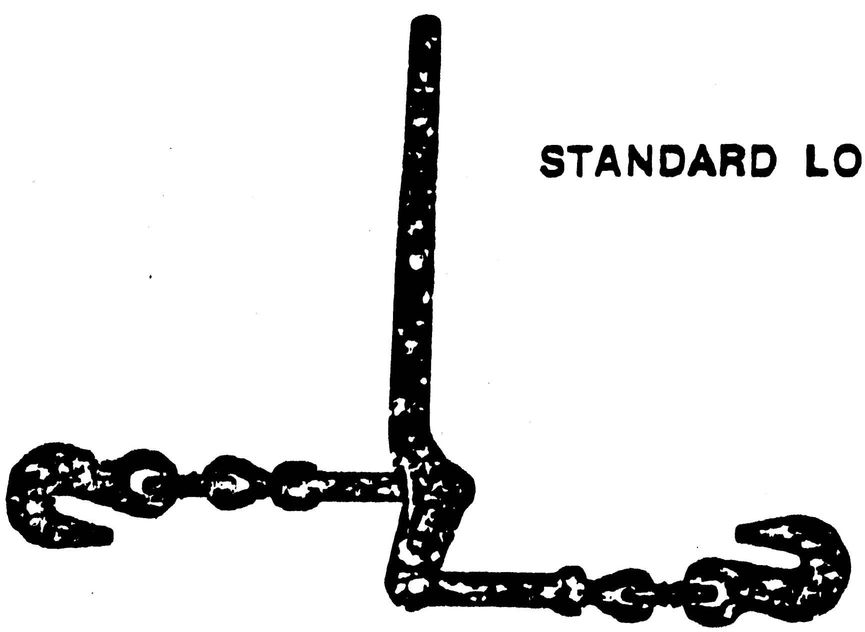
Figure VII-1

CLEVIS GRAB HOOK



SCREW PIN

CHAIN SHACKLE



STANDARD LOAD BINDER

Source: The Crosby Group, Inc. General Catalog, September 1984.

of these products is shown in table VII-1. An excerpt from the TSUSA covering hooks, shackles, loadbinders, and other attachments and an explanation of the various rates of duty are provided in app. E.

Taiwan has been ineligible under the GSP for this item since March 30, 1984, because its shipments have equaled or exceeded the competitive-need limits. All other GSP beneficiaries have been eligible for duty-free treatment for this item during 1981-85. In addition, this item is eligible for duty-free treatment under CBERA. There have been no trade investigations conducted on this product by the Commission or the Department of Commerce during the period.

Foreign tariff treatment

Most of the major foreign sources of forged steel hooks, shackles, loadbinders, and other attachments classify imports of these products as part of item No. 73.40, "Other articles of iron or steel," within the CCCN System. Japan and the European Community negotiated trade reductions during the Tokyo round of the MTN, to achieve final rates of 5.8 percent ad valorem and 5.3 percent ad valorem, respectively, by January 1, 1987. The current rates of duty applicable to imports of forged steel hooks, shackles, loadbinders, and other attachments for the major foreign sources of these forged products are shown in the following tabulation:

Item No.	Description	Country	Present rate of duty
73.40	Other articles of iron or steel.	Japan	5.8% ad val.
		Korea	30.0% ad val.
		Taiwan	40.0% ad val.
		EC	6.0% ad val.

Canada classifies imports under its own tariff system, the Tariff Schedules of Canada, as follows:

Item No.	Description	Country	Present rate of duty
44603-1	Other manufactures, articles or wares, of iron or steel or of which iron or steel or both are the component materials of chief value, n.o.p.	Canada	11.1% ad val.

Table VII-1.—Forged steel hooks, shackles, loadbinders, and other attachments: U.S. rates of duty, by TSUS items, 1980-87

TSUS item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rates of duty effective with respect to articles entered on or after Jan. 1—								Col. 2 rate of duty
			1980	1981	1982	1983	1984	1985	1986	1987	
	Articles of iron or steel, not coated or plated with precious metal:										
	Other articles:										
	Other:										
657.25A*(pt.)	Other	9.5%	9%	8.6%	8.1%	7.6%	7.1%	6.7%	6.2%	5.7%	45%.

1/ The designation "A*" indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP), and that certain of these countries, specified in general headnote 3(c) of the Tariff Schedules of the United States Annotated, are not eligible.

2/ Rate effective prior to Jan. 1, 1980.

Profile of the U.S. Industry

Overview

At least 15 companies manufacture forged steel hooks, shackles, and loadbinders in the United States. The largest firm, which accounts for over an estimated 50 percent of shipments, is located in Oklahoma. The majority of these forge shops are multiproduct facilities equipped with such machinery as hammers, upsetters, and formers. Respondents to the Commission's questionnaire indicated that the majority of the machinery and equipment used in the manufacture of these products were 20 years or older, as shown in the following tabulation:

Age	Total machinery and equipment (number)
0-2 years	19
3-4 years	39
5-9 years	67
10-19 years	68
20 years or older	118

Production, capacity, and employment

During 1981-83, reported production (representing less than 50 percent of industry total) declined by 23 percent before rising in 1984 by 26 percent to 15.8 million units (table VII-2). Capacity to produce forged steel hooks, shackles, and loadbinders increased by 10 percent during 1981-82 to 24.6 million units and stabilized near that level during 1982-84. Capacity utilization of Commission respondents ranged from a low of 52.2 percent in 1983 to a peak of 72.4 percent in 1981.

Table VII-2.--Forged steel hooks, shackles, and loadbinders: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, and hourly wage rates, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August	
					1984	1985
Production and capacity:						
Production-----1,000 units--	16,248	14,088	12,571	15,839	11,007	9,687
Capacity--------------do----	22,435	24,611	24,091	24,438	23,623	25,779
Capacity utilization percent--	72.4	57.2	52.2	64.8	46.6	37.6
Employment of production and related workers:						
Number----------------------	744	674	434	529	522	483
Manhours worked-------------	617,364	432,289	361,985	437,936	297,711	224,598
Wages--------1,000 dollars--	7,142	5,835	5,019	5,930	4,127	3,402
Hourly wage rate------------	$11.57	$13.50	$13.87	$13.54	$13.86	$15.15

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Employment, wages, and man-hours worked exhibited the same trend as that for production, declining during 1981-83 before recovering in 1984. Estimated hourly wage rates, however, rose 20 percent during 1981-83 before falling to an estimated $13.54 in 1984. This compares with the average hourly wage rates of workers manufacturing all forged products and those in all operating U.S. manufacturing establishments, as shown in the following tabulation:

	Forgers producing forged steel hooks, shackles, and loadbinders 1/	All forged products 1/	All operating U.S. manufacturing establishments 2/
1981----------	$11.57	$14.73	$7.99
1982----------	13.50	17.05	8.49
1983----------	13.87	16.82	8.83
1984----------	13.54	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.
2/ Compiled from official statistics of the U.S. Department of Labor.

Financial data

Reported net sales declined during 1981-83 before rising to $26.4 million in 1984 (table VII-3). U.S. manufacturers of these products experienced net profits in all years except 1982, with profitability ranging between 5.7 and 10.6 percent of net sales. Capital expenditures and research and development expenditures, accounted for approximately 3 percent of total net sales during January 1981-August 1985, as shown in the following tabulation:

Item	Value (1,000 dollars)
Capital expenditures----------------	2,293
Research and development expenditures----------------------	700

Table VII-3.--Forged steel hooks, shackles, and loadbinders: U.S. producers' net sales and net profit or (loss), 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August--	
					1984	1985
Net sales------1,000 dollars--	29,768	22,280	22,236	26,428	18,266	16,910
Net profit or (loss)----do----	1,698	(320)	1,613	2,812	1,995	1,338
Ratio of net operating profit or (loss) to net sales percent--	5.7	(1.4)	7.3	10.6	10.9	7.9

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Structural Factors of Competition Between U.S. and Foreign Industries

Foreign producers 1/ of forged steel hooks, shackles, and loadbinders are equally competitive in the U.S. market with U.S.-produced articles, according to respondents to the Commission's questionnaire (table VII-4). Foreign producers' competitive strengths, according to U.S. manufacturers, lie in lower costs (raw materials, capital, and labor), the ability of industry profits to attract funds, alleged foreign government subsidies, and tariff and nontariff barriers to imports. A discussion of these competitive factors and the basis for foreign producer advantages is contained in the overview. U.S. Government regulations that increase costs are generally indicated to be of no advantage to either U.S. or most foreign producers, except West Germany and Italy. U.S. producers indicated that they were in a comparable position with most foreign producers in regard to fuel cost, production technology,

1/ Countries identified by respondents to the Commission's questionnaire include Taiwan, Japan, Korea, West Germany, and Italy.

distribution channels, and responsiveness. U.S. producers also indicated that generally neither U.S. nor foreign producers have an advantage in government research and development assistance or foreign government regulations that increase costs. After-sale service capabilities was the only factor U.S. producers considered to be their advantage.

Table VII-4.--Forged steel hooks, shackles, and loadbinders: U.S. producers' assessment of structural factors of competition for the U.S. industry and selected foreign industries, 1/ by major competing countries, 1984-85

Item	Taiwan	Japan	Korea	West Germany	Italy
Overall competitive advantage	S	S	S	S	S
Fuel cost	S	D	S	S	D
Raw materials costs	F	F	F	F	F
Capital:					
Cost	F	F	F	F	F
Ability of industry profits to attract funds	F	F	F	S	F
Labor cost	F	F	F	F	F
Production technology	S	S	S	S	S
Marketing:					
Channels of distribution	S	S	S	S	S
Responsiveness to orders	D	S	S	S	D
After-sale service capabilities	D	S	D	D	D
Government involvement:					
Subsidies	F	F	F	F	F
Research and development assistance	S	F	S	S	S
Tariff levels on imports	S	F	F	S	F
Nontariff barriers to imports	F	F	F	F	F
U.S. Government regulations which increase costs	S	S	S	F	F
Foreign government regulations which increase costs	S	S	S	S	S

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

The U.S. Market

Overview

Estimated apparent consumption of forged steel hooks, shackles, and loadbinders declined 12 percent during 1981-83 before rising to $97.6 million in 1984 (table VII-5). The level of producers' shipments and exports exhibited the same trend during the period, whereas reported U.S. imports fluctuated between a low of an estimated $9.6 million in 1981 to a peak of $33.5 million in 1984. During the period, imports ranged between 12.1 and 34.3 percent of apparent consumption, whereas exports accounted for an estimated 3 to 4 percent of producers' shipments. During January-August 1985, imports totaled less than one-half of the 1984 quantity level, amounting to $11.9 million, and accounting for 22.5 percent of apparent consumption.

U.S. producers generally transport their shipments by truck in a marketing area of over 500 miles, with average transportation costs representing less than 5 percent of the sales value. Many producers indicated that the transportation costs associated with their shipments were usually paid by their customers. U.S. producers and importers of forged steel hooks, shackles, and loadbinders generally market their products through the same channels, primarily through distributors (table VII-6). U.S. manufacturers shipped the largest percentage of their products (25 percent) to the farm

Table VII-5.—Forged steel hooks, shackles, and loadbinders: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, and apparent consumption, 1981-84, January-August 1984, and January-August 1985

Period	Shipments	Exports	Imports	Apparent consumption	Ratio of imports to consumption
	1,000 dollars				Percent
1981	72,766	2,764	9,623	79,625	12.1
1982	55,178	2,273	20,034	72,939	27.5
1983	54,769	1,754	17,115	70,130	24.4
1984	66,323	2,259	33,503	97,567	34.3
January-August—					
1984	45,786	1,556	25,147	69,377	36.2
1985	42,228	1,197	11,885	52,916	22.5

Source: Estimated from data submitted in response to questionnaires of the U.S. International Trade Commission.

machinery and equipment market (table VII-7). The largest markets for U.S. importers were the marine equipment and industrial machinery markets (19 percent each), with off-highway equipment a secondary market (15 percent).

The leading market (22 percent) for producers' shipments for defense-related uses in 1984 was aircraft parts (except engines) including missiles, followed by the trucks and buses (15 percent) and ordnance (11 percent) markets (table VII-8).

Table VII-6.--Forged steel hooks, shackles, and loadbinders: Percentage distribution of U.S. producers' and importers' shipments, by channels of distribution, 1984

Channel of distribution	Producers	Importers
Original-equipment manufacturers	15	8
Machine shops/other fabricators	1	1/
Distributors	82	89
All other (end users)	2	3
Total	100	100

1/ Less than 0.5 percent.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VII-7.--Forged steel hooks, shackles, and loadbinders: Percentage distribution of U.S. producers' and importers' shipments, by types of markets, 1984

Type of market	Producers	Importers
Passenger cars	1/	1/
Trucks and buses	6	4
Aircraft engines	1/	0
Aircraft parts (except engines) including missiles	1/	0
Off-highway equipment (construction, mining, and material handling)	6	15
Ordnance (except missiles)	1	0
Marine equipment	3	19
Plumbing fixtures, valves, and fittings	1/	0
Oil-field machinery and equipment	1	4
Railroad equipment	3	0
Farm machinery and equipment	25	3
Industrial machinery	3	19
All other (e.g. hardware stores and lumber yards)	50	35
Total	100	100

1/ Less than 0.5 percent.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Note.--Because of rounding, totals may not add to 100.

