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No 66

ECONOMIC INTELLIGENCE REPORT

PRODUCTION AND USE OF METALFORMING MACHINERY IN THE USSR 1932-56

CIA/RR 124
1 February 1958

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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(ORR Project 34.501)

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FOREWORD

This report presents information on production and use of metalforming machinery in the USSR, including definitions, a brief history of production, the product mix, the inventory, ministerial and administrative organizations, major facilities for production and research, and major problems.

Production and inventories of metalforming machinery are measured in units (individual pieces of equipment). Because of the wide range of equipment included in the category of metalforming machinery, however, measurement in units often conceals important characteristics. For example, individual machines of a large size or of particular types may have a potential for military or heavy industrial production which cannot be matched by any number of smaller machines. The significance of some of these large or special machines will be discussed in the sections on inventory problems and on production and use of heavy presses.

As used in this report, the term heavy presses includes hydraulic forging presses of 10,000 metric tons and more and extrusion presses of 5,000 metric tons and more. The term large metalforming machines includes other machines such as vertical forging presses of large sizes (4,000 to 6,000 metric tons), large forging machines, large bending presses, and the like, in addition to the heavy forging and extrusion presses.

Although a preliminary estimate of the value of Soviet production of metalforming machinery in 1955 and an index of the value of production for 1950-55 are included in this report, these data must be regarded as a first approximation subject to refinement. A description of the estimating method employed and some important reservations about the method also are included in this report.

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PRODUCTION AND USE OF METALFORMING MACHINERY IN THE USSR* 1932-56

Summary

Production of metalforming machinery** in the USSR increased from about 9,000 units in 1950 to about 20,500 units in 1956. Despite this substantial increase, Soviet domestic production of metalforming machinery admittedly has been insufficient to meet the requirements of Soviet industry in terms both of total units produced and of product mix. Moreover, Soviet production has lagged behind that of the US in total units produced (US production in 1955 was 37,200 units), in the adequacy of the product mix, and in the level of technology (as measured by new or advanced types designed and produced). The USSR, however, does not have to equal US production of metalforming machinery to supply adequately its defense and capital goods industries, inasmuch as the US uses much of its annual production for the consumer goods industries.

In contrast to metalcutting and metal rolling equipment and processes, areas of great emphasis in the USSR, metalforming equipment and processes have received much less emphasis. Consequently, even though the machine building industries have been among the fastest growing sectors of the economy, the forging shops in the various machine building industries constitute a major production bottleneck. Since 1953, therefore, production of more and better metalforming machinery has received increased emphasis. This emphasis is expected to continue, especially in regard to large presses and large forging machines.

Poor organization has been a major problem in the production of metalforming machinery in the USSR. Production has been scattered among plants subordinate to many ministries, with little liaison or cooperation between the producing ministries. This scattered production has resulted in duplication of research and design, infrequent and sporadic deliveries of semifinished components, and a general dispersal of productive effort.

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* The estimates and conclusions contained in this report represent the best judgment of ORR as of 15 October 1957.

** For a definition of metalforming machinery, see I, A, p. 2, below.

Although the USSR has had little experience in building heavy presses, it is probable that a program for building heavy presses is under way, including the building of a 30,000-ton* press, being built and to be erected by the Ural Heavy Machine Building Plant imeni Ordzhonikidze. The undertaking of a program for heavy presses probably indicates a trend in the USSR toward greater use of forging and extrusion techniques in production of aircraft. New heavy presses built by the USSR for these purposes would join the 30,000-ton and 15,000-ton forging presses which were removed from Germany after World War II and which are already engaged in production of aircraft at Plant No. 268, Kamensk-Ural'skiy.

The Soviet inventory of metalforming machinery has diverse origins, most machines having been acquired from the conquered nations after World War II or imported. The inventory, although respectable in numbers (365,000 units as of 1 January 1956), is not highly productive and is in need of substantial renovation. The USSR therefore planned to replace 20 percent of its 1 January 1956 inventory during the 1956-60 period -- a high rate of replacement. Although the Soviet high-priority heavy and defense industries may replace and modernize their inventories significantly by 1960, the inventory in light industry, local industry, repair shops, and other low-priority branches of the economy will contain large numbers of machines of low productivity.

Significant increases in production of metalforming machinery in the USSR will depend on the completion of the 4 plants presently under construction, the construction of 7 new plants, and the development at the various research institutes and design bureaus of new types of machinery not previously produced.

I. Introduction.

A. Definitions.

Metalforming machinery includes power-driven machines which process metal by shaping or bending,** including hot and cold forging machines; mechanical and hydraulic presses; and bending and forming,

* Unless otherwise indicated, tonnages are given in metric tons throughout this report.

** The definition is the Soviet definition. For a listing of the various types of machines probably included in each category and for photographs of some Soviet machines, see Appendix A.

punching and shearing, and riveting machinery. The products range in size from small mechanical presses weighing several hundred pounds to heavy hydraulic forging presses weighing hundreds of tons.

Metalforming machines are closely related to metalcutting machine tools,* and in the USSR both metalforming machinery and metalcutting machine tools often are produced at the same plant. Although a metalcutting machine tool or a combination of metalcutting machine tools can produce the metal shapes made by metalforming machines, it is often uneconomical to produce these items solely by the use of metalcutting machine tools. In addition, the increased strength imparted by forging to crankshafts, connecting rods, and the like cannot be duplicated by fabrication on metalcutting machine tools.

B. Uses of Equipment.

Metalforming machines are used extensively in production of aircraft airframes and engine parts, artillery and small arms ammunition, and armor plate for tanks and warships as well as in production of parts for numerous types of general industrial machinery. Metalforming machines are also of major importance in making automobile bodies and frames and in production of refrigerators, washing machines, radios, television sets, and other consumer durables.

Recent trends in industrial processes indicate an increasing use of metalforming machines. The major reasons for this trend are as follows: (1) forming of metal to close tolerances reduces costly machining time and saves metal; (2) forging improves the density and stress characteristics of the worked metal; and (3) operation of metalforming machinery requires in some cases less skilled labor than does the operation of the necessary machine tools.

II. Production Facilities and Production of Metalforming Machines.

A. History.

Production of metalforming machinery before the Communist Revolution in Russia was confined to two plants. One, now known as the Bryansk Steam Locomotive Building Plant, produced small pneumatic hammers, and a second plant, now known as the Staro-Kramatorsk Plant imeni Ordzhonikidze, made presses, shears, and hammers on order. 1/**

* Machine tools are power-driven machines, nonportable by hand, such as lathes, milling machines, shapers, and planers, which progressively remove metal in the form of chips and shavings. Grinding, honing, and lapping machines are also included, although the chips removed are microscopic.

50X1

The USSR placed little emphasis on production of metalforming machinery during the First Five Year Plan (1928-32). Although production of metalforming machinery received somewhat greater attention after 1935, production in 1940 was only 4,668 units. 2/

During World War II, numerous Soviet plants producing metalforming machinery were overrun and severely damaged. Equipment, materials, and personnel were removed to the eastern regions of the USSR, the new plants being given an identical or similar name to the old plants. 3/ After the war, plants in the Western USSR were reestablished in their old locations.*

Production of metalforming machinery was established on a much larger scale after World War II. Many of the plants relocated in the eastern regions were still under construction at the cessation of hostilities, but some production had started. During the Fourth Five Year Plan (1946-50) the plants in the Western USSR were rebuilt and those in the Eastern USSR completed and maintained. By 1950, therefore, the number of primary producing plants had almost doubled compared with the 1940 level, with nearly corresponding increases in total production and in the number of type-sizes** produced.