Table VII-8.--Forged steel hooks, shackles, and loadbinders: U.S. producers' shipments for defense equipment uses, by types of markets, 1984

(In percent)

Type of market	Share of shipments
Passenger cars	-
Trucks and buses	15
Aircraft engines	-
Aircraft parts (except engines) including missiles	22
Off-highway equipment (construction, mining, and material handling)	8
Ordnance (except missiles)	11
Marine equipment	-
Plumbing fixtures, valves, and fittings	-
Oilfield machinery and equipment	-
Railroad equipment	-
Farm machinery and equipment	-
Industrial machinery	-
All other	44
Total	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Note.--Because of rounding, total may not add to 100.

U.S. imports

Estimated U.S. imports of forged steel hooks, shackles, and loadbinders fluctuated between $9.6 million in 1981 and $33.5 million in 1984. Major import sources were Japan, Taiwan, Korea, and Italy.

Respondents to the Commission's importers' questionnaire indicated that their imports increased overall by 73 percent during the period to * * * million units * * * (table VII-9). * * *.

Table VII-9.--Forged steel hooks, shackles, and loadbinders: U.S. producers' and importers' imports, 1981-84, January-August 1984, and January-August 1985

(Quantity in thousands of units; value in thousands of dollars)

Period	Producers	Importers	Total	U.S. producers' share (percent) of total imports
	Quantity			
1981	***	1,487	***	***
1982	***	2,496	***	***
1983	***	1,923	***	***
1984	***	2,575	***	***
January-August--				
1984	***	1,626	***	***
1985	***	2,558	***	***
	Value			
1981	***	3,738	***	***
1982	***	4,667	***	***
1983	***	3,761	***	***
1984	***	5,921	***	***
January-August--				
1984	***	3,474	***	***
1985	***	4,003	***	***

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Transportation costs are believed to account for 5 to 6 percent of the value of the imported merchandise, and are not considered to be a significant factor in their international trade.

Competitive Assessment of Product-Related Factors in the U.S. Market

U.S. producers and importers responding to the Commission's questionnaire indicated that imports from all sources of forged steel hooks, shackles, and loadbinders, except Japan which is considered equally competitive, have an overall competitive advantage in the U.S. market (table VII-10). The principal reasons for these advantages, as reported by the respondents, were price factors, specifically lower purchase price, cost of tooling/dies, favorable terms of sales, and favorable exchange rates. U.S. producers credit themselves with advantages in service-oriented and product performance features.

Table VII-10.--Forged steel hooks, shackles, and loadbinders: U.S. producers' (P) and importers' (I) competitive assessment of U.S.-produced and foreign-made products in the U.S. market, 1/ by major supplying countries, and the principal factors (X) underlying overall competitive advantages, 1984-85

Item	Japan		Korea		Taiwan		Italy	
	P	I	P	I	P	I	P	I
Overall competitive advantage	S	F	F	F	F	2/	F	F
Principal factors:								
Lower purchase price (delivered)	-	X	X	X	X	-	X	X
Cost of tooling/dies	-	X	X	X	X	-	X	-
Shorter delivery time	-	-	-	-	-	-	-	-
Engineering/technical assistance	-	-	-	-	-	-	-	X
Favorable terms of sale	-	-	-	-	-	-	X	X
Favorable product guarantees	-	-	-	-	-	-	-	-
Favorable exchange rates	-	X	-	X	X	-	X	X
Reliability of supplier	-	X	X	X	-	-	-	-
Product performance features:								
Superior design	-	X	-	-	-	-	-	-
Quality	-	X	-	X	-	-	-	X
More durable	-	X	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.
2/ Insufficient data.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. purchasers of forged steel hooks, shackles, and loadbinders were unanimous in ranking lower purchase price as the principal reason for their purchases of foreign-produced forgings. Their reasons for purchasing U.S.-produced forgings were numerous, but shorter delivery time was a unanimous choice. Secondary reasons were engineering/technical assistance, reliability of supplier, and product quality (table VII-11).

Until 1984, U.S. purchasers who responded to the Commission's questionnaire generally purchased their forgings from domestic suppliers, representing 86 to 98 percent of their purchases (table VII-12). In 1984, a major purchaser began buying imported forged steel hooks, shackles, and loadbinders in lieu of U.S.-produced forgings due to the lower purchase price of the imported article. At that time, U.S. purchasers bought an estimated 57 percent of their merchandise from foreign suppliers.

Pricing considerations

The price data supplied by purchasers responding to the Commission's questionnaire were not sufficient to warrant price comparisons. Producers did indicate, however, that imported forgings generally sold at much lower prices than U.S.-produced forgings, allowing for payment of higher fees or commissions than those normally made by the U.S. industry.

All producers responding to the Commission's questionnaire reported that the high value of the dollar relative to other foreign currencies adversely affected their competitive position in the U.S. market.

Product performance features

U.S. producers ranked engineering/technical assistance as a competitive advantage for U.S.-produced forgings, especially in the area of superior design facilitated by the application of computer-aided design/computer-aided manufacturing.

Table VII-11.--Forged steel hooks, shackles, and loadbinders: Ranking 1/ of U.S. purchasers' reasons for purchases of U.S.-produced and foreign-made forgings, 1984-85

Reason for purchase	U.S.-produced forged steel hooks, shackles, and loadbinders	Foreign-made forged steel hooks, shackles and loadbinders
Lower purchase price (delivered)	8	1
Cost of tooling/dies	6	4
Shorter delivery time	1	-
Engineering/technical assistance	2	4
Favorable terms of sale	-	-
Favorable product guarantees	5	4
Favorable exchange rates	8	2
Reliability of supplier	2	4
Product performance features:		
Superior design	6	2
Quality	4	4
More durable	8	4

1/ Ranking numbers range from 1 to 8, number 1 indicating the most important reason for purchase and number 8 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VII-12.--Forged steel hooks, shackles, and loadbinders: Purchases of U.S.-produced and foreign-made forgings by U.S. purchasers, 1981-84, January-August 1984, and January-August 1985

(Quantity in number of units; value in thousands of dollars)

Year	U.S.-produced	Foreign-made	Total	Share (percent) of U.S.-produced to total
	Quantity			
1981	304,632	7,619	312,251	97.6
1982	275,457	18,466	293,923	93.7
1983	324,616	52,745	377,361	86.0
1984	198,292	263,203	461,495	43.0
January-August--				
1984	193,558	175,113	368,671	52.5
1985	66,629	110,414	177,043	37.6
	Value			
1981	830	69	899	92.3
1982	666	66	732	91.0
1983	501	309	810	61.9
1984	555	382	937	59.2
January-August--				
1984	316	280	596	53.0
1985	398	249	647	61.5

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Market response

U.S. producers indicated that the lower purchase price of an imported forging often outweighs the significance of marketing factors such as delivery time, availability, servicing, and supplier reliability. The imported product price has been reported to be significantly lower, thereby diminishing the importance of the other factors.

U.S. producers' responses to import competition in the U.S. market

In response to import competition in the U.S. market, nearly all responding producers of forged steel hooks, shackles, and loadbinders indicated that they had lowered prices or suppressed price increases to

VIII. FORGED METAL TURBINE ROTOR AND GENERATOR COMPONENTS

Description and Uses

The forged metal components which are included in this grouping consist primarily of the main rotor shafts for large electrical generators and for land-gas and steam turbines and gas turbine aircraft engines. In addition to these major components that constitute a significant portion of the total cost of a turbine or generator, smaller components such as seals, hubs, discs, and turbine "buckets," or blades, are also formed through forging operations (fig. VIII-1-6). Rotor shafts are very large components which range in size from approximately 6-7 feet long and 2 feet in diameter to 25-30 feet long and 6 feet in diameter.

Hydraulic presses are commonly employed in the forging operations on turbine and generator rotor shafts. These processes most often employ cold, open die forging techniques and involve a considerable amount of upsetting. The manufacturing cycle from forging to rotor includes a continuous program of tests and inspections to ensure the quality of the finished product. The forging is given a normalizing and tempering treatment and is usually subjected to numerous ultrasonic tests to detect possible internal flaws. Heat indication tests are also made to determine the forging's stability and forging specimens are routinely chemically analyzed and undergo physical property tests to verify the specified alloy. If the forging successfully passes these tests, it begins the many machining operations required to make it a high performance rotor. High chromium alloy steels are among the latest materials being used for turbine rotors because of their strength over a wide temperature range. Chromium-molybdenum-vanadium steel alloys have also been used in high-temperature turbine applications with steel alloys of nickel, chromium, molybdenum, and vanadium being used in lower temperature generator applications.

Forged turbine buckets or blades are used principally where operating temperatures are not severely high. These applications are thus typically limited to the compressor, or cooler intake sections, of land and aircraft gas turbine engines. In aircraft engines, titanium, nickel alloys, and other exotic alloy materials are employed in consideration of the desire for light weight and strength under high engine torques. In land-based turbines where the weight of rotor components is not an important consideration, chromium alloys are commonly employed for their temperature stability. With all of these rotor components, producers commonly utilize mechanical presses and warm or hot closed dies in their forging operations. The finished forgings range in size from approximately 5 inches long, such as the components found in the seventh and eighth stages of aircraft compressor units, to several feet in length which are common in the first and second stages of land-based steam turbines.

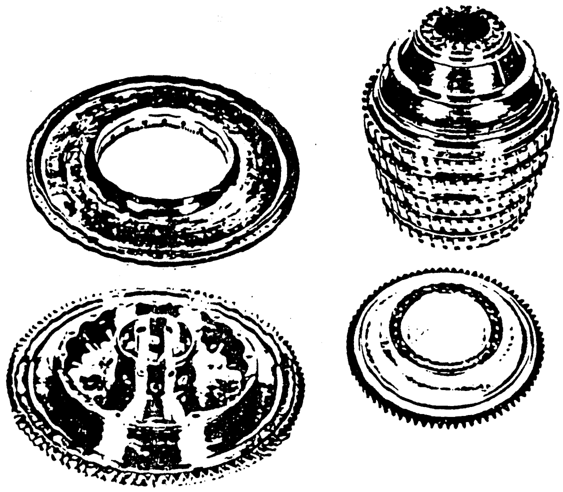


Fig. VIII-1. Forged disc and disc assembly.

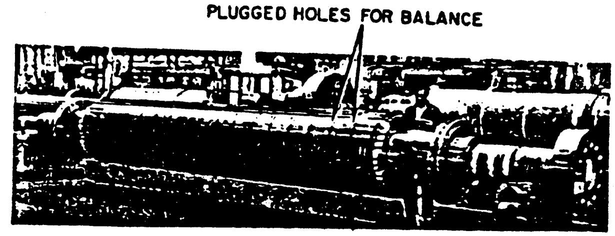


Fig. VIII-2. *A 200,000-kva, 3600-rpm, conventionally cooled generator rotor, prior to winding.*

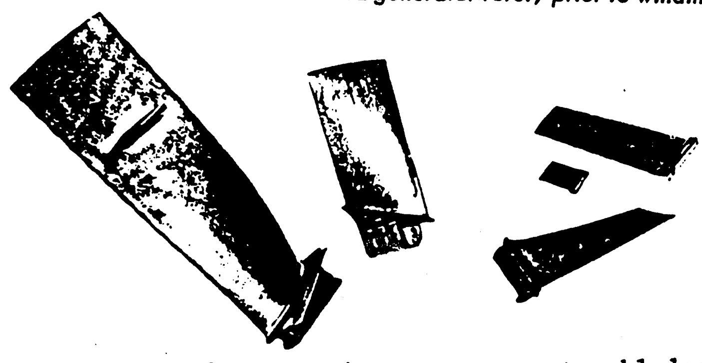


Fig. VIII-3. Forged compressor rotor blades.

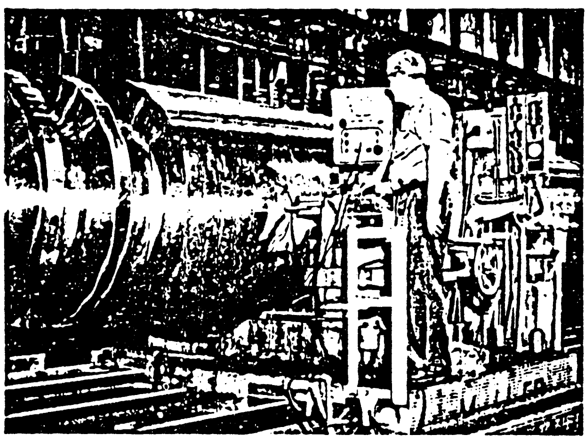


Fig. VIII-4. Ultrasonic testing of a 115-ton generator rotor forging using automatic scanning.

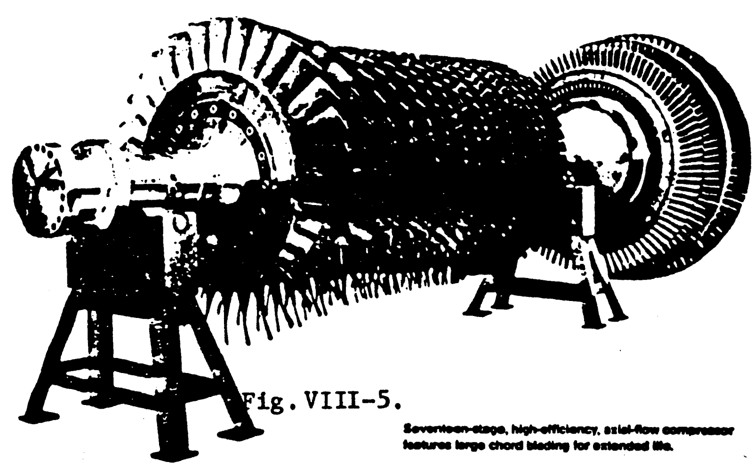


Fig. VIII-5.