During the Fifth Five Year Plan (1951-55), five new plants, all in the Western USSR, were under construction, and some of these

* The names of the relocated plants, however, remained similar to the parent plants in the Western USSR, although, for the most part, the products manufactured have been differentiated. The following are examples of old and relocated plants with similar names:

Western USSR	Eastern USSR
Forge and Press Equipment Plant imeni Kalinin, Voronezh	Press and Automatics Plant imeni Kalinin, Chimkent
Metallist Forge and Press Equipment Plant, Taganrog	Metallist Hydraulic Press Plant, Chkalov
Forge and Press Equipment Plant imeni Eighth Anniversary of the October Revolution, Serpukhov	Mechanical Press Plant imeni Eighth Anniversary of the October Revolution, Slavgorod
Forge and Press Equipment Plant imeni Sixteenth Party Congress, Odessa	Machine Tool Plant imeni Sixteenth Party Congress, Novosibirsk (now producing chiefly machine tools)

** The term type-size is a Soviet term referring to one size of a particular type of machine. For example, inclinable gap-frame presses of 10, 20, 30, and 40 tons would represent 4 type-sizes.

plants began to produce metalforming machinery before 1955.* In addition, preliminary steps were taken for the building of a new Experimental Scientific Research Institute of Forging and Press Machine Building (Eksperimental'nyy Nauchno-Issledovatel'skiy Institut Kuznechno-Pressovogo Mashinostroyeniya -- ENIIKMASh) and its experimental plant at Voronezh.** 4/

B. Ministerial Jurisdiction.

Before the 1957 reorganization of Soviet industry, metalforming machinery had been produced by many ministries in the USSR,*** with little or no liaison between the producing ministries. The most important plants, however, were subordinate to the Ministry of Machine Tool Building and Tool Industry and the Ministry of Heavy Machine Building. Plants of the Ministry of Machine Tool Building and Tool Industry concentrated upon hammers, mechanical presses, sheet metal shears and bending machines, some hydraulic presses, cold headers, and other cold forging machines, whereas plants of the Ministry of Heavy Machine Building generally were responsible for large machines such as horizontal forging machines, heavy hydraulic presses, heavy ingot shears, and straightening and bending machines. This division of labor between the two ministries was the result of the limited availability of large-size casting and machining facilities and an emphasis on production of metalcutting machine tools. The available large-size casting and machining facilities within the Ministry of Machine Tool Building and Tool Industry were not at the primary metalforming machinery plants but at the heavy machine tool building plants, where until recently primary emphasis was on the building of heavy metalcutting machine tools. It was therefore necessary to use the plants of the Ministry of Heavy Machine Building, which possessed adequate facilities, for the construction of the heavy presses and forging machines.

Although it was planned that the Ministry of Heavy Machine Building would continue to be an important producer of large metalforming machines during the original Sixth Five Year Plan (1956-60),

* For the first year of operation of each major plant, see Appendix B, Table 7, p. 36, below.

** For a discussion of this research institute, see C, 2, p. 7, below.

*** [redacted] 26 ministries were engaged in the production of metalforming machinery during 1957. 5/ This fact, however, overemphasizes the spread of production because the six ministries noted below contributed the vast bulk of production. It is likely, however, that metalforming machines were produced in plants subordinate to 20 other ministries from time to time. The problem will be discussed in further detail in D, 4, p. 19, below, under the discussion on jurisdictional control. 50X1

the Ministry of Machine Tool Building and Tool Industry was to play the major role in the planned expansion of production. New plants capable of building heavier presses and forging machines were to be placed under the control of the Ministry of Machine Tool Building and Tool Industry, and greater emphasis was to be given to the production of metalforming machinery at the heavy metalcutting machine tool building plants.

Metalforming machinery also has been produced by the Ministry of Agriculture, the Ministry of Ferrous Metallurgy, the Ministry of Construction and Road Building, and the Ministry of Motor Vehicles. Although plants subordinate to the Ministry of Agriculture reportedly produced 24 percent of the total unit production of metalforming machinery in 1955, 6/ this machinery included chiefly small hydraulic presses and small pneumatic hammers for machine tractor stations, collective farms, and state farms.

No person or group of persons has played a dominant role in the production of the metalforming machinery industry as did A.I. Yefremov and A.I. Kostousov in the Soviet metalcutting machine tool industry. Kryzhanovskiy headed the Main Administration of Forging and Press Machine Building (Glavnoye Upravleniye Kuznechno-Pressovogo Mashinostroyeniya -- GUKMASh) of the now defunct Ministry of Machine Tool Building and Tool Industry, 7/ and GUKMASh had jurisdiction over the primary metalforming machinery plants. According to reports of the Soviet press and trade journals, however, Dmitriy A. Ryzhkov, Deputy Minister for the Introduction of New Technology of the Ministry of Machine Tool Building and Tool Industry, had played the most prominent role in the drive to increase the production of metalforming machinery.

The effect of 1957 administrative changes in the USSR is not yet clear. The decentralization of industrial control and the abolition of the Ministry of Machine Tool Building and Tool Industry, the Ministry of Heavy Machine Building, and other ministries producing metalforming machines makes certain, however, that the continued expansion of production of metalforming machinery will not follow the past pattern of machine tool development -- that is, forced draft development under one primary ministry. The decentralization, however, is not expected to alter the emphasis given to the production of metalforming machines, which will continue to be stressed.

C. Production and Research Facilities.

1. Major Plants.

The locations of the principal and the major secondary metalforming machinery plants in the USSR are shown on the

accompanying map, Figure 1.* All of the principal plants formerly were subordinate to GUKMASh, whereas the secondary facilities were under the jurisdiction of other main administrations of the Ministry of Machine Tool Building and Tool Industry or under other ministries. In addition to plants in which production was centrally planned (that is, those subordinate to all-union and union-republic ministries), plants subordinate to republic ministries and local and cooperative industry produced approximately 5,500 units of metalforming machinery in 1955 (29 percent of total production).

The principal and the major secondary metalforming machinery plants, their primary products, and the year in which they began producing metalforming machinery are shown in Table 7.** The principal metalforming machinery plants (15 plants including those under construction) produce a variety of small- and medium-size equipment, whereas the 20 major secondary plants each produce a more limited number of types. The major secondary plants often concentrate on the production of metalforming machines which are directly applicable to the work of their respective ministries. As shown in Figure 1,* most of the principal and the major secondary plants are in the Western USSR, only seven of these plants being located in the Eastern USSR (the Urals, Siberia, and the Central Asia areas).

For the most part, production of metalforming machinery is on a custom or small-series basis, utilizing general-purpose machine tools. Some of the plants have foundries and forging shops capable of providing the types of castings and forgings necessary for their products, whereas other plants must rely on larger or specialized plants to supply these items. The chief limitations to flexibility of production between types and sizes of machines rest in the size of the machining and casting facilities, the size of the cranes, and the available work space.

2. Research Facilities.

In the future, production of new types of metalforming machinery will be supported by the research carried out by ENIIKMASh and its experimental plant, both of which are currently being established at Voronezh. The institute, scheduled to be one of the largest industrial research centers in the USSR, will employ 700 persons (presumably including plant employees) and was originally slated to be under the jurisdiction of the Ministry of Machine Tool Building

* Following p. 8.
** P. 36, below.

and Tool Industry.* The institute and the experimental plant are ultimately to have responsibility for experimentation on theoretical questions concerning the design and operation of metalforming machines and the pressure processing of metal, for working with new processes and new types of machines, and for emphasizing the development of highly productive presses and automatic lines (using metalforming machines). Both the structure and the responsibilities of this institute have a striking resemblance to those of the Experimental Scientific Research Institute of Metalcutting Machine Tools (Eksperimental'nyy Nauchno-Issledovatel'skiy Institut Metallorezhushchikh Stanko -- ENIMS) in Moscow. ENIMS and its experimental plant, Stankokonstruktsiya, have contributed substantially to the progress of the highly developed metalcutting machine tool industry. 8/

In the past the only research in the USSR on forging and forming processes was conducted by the Central Scientific Research Institute of Technology and Machine Building (Tsentral'nyy Nauchno-Issledovatel'skiy Institut Tekhnologii i Mashinostroyeniya -- TsNIITMASh). TsNIITMASh will continue to do research in this field.

Industrial research institutes such as ENIIKMASh, ENIMS, and TsNIITMASh are designed to investigate and experiment with industrial processes and equipment with the following two goals in mind:

a. To permit the USSR to obtain in a relatively short period of time the knowledge gained by other nations through long years of practical experience (in part, through a systematic exploitation of foreign technical literature and foreign equipment) and

b. To lay a firm theoretical and experimental foundation for future development.

The existence of centralized research institutes such as ENIIKMASh subordinate to various ministries constitute a special problem in the 1957 reorganization of Soviet industry. As yet no new control mechanism for ENIIKMASh and the other industrial research institutes has been announced, although some suggestions have been advanced. 9/ It is clear, nevertheless, that new mechanisms and channels must be established for the proper selection of research

* It is not known what administrative arrangements have been made since the abolition of the ministry. It is practically certain, however, that ENIIKMASh will not be disbanded, thus making necessary the establishment of channels through which ENIIKMASh can influence or control the types of metalforming machines produced at the various plants.

Figure 1

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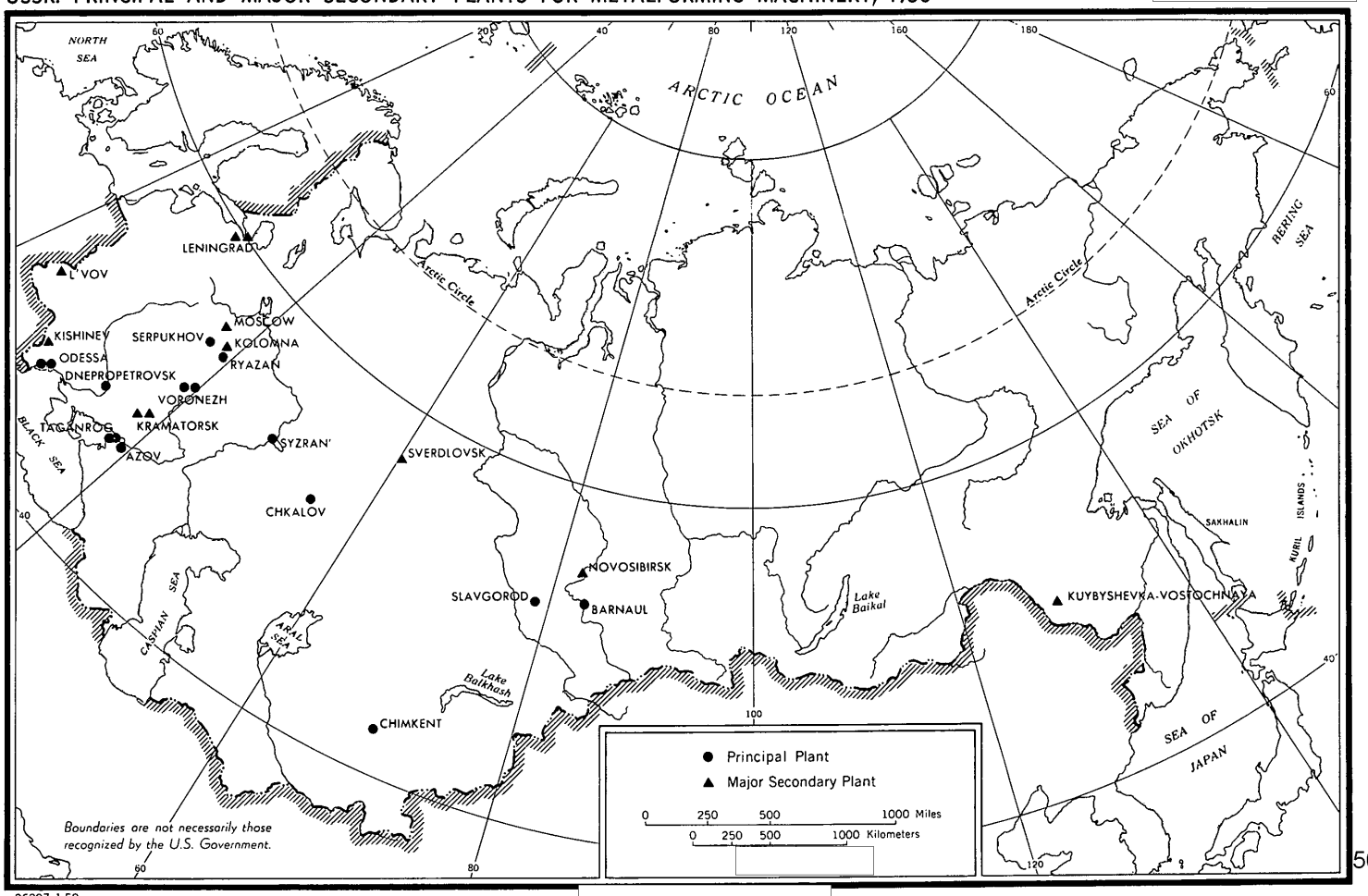
USSR: PRINCIPAL AND MAJOR SECONDARY PLANTS FOR METALFORMING MACHINERY, 1956



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50X1

topics and for the dissemination and implementation of new techniques and equipment developed by the institutes to replace the ministerial arrangements. Because ENIMS had considerable success under the Ministry of Machine Tool Building and Tool Industry, a comparison of its development under the old system with the development of ENIIKMASh under the new system should prove interesting at some later date.

In addition to centralized research institutes, some of the producing plants have special design bureaus. Before the reorganization of industry, a Central (Design) Bureau of Press and Forging Machine Building (Tsentral'noye Byuro Kuznechno-Pressovogo Mashinostroyeniya -- TsBKM) was subordinate to GUKMASh. 10/

D. Past Production and 1960 Goals.*

1. Annual Production and Product Mix.

Estimated production of metalforming machinery in the USSR from 1932 through 1956 and in 1960 is shown in Table 1.** In addition to the increase in the number of units produced, the size and mix of the machines has changed substantially. Although unit production in 1955 (19,422 units) was reported to be more than 4 times the 1940 level in units, production in 1955, in tonnage, was 15 times the 1940 level. 12/

Although all of the principal and a number of the secondary metalforming machinery plants were formerly subordinate to the Ministry of Machine Tool Building and Tool Industry, plants of this ministry produced only 1,700 units in 1940, 3,600 units in 1950, 5,400 units in 1955, and 6,900 units in 1956. 13/

A preliminary estimate of the value of production of Soviet metalforming machinery in 1955 is approximately 453 million rubles (at 1955 prices).*** The following index of value of production (based upon 1955 prices and estimated 1955 product mix) has been computed****:

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* The USSR announced on 25 September 1957 that various alterations in conditions, including reorganization and the discovery of new reserves, require some modifications of Soviet long-term planning. It was further announced that the appropriate bodies would prepare new draft plans for 1959-65. This announcement appears to cancel the Sixth Five Year Plan (1956-60), but no new plans have been announced. 11/

** Table 1 follows on p. 10.

*** This amount equals US $113 million at the official conversion rate of 4 to 1.

**** For an explanation of the methodology employed and several important reservations about these estimates, see Appendix I.

Year	Index
1950	100.0
1951	125.4
1952	131.3
1953	151.4
1954	170.9
1955	200.8

Table 1

Reported and Estimated Production of Metalforming Machinery in the USSR a/ 1932-56 and 1960

Units

Year	Production	Year	Production
1932	1,125 b/	1945	2,871 b/
1933	1,500	1946	4,000
1934	1,900	1947	5,300
1935	2,300	1948	6,500
1936	2,700	1949	7,800
1937	3,125 b/	1950	8,991 b/
1938	3,600	1951	10,218 b/
1939	4,100	1952	10,711 b/
1940	4,668 b/	1953	12,707 b/
1941	1,500	1954	15,328 b/
1942	500	1955	19,422 b/
1943	1,000	1956	20,500 b/
1944	1,600	1960	c/

a. 14/. For methodology, see Appendix D.
b. Reported production.
c. The 1960 planned production of 25,800 units refers only to all-union and union-republic ministries, which were responsible for 13,900 units out of total production of 19,422 units in 1955.

Table 2* shows the Soviet product mix for selected years. Figure 2** shows the changing composition of Soviet production in the

* Table 2 follows on p. 11.
** Following p. 10.