Seventeen-stage, high-efficiency, axial-flow compressor features large chord blading for extended life.

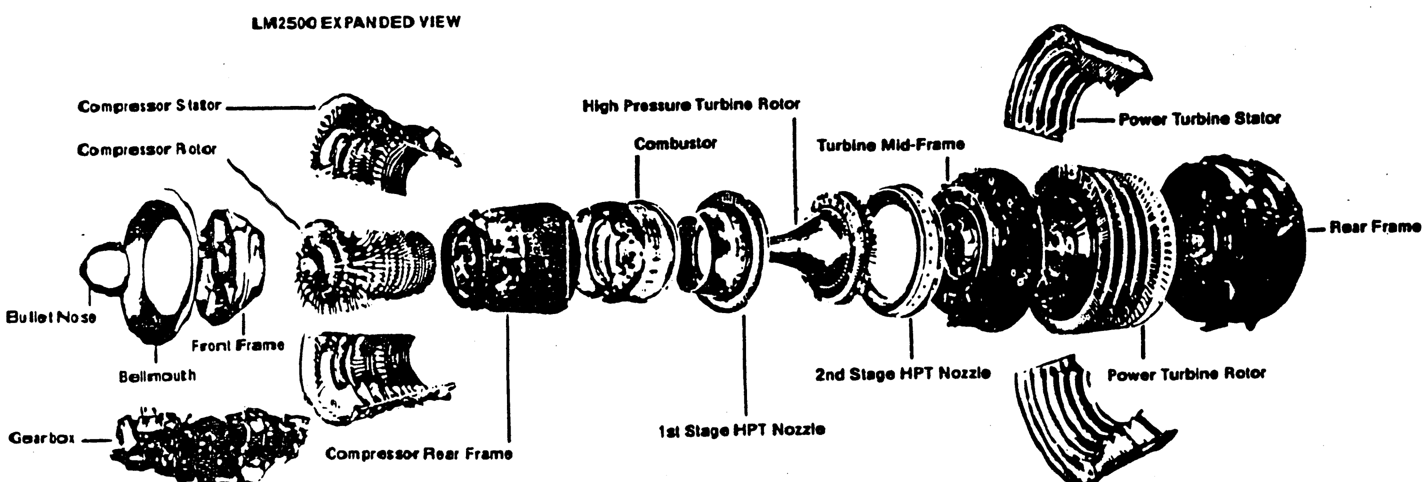


Fig. VIII-6. Expanded view of typical land-gas turbine.

Source: Ishikawajima-Harima Heavy Industries Co., Ltd. (figures 1 and 3) and the General Electric Co. (figures 2, 4, 5, and 6).

Customs Treatment

U.S. tariff treatment

Forged metal turbine rotor and generator components are provided for under items 660.30, 660.71, and 682.60 of the TSUS. The most-favored-nation (MFN) rates of duty (col. 1) applicable to imports of articles under these provisions currently range from 3.6 to 7.5 percent ad valorem (table VIII-1). Under an agreement reached in the Tokyo round of the MTN, some of these articles will undergo annual staged reductions through January 1, 1987. On that date, the MFN duty rates will range from 3.0 to 7.5 percent ad valorem; these final staged reductions are those currently applicable to imports from certain least developed developing countries (LDDC's). The column 2 rates of duty applicable to imports of these products from designated Communist countries range from 20 to 35 percent ad valorem. In addition, these articles have been designated for duty-free treatment when imported under the GSP from certain beneficiary developing countries, subject to the "competitive-need limitation" covered under Title V of the Trade Act of 1974. 1/

Foreign tariff treatment

With the principal exception of the United States and Canada, most countries use the CCCN as the basis for their tariff classifications. Steam and gas turbines and parts are classified under headings 84.05 and 84.08, whereas generators and parts thereof are provided for under heading 85.01 of the CCCN. The present and negotiated rates of duty applicable to imports of U.S.-made forged metal turbine rotor and generator components into the markets of the major U.S. trading partners for this equipment are shown in table VIII-2. The current rates of duty applicable to these markets range from 5.0 to 15.0 percent ad valorem. When the final staged duty reductions are implemented in these markets, the range of duties applicable to these forged components will range from 3.8 to 10.0 percent ad valorem.

Profile of the U.S. Industry

United States

Overview.--There are currently approximately 60 U.S. companies engaged in the manufacture of forged metal turbine rotor and generator components. Seven of these companies account for the vast majority of U.S. shipments of the larger main rotor and generator shafts. Approximately 10 U.S. firms account for a major portion of U.S. shipments of rotor blades or buckets, and 40 to 45 companies are engaged in the forging of the typically smaller discs, hubs, and seals for turbine and generator rotors. The production of these components is concentrated in Pennsylvania, Ohio, Texas, and California. As is apparent

1/ Duty-free imports entered under a TSUS item from a beneficiary developing country are limited to a percentage of the U.S. gross national product and to 50 percent of the appraised value of imports. Eligibility also requires that at least 35 percent of the appraised value of the TSUS item eligible under the GSP be added in the beneficiary developing countries.

Table VIII-1.—Forged metal turbine rotor and generator components: U.S. rates of duty, by TSUS items, 1980–87

(Percent ad valorem)

TSUS item No. 1/	Description	Pre-MTN col. 1 rate of duty 2/	Staged col. 1 rates of duty effective with respect to articles entered on or after Jan. 1— 1980	1981	1982	1983	1984	1985	1986	1987	Col. 2 rate of duty
660.30(pt.)A	Parts of steam turbines	7.5%	3/	3/	3/	3/	3/	3/	3/	3/	20.0%.
660.71(pt.)A	Parts of non-piston type engines.	5.0%	4.8%	4.7%	4.5%	4.4%	4.2%	4.0%	3.9%	3.7%	35.0%.
682.60(pt.)A*	Parts of generators	7.5%	6.9%	6.4%	5.8%	5.3%	4.7%	4.1%	3.6%	3.0%	35.0%.

1/ The designation "A" or A* indicates that the item is currently designated as an eligible article for duty-free treatment under the Generalized System of Preferences (GSP). "A" indicates that all beneficiary developing countries are eligible for the GSP. "A*" indicates that certain of these countries, specified in general headnote 3(c) of the Tariff Schedules of the United States Annotated, are not eligible.

2/ Rate effective prior to Jan. 1, 1980.

3/ The column 1 rate was not reduced under the Tokyo round of the Multilateral Trade Negotiations.

Table VIII-2.--Forged metal turbine rotor and generator components: Rates of duty, present and negotiated, applied to imports from the United States by major trading partners

(Percent ad valorem)

Item No.	Country and product description	Present rate of duty 1/	Concession rate of duty 2/
	Canada:		
42805-3	Turbines, steam or gas, and complete parts thereof, n.o.p.	15.0%	10.0%
44514-1	Electric dynamos or generators and transformers and complete parts thereof, n.o.p.	9.9%	6.5%
44514-2	Electric dynamos or generators 150KW and over; and complete parts thereof, n.o.p.	15.0%	10.0%
	European Economic Community:		
84.05	Steam or other vapor power units, whether or not incorporating boilers.	5.0%	3.8%
84.08-DI	Parts of reaction engines or of turbo-propellers.	5.0%	3.8%
84.08-DII	Parts of other engines	5.5%	4.1%
85.01-C	Parts of generators, motors, etc.	6.0%	4.4%
	Japan:		
84.05.120	Parts of steam turbines	8.0%	6.9%
84.08.210(1)	Parts for aircraft engines	5.0%	5.0%
84.08.210(2)	Parts for other engines	5.7%	5.0%
85.01.610	Parts of generators, motors or rotary converters, etc.	5.6%	5.2%

1/ Rate currently applicable to imports from the United States.
2/ Final rate negotiated under the Multilateral Trade Negotiations (Tokyo round).

from the information above, the concentration of U.S. forgers for a given component generally increases with its size. This is largely due to the substantial investment which is required by producers in order to purchase and maintain the equipment (such as hydraulic presses, dies, cranes, etc.) necessary to work the larger forgings. This heavy investment in equipment is not only an impediment to the entry of new firms but eliminates those competitors from the industry which are unable to efficiently and fully employ their facilities to reduce the substantial fixed overhead costs associated with producing large forgings. Many of these firms are also vertically integrated into the production of steel. In most cases, U.S. producers of forged metal rotor and generator components are also involved in the production of other forged products. This enables these firms to avoid the underutilization of their facilities during downturns in demand for rotor and generator forgings.

The technology employed by most of the companies which produce these products is relatively high. New developments in technology are principally concentrated in metallurgical research into new metal alloys and material forming processes. In the area of forged aircraft components, the emphasis in product development has been on stronger and lighter materials, while for land-based turbines and generators, strength and stability under high torque and temperature has been of prime importance.

U.S. producers reported in response to the Commission's questionnaire that only 13 percent of the machinery and equipment used in their domestic facilities was less than 5 years old, 35 percent was between 5 and 19 years old, and 52 percent was 20 years and older. A number of respondents indicated that the decline in their capital equipment expenditures was the result of diminished profitability attendant with increased competition in U.S. and foreign markets. Stagnant demand for the end products (particularly steam turbine generators) into which these forgings are incorporated was also noted as a factor in the decline in purchases of new equipment. The physical tally of machinery and equipment in current use by U.S. producers of forged metal rotor and generator components is presented in the following tabulation (in units):

Age	Total machinery and equipment
0-2 years	38
3-4 years	49
5-9 years	103
10-19 years	125
20 years or older	340
Total	655

U.S. production, capacity, and employment.--Reported U.S. production (representing approximately 70 percent of the industry total) of forged metal turbine rotor and generator components declined from 796,131 units in 1981 to 565,990 units in 1983, or by 29 percent, before recovering to 592,358 units in 1984 (table VIII-3). U.S. production increased by 34 percent to 405,967 units during January-August 1985 from approximately 302,723 units during the corresponding period of 1984. The decline in U.S. production during 1981-83 was attributable to reduced demand in U.S. markets for steam turbine generators and gas turbine aircraft engines and to the strong dollar which bolstered U.S. demand for foreign-made forgings.

U.S. producers' production capacity increased irregularly from approximately 2,060,000 units in 1981 to just over 2,265,000 units in 1984, or by 10 percent, in response to increased U.S. demand for aircraft components. As a result, the capacity utilization rate of U.S. producers fell from 39 percent in 1981 to 26 percent in 1984, before increasing to approximately 29 percent during January-August 1985 on the strength of recovering U.S. market demand and economic activity.

Employment of production and related workers in this sector of the forging industry declined annually from 4,972 workers in 1981 to 3,288 workers in 1984, or by 34 percent. The man-hours worked by these employees also declined annually from nearly 8.8 million hours in 1981 to 6.3 million hours

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Table VIII-3.—Forged metal turbine rotor and generator components: U.S. production, capacity, capacity utilization, number of production and related workers, man-hours worked, wages, hourly wage rates, and productivity, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August— 1984	January-August— 1985
Production and capacity:						
Production——units——	796,131	629,357	565,990	592,358	302,723	405,967
Capacity——do——	2,059,598	2,060,308	2,057,228	2,267,428	1,399,419	1,402,300
Capacity utilization percent——	39	31	28	26	22	29
Employment of production and related workers:						
Number——	4,972	4,177	3,436	3,288	3,302	3,362
Man-hours worked——	8,756,096	7,182,184	6,389,419	6,336,618	4,250,279	4,399,427
Wages——1,000 dollars——	119,118	108,236	96,323	98,333	65,943	71,760
Hourly wage rate——	$13.60	$15.05	$15.08	$15.52	$15.51	$16.31
Productivity man-hours/unit——	11	11	11	11	14	11

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

in 1984, or by 28 percent. The average hourly wage rate for production and related workers increased, annually from $13.60 in 1981 to $15.52 in 1984, or by 14 percent. Average hourly compensation for these workers increased by 5 percent to $16.31 during January-August 1985 from $15.51 in 1984. In 1984, average hourly wages for workers engaged in the production of forged turbine rotor and generator components were nearly equal to those paid to workers employed on all forged products and were 69 percent higher than those in all U.S. manufacturing establishments as shown in the following tabulation (in dollars):

	Forgers producing turbine rotor and generator components 1/	All forged products 1/	All operating U.S. manufacturing establishments 2/
1981-------	$13.60	$14.73	$7.99
1982-------	15.05	17.05	8.49
1983-------	15.08	16.82	8.83
1984-------	15.52	15.67	9.18

1/ Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.
2/ Compiled from official statistics of the U.S. Department of Labor.

Financial data.--Net sales of forged metal turbine rotor and generator components by U.S. producers rose from $569.2 million in 1981 to a peak of $590.1 million in 1982, before declining by 22 percent to $448.1 million in 1984 (table VIII-4). Annual U.S. producers' profits before taxes declined from a peak of $128.8 million in 1982 to $68.2 million in 1984, or by 47 percent. As a percentage of total net sales, the net operating profit of U.S. producers increased from 19.9 percent in 1981 to 22.8 percent in 1983 before declining to 15.2 percent in 1984. During January 1981-August 1985, capital expenditures of U.S. producers of forged metal turbine rotor and generator components amounted to $152.5 million, or 6 percent of total net sales during the period. Over the same time period, research and development expenses of U.S. producers totaled $13.2 million, or less than 1 percent of total net sales.