Figure 250X1

USSR

COMPOSITION OF PRODUCTION OF METALFORMING MACHINERY 1945 AND 1950-55

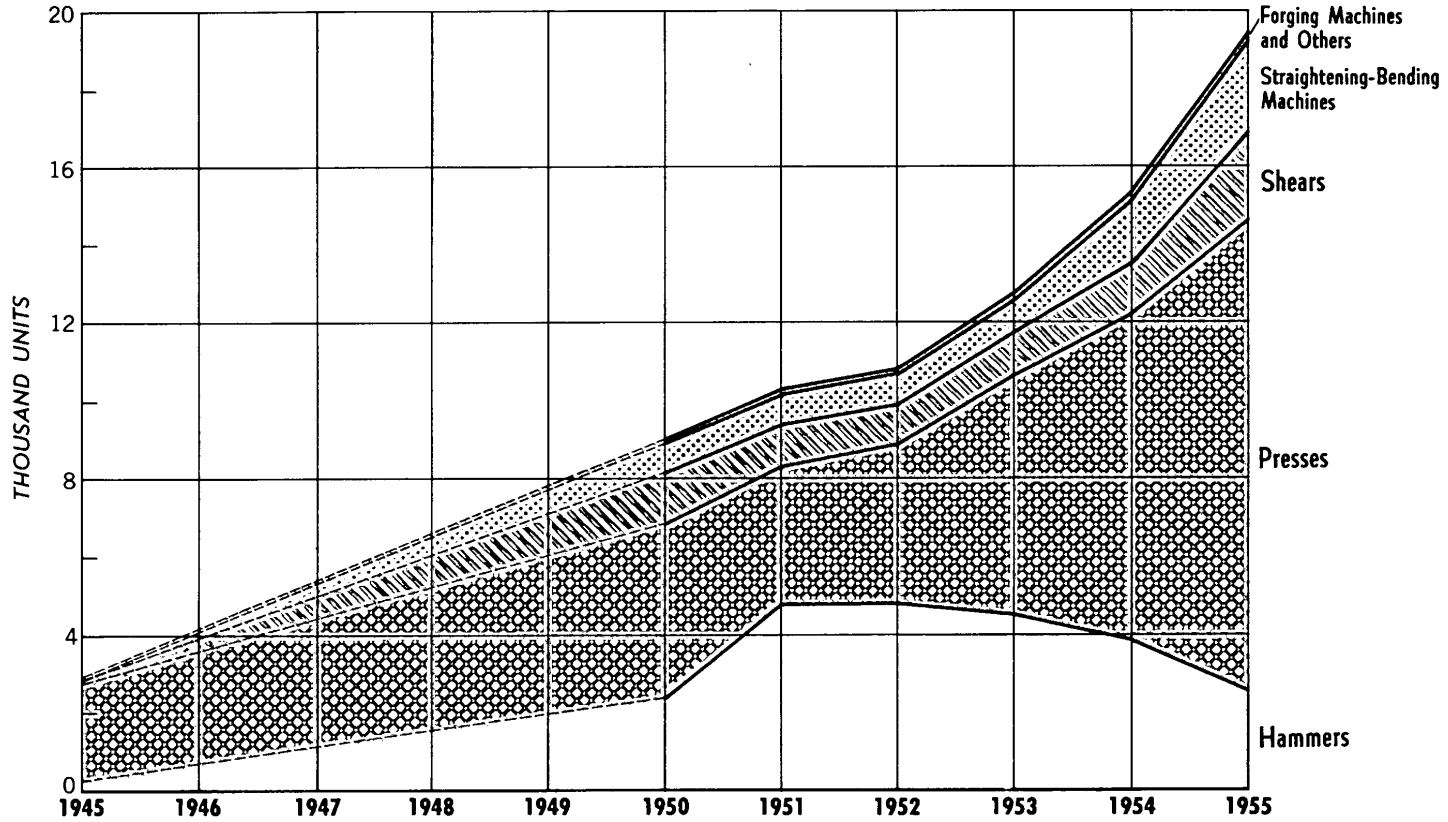

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Table 2

Production of Metalforming Machinery in the USSR, by Type a/
Selected Years, 1932-55

Units

	1932	1937	1940	1945	1950	1951	1952	1953	1954	1955
Hammers	228	521	325	260	2,327	4,728	4,756	4,497	3,904	2,572
Forging	212	490	281	260	2,262	4,677	4,742	4,470	3,861	2,491
Stamping	16	31	44		65	51	14	27	43	81
Presses	797	2,414	4,061	2,466	4,562	3,508	4,100	6,169	8,323	12,071
Forging machines		4		11	12	14	11	27	35	37
Power-driven shears	100	186	278	128	1,263	1,114	1,047	1,098	1,319	2,207
Straightening and bending machines			4	6	799	824	754	862	1,694	2,490
Other					28	30	43	54	53	45
Total metalforming machinery	1,125	3,125	4,668	2,871	8,991	10,218	10,711	12,707	15,328	19,422

a. 15/

post-World War II period, and Figures 4 through 11* show examples of Soviet metalforming machinery. In the period before World War II, production was composed chiefly of small mechanical presses and hammers. In 1935, for example, more than 50 percent of the units produced by all-union and union-republic ministries (1,675 units out of an estimated total production of 2,300 units) were small mechanical presses of from 12 to 70 tons pressure; and 25 percent were 1- , 2- , and 3-ton forging hammers. 16/ No large machines were produced, and the range of machine type-sizes probably was less than 50. By 1950, 99 type-sizes were available to consumers from centrally controlled production, with total Soviet production equaling approximately 9,000 units. In 1955, all-union and union-republic ministries produced 13,900 units (out of a total of 19,422 units) in 220 type-sizes. 17/

Of considerable importance are the number of hammers in production during the 1950-53 period and the marked shift away from hammer production in 1954 and 1955 in line with the increased emphasis by the Soviet leadership on production of forging machines and forging presses. Although there undoubtedly have been major increases in the number of forging presses produced in the USSR since 1953, Soviet statistics have not itemized forging presses as distinct from production of other presses. Compared with hammers, these forging machines and forging presses will produce forgings with smaller metal waste and can be better adapted to large series and mass production. Nevertheless, hammers still constituted 13 percent of Soviet annual production in 1955. Equally significant is the very small number of forging machines produced in the USSR in spite of efforts by the State Committee for New Technology (Gosudarstvennaya Tekhnicheskaya Komissiya -- Gostekhnika), the Communist Party, and the press to stimulate greater production of these machines.

2. Comparison of Soviet and US Production and Product Mix.

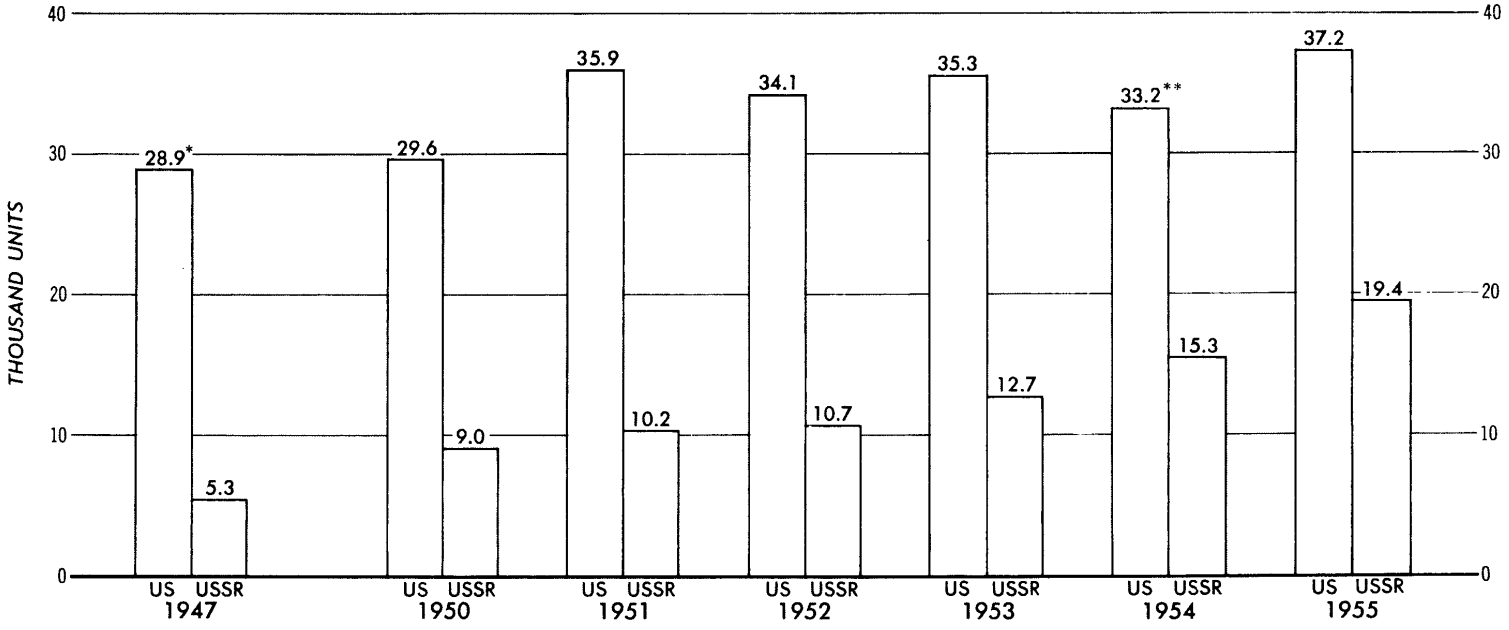
Because a large part of US annual production of metalforming machinery is used for production of consumer goods, such as automobiles, refrigerators, and the like, comparisons of annual Soviet and US production are, at best, partial and therefore potentially deceptive measures of the relative positions of the two nations. In addition, comparisons of annual production do not imply a comparison of productive capacity under full industrial mobilization.

On a quantitative basis, Soviet production in recent years compares unfavorably with that of the US, as shown in Figure 3.** 18/

* Following p. 34.
** Following p. 12.

Figure 1

COMPARISON OF US AND SOVIET ANNUAL PRODUCTION OF METALFORMING MACHINERY 1947 AND 1950-55



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*Based on incomplete returns.

**A minimum. Excludes approximately 17,645,000 US dollars worth of equipment for which amount figures are not available.

Even the original Soviet 1960 goal of 25,800 units (for centrally controlled production) is substantially below US production during 1951-55.

It is probable, however, that the USSR does not have to equal US production of this type of equipment to supply adequately the needs of its defense and capital goods industries, inasmuch as the US uses a large part of its annual production for production of consumer goods.

Qualitatively the USSR has lagged behind the US in many respects. Table 3* compares the mix of machines produced in the US and the USSR during 1952 and 1955. These years were chosen to emphasize the shift in the Soviet product mix compared with the relatively constant mix of the US. Over this 4-year period the USSR shifted away from the production of hammers while increasing the proportion of presses, forging machines, shears (slightly), and straightening and bending machines -- a change which Soviet leaders describe as an increase in the level of technology. The Soviet leaders and the Party press, however, remain critical of the poor quality of the various presses produced, the small number of type-sizes produced, and the low unit production of forging machines. The comparison of US and Soviet production of forging machines emphasizes the low level of Soviet production compared with that of the US. US production in 1955 included 387 headers and upsetters, 286 forging rolls and swaging machines, and 155 other forging machines, whereas the USSR produced 37 forging machines during the year. Although there is a possibility of a difference in definition (such as the exclusion of headers and upsetters from the category), it is known that by early 1957 the USSR had produced only one forging roll and had constructed only a few horizontal forging machines. In addition, according to available evidence, the USSR had not produced any horizontal counterblow hammers (impactors of the Chambersburg type**), 19/ and there is no evidence of Soviet production of stretch-forming presses and large forming rolls.

The USSR also has lagged behind the US in the production of large presses. No press larger than the 12,000-ton hydraulic pipe-forming press, assembled in late 1955 or early 1956, has ever

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* Table 3 follows on p. 14.

** Impactors of the Chambersburg type have two movable rams counterposed in horizontal position rather than a movable ram falling against a stationary block as in the case of ordinary hammers. This arrangement eliminates many of the problems of vibration and reinforcement prevalent in the use of drop hammers.

Table 3

Comparison of Soviet and US Product Mix of Power-Driven Metalforming Machinery a/*
1952 and 1955

	1952		1955	
Types of Machinery	USSR	US	USSR	US
Hammers				
Units	4,756	538	2,572	157
Percent of total	44.4	1.6	13.2	0.4
Presses				
Units	4,100	17,128 b/	12,071	20,712 b/
Percent of total	38.3	50.2	62.2	55.7
Forging machines				
Units	11	724 c/	37	828 c/
Percent of total	0.1	2.1	0.2	2.2
Shears				
Units	1,047	4,657 d/	2,207	3,956 d/
Percent of total	9.8	13.6	11.4	10.6
Straightening and bending machines				
Units	754	6,516 e/	2,490	6,705 e/
Percent of total	7.0	19.1	12.8	18.0
Other metalforming machines				
Units	43	4,556 f/	45	4,849 f/
Percent of total	0.4	13.4	0.2	13.1
Total units	10,711	34,119	19,422	37,207
Percent	100	100	100	100

* Footnotes for Table 3 follow on p. 15.

Table 3

Comparison of Soviet and US Product Mix of Power-Driven Metalforming Machinery a/ 1952 and 1955 (Continued)

a. 20/. US figures exclude metal-container-making machines, die casting machines, wireweaving and fabricating machines, and drawing machines and draw benches believed to be excluded under the Soviet definition.
b. Including forging presses, undefined in Soviet data.
c. Excluding presses, undefined in Soviet data.
d. Punching and shearing machines.
e. Bending and forming machines (US classification).
f. Riveting machines, except hand-held portable types.

been produced in the USSR, whereas the US has built a number of presses from 10,000 to 50,000 short tons. 21/ The largest extrusion presses known to have been built in the USSR are 2 of 5,000 tons, produced for export in 1956 at the Izhora Metallurgical Plant. 22/ Larger presses, however, are presently in production.* Extrusion presses up to 12,000 short tons have been built in the US. The largest vertical forging presses and horizontal forging machines constructed in the USSR have been of 6,300 and 3,000 tons, respectively. Large vertical forging presses are a relatively new development in the USSR. The first 4,000-ton vertical forging press was test-assembled in November 1955, and in September 1956 the assembly of the first 6,300-ton vertical forging press was under way at the Novo-Kramatorsk Plant imeni Stalin. 23/ There are only 4 sizes of horizontal forging machines built in the USSR -- 800 tons, 1,200 tons, 2,000 tons, and 3,000 tons (probably in prototype only). Work on a 3,000-ton horizontal forging machine was begun in late 1954, but there is no evidence that this model is being built on a small-series basis as are the other 3 type-sizes. 24/

Indirect evidence of the relatively poor position of Soviet production compared with that of the US can be found in the production of closely associated items such as manipulators and die-making machines. The USSR did not build its first forging manipulator**

* See III, C, p. 25, below.
** A forging manipulator is a wheeled or track-type vehicle designed to hold, transport, and position ingots during the forging and heating process.

for a press until after early 1955, and, as of January 1956, no floor- or rail-type manipulators for ingots weighing more than 5 tons had been constructed. 25/ Similarly, press reports indicate that the Machine Tool Plant imeni Sverdlov in Leningrad only recently began the construction of large die-making machines for dies used on large presses. 26/

In general, therefore, the USSR lags behind the US in total units produced and in the mix of its machinery, but the Soviet leaders are attempting with some success to alter the product mix toward more productive and advanced types of machinery. This movement is relatively new, having begun in 1953-54, and production of substantial numbers of heavier machines and of highly productive types is not yet far advanced. Although the building of heavier types is a relatively new field in the USSR, it is one which the Soviet planners had hoped to master during the original Sixth Five Year Plan (1956-60).

3. Soviet Inventory of Metalforming Machinery.

The USSR announced that its inventory of metalforming machinery was 365,000 units as of 1 January 1956, more than 3 times the figure of 119,000 for late 1940. 27/ Most of this increase has come from sources other than domestic production -- for example, postwar removals and postwar imports.*

Soviet domestic production of metalforming machinery totaled only 108,000 units from 1941 through 1955, and the US shipped the USSR about 6,000 units during 1941-48. 28/ Other shipments from the West during 1941-55 were small and probably did not exceed 3,000 units. War losses were reported as 34,000 units. 29/ Table 4** summarizes this information and shows that most of the increase in metalforming machinery was the result of postwar removals from the conquered countries (Germany, Austria, Hungary, Rumania, and Manchuria) and of exports from the European Satellites, primarily from East Germany and Czechoslovakia.

Information on European Satellite-Soviet trade and postwar removals is too scanty to permit an apportionment of the residual of 174,000 units. Available information on East German and Czechoslovak levels of production indicates, however, that all of this

* Removals are defined here as those machines taken from the stock of installed or stored machines at the end of hostilities as distinct from reparations from current production, which are treated here as Soviet imports.