Table VIII-4.--Forged metal turbine rotor and generator components: U.S. producers' net sales, net profit (loss), capital expenditures, and research and development expenditures, 1981-84, January-August 1984, and January-August 1985

Item	1981	1982	1983	1984	January-August-- 1984	January-August-- 1985
Net sales-------1,000 dollars--	569,216	590,126	484,461	448,096	298,302	319,602
Net profit (loss)---------do----	113,125	128,825	110,379	68,203	43,188	38,989
Ratio of net operating profit (loss) to net sales percent--	19.9	21.8	22.8	15.2	14.5	12.2

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Structural Factors of Competition Between U.S. and Foreign Industries

The competitiveness of U.S. producers of forged metal turbine rotor and generator components in U.S. markets is affected by a number of structural factors. The U.S. producers of these products which responded to the Commission's questionnaire indicated that the competitive strength of U.S. producers in domestic markets was largely because of their production technology, their responsiveness to orders, and their aftersale service capabilities. The strength of foreign producers in U.S. markets was reported by respondents to be the result of lower raw material cost, a larger investment in capital equipment, and lower labor costs and of foreign government assistance in the form of subsidies, tariff and nontariff barriers, and U.S. government regulations which increase U.S. producers' costs 1/ (table VIII-5).

Raw materials, energy, and technology

U.S. producer responses indicated that foreign producers held a slight advantage over their U.S. counterparts as the result of lower fuel costs and a more decided advantage in the costs of raw materials. U.S. producers, however, were seen as having a significant advantage over their foreign competitors as the result of better production technology.

Capital

Foreign producers were judged by questionnaire respondents to have an advantage in both the availability and cost of capital. Discussions with U.S. producers provided evidence that many foreign producers are able to secure financing or financial guarantees as the result of their close ties with foreign governments. This is particularly true of producers which are partially or wholly owned by arms of foreign governments, or which benefit from nationalist policies designed to sponsor full employment and industrial activity and bolster export shipments to relieve balance of payments difficulties.

1/ A discussion of these competitive factors is contained in the overview.

Table VIII-5.--Forged metal turbine rotor and generator components: U.S. producers' assessment of structural factors of competition for the U.S. industry and selected foreign industries, by major competing countries, 1984-85

Item	Competitive advantage 1/				
	Australia	Japan	West Germany	France	Italy
Overall competitive advantage	F	F	F	F	F
Fuel cost	F	D	F	D	D
Raw materials costs	F	F	F	D	F
Capital:					
Cost	F	F	F	S	F
Ability of industry profits to attract funds	S	S	F	S	F
Labor cost	F	F	F	F	F
Production technology	F	D	D	D	D
Marketing:					
Channels of distribution	S	S	F	F	D
Responsiveness to orders	S	D	F	D	D
After-sale service capabilities	S	D	D	D	D
Government involvement:					
Subsidies	S	F	F	F	F
Research and development assistance	S	F	S	F	D
Tariff levels on imports	S	F	F	F	F
Nontariff barriers to imports	S	F	F	F	F
U.S. Government regulations which increase costs	S	F	F	F	F
Foreign government regulations which increase costs	S	S	F	D	F

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Labor

With the exception of Japan, all of the U.S. industry's major foreign competitors were felt by U.S. respondents to have a significant labor cost advantage. This information is corroborated by official U.S. statistics that indicated that the average cost of U.S. labor was approximately 37 percent higher during 1981-84 than that reported in the domestic markets of the major competitors. 1/

Marketing

With respect to the marketing of forged metal turbine rotor and generator components, respondents acknowledged that U.S. producers had a significant advantage over their foreign counterparts owing to the fact that contacts with customers have been well established over many years and the close proximity to U.S. markets has aided U.S. producer responsiveness and after-sale service. Several U.S. producers did indicate, however, that numerous foreign companies had established central sales headquarters which, although not nearly as extensive as those of U.S. producers, were nonetheless adequate enough to meet most U.S. customers' basic marketing requirements.

Government involvement

Respondents were nearly unanimous in signifying that foreign producers benefited much more from government involvement in their activities than comparable assistance granted to U.S. producers. This was particularly evident with respect to the advantage noted as the result of alleged foreign government subsidies, and tariff and nontariff trade barriers which allegedly have significantly bolstered the operations of foreign producers and protected their domestic markets from outside competition. Again, the close linkages between many foreign producers and their respective governments and nationalistic cooperation were cited by U.S. respondents as significant factors increasing the competitiveness of foreign producers in the U.S. market.

The U.S. Market

Overview

Based upon responses from U.S. producers and importers, there is very little difference in the marketing channels through which each of these groups distributes their products. U.S. producers shipped 65 percent of their products to original equipment manufacturers and 35 percent to machine shops and other fabricators. All of the shipments of U.S. importers were sold to original equipment manufacturers (table VIII-6).

U.S. producers shipped 46 percent of their output in terms of quantity, to manufacturers of aircraft engines and 23 and 22 percent, respectively, to manufacturers of aircraft parts and industrial machinery. U.S. importers, on the other hand, sold 27 percent of their products to U.S. producers of industrial machinery (table VIII-7) and 73 percent to manufacturers of aircraft parts.

1/ Bureau of Labor Statistics, Hourly Compensation Costs for Production Workers.

Table VIII-6.--Forged metal turbine rotor and generator components: U.S. producers' and importers' shipments, by channel of distribution, 1984

(In percent)

Channel of distribution	Share of shipments	
	Producers	Importers
Original equipment manufacturers	65	100
Machine shops/other fabricators	35	-
Distributors	-	-
Other	-	-
Total	100	100

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VIII-7.--Forged metal turbine rotor and generator components: U.S. producers' and importers' shipments, by type of market, 1984

(In percent)

Type of market	Share of shipments	
	Producers	Importers
Passenger cars	1/	-
Trucks and buses	1/	-
Aircraft engines	46	73
Aircraft parts (except engines) including missiles	23	-
Off-highway equipment (construction, mining and material handling)	1	-
Ordnance (except missiles)	1	-
Marine equipment	1/	-
Plumbing fixtures, valves, and fittings	1/	-
Oil-field machinery and equipment	1/	-
Railroad equipment	1/	-
Farm machinery and equipment	1/	-
Industrial machinery	22	27
Other	6	1/
Total	100	100

1/ Less than 1 percent.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. industry sources indicated that the average shipping charges for all forged metal turbine rotor and generator components currently account for between 3 and 6 percent of the selling prices of these articles. Most of the U.S. producers which were questioned did not believe that transportation costs were a significant factor affecting the competitiveness of U.S.- or foreign-produced products in U.S. markets.

On the basis of questionnaire responses, apparent U.S. consumption of forged metal turbine rotor and generator components peaked at $545 million in 1982, or 11 percent above the 1981 total, before declining by 20 percent to $435 million in 1984 (table VIII-8). The decline was principally due to reduced U.S. demand for power generation equipment, particularly land-steam turbine generator units, and to a substantial decline in the average unit value of components in 1984. The latter decline is believed to be the result of an increase in U.S. shipments of forged metal components for aircraft engines that are much lower in price than the huge forged metal shafts for land-steam and land-gas generator units.

Table VIII-8.--Forged metal turbine rotor and generator components: U.S. producers' shipments, exports of domestic merchandise, imports for consumption, apparent consumption, end of period inventories, and ratio of imports to consumption, 1981-84, January-August 1984, and January-August 1985

(Quantity in units; value in thousands of dollars)

Period	Shipments	Exports	Imports	Apparent consumption	End of period inventories	Ratio (percent) of imports to consumption
	Quantity					
1981	750,275	12,836	11,278	748,717	133,180	1.5
1982	630,290	26,226	13,633	617,697	90,184	2.2
1983	553,773	19,002	14,352	549,123	76,153	2.6
1984	528,915	14,823	21,833	535,925	122,200	4.1
Jan.-Aug.--						
1984	342,847	11,034	13,330	345,143	67,745	3.9
1985	360,669	37,794	12,589	335,464	67,796	3.8
	Value					
1981	501,749	44,266	35,290	492,773	149,663	7.2
1982	530,198	30,173	44,653	544,678	115,479	8.2
1983	440,847	18,477	31,869	454,239	88,915	7.0
1984	418,350	22,559	39,195	434,986	91,441	9.0
Jan.-Aug.--						
1984	284,298	10,910	24,401	297,789	90,060	8.2
1985	287,972	26,555	40,966	302,383	90,671	13.5

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

<u>U.S. imports</u>

U.S. imports of forged metal turbine rotor and generator components increased from $35.3 million in 1981 to a peak of $44.7 million in 1982, or by

27 percent before declining irregularly by 12 percent to $39.2 million in 1984. During January-August 1985, imports increased to $41.0 million, or 68 percent greater than those recorded during January-August 1984. The principal sources of these imports were Canada, Japan, France, West Germany, Italy, and the United Kingdom. Imports accounted for between 7 and 9 percent of the value of apparent U.S. consumption during 1981-84. Import penetration rose to 13.5 percent, however, during January-August 1985. The average unit value of imports, as reported by respondents, was quite high, ranging from nearly $1,800 per unit during 1984 to over $3,200 per unit during 1982 and January-August 1985. These values suggest that imports were principally of larger forgings for use in power generation equipment.

On the basis of questionnaire information, U.S. producers of forged metal turbine rotor and generator components were also significant importers of this equipment. During 1981-84, U.S. producers accounted for only 2 percent of the quantity but 23 percent of the value of imports. The share of the value of imports accounted for by U.S. producers, however, declined to only 9 percent during January-August 1985 (table VIII-9).

Table VIII-9.--Forged metal turbine rotor and generator components: U.S. producers' and U.S. importers' imports, and U.S. producers' share of total imports, 1981-84, January-August 1984, and January-August 1985

(Quantity in units; value in thousands of dollars)

Period	U.S. producers	U.S. importers	Total	U.S. producers' share of total imports (percent)
	Quantity			
1981	260	11,018	11,278	2.3
1982	230	13,403	13,633	1.7
1983	350	14,002	14,352	2.4
1984	210	21,623	21,883	1.0
Jan.-Aug--				
1984	140	13,190	13,330	1.1
1985	110	12,479	12,589	.9
	Value			
1981	8,500	26,790	35,290	24.1
1982	8,600	36,053	44,653	19.3
1983	8,000	23,869	31,869	25.1
1984	8,900	30,295	39,195	22.7
Jan.-Aug--				
1984	5,400	19,001	24,401	22.1
1985	3,800	37,166	40,966	9.3

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Discussions with U.S. producers and importers revealed that many importers enter finished major subassemblies into which forged metal turbine rotor and generator components have been incorporated. This is because many of the major foreign-based importers are also producers of the end products, such as land-steam turbine generator units, and most of these companies have limited U.S. assembly capabilites. A considerable portion of actual U.S. entries of forged metal turbine rotor and generator components are thus "masked" elements of larger assemblies. Wherever possible, importers were requested to report such shipments. This was not feasible in many cases, however. U.S. producers' operations which are geared towards the purchase of basic components for direct resale or for use in the assembly of finished components thus tend to overstate their role in the level of import entries.

As shown below in table VIII-10, U.S. producers who responded to the Commission's questionnaire cited lower delivered purchase prices as the principal consideration governing their decision to purchase foreign components. The second and third leading product-related factors affecting their decision to import were the cost of foreign tooling and dies and favorable foreign exchange rates, respectively.

Table VIII-10.-- Forged metal turbine rotor and generator components: U.S. producers' ranking of product-related factors that were the principal reasons for their imports, 1984-85

Reason for importing	Ranking 1/
Lower purchase price (delivered)	1
Cost of tooling/dies	2
Shorter delivery time	-
Engineering/technical assistance	-
Favorable terms of sale	-
Favorable product guarantees	-
Favorable exchange rates	3
Historical supplier relationship	-
Product performance features:	
Superior design	-
Quality	-
More durable	-
Other	-

1/ Ranking numbers range from 1 to 3, number 1 indicating the most important reason for importing and number 3 indicating the least important reason for importing.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

U.S. exports

U.S. exports of domestic merchandise declined by 58 percent from $44.3 million in 1981 to $18.5 million in 1983, but then recovered somewhat to $22.6

million in 1984. Much of the early decline was attributable to the strong U.S. dollar, to the worldwide economic recession (which exacerbated the balance of payments difficulties of the principal worldwide importing countries), and to increased foreign competition. The modest recovery in export shipments in 1984 and the more than doubling of shipments during January-August 1985 compared with the corresponding 1984 period was largely because of renewed worldwide economic growth.