** Table 4 follows on p. 17.

Table 4

Origins of Inventory of Metalforming Machinery in the USSR
1940 - January 1956

Thousand Units

Category of Inventory	Additions	Reductions	Balance
Total inventory, late 1940			119
Explained additions			
Domestic production	108		
Less exports a/		11	
Net addition from domestic production	97		
US shipments (1941-48)	6		
Other Western shipments (1941-55)	3		
Total explained additions	106		
Explained reductions b/			
War losses		34	
Total explained reductions		34	
Announced inventory, 1 January 1956			365
Explained inventory, 1 January 1956			191
Unexplained increase in inventory			174 b/

a. [redacted] the USSR has exported some metalforming machinery to the European Satellites and Communist China, but the only exports of major strategic significance are two 5,000-ton extrusion presses shipped to Communist China during 1956. 30/ Another extrusion press of this size is being built for the Chinese Communists at the Izhora Metallurgical Plant. Large presses of this type for aluminum or other light metal extrusions

50X1

Table 4

Origins of Inventory of Metalforming Machinery in the USSR
1940 - January 1956
(Continued)

will be a definite advantage to China in its plans for the development of a modern aircraft industry. For comparative purposes it should be noted that the largest installed extrusion press in the US during World War II was one of 5,500 short tons. 31/ In addition, the Soviet press has announced that the Moscow Motor Vehicle Plant imeni Likhachev (formerly imeni Stalin) is building 725- and 3,500-ton mechanical presses for the motor vehicle industry of China. 32/

b. This figure does not take into account retirements since World War II.

equipment could not have come from postwar imports,* and other data suggest that large amounts of metalforming machines -- perhaps up to 100,000 units -- were obtained by removals from the conquered countries.**

In addition, it is estimated that 75 to 80 percent of the prewar inventory of 119,000 units was imported. During the 1920's and 1930's, when Soviet production was small, the USSR imported substantial quantities of metalforming machinery from the US, the UK, Germany, and Czechoslovakia.

* Announced information on East German and Czechoslovak production of metalforming machinery in units is as follows 33/:

Year	East Germany a/	Czechoslovakia
1950	3,706	N.A.
1951	3,928	N.A.
1952	3,866	N.A.
1953	4,519	N.A.
1954	5,586	N.A.
1955	7,409	5,000
1960 Plan	N.A.	6,800

a. Including only eccentric, crank, and knuckle-joint presses; probably excluding hydraulic presses and shears.

** For indications of the extent of removals from these countries, see Appendix H.

One of the most significant areas of interest is the Soviet inventory of large and special-purpose metalforming machines. Most of the Soviet inventory of large metalforming machines has been imported from the West or obtained in the postwar removals. Although the USSR received only about 6,000 units of US metalforming machinery from 1941 through 1948, a number of the machines shipped were of major importance, including extrusion presses up to 3,500 short tons; two 10,000-short-ton and one 6,500-short-ton hydraulic forging press; other hydraulic forging presses up to 5,000 short tons; a 3,000-short-ton hydraulic armor-plate bending press; nine 2,500-short-ton rubber-pad forming presses; hammers of all types and sizes up to 47,000 pounds (23.5 short tons) falling weight; horizontal forging machines and forging rolls of large sizes; and numerous shell piercing and drawing presses. 34/ In addition, a 5,000-short-ton rubber-pad hydraulic forming press for aircraft and a 5,000-ton extrusion press were shipped to the USSR in 1938 and 1939. 35/ Together with the machinery received from Germany during the period of rapprochement in the late 1930's and the postwar removals, these machines constitute an important part of the present Soviet inventory of large presses and forging machines. Among the postwar removals from Germany were the largest hydraulic closed-die forging press in the world, the 30,000-ton press located at I.G. Farben's Bitterfeld Plant, and the largest extrusion press in the world, the 12,000-ton Schloemann press installed at Durener Metallwerke AG, at Waren in Mecklenburg, as well as other large forging and extrusion presses.* 36/

4. Original 1960 Goals.

Under the original Sixth Five Year Plan (1956-60), annual unit production of metalforming machinery in the USSR was to increase to 25,800 units by 1960, 85 percent more than the 1955 level of production for centrally controlled facilities. This rate of increase approximates that planned for the production of machine tools. 37/ No less than 29 percent of the planned increase was to have resulted from more efficient use of existing facilities, and the remainder presumably was to have been produced by plants under construction or to be constructed. 38/

Four metalforming machinery plants -- at Azov, Dnepropetrovsk, Ryazan', and Voronezh -- are still in various stages of construction, although production has begun. The plants at Dnepropetrovsk and Voronezh began production before the end of the Fifth Five Year Plan (1951-55). Six metalforming machinery plants were to be constructed in the Urals and Siberia during the original Sixth Five Year Plan. 39/ In addition, preparations for the

* For further discussion of these machines, see III, C, below.

construction of a metalforming machinery plant at Syzran' were under way in June 1956. 40/ ENIIKMASh will be developed during 1956-60, and the original plan also anticipated changes in the product mix and in the technical level of production as described above.

By 1960, plants of the Ministry of Machine Tool Building and Tool Industry were to produce approximately 13,300 units -- 52 percent of the total planned production of 25,800 units. 41/ The future range of planned production by these plants was indicated by an article in a Soviet trade journal in early 1956. Table 5, based on this article, shows the number of type-sizes available in 1955 and the planned increase in the number of type-sizes during the original Sixth Five Year Plan. 42/

Table 5

Type-Sizes of Machinery Available at Plants of the Ministry of Machine Tool Building and Tool Industry of the USSR and Increases Planned by 1960

Type of Machinery	Number of Type-Sizes 1955	1960	Percentage Increase 1960 Compared with 1955
Mechanical presses	47	121	157
Hydraulic presses	57	154	170
"Automatics" (headers, upsetters, and multipunch machines)	71	112	58
Forging machines	6	20	233
Total	181	407	125

During 1950-53, emphasis within the Ministry of Machine Tool Building and Tool Industry was placed on the production of "automatics" and has now shifted to mechanical presses, hydraulic presses, and forging machines. By 1960, 500 type-sizes were to be produced by plants of this ministry. This total presumably included hammers, shears, and other types in addition to the types listed above. 43/ Additional type-sizes, of course, will be produced by plants formerly subordinate to other ministries as in the past.

Unfortunately, information relating to the value of Soviet production of metalforming machinery in current rubles is not available. A preliminary estimate of the annual value of production for selected years in 1955 rubles is included in Appendix I and in 2, above.*

III. Major Problems in Production and Use of Metalforming Machinery.

A. Ministerial Inertia and Lack of Coordination.

As previously noted, 26 ministries in the USSR were engaged in the production of metalforming machinery during early 1957. Although this figure overemphasizes the spread of production between ministries and implicitly overemphasizes the problem of coordination and planning, numerous difficulties in coordination and planning have existed between the six major producing ministries.

In the eyes of the Soviet leaders the Ministry of Machine Tool Building and Tool Industry was negligent in the production of metalforming machines. The following examples illustrate the reluctance and inertia which has characterized the behavior of this ministry. In spite of the decree issued in mid-1954 to establish a research organization, the construction of the main building and the hiring of personnel for ENIIKMASh was still in preliminary stages in mid-1956. 44/ Second, the product lists (number of type-sizes) produced at each of the metalforming machinery plants (under GUKMASh) were very large, and there had been little progress made in plant specialization as late as February 1956. Plants of the Main Administration of Heavy Machine Tool Building which possessed large casting and machining facilities were emphasizing the production of machine tools at the expense of planned production of metalforming machinery. Moreover, the various metalforming machinery plants were plagued by irregular deliveries of semifinished articles, such as castings and forgings, from other plants within the ministry. 45/

The best indication of the difficulties experienced by the Soviet leadership with the Ministry of Machine Tool Building and Tool Industry was the pressure campaign conducted by Promyshlenno-ekonomicheskaya gazeta (Industrial-Economic Newspaper) from 16 May through 27 July 1956. This newspaper, at that time the official organ for Gostekhnika, sent its correspondents to "raid" the plants of the ministry, to investigate conditions, and to report the findings in a series of articles. The team of correspondents was highly critical of the ministry for not recognizing and rectifying the poor

* P. 10, above.

conditions found at these plants,* and they urged immediate remedies for the conditions delaying production.

Ministerial inertia with regard to the production of metal-forming machines has not been confined to the Ministry of Machine Tool Building and Tool Industry. The Ministry of Heavy Machine Building was criticized for overemphasizing rolling mill equipment to the detriment of metalforming machinery in a manner similar to the criticisms of the Ministry of Machine Tool Building and Tool Industry for overemphasizing production of metalcutting machine tools. 46/

In addition to the difficulties experienced within individual ministries, there has been a decided lack of coordination among the various ministries. The following example, emphasizing the nature of the problem, is only one of the numerous instances of coordination difficulties. The Ministry of Machine Tool Building and Tool Industry and the Ministry of Heavy Machine Building were primarily responsible for the production of medium and large hydraulic presses, but the two ministries never negotiated a working agreement on the production of hydraulic apparatus and pumps for these presses. Plants such as the Ural Heavy Machine Building Plant, therefore, have had to manufacture these products in addition to the regular casting, machining, and assembly work and in addition to the large number of products already manufactured.** 48/

Although incidents like those cited above are good examples of the "narrow ministerial approach," prospects for increased specialization, better flow of semifinished goods, and increased subcontracting under the new system are not too good. In all likelihood the Barnaul Mechanical Press Plant would receive its castings from the Yefremov Plant at Novosibirsk more rapidly if both were responsible to a Council of National Economy (Sovet Narodnogo Khozyaystva -- Sovnarkhoz) located nearby rather than to the same ministry centered in Moscow. Considerable difficulties might still be encountered, however, in obtaining semifinished products from plants under the jurisdiction of other Councils of National Economy --

* A summary of the "raid" articles is included in Appendix C as an interesting commentary on the condition of the plants and on the status of management in the USSR.

50X1

the danger described as "narrow regionalism." In addition, individual plant managers will certainly be cautious about dependence on other plants for crucial inputs, even though enforcement of supply contracts is stiffened and permission for inventory expansion is granted as suggested. Therefore, although the new system is designed to meet some of the problems, the optimum operation of the new system will require a significant alteration in the thinking and instincts of Soviet managers at the plant level after the initial period of confusion -- a process that may require a few years time.

B. Obsolescence, Replacement, and Modernization of Inventory.

The problem of a diverse and antiquated inventory in the USSR was highlighted in 1955 by V.A. Malyshev (now deceased), the former Chairman of Gostekhnika, who listed the forging and foundry shops as the major bottlenecks in the Soviet machine building industries. More specifically he stated that the reequipment of the machine building plants must begin with the forging and foundry departments. 49/ Further evidence of the difficulties inherent in the present Soviet inventory are the following ratios, showing the percentage of forging done by free-falling hammers rather than by mechanical or hydraulic forging presses, counterblow hammers, or horizontal forging machines in selected machine building ministries during 1955 50/:

	Percent
Plants of the Ministry of Machine Building and Instruments	70
Plants of the Ministry of Construction and Road Building	85
Plants of the Ministry of Transport Machine Building	41

One of the major tasks of the original Sixth Five Year Plan was the replacement of these hammers with forging presses and forging machines, thereby improving the quality of the product, reducing the loss of metal, and increasing the rate of production. 51/ This plan envisioned the establishment of centralized forging shops, equipped with the most modern machinery to serve all of the industries within an area. Among these shops a metalforming shop with a capacity of 120,000 tons of forged metal per year was to be built in the Urals, and 2 more of 95,000 tons each were to be constructed at the Pavlodar Combine Plant and the Petropavlovsk Metallurgical Equipment Plant. 52/ These specialized shops were designed to make available the most up-to-date equipment for the greatest number of enterprises and to use the new equipment to the best advantage.

The data on the size, composition, and origin of the Soviet inventory cited above* provide some of the reasons for the present bottleneck condition and some measure of the extent of the difficulty. From these data it is apparent that the Soviet inventory is a conglomeration of machines of diverse origin, a fact that has undoubtedly created many problems of operation, maintenance, and repair. Furthermore, up to 1955 little or no replacement or modernization was taking place.

In previous sections it has been noted that the product mix of machines manufactured in the postwar period has not been satisfactory to the Soviet leaders. In addition, hammers comprised approximately 10 percent of the 1955-56 inventory (compared with about 2 percent in the US). 53/ These few facts suggest that the inventory, although respectable in numbers of units, is not highly productive and is in need of substantial renovation.**

The Soviet inventory of metalforming machinery will be a continuing problem for the USSR. During the original Sixth Five Year Plan, for example, the USSR planned to replace 20 percent of its 1 January 1956 inventory. 54/ This high rate of replacement would have involved approximately 73,000*** machines, an amount equal to more than 3-1/2 years of production at the 1955 rate. In this regard it is important to remember that only a portion of the production for each year probably will serve as replacements -- presuming that the product mix is altered in a satisfactory manner.

If this replacement program is still applicable, the USSR will have considerable difficulty implementing the program and eliminating the industrial bottleneck without purchases from other nations. Present purchases are restricted primarily to East Germany and Czechoslovakia, although the USSR would like to purchase from the West.****

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* See p. 17, above.

** For US wartime deliveries of metalforming machinery to the USSR, see Appendix E.

*** It is not clear that the term replacement as used by the USSR in this context means scrapping or removal of the machinery from the inventory. It is more likely that it refers to the replacement of machines of low productivity with new models in important plants, relegating the old machinery to repair shops or low-priority work.

**** For a list of types of metalforming machinery which the USSR would like to purchase from the UK, see Appendix F.

C. Production and Use of Heavy Presses.*

Production and use of heavy presses constitute special problems for the USSR because the USSR has had little experience in the construction of heavy presses. The largest presses known to have been built in the USSR -- none of which are forging presses -- are as follows:

1. A hydraulic bending press of 8,000 tons pressure, constructed at Ural'mash in 1954 and now installed at the Barnaul Boiler Plant. This press is very similar to the armor plate bending press of a leading US company which is built in sizes up to 8,000 short tons. During World War II the US shipped a 3,000-short-ton press of this type to the USSR. 55/

2. Two 5,000-ton hydraulic extrusion presses built at the Izhora Metallurgical Plant during 1956. 56/

3. A 9,600-ton hydraulic rubber-pad forming press assembled and tested at the Kolomna Heavy Machine Tool Plant in May 1956. 57/

4. A 12,000-ton hydraulic pipe-forming press under assembly at the Kolomna Heavy Machine Tool Plant in early 1956 and destined for the Chelyabinsk Pipe Rolling Plant along with two ancillary presses of smaller size. 58/

Notwithstanding the Soviet lack of experience, production of a 30,000-ton hydraulic press in the USSR was revealed in two newspaper articles in January 1956. The Ural Heavy Machine Building Plant imeni Ordzhonikidze (Ural'mash) in Sverdlovsk is responsible for the over-all supervision of the project with the assistance of the Novo-Kramatorsk Plant imeni Stalin. In late 1955, Novo-Kramatorsk completed a 220-ton casting for the press, 59/ and other plants such as the Zhdanov Metallurgical Plant imeni Il'ich are assisting in the fabrication and welding of parts. A newspaper report of January 1957 stated that Ural'mash had completed making the parts for the press, but no mention was made of the site of erection or the progress of installation. 60/

This press appears to be the first of a number of large presses planned for the USSR. Shortly after the publication of the initial references the Soviet government reported that the designers of

* The Soviet definition of the term heavy presses is not known, but the term as here defined includes hydraulic forging presses of 10,000 or more tons and extrusion presses of 5,000 or more tons.

Ural'mash, Novo-Kramatorsk, and TsNIITMASh had completed the technical plans and most of the working drawings for hydraulic presses with pressures of "tens of thousands of tons," 61/ and 1957 reports have discussed a "12,000-ton horizontal press," presumably an extrusion press, that is under construction. 62/

In the past, reports have stated that Ural'mash was producing presses "up to" 10,000 tons.* [redacted] the plant produces presses "up to" 70,000 tons, 63/ even though there is no evidence of any press larger than 30,000 tons under construction. [redacted] the new Syzran' plant will produce hydraulic presses with pressures "up to" 100,000 tons and extrusion presses with pressures "up to" 20,000 tons. 64/ 50X1 50X1

It is probable that the building of accumulators, pumps, valves, and hydraulic lines will be undertaken at the Tyazhstankogidropress Plant in Novosibirsk, the Slavgorod Plant imeni Eighth Anniversary of the October Revolution, the Khar'kov Hydraulic Equipment Plant, and similar establishments already producing such items for smaller presses. In view of the difficulties in coordination experienced in the past, however, it is probable that Ural'mash and Novo-Kramatorsk also will build these necessary items.