Competitive Assessment of Product-Related Factors in the U.S. Market

U.S. producers responding to the Commission's questionnaire reported that domestic forgers were equally as competitive or more competitive only with producers of metal turbine rotor and generator components in Japan, the United Kingdom, and Italy. With respect to producers of these articles in Australia, West Germany, and France, however, U.S. producers were felt to be at a considerable competitive disadvantage (table VIII-11). The factors most often cited as placing foreign forgers in a favorable competitive position vis-a-vis their U.S. counterparts were lower delivered purchase prices, lower cost of tooling and dies, and favorable foreign exchange rates. U.S. producers indicated that competitors in Italy, the United Kingdom, and Japan had not gained a competitive edge by offering U.S. purchasers lower delivered purchase prices. U.S. respondents also assigned a competitive advantage to foreign forgers in Australia in terms of their cost of tooling and dies and to forgers in Australia and France on the basis of favorable foreign exchange rates. Only forgers in Japan and the United Kingdom, which were felt to be on an equal footing with U.S. producers in terms of these product factors, were not assigned a competitive advantage. U.S. producers gave themselves a clear competitive edge only with respect to their engineering and technical assistance capabilities, versus forgers in Italy. A sufficient number of responses from U.S. importers as to their competitiveness, vis-a-vis U.S. producers, were recorded only with respect to producers in France and the United Kingdom. These responses accorded a clear advantage in both cases to U.S. producers on the basis of lower purchase prices, shorter delivery times, and the reliability of suppliers.

U.S. purchasers of forged metal turbine rotor and generator components in their questionnaire responses ranked reliability of suppliers as the leading reason for their purchases of domestically produced forgings (table 12). Purchasers also ranked, in order of importance, product quality, lower purchase price and engineering and technical assistance, shorter delivery times, and tooling and die costs as important considerations in purchasing equipment from U.S. suppliers. On the other hand, U.S. purchasers indicated that lower purchase prices, followed by favorable exchange rates, tooling and die costs, engineering and technical assistance, shorter delivery times, reliability of suppliers, and product quality were of descending importance in their decision to purchase foreign-produced forgings.

The U.S. purchasers surveyed displayed an overwelming preference for U.S.-produced forged metal turbine rotor and generator components (table VIII-13). These responses, however, represent a very small percentage of the quantity and value of the domestic shipments and imports which have been reported to date by U.S. producers and importers.

Table VIII-11.--Forged metal turbine rotor and generator components: U.S. producers' (P) and importers' (I) competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in the U.S. market, by major supplying countries, 1984-85

Item	Competitive advantage 1/											
	Australia		Japan		West Germany		France		Italy		United Kingdom	
	P	I	P	I	P	I	P	I	P	I	P	I
Overall competitive advantage	F	2/	S	2/	F	2/	F	D	D	2/	S	D
Lower purchase price (delivered)	X	-	-	-	X	-	X	X	-	-	-	X
Cost of tooling/ dies	X	-	-	-	-	-	-	-	-	-	-	-
Shorter delivery time	-	-	-	-	-	-	-	X	-	-	-	X
Engineering/technical assistance	-	-	-	-	-	-	-	-	X	-	-	-
Favorable terms of sale	-	-	-	-	-	-	-	-	-	-	-	-
Favorable product guarantees	-	-	-	-	-	-	-	-	-	-	-	-
Favorable exchange rates	-	-	-	-	-	-	X	-	-	-	-	-
Historical supplier relationship	-	-	-	-	-	-	-	X	-	-	-	X
Product performance features:												
Superior design	-	-	-	-	-	-	-	-	-	-	-	-
Quality	-	-	-	-	-	-	-	-	-	-	-	-
More durable	-	-	-	-	-	-	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; S = Competitive position the same.
2/ Insufficient data.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Cost of tooling and dies

Tooling and die costs for U.S. forgers of metal turbine rotor and generators are generally acknowledged by U.S. producers to be higher than those of foreign producers. As these costs constitute a significant factor affecting the prices which U.S. producers charge for domestically produced forgings, they also represent one of the major impediments to U.S. producers in pricing their products on a competitive with comparable foreign merchandise. There are indications from U.S. producers that the low cost of tooling and dies for selected foreign producers is the principal reason for lower foreign pricing of their rotor and generator components.

Table VIII-12.--Forged metal turbine rotor and generator components: Ranking 1/ of U.S. purchaser's reasons for purchases of domestically-produced and foreign-produced forgings, 1984-85

Reason for purchase	U.S.-made forged metal turbine rotor and generator components	Foreign-made forged metal turbine rotor and generator components
Lower purchase price (delivered)	3	1
Cost of tooling/dies	6	3
Shorter delivery time	5	7
Engineering/technical assistance	3	3
Favorable terms of sale	7	-
Favorable product guarantees	7	7
Favorable exchange rates	7	2
Historical supplier relationship	1	3
Product performance features:		
Superior design	7	-
Quality	2	3
More durable	-	-

1/ Ranking numbers range from 1 to 7, number 1 indicating the most important reason for purchase and number 7 indicating the least important reason for purchase.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Terms of sale

The terms of sale for these products vary considerably from component to component, and are usually negotiated between purchaser and supplier, and rarely differ from foreign to domestic supplier enough to affect the ultimate purchase price.

Exchange-rate changes

The strength of the dollar relative to foreign currencies in recent years has, according to U.S. industry sources, played an important role in reducing the prices to U.S. consumers of selected foreign forgings. Such swings have provided foreign producers with effective price reductions of 25 to 30 percent or more.

Table VIII-13.--Forged metal turbine rotor and generator components: Purchases of U.S.-produced and foreign-made forgings by U.S. purchasers, 1981-84, January-August 1984, and January-August 1985

(Quantity in units, value in thousands of dollars)

Period	U.S.-produced	Foreign-produced	Total	Share of U.S.-produced to total
	Quantity			
1981	38	2	40	95.0
1982	50	5	55	90.9
1983	41	3	44	93.2
1984	20	2	22	90.9
Jan.-Aug--				
1984	11	1	12	91.7
1985	10	2	12	83.3
	Value			
1981	286	1	287	99.7
1982	222	3	225	98.7
1983	222	2	224	99.1
1984	206	1	207	99.5
Jan.-Aug--				
1984	144	1	145	99.3
1985	106	2	108	98.1

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Produce performance features

U.S. industry sources indicate that comparable domestic- and foreign-produced forged metal turbine rotor and generator components are essentially interchangeable in terms of their performance characteristics. This is due to the fact that most of these products are produced to the exacting design characteristics specified by the domestic purchaser. Thus these features rarely affect the pricing considerations involving comparable foreign and domestic products unless a particular supplier, for one reason or another, is unable to produce an item to specification.

Quality and durability

The quality of U.S.-produced forged metal turbine rotor and generator components was noted by U.S. purchasers as having affected their decision to purchase U.S.-produced merchandise. However, purchasers would rarely pay more for components that exceed their design specifications. U.S. industry sources also recognize most imported forgings to be of at least equal quality to domestic merchandise. Quality and durability are thus factors which have not had a significant effect on U.S. prices for forged metal turbine rotor and generator components.

VIII-19

Market response

Shorter delivery time.--Lead times for delivery of U.S.- or foreign-produced forged turbine rotor and generator components have not been found to vary significantly. Some U.S. producers have, however, noted that foreign suppliers have been known to inventory parts not normally found in U.S. inventories in order to gain a response time advantage. This has been particularly true of forged metal aircraft engine components.

Availability and servicing.--There has generally been found to be no recognizable difference in the availability of U.S.- and foreign-produced components. U.S. producers, in most cases, have been found to be considerably more responsive to the service related difficulties of U.S. purchasers than their foreign counterparts.

U.S. producers' response to import competition in the U.S. market

U.S. producers indicated that their principal response (13 firms reporting) to foreign competition was to lower their prices or suppress price increases in order to maintain their market share (table VIII-14). Their other principal responses took the form of the implementation of cost reduction efforts (11 firms), the improvement of product quality (9 firms), and cuts in production (8 firms).

Competitive Assessment of Product-Related Factors in Foreign Markets

U.S. producers in their questionnaire responses indicated that, with the exception of Italy, manufacturers in all of the major foreign countries which produce forged metal turbine rotor and generator components held an overall competitive advantage in sales of these products in foreign markets (table VIII-15). The overwhelming reason cited by U.S. producers for this foreign advantage was the lower delivered purchase prices of foreign producers. The lower cost of tooling and dies incurred by foreign forgers and favorable foreign exchange rates were also cited by U.S. producers as significantly benefiting the competitive advantage of foreign producers. The only factor which was heavily cited by U.S. producers as aiding their own competitiveness in foreign markets was their historical supplier relationships.

U.S. producers indicated in their replies to the Commission's questionnaire that their principal response (10 firms reporting) to increased competition in foreign markets was to lower their prices or suppress price increases in order to maintain their market share (table VIII-16). Their next most frequent responses were to implement cost-reduction efforts (7 firms) and cut back production (6 firms).

Table VIII-14.--Forged metal turbine rotor and generator components: U.S. producers' responses to import competition in the U.S. market, 1984-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	1
Had already shifted production to other lines of forgings	1
Lacked capital funds to counter foreign competition	3
Took the following actions:	
Lowered prices or suppressed price increased to maintain market share	13
Reduced or dropped plans to expand capacity	5
Cut back production	8
Closed production lines or manufacturing	4
Shifted to more advanced types of forgings	4
Implemented cost-reduction efforts	11
Improved quality of the products	9
Imported	-
Opened a plant to manufacture abroad	1
Other	-

1/ Data include responses of 15 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VIII-15.--Forged metal turbine rotor and generator components: U.S. producers' competitive assessment of product-related factors of competition for U.S.-produced and foreign-made products in foreign markets, by major supplying countries, 1984-85

Item	Competitive advantage 1/					
	Australia	Japan	West Germany	France	Italy	United Kingdom
Overall competitive advantage	F	F	F	F	S	F
Lower purchase price (delivered)	X	X	X	X	-	X
Cost of tooling/ dies	X	-	X	-	-	-
Shorter delivery time	-	-	-	-	-	-
Engineering/technical assistance	-	-	-	-	-	-
Favorable terms of sale	-	-	-	-	-	-
Favorable product guarantees	-	-	-	-	-	-
Favorable exchange rates	X	-	X	-	-	-
Historical supplier relationship	-	-	-	-	-	-
Product performance features:						
Superior design	-	-	-	-	-	-
Quality	-	-	-	-	-	-
More durable	-	-	-	-	-	-

1/ D = 60 percent or more of total respondents accorded domestic forgers an advantage; F = 60 percent or more of total respondents accorded foreign forgers an advantage; and S = Competitive position the same; X = Over 50 percent of respondents designated item as a principal factor underlying foreign or domestic firms' overall competitive advantage.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

Table VIII-16.--Forged metal turbine rotor and generator components: U.S. producers' responses to import competition in foreign markets, 1984-85

Nature of response	Number of responses 1/
Took no or few actions because your firm:	
Had already shifted production to more advanced type of forgings	2
Had already shifted production to other lines of forgings	1
Lacked capital funds to counter foreign competition	1
Took the following actions:	
Lowered prices or suppressed price increased to maintain market share	10
Reduced or dropped plans to expand capacity	2
Cut back production	6
Closed production lines or manufacturing	1
Shifted to more advanced types of forgings	2
Implemented cost-reduction efforts	7
Improved quality of the products	2
Imported	1
Opened a plant to manufacture abroad	1
Other	-

1/ Data include responses of 10 firms.

Source: Compiled from data submitted in response to questionnaires of the U.S. International Trade Commission.

APPENDIX A

COPY OF LETTER TO CHAIRWOMAN PAULA STERN FROM AMBASSADOR MICHAEL B. SMITH, UNITED STATES TRADE REPRESENTATIVE, REQUESTING AN INVESTIGATION

THE UNITED STATES TRADE REPRESENTATIVE
WASHINGTON
20506

OFFICE OF THE SECRETARY
85 MAY 21 P12:4
774

May 17, 1985

The Honorable Paula Stern
Chairwoman, U.S. International
Trade Commission
701 E Street, N.W.
Washington, D.C. 20436

Dear Madame Chairwoman:

The U.S. forging industry is one of our basic industries. Composed of some 400 forge shops, the industry produces a large and diverse array of forgings for aerospace, automotive, power generation and marine equipment, and numerous other applications. Forgings are made from a number of metals, steel and aluminum being the principal ones. Forgings are labor- and energy-intensive; they are required whenever the functions they are to perform involve high stresses and where reliability is more important than cost. The number of production workers employed by the industry as a whole is estimated at 50,000, down from over 80,000 in 1982.

Because of the pervasive use of its product, the health of the forging industry historically has been closely aligned with the general state of the national economy. The recent performance of the industry, however, has caused industry representatives to become concerned about erosion of their industry's production levels and competitive position in domestic and world markets. A serious erosion of production levels in the forging industry could have significant effects on our ability to maintain an adequate industrial mobilization base.

A number of factors may be contributing to the industry's situation, including increased imports of forged products and of manufactured items incorporating forgings. It is difficult, however, for the U.S. forging industry to analyze its problems because data on the industry's production and trade composition are fragmented and incomplete. Because forging entails so many processes and products, neither the industry nor the U.S. Government has adequate information to evaluate the industry's problems on a sound quantitative basis.

To provide the industry with a comprehensive set of objective data, at the direction of the President I am requesting the U.S. International Trade Commission, pursuant to section 332 (g) of the Trade Act of 1930, to conduct an investigation and to report to the U.S. Trade Representative on the competitive position of the U.S. forging industry in domestic and world markets. The report should include an overview of the entire forging industry, as well as a detailed analysis of selected key products which, to the extent possible, are representative of major segments of the entire industry in terms of manufacturing process, import competition, marketing and financial condition.

The product analysis should cover the following points: (1) current profile of the U.S. and foreign forging industries; (2) conditions of competition between U.S. and foreign forging producers; (3) factors affecting the future competitive posture of domestic and foreign forging operations; and (4) the implications of the U.S. competitive position on the forging industry itself, related industries, and the U.S. economy in general.

Based on discussions with the industry, I request that the product analysis focus on the following key product areas: forged steel crankshafts; forged steel connecting rods; forged steel undercarriage components; forged steel axles and spindles, steering arms and knuckles for motor vehicles; forged steel valves, valve bodies, fittings and flanges; forged steel gears, clutches and hubs; forged steel hooks, shackles, loadbinder and other attachments; forged steel drive train components; forged steel ground-engaging components for mining, drilling and excavating equipment; forged aerospace components of ferrous, nonferrous or high temperature alloy materials; and forged steel hand tools or garden tools and parts thereof.

The Commission's report on this investigation should be submitted to the United States Trade Representative within eight months of receipt of this request.

Sincerely yours,

MICHAEL B. SMITH
Acting

APPENDIX B

NOTICE OF THE COMMISSION'S INVESTIGATION

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

(332-216)

Competitive Assessment of the U.S. Forging Industry

AGENCY: United States International Trade Commission

ACTION: Institution of an investigation and the scheduling of a hearing.

EFFECTIVE DATE: June 28, 1985

FOR FURTHER INFORMATION CONTACT: Mr. Dennis Rapkins (202-523-0438), Minerals and Metals Division, U.S. International Trade Commission, Washington, D.C. 20436.

BACKGROUND AND SCOPE OF INVESTIGATION: The Commission instituted investigation No. 332-216, following receipt on May 21, 1985, of a letter from the United States Trade Representative (USTR), requesting, at the direction of the President that the Commission conduct an investigation under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)) concerning the competitive position of the U.S. forging industry in domestic and world markets.

In accordance with the request, the Commission will examine the competitive position of the U.S. forging industry in domestic and world markets. As requested by USTR, the study will include an overview of the U.S. forging industry, together with a detailed analysis of selected key products which are important to the U.S. forging industry and representative of major segments of the entire forging industry in terms of manufacturing process, import competition, marketing, and financial condition.

In conducting its investigation, the Commission, at the request of USTR, will cover the following points: (1) current profile of the U.S. and foreign forging industries; (2) conditions of competition between U.S. and foreign forgers; (3) factors affecting the future competitive posture of domestic and foreign forging operations; and (4) the implications of the U.S. competitive position on the forging industry itself, related industries, and the U.S. economy as a whole.

PUBLIC HEARING AND PREHEARING BRIEFS: A public hearing in connection with this investigation will be held in the Commission Hearing Room, 701 E Street, NW, Washington, DC 20436, beginning at 10:00 a.m. on January 20, 1986. 1/ All persons shall have the right to appear by counsel or in person, to present information and to be heard. Persons wishing to appear at the public hearing should file requests to appear and should file prehearing briefs (original and 14 copies) with the Secretary, U.S. International Trade Commission, 701 E Street, NW, Washington, D.C. 20436, not later than noon, January 13, 1986.

WRITTEN SUBMISSIONS: In lieu of or in addition to appearance at the public hearing, interested persons are invited to submit written statements concerning the investigation. Commercial or financial information which a submitting party desires the Commission to treat as confidential must be submitted on separate sheets of paper, each clearly marked "Confidential Business Information" at the top. All submissions requesting confidential treatment must conform with the requirements of section 201.6 of the

1/ The hearing date was changed to January 21, 1986, notice of which was published in the Federal Register of August 14, 1985 (50 F.R. 32777).

Commission's Rules of Practice and Procedure (19 CFR 201.6). All written submissions, except for confidential business information, will be available for inspection by interested persons. To be assured of consideration by the Commission, written statements should be submitted at the earliest possible date, but no later than January 13, 1986. All submissions should be addressed to the Secretary at the Commission's office in Washington, D.C.

Hearing-impaired individuals are advised that information on this matter can be obtained by contacting our TDD terminal on (202) 724-0002.

By order of the Commission.

Kenneth R. Mason
Secretary

Issued: July 1, 1985

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

(332-216)

COMPETITIVE ASSESSMENT OF THE U.S. FORGING INDUSTRY

Change of Date of Public Hearing

Notice is hereby given that the public hearing in this matter will be held on Tuesday, January 21, 1986, in Washington, D.C., at the U.S. International Trade Commission Hearing Room, at 10:00 a.m. The hearing was previously scheduled for January 20, 1986.

Notice of the investigation and hearing was published in the Federal Register of July 11, 1985 (50 F.R. 28293).

By order of the Commission:

Kenneth R. Mason
Secretary

Issued: August 6, 1985

APPENDIX C

CALENDAR OF PUBLIC HEARING

TENTATIVE CALENDAR OF PUBLIC HEARING

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject : Competitive Assessment of the U.S. Forging Industry

Inv. No. : 332-216

Date and time: January 21, 1986 - 10:00 a.m.

Sessions were held in connection with the investigation in the Hearing Room of the United States International Trade Commission, 701 E Street, N.W., in Washington.

Congressional appearance:

Honorable Ralph Regula, United States Representative, State of Ohio

Domestic:

Hogan & Hogan--Counsel
Washington, D.C.
on behalf of

Paul Hausmann, Wyman-Gordon, Midwest Division, Harvey, Illinois

Robert Sterne, National Forge Company, Irvine, Pennsylvania

Richard Steele, Ladish Company, Cudahy, Wisconsin

Robert W. Atkinson, Forging Industry Association, Cleveland, Ohio

Ilona M. Hogan--OF COUNSEL

- more -

Foreign:

German American Chamber of Commerce, Inc., Washington, D.C.
on behalf of:

Industrieverband Deutscher Schmieden e.V. (Industrial Association of German Forges)

Dr. Lothar Griessbach

Theodore L. Tutmann, Director, Industrial Association of German Forges

APPENDIX D

PLANT CLOSURES IN THE U.S. FORGING INDUSTRY

Table D-1.--U.S. forging industry: Number of plant closures by firms and estimated number of job losses, 1980-85

State	Number of closures	Estimated number of job losses
Alabama	1	25
California	1	50
Colorado	2	550
Connecticut	1	100
Illinois	7	882
Indiana	3	125
Iowa	2	110
Kentucky	4	580
Maine	1	10
Massachusetts	2	250
Michigan	10	1,178
Minnesota	1	10
New Hampshire	1	25
New Jersey	1	50
New York	4	845
Ohio	4	546
Oklahoma	2	35
Oregon	1	160
Pennsylvania	16	3,558
Tennessee	2	180
Texas	4	200
Total	70	9,469

Source: Forging Industry Association.

APPENDIX E

EXPLANATION OF THE RATES OF DUTY APPLICABLE TO CERTAIN FORGED PRODUCTS AND SELECTED PORTIONS OF THE TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1986)

<u>Explanation of the rates of duty applicable to forged products</u>

The rates of duty in column 1 are most-favored-nation (MFN) rates and are applicable to imported products from all countries except those Communist countries and areas enumerated in general headnote 3(d) of the Tariff Schedules of the United States (TSUS). The People's Republic of China, Hungary, Romania, and Yugoslavia are the only Communist countries currently eligible for MFN treatment. However, MFN rates do not apply if preferential tariff treatment is sought and granted to products of developing countries under the Generalized System of Preferences (GSP) or the Caribbean Basin Economic Recovery Act (CBERA), or to products of Israel or of least developed developing countries (LDDC's), as provided under the Special rates of duty column.

Preferential rates of duty in the Special column followed by the code "D" reflect the full U.S. MTN concession rates implemented without staging for particular products of LDDC's enumerated in general headnote 3(e)(vi) of the TSUS. Where no rate of duty is provided for LDDC's in the Special column for a particular tariff item, the rate of duty in column 1 applies.

The rates of duty in column 2 apply to imported products from those Communist countries and areas enumerated in general headnote 3(d) of the TSUS.

The GSP affords nonreciprocal tariff preferences to developing countries to aid their economic development and to diversify and expand their production and exports. The U.S. GSP, enacted in title V of the Trade Act of 1974, was implemented by Executive Order No. 11888 of November 24, 1975, and renewed in title V of the Trade and Tariff Act of 1984. It applies to merchandise imported on or after January 1, 1976, and is scheduled to remain in effect through July 4, 1993. It provides duty-free entry to eligible articles imported directly from designated beneficiary developing countries. Eligible articles are identified in the Special column with the duty rate of "Free" followed by an "A" or "A*." The designation "A" means that products of all beneficiary developing countries are eligible for benefits of the GSP, and "A*" indicates that products of certain developing countries, specified in general headnote 3(e)(v)(D) of the TSUS, are not eligible.

The CBERA affords nonreciprocal tariff preferences to developing countries in the Caribbean Basin area to aid their economic development and to diversify and expand their production and exports. The CBERA, enacted in title II of Public Law 98-67 and implemented by Presidential Proclamation 5133 of November 30, 1983, applies to merchandise entered, or withdrawn from warehouse for consumption, on or after January 1, 1984; it is scheduled to remain in effect until September 30, 1995. It provides duty-free entry to eligible articles imported directly from designated Basin countries, as reflected by the rate of duty "Free" followed by the code "E" in the Special column. (See general headnote 3(e)(i) and (vii) of the TSUS.)

Preferential rates of duty in the Special column followed by the code "I" reflect the rates of duty applicable to products of Israel under the United States-Israel Free Trade Area Implementation Act of 1985, as provided in general headnote 3(e)(viii) of the TSUS. Where no rate of duty is provided for products of Israel in the Special column for a particular tariff item, the rate of duty in column 1 applies.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1986)

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty		
				1	Special	2
		Forgings of iron or steel, not machined, not tooled, and not otherwise processed after forging:				
606.71		Other than alloy iron or steel	....	4.5% ad val.	4.2% ad val.(D) Free (A,E,I)	25% ad val.
	10	Flanges	Lb.			
	20	Other	Lb.			
606.73		Alloy iron or steel	....	4.7% ad val. + additional duties (see headnote 4)	4% ad val. + additional duties (see headnote 4)(D) Free (A,E,I)	33% ad val. + additional duties (see headnote 4)
		Stainless steel:				
	10	Flanges	Lb.			
	20	Other	Lb.			
		Other:				
	30	Flanges	Lb.			
	40	Other	Lb.			
		Bars of wrought iron:				
606.75	00	Other than alloy wrought iron	Lb.	2.1% ad val.	2% ad val.(D) Free (A,E,I)	7% ad val.
606.77	00	Alloy wrought iron	Lb.	2.4% ad val. + additional duties (see headnote 4)	2.3% ad val. + additional duties (see headnote 4)(D) Free (A,E,I)	10.5% ad val. + additional duties (see headnote 4)
		Bars of steel:				
		Deformed concrete reinforcing bars:				
606.79	00	Other than alloy steel	Lb.	5.3% ad val.	4.9% ad val.(D) Free (E,I)	20% ad val.
606.81	00	Alloy steel	Lb.	6.3% ad val. + additional duties (see headnote 4)	5.7% ad val. + additional duties (see headnote 4)(D) Free (E,I)	28% ad val. + additional duties (see headnote 4)

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Cast-iron pipes and tubes:				
610.56		Other than alloy cast iron		5% ad val.	4% ad val.(D) Free (A,E,I)	25% ad val.
	20	Cast-iron soil pipe	Lb.			
	35	Cast-iron pressure pipe under 14 inches (inside diameter)	Lb.			
	45	Other	Lb.			
610.58	00	Alloy cast iron	Lb.	7.4% ad val. + additional duties (see headnote 4)	6.5% ad val. + additional duties (see headnote 4)(D) Free (A,E,I)	33% ad val. + additional duties (see headnote 4)
		Pipe and tube fittings of iron or steel:				
		Cast-iron fittings, not malleable:				
		For cast-iron pipe:				
610.62		Cast iron, other than alloy cast iron		6.5% ad val.	5.8% ad val.(D) Free (A,E,I)	25% ad val.
	20	For cast-iron soil pipe	Lb.			
	40	Other	Lb.			
610.63	00	Alloy cast iron	Lb.	7.4% ad val. + additional duties (see headnote 4)	6.5% ad val. + additional duties (see headnote 4)(D) Free (A,E,I)	33% ad val. + additional duties (see headnote 4)
		Not for cast-iron pipe:				
610.65	00	Cast iron, other than alloy cast iron	Lb.	2.6% ad val.	2.5% ad val.(D) Free (A*,E,I)	20% ad val.
610.66	00	Alloy cast iron	Lb.	3.9% ad val. + additional duties (see headnote 4)	3.7% ad val. + additional duties (see headnote 4)(D) Free (A,E,I)	28% ad val. + additional duties (see headnote 4)
		Cast-iron fittings, malleable:				
		Not advanced in condition by operations or processes subsequent to the casting process:				
610.70	00	Cast iron, other than alloy cast iron	Lb.	5.6% ad val.	5.1% ad val.(D) Free (A*,E,I)	20% ad val.
610.71	00	Alloy cast iron	Lb.	6.5% ad val. + additional duties (see headnote 4)	5.8% ad val. + additional duties (see headnote 4)(D) Free (A,E,I)	28% ad val. + additional duties (see headnote 4)
610.74	00	Advanced in condition by operations or processes subsequent to the casting process	Lb.	7% ad val.	6.2% ad val.(D) Free (A*,E,I)	45% ad val.
		Other fittings:				
610.82	00	Ductile fittings	Lb.	7% ad val.	6.2% ad val.(D) Free (A*,E,I)	45% ad val.
		Other:				
610.84		Flanges		7% ad val.	6.2% ad val.(D) Free (A,E,I)	45% ad val.
		Under 14 inches (inside diameter):				
	13	Other than alloy iron or steel	Lb.			
		Alloy iron or steel:				
	15	Stainless steel	Lb.			
	18	Other	Lb.			
		14 inches and over (inside diameter):				
	21	Other than alloy iron or steel	Lb.			
		Alloy iron or steel:				
	24	Stainless steel	Lb.			
	28	Other	Lb.			

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Special	2
		Pipe and tube fittings of iron or steel (con.):				
		Other fittings (con.):				
		Other:				
610.86		Couplings	....	7% ad val.	6.2% ad val.(D) Free (A,E,I)	45% ad val.
	35	Other than alloy iron or steel	Lb.			
	42	Alloy iron or steel	Lb.			
		Other:				
		Butt-weld type fittings:				
		Under 14 inches (inside diameter):				
610.88	00	Other than alloy iron or steel	Lb.	7% ad val.	6.2% ad val.(D) Free (A*,E,I)	45% ad val.
610.89		Alloy iron or steel	....	7% ad val.	6.2% ad val.(D) Free (A,E,I)	45% ad val.
	48	Stainless steel	Lb.			
	55	Other	Lb.			
610.90		14 inches and over (inside diameter)	....	7% ad val.	6.2% ad val.(D) Free (A,E,I)	45% ad val.
	58	Other than alloy iron or steel	Lb.			
		Alloy iron or steel:				
	60	Stainless steel	Lb.			
	62	Other	Lb.			
610.92		Other	....	7% ad val.	6.2% ad val.(D) Free (A,E,I)	45% ad val.
		Socket-weld or threaded:				
	66	Other than alloy iron or steel	Lb.			
	68	Alloy iron or steel	Lb.			
	75	Other	Lb.			
610.93	00	Any article described in the foregoing items 610.82 to 610.92, inclusive, if Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)	Lb.	Free		

Subpart C. - Copper

Subpart C headnotes:

1. This subpart covers copper, its alloys, and their so-called basic shapes and forms, and in addition covers copper waste and scrap.

2. For the purposes of the tariff schedules, the following terms have the meanings indicated:

(a) Allovs of copper: Copper-base alloys or metals in which the copper content is, by weight, less than 99.3 percent, but not less than any other metallic element. For the purposes of this subpart --

(i) nickel silver is an alloy of copper which contains by weight 5 percent or more of zinc and 5 percent or more of nickel, with or without small quantities of other elements;

(ii) brass is an alloy of copper (not including nickel silver) in which zinc is the principal alloying element, with or without small quantities of other elements;

(iii) cupro-nickel is an alloy of copper in which nickel is the principal alloying element and which does not contain by weight over 2 percent of any other single element.

In the absence of context which requires otherwise, the term "copper", wherever used in the tariff schedules, includes alloys of copper.

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Special	2
		Articles of iron or steel, not coated or plated with precious metal (con.):				
		Other articles (con.):				
		Other (con.):				
657.25		Other........	....	6.2% ad val.	5.7% ad val.(D) Free (A*,E,I)	45% ad val.
	05	Animal traps........	No.			
		Articles wholly or in chief weight of wire:				
	20	Belts and belting........	Lb.			
	25	Other........	X			
		Cast articles:				
	40	With over 2.5% carbon by weight........	Lb.			
	50	Other........	Lb.			
		Other:				
	62	Cable traction devices for tires........	Lb.			
	63	Drum plugs........	Lb.			
	65	Ring binder mechanisms........	M.			
	90	Other........	X			
		Articles of copper, not coated or plated with precious metal:				
657.30	00	Of copper, other than alloys of copper; of nickel silver or of cupro-nickel........	Lb......	6.9% ad val.	6.3% ad val.(D) Free (A,E,I)	45.5% ad val.
657.35		Other........	....	5.3% ad val.	5% ad val.(D) Free (A*,E,I)	46% ad val.
	20	Brass plumbing goods, not specially provided for........	Lb.			
	30	Ship propellers and blades therefor........	No.			
	35	Other........	Lb.			
657.40		Articles of aluminum, not coated or plated with precious metal........	....	6.2% ad val.	5.7% ad val.(D) Free (A,E,I)	45% ad val.
	10	Tripods for photographic or other use........	No.			
	15	Ladders........	No.			
	80	Other........	X			
657.50	00	Articles of nickel, not coated or plated with precious metal........	Lb......	5.9% ad val.	5.5% ad val.(D) Free (A,E,I)	45% ad val.
657.60	00	Articles of tin, not coated or plated with precious metal........	X.......	4.4% ad val.	4.2% ad val.(D) Free (A,E,I)	45% ad val.
		Articles of lead, not coated or plated with precious metal:				
657.70	00	Valued not over 13-1/3 cents per pound........	Lb......	0.6% ad val.	Free (A,E,I)	2.5% ad val.
657.75	00	Valued over 13-1/3 cents per pound........	Lb......	4.1% ad val.	3.9% ad val.(D) Free (A,E,I)	45% ad val.
657.80	00	Articles of zinc, not coated or plated with precious metal........	Lb......	6.2% ad val.	5.7% ad val.(D) Free (A,E,I)	45% ad val.
657.90	00	Articles of magnesium, not coated or plated with precious metal........ magnesium content..	.... Lb.	6.7¢ per lb. on magnesium content + 3.5% ad val.	Free (A,E,I)	40¢ per lb. on magnesium content + 20% ad val.
658.00	00	Articles of base metals not provided for in the foregoing provisions of this subpart, not coated or plated with precious metal........	X.......	5.9% ad val.	5.5% ad val.(D) Free (A,E,I)	45% ad val.
658.10	00	Any article described in the foregoing items 657.09 to 658.00, inclusive, if Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)........	X.......	Free		

SCHEDULE 6. - METALS AND METAL PRODUCTS
Part 4. - Machinery and Mechanical Equipment

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
660.10		Steam and other vapor generating boilers (except central heating hot water boilers capable also of producing low pressure steam), and parts thereof	....	6.5% ad val.	Free (A,E,I)	45% ad val.
		Boilers:				
	10	Water tube stationary steam generating boilers	Ton			
	20	Other	Ton			
		Parts:				
	30	Heat exchangers	Ton			
	40	Other	Ton			
660.15		Economizers, superheaters, soot removers, gas recoverers, and auxiliary plants for use with steam and other vapor generating boilers; condensers for vapor engines and power units; all of the foregoing and parts thereof	....	7% ad val.	Free (A,E,I)	45% ad val.
	10	Condensers	Ton			
	20	Other	Ton			
		Producer gas and water gas generators, with or without purifiers; acetylene gas generators (water process) and other gas generators, with or without purifiers; all the foregoing and parts thereof:				
660.20	00	Apparatus for the generation of acetylene gas from calcium carbide, and parts thereof	X.......	3.2% ad val.	3.1% ad val.(D) Free (A,E,I)	20% ad val.
660.22	00	Other	X.......	3.3% ad val.	2.8% ad val.(D) Free (A,E,I)	45% ad val.
		Steam engines, steam turbines, and other vapor power units, and parts thereof:				
660.25	00	Steam engines and parts thereof	X.......	4% ad val.	Free (A,E,I)	15% ad val.
660.30		Steam turbines and parts thereof	....	7.5% ad val.	Free (A,E,I)	20% ad val.
	20	Steam turbines	No.			
	40	Parts	X			
660.35	00	Other	X.......	4.5% ad val.	Free (A,E,I)	27.5% ad val.
		Internal combustion engines and parts thereof:				
		Piston-type engines:				
660.40		To be installed in tractors of a type provided for in item 692.34 or in agricultural or horticultural machinery or implements provided for in item 666.00	....	Free		Free
		Compression-ignition engines:				
	04	50 horsepower and under	No.			
	06	Over 50 horsepower	No.			
		Other:				
	08	50 horsepower and under	No.			
		Over 50 horsepower:				
	10	Air cooled	No.			
	12	Other	No.			
		Other:				
660.42		Compression-ignition engines	....	3.9% ad val.	3.7% ad val.(D) Free (A*,E,I)	35% ad val.
	20	For automobiles (including trucks and buses)	No.			
		Other:				
		For marine craft:				
	42	150 horsepower and under	No.			
	44	Over 150 but not over 300 horsepower	No.			
	46	Over 300 horsepower	No.			
	60	Other	No.			
660.43	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)	No......	Free		

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Internal combustion engines and parts thereof (con.):				
		Parts (con.):				
		Other parts:				
660.67		Parts of piston-type engines other than compression-ignition engines........	....	3.2% ad val.	3.1% ad val.(D) Free (A,E,I)	35% ad val.
		Parts of automobile engines (including truck and bus engines):				
	05	Automotive filters............	No. v Lb.			
	07	Connecting rods...............	No. v Lb.			
	13	Crankshafts...................	No. v Lb.			
	19	Other.........................	X			
		Parts of marine craft engines:				
	23	Connecting rods...............	No. v Lb.			
	27	Crankshafts...................	No. v Lb.			
	32	Other.........................	X			
		Other:				
	43	Connecting rods...............	No. v Lb.			
	47	Crankshafts...................	No. v Lb.			
	52	Other.........................	X			
660.68	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)....	X.......	Free		
660.69	00	If certified for use in civil aircraft (see headnote 3, part 6C, schedule 6)...............	X.......	Free		35% ad val.
660.71		Other..................................	....	3.9% ad val.	3.7% ad val.(D) Free (A,E,I)	35% ad val.
		Parts of compression-ignition piston-type engines:				
		Parts of automobile engines (including truck and bus engines):				
	05	Automotive filters........	No. v Lb.			
	07	Connecting rods...........	No. v Lb.			
	13	Crankshafts...............	No. v Lb.			
	19	Other.....................	X			

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Special	2
		Internal combustion engines and parts thereof (con.):				
		Parts (con.):				
		Other parts (con.):				
660.71 (con.)		Other (con.):				
		Parts of compression-ignition piston-type engines (con.):				
		Parts of marine craft engines:				
	23	Connecting rods..........	No. v Lb.			
	27	Crankshafts..............	No. v Lb.			
	32	Other....................	X			
		Other:				
	43	Connecting rods..........	No. v Lb.			
	47	Crankshafts..............	No. v Lb.			
	50	Other....................	X			
		Parts of non-piston type engines:				
	60	Parts of aircraft engines.....	X			
	65	Parts of non-aircraft gas turbine engines..............	X			
	70	Other........................	X			
660.72	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)....	X.......	Free		
660.73	00	If certified for use in civil aircraft (see headnote 3, part 6C, schedule 6)...............	X.......	Free		35% ad val.
		Water wheels, water turbines, and other water engines, and parts including governors therefor:				
660.74	00	Governors....................................	No......	$1.12 each + 17.5% ad val.	Free (A,E) 90¢ each + 14% ad val.(I)	68.5% ad val.
660.76		Other..	....	7.5% ad val.	Free (A,E,I)	27.5% ad val.
	20	Water wheels, water turbines, and other water engines..........................	No.			
	40	Parts....................................	X			
		Non-electric engines and motors not specially provided for, and parts thereof:				
660.77	00	Hydrojet engines for motor boats, and parts thereof..	X.......	2.4% ad val.	Free (A,E,I)	30% ad val.
660.80	00	Spring-operated and weight-operated motors.........	No......	4.8% ad val.	4% ad val.(D) Free (A,E,I)	35% ad val.
660.85		Other..	....	3.5% ad val.	3.4% ad val.(D) Free (A,E,I)	27.5% ad val.
	10	Linear hydraulic motors (hydraulic cylinders) and parts thereof.................	X			
	20	Other....................................	X			
660.86	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6).........................	X.......	Free		
660.87	00	If certified for use in civil aircraft (see headnote 3, part 6C, schedule 6)..............	X.......	Free		27.5% ad val.

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Subpart B. - Elevators, Winches, Cranes, and Related Machinery; Earth-Moving and Mining Machinery				
		Subpart B headnote:				
		1. This subpart does not cover -- (i) cranes or other machines mounted on vehicles, on vessels or other floating structures, or on other transport equipment (see part 6 of this schedule); or (ii) agricultural implements (see subpart C of this part).				
		Mechanical shovels, coal-cutters, excavators, scrapers, bulldozers, and other excavating, levelling, boring, and extracting machinery, all the foregoing, whether stationary or mobile, for earth, minerals, or ores; pile drivers; snow plows, not self-propelled; all the foregoing and parts thereof:				
664.06	00	Peat excavators	No.	0.6% ad val.	Free (A,D,E,I)	35% ad val.
664.07		Backhoes, shovels, clamshells, draglines, and wheel-type front-end loaders		2.4% ad val.	2% ad val.(D) Free (A,E,I)	35% ad val.
	10	Backhoes, shovels, clamshells and draglines	No.			
	20	Wheel-type front-end loaders	No.			
664.08		Other		2.8% ad val.	2.5% ad val.(D) Free (A,E,I)	35% ad val.
	05	Rock breaking machines	No.			
	08	Drilling or boring machines	No.			
	20	Tracklaying-type front-end loaders	No.			
	30	Other machines	No.			
		Parts (including parts for articles provided for in items 664.06 and 664.07):				
	35	Track links	Lb.			
	45	Cast axle housings	No.			
	50	Other	X			
664.10		Elevators, hoists, winches, cranes, jacks, pulley tackle, belt conveyors, and other lifting, handling, loading, or unloading machinery, and conveyors, all the foregoing and parts thereof not provided for in item 664.06, 664.07, or 664.08		2.4% ad val.	2% ad val.(D) Free (A*,E,I)	35% ad val.
	05	Industrial robots	No.			
		Other:				
	15	Elevators, including freight, and moving stairways	No.			
		Conveyors:				
	25	Belt	No.			
	31	Other	No.			
	44	Hoists	No.			
	55	Overhead traveling cranes	No.			
		Jacks:				
	56	Hydraulic	No.			
	57	Other	No.			
	59	Winches	No.			
	60	Other, except parts	No.			

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Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Molds of types used for metal (except ingot molds), for metallic carbides, for glass, for mineral materials, or for rubber or plastics materials (con.):				
680.13		Other..	....	4.1% ad val.	3.9% ad val.(D) Free (A,E,I)	35% ad val.
	05	Injection, including die cast dies............	No.			
	10	Compression (compaction)..................	No.			
	15	Blow..	No.			
	20	Gravity pour (permanent)..................	No.			
	25	Other..	No.			
		Taps, cocks, valves, and similar devices, however operated, used to control the flow of liquids, gases, or solids, all the foregoing and parts thereof:				
		Hand-operated and check, and parts thereof:				
680.14		Of copper....................................	....	6.1% ad val.	5.6% ad val.(D) Free (A*,E,I)	47% ad val.
	10	Under 125 pounds working pressure........	Lb.			
		125 pounds working pressure and over:				
	20	Check..............................	Lb.			
	30	Gate..............................	Lb.			
	40	Globe..............................	Lb.			
	50	Plug..............................	Lb.			
	60	Ball..............................	Lb.			
	70	Butterfly..............................	Lb.			
	80	Other..............................	Lb.			
680.16	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6).........	Lb......	Free		
680.17		Of iron or steel..............................	....	8.5% ad val.	8% ad val.(D) Free (A,E,I)	45% ad val.
		Of iron or steel containing over 2.5 percent carbon by weight:				
	05	Check..............................	Lb.			
	10	Gate..............................	Lb.			
	15	Globe..............................	Lb.			
	18	Plug..............................	Lb.			
	25	Ball..............................	Lb.			
	30	Butterfly..............................	Lb.			
	35	Other..............................	Lb.			
		Other:				
	42	Check..............................	Lb.			
	45	Gate..............................	Lb.			
	50	Globe..............................	Lb.			
	55	Plug..............................	Lb.			
	60	Ball..............................	Lb.			
	65	Butterfly..............................	Lb.			
	68	Other..............................	Lb.			
680.18	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)..........................	Lb......	Free		
680.19	00	Other..	Lb......	5.2% ad val.	4.4% ad val.(D) Free (A,E,I)	45% ad val.
680.24	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)..........................	Lb......	Free		

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Generators, motors, motor-generators, converters (rotary or static), transformers, rectifiers and rectifying apparatus, and inductors; all the foregoing which are electrical goods, and parts thereof (con.):				
682.60		Other	....	3.6% ad val.	3% ad val.(D) Free (A*,E,I)	35% ad val.
		Generators, except generator sets:				
	05	Of not over 400 kilowatts	No.			
	15	Of over 400 kilowatts, but less than 10,000 kilowatts	No.			
	20	Of 10,000 kilowatts or more, but not over 40,000 kilowatts	No.			
	30	Of more than 40,000 kilowatts	No.			
		Generator sets (integral unit mounted on a common base):				
		Diesel engine driven:				
	31	Of not over 400 kilowatts	No.			
	33	Of over 400 kilowatts, but not over 1,000 kilowatts	No.			
	35	Of over 1,000 kilowatts	No.			
		Gaseoline engine driven:				
	42	Of less than 1.5 kilowatts	No.			
	44	Of 1.5 kilowatts or more, but not over 5 kilowatts	No.			
	46	Of over 5 kilowatts	No.			
	48	Other	No.			
	49	Motor-generators and rotating converters	No.			
	50	Rectifiers and rectifying apparatus	X			
	52	Coils and inductors	No.			
	54	Lamp ballasts	No.			
	56	Parts of transformers	X			
	59	Parts of motors (other than commutators and parts of motors under 1/40 horsepower)	X			
	62	Parts of generators	X			
	64	Other	X			
682.61	00	Generators, motor-generators, converters (rotary and static), rectifiers and rectifying apparatus, and inductors; all the foregoing, if certified for use in civil aircraft (see headnote 3, part 6C, schedule 6)	X	Free		35% ad val.
682.65	00	Any article described in the foregoing items 682.05 to 682.60, inclusive (except 682.50), if Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)	X	Free		
		Magnets; chucks, clamps, vises and similar work holders, all the foregoing which are magnetic; electro-magnetic clutches and couplings; electro-magnetic brakes; electro-magnetic lifting heads; all the foregoing and parts thereof:				
682.70	00	Permanent magnets	No.	3.8% ad val.	3.2% ad val.(D) Free (A,E,I)	45% ad val.
682.71	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)	X	Free		
682.80	00	Work holders and parts thereof	X	5.2% ad val.	4.9% ad val.(D) Free (A,E,I)	30% ad val.
682.90	00	Other	X	4.1% ad val.	3.9% ad val.(D) Free (A,E,I)	35% ad val.
682.91	00	If Canadian article and original motor-vehicle equipment (see headnote 2, part 6B, schedule 6)	X	Free		
682.95	00	Primary cells and primary batteries, and parts thereof	X	5.7% ad val.	5.3% ad val.(D) Free (A,E,I)	35% ad val.

SCHEDULE 6. - METALS AND METAL PRODUCTS
Part 6. - Transportation Equipment

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Chassis, bodies (including cabs), and parts of the foregoing motor vehicles (con.):				
		Other:				
692.24	00	Cast-iron (except malleable cast-iron) parts, not alloyed and not advanced beyond cleaning, and machined only for the removal of fins, gates, sprues, and risers or to permit location in finishing machinery..........	Lb......	Free		10% ad val.
		Other:				
692.29	00	Automobile truck tractors, if imported without their trailers..................	No......	4% ad val.	Free (A,E,I)	25% ad val.
692.31		If Canadian article (see headnote 2 of this subpart)....................	....	Free		
	20	Gasoline fueled................	No.			
	40	Other..........................	No.			
692.32		Other..................................	....	3.2% ad val. 1/	3.1% ad val.(D) 1/ Free (A*,E,I)	25% ad val.
	07	Axle spindles......................	No. v Lb.			
	09	Beam hanger brackets................	No.			
	15	Body stampings......................	X			
	20	Bumpers.............................	X			
	30	Wheels designed to be mounted with pneumatic tires................	X			
	40	Hubcaps and wheel covers............	X			
		Radiators and parts thereof:				
	42	Complete radiators.............	No.			
	44	Radiator cores.................	No.			
	46	Parts of radiators (other than cores)...................	X			
	60	Mufflers and tailpipes..............	X			
		Brakes and parts thereof:				
	62	Brake drums and rotors (discs).......................	No.			
	64	Other..........................	X			
		Transmissions:				
	74	For automobile trucks and motor buses....................	X			
	76	For passenger automobiles......	X			
	78	Other..........................	X			
	82	Shock absorbers.....................	X			
		Truck trailers:				
	84	Van type.......................	No.			
	86	Other..........................	No.			
	88	Safety seat belts...................	X			
	95	Other...............................	X			

1/ Duty on axle spindles and shock absorbers temporarily reduced. See item 947.36 in part 2, Appendix to the Tariff Schedules and general headnote 3(d)(ii).

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Chassis, bodies (including cabs), and parts of the foregoing motor vehicles (con.):				
		Other (con.):				
		Other (con.):				
		Other (con.):				
692.33		If Canadian article and original motor-vehicle equipment (see headnote 2 of this subpart).............	....	Free		
	10	Body stampings................	X			
	20	Bumpers........................	X			
	30	Wheels designed to be mounted with pneumatic tires...........	X			
	40	Hubcaps and wheel covers.......	X			
	50	Radiators......................	X			
	60	Mufflers and tailpipes.........	X			
	72	Brakes and parts thereof.......	X			
		Transmissions:				
	74	For automobile trucks and motor buses...........	X			
	76	For passenger automobiles...............	X			
	78	Other.....................	X			
	80	Shock absorbers................	X			
	90	Other..........................	X			
		Tractors (except tractors in item 692.40 and except automobile truck tractors), whether or not equipped with power take-offs, winches, or pulleys, and parts of such tractors:				
692.34		Tractors suitable for agricultural use, and parts thereof................................	....	Free		Free
		New tractors:				
		Wheel type except garden tractors:				
		Power take-off horsepower type:				
	02	Under 20-PTO horsepower........	No.			
	04	20-PTO horsepower or more, but less than 30-PTO horsepower.........................	No.			
	05	30-PTO horsepower or more, but less than 40-PTO horsepower.........................	No.			
	06	40-PTO horsepower or more, but less than 80-PTO horsepower.........................	No.			
	09	80-PTO horsepower or more, but less than 100-PTO horsepower.........................	No.			
	11	100-PTO horsepower or more.....	No.			
		Other:				
	15	Riding........................	No.			
	17	Other.........................	No.			

SCHEDULE 6. - METALS AND METAL PRODUCTS
Part 6. - Transportation Equipment

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty Special	Rates of Duty 2
		Tractors (except tractors in item 692.40 and except automobile truck tractors), whether or not equipped with power take-offs, winches, or pulleys, and parts of such tractors:				
692.34 (con.)		Tractors suitable for agricultural use, and parts thereof (con.):				
		New tractors (con.):				
	30	Track-laying type (including half-track)	No.			
	40	Other	No.			
	50	Used tractors	No.			
	60	Parts of tractors	X			
692.35		Other	....	2.6% ad val.	2.2% ad val.(D) Free (A,E,I)	27.5% ad val.
	10	Track-laying tractors (including half-track)	No.			
		Other tractors:				
	22	Off-the-highway type	No.			
	26	Other	No.			
		Parts of the foregoing:				
	32	Tracklinks for track-laying tractors	No. v Lb.			
	34	Other	X			
692.40		Fork-lift trucks, platform trucks and other self-propelled work trucks, and platform tractors; all of the foregoing of off-the-highway types used in factories, warehouses, or transportation terminals for short-distance transport, towing, or handling of articles; and parts of the foregoing trucks and tractors	....	0.6% ad val.	Free (A,D,E,I)	35% ad val.
		Vehicles:				
	05	Operator walking	No.			
		Operating riding:				
	15	Electric powered	No.			
	25	Gasoline powered	No.			
	30	Other	No.			
	50	Other	No.			
	70	Parts thereof	X			
692.45		Tanks and other self-propelled armored military vehicles, whether or not fitted with weapons, and parts thereof	....	0.6% ad val.	Free (A,D,E,I)	35% ad val.
	10	Vehicles	No.			
	20	Other	X			

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1986)

APPENDIX TO THE TARIFF SCHEDULES
Part 2. - Temporary Modifications Proclaimed Pursuant to Trade-Agreements Legislation

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1: Effective on or after January 1, 1984	1985	1986	1987 1/	2
947.33	2/	Illuminating articles and parts thereof, of brass, other than table, floor and other portable lamps for indoor illumination (provided for in item 653.37, part 3F, schedule 6)	2/	5% ad val.	4.7% ad val.	4.8% ad val.	4.8% ad val.	No change
947.34	2/	Articles of base metal, coated or plated with gold (provided for in item 656.25, part 3G, schedule 6)	2/	10.9% ad val.	9.7% ad val.	9.2% ad val.	8.5% ad val.	No change
947.35	2/	Articles of copper or nickel silver, coated or plated with silver (provided for in item 656.30, part 3G, schedule 6)	2/	7% ad val.	7% ad val.	7.8% ad val.	8.5% ad val.	No change
947.36	2/	Axle spindles and shock absorbers for motor vehicles (provided for in item 692.32, part 6B, schedule 6)	2/	2.4% ad val.	2.3% ad val.	2.5% ad val.	2.6% ad val.	No change
947.37	2/	Photographic motion-picture cameras, with or without sound recording systems, valued $50 or more each (provided for in item 722.04, part 2F, schedule 7)	2/	3.6% ad val.	3.4% ad val.	3.6% ad val.	3.8% ad val.	No change
947.38	2/	Photographic papers other than silver halide papers, sensitized but not exposed (provided for in item 723.32, part 2F, schedule 7)	2/	2.4% ad val.	2.3% ad val.	2.5% ad val.	2.6% ad val.	No change
947.39	2/	Swords, bayonets and other side arms (except fire-arms), parts thereof, and scabbards and sheaths therefor (provided for in item 730.05, part 5A, schedule 7)	2/	4.6% ad val.	4.3% ad val.	4.4% ad val.	4.5% ad val.	No change
947.40	2/	Buckles and buckle slides, and parts thereof (provided for in item 745.45, part 7A, schedule 7)	2/	5% ad val.	4.7% ad val.	4.8% ad val.	4.8% ad val.	No change
947.41	2/	Toys for pets, of rubber or plastics (provided for in item 773.05, part 12C, schedule 7)	2/	6% ad val.	6% ad val.	6.6% ad val.	7.2% ad val.	No change

1/ Effective rates for reduced duties terminates at the close of December 31, 1987.
2/ See Appendix statistical headnote 1.