Heavy hydraulic presses, such as the one of 30,000 tons being built and to be erected by Ural'mash, are used primarily for the production of aircraft parts including support beams, wing spars, wing caps, and the like. The increased strength imparted to these large pieces by forging as against machining or machining and fastening is a valuable asset in high-speed aircraft.**

* The peculiar use of the term up to (do in Russian) apparently describes the upper limit in the size of presses for which the plant will be held responsible in the foreseeable future and therefore serves as a possible indication of intentions.

** Although there is a clear advantage in strength gained by forging of parts, the economics of the use of heavy hydraulic forging presses compared with the production of the same parts by machining has not yet been adequately determined. Theoretically, given long production runs, the use of heavy hydraulic forging presses for light metal forming should save metal and speed up production by eliminating construction of bits and pieces. Although there has been some discussion of the use of heavy hydraulic forging presses for the forging of locomotive, ship, and motor vehicle parts in addition to aircraft parts, it is obvious that the items forged would not utilize the full capacity of the presses in many cases or that the production runs would be too short (or changes in design too frequent) to warrant the high overhead cost of the press and its /footnote continued on p. 27/

Heavy extrusion presses also are used for production of aircraft components, generally producing parts of a more symmetrical shape than those produced on heavy forging presses -- for example, integrally stiffened wing panels. Although there is some duplication in the parts that can be produced by either forging or extrusion presses, extrusion presses are of particular importance for production of jet aircraft and are being used in US production of missiles. According to a report of the US Air Force,

> "Sections with desirable metallurgical properties can be extruded simply and rapidly on single or multiple extrusion dies. Also, dies for extruding sections are simpler and less expensive than forging dies. The possible potential, therefore, for application to jet engine production, particularly for axial-flow engines, is of considerable importance. Extruded stock can be subsequently forged or machined into compressor blades and gears. Moreover, shroud rings, channel rings, sealer and spacer rings (multiple quantities of which are required in axial-flow engines) can be extruded as straight sections and then formed into circular sections by rolling or welding. The possibility also exists for extruding hollow compressor and turbine shafts and extruding billets which are later forged into compressor disks." 65/

As the speed of aircraft increases, more use probably will be made of titanium alloys and stainless steel to avoid or minimize the effects of thermal fatigue. Heavy forging and extrusion presses, now working light metals, will be used for steel and titanium forgings and for steel extrusions. Some problems will be encountered in any such changeover. For example, even the hot extrusion of steel by means of the Ugine-Sejournet process, a method designed to reduce friction,* involves considerable costly die erosion. In addition, a considerable amount of research and experimentation must be done on the forging of some titanium alloys before extensive use of such alloys can become operationally feasible. 66/

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supporting equipment plus the cost of the dies. Many of the parts for motor vehicles, in particular, can be and are being forged on smaller mechanical and hydraulic forging presses.

* The Ugine-Sejournet process uses glass lubricants to reduce friction and erosion.

Although it is impossible to estimate the capacity of a country to produce modern aircraft by the number and size of its heavy forging and extrusion presses, the existence of such facilities implies an advanced technology. In addition, the construction of new heavy presses in the USSR, together with discussions in technical magazines and newspapers, probably indicates the intentions of the USSR to alter its methods of aircraft production toward greater use of forging and extrusion techniques rather than to continue the older fabricating methods presently employed.

Except for two 5,000-ton extrusion presses for Communist China, the USSR has not completed the construction and erection of any known heavy forging and extrusion presses, although at least 1 and possibly 2 are currently being produced and erected. Considerable experience, however, has been gained in the erection and operation of the heavy presses removed from Germany in the immediate post-World War II period. The heavy presses removed from Germany are included in Table 6.*

Along with the heavy presses removed from Germany, numerous other smaller presses were removed from German light metal fabricating plants together with many furnaces, straightening machines, pumps, accumulators, electrolytic baths, and other ancillary equipment. A large part of the equipment taken from the I.G. Farben Plant at Bitterfeld was erected at Plant No. 268, an aircraft parts plant at Kamensk-Ural'skiy in the Urals constructed in the early 1940's and equipped primarily with US-built metalforming machines.

The erection of the 30,000- and the 15,000-ton forging presses taken from Germany was completed in April-May 1951, and tests began immediately. Because aircraft design must be tailored to the use of heavy forging presses, some design lag probably occurred. If design changes were made immediately, the two presses probably could not have been utilized generally on a full-time basis until late 1952 or early 1953.** Because of a lack of parts and of instructions, the 12,000-ton extrusion press had not been operated in late 1953. The 5,000-ton extrusion press at Kamensk-Ural'skiy, together with some smaller ones, was used primarily to "rough out" billets for the forging presses.

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* Table 6 follows on p. 29.

** All evidence concerning the "Bitterfeld" presses indicates that they are used currently in the production of aircraft components. However, Soviet-built aircraft now in Western hands -- 1953 models or older -- show no extensive use of heavy forging and extrusion techniques.

Table 6

Known Heavy Presses in the USSR a/

Press Type and Size	Location	Manufacturer and National Origin	Comments
Forging presses			
30,000 metric tons	Plant No. 268, Kamensk-Ural'skiy	Schloemann, Germany	Post-World War II removal
15,000 metric tons	Plant No. 268, Kamensk-Ural'skiy	Schloemann, Germany	Post-World War II removal
15,000 metric tons	Unknown	Schloemann, Germany	Delivered to Kramatorsk in 1936 Present location unknown
12,000 metric tons	Kirov Heavy Machine Building Plant, Leningrad	Davy and United Engineering Company, Ltd., UK	Delivered in 1939
12,000 metric tons	Izhora Metallurgical Plant, Leningrad	Unknown	Installed during 1956. Origin could be Czechoslovakia, where presses of this size are in production
10,000 metric tons	Ural Heavy Machine Building Plant, Sverdlovsk	Hydraulic-Duisburg GmbH., Germany	Delivered in 1934
10,000 metric tons	Ural Heavy Machine Building Plant, Sverdlovsk	Hydraulic-Duisburg GmbH., Germany	Delivered in 1934
10,000 short tons	Plant No. 268, Kamensk-Ural'skiy	US built	
10,000 short tons	Leningrad	US built	
Extrusion presses b/			
12,000 metric tons	Plant No. 268, Kamensk-Ural'skiy	Schloemann, Germany	Post-World War II removal
5,000 metric tons	Plant No. 268, Kamensk-Ural'skiy	Eumuco, Germany	Post-World War II removal
5,000 metric tons	Unknown	Hydraulic-Duisburg GmbH., Germany	Purchased by Mashinoimport during post-World War II period
5,000 short tons	Unknown	US built	Shipped in 1939 Perhaps the press now located at Plant No. 26, Ufa

a. 67/
b. In addition to the extrusion presses listed below, there were three 5,000-metric-ton extrusion presses installed at Durener Metallwerke AG, at Waren in Mecklenburg (former location of the 12,000-metric-ton extrusion press), about which no information is available.

In addition to the presses installed at Kamensk-Ural'skiy, other German presses were set up in light metal fabricating plants in Kazan' and Kiev. Numerous mistakes were made in erecting, testing, and operating the presses, and the effect of these mistakes, together with designing errors, resulted in the breaking of columns, cylinders, and cylinder casings, causing excessive "down time." In the case of the 15,000-ton Schloemann press at Plant No. 268, a cracked cylinder casing reduced the pressure of the press to 5,000 to 7,500 tons. No precision die forging was attempted as late as 1953, as the USSR apparently emphasized large tolerances to insure rapid production with a low reject rate and preferred to machine off the surplus.

It is apparent from Table 6* that most of the heavy presses installed in the USSR are of US and German manufacture. No complete list of Soviet heavy presses, however, can be compiled at this time.

For purposes of comparison, the presses constructed under the US Air Force Heavy Press Program during 1951-57 are listed in Table 8.** Included under the US Air Force Heavy Press Program were two 50,000-short-ton and two 35,000-short-ton forging presses and six extrusion presses of from 8,000 to 14,000 short tons. The last of these was undergoing tests in mid-1957. These presses are in addition to the 18,000-short-ton Mesta forging press at North Grafton, Massachusetts; two 15,000-ton Schloemann forging presses taken from Germany and located at Alcoa's Cleveland Plant and the US Air Force Plant at Adrian, Michigan, respectively; and two 14,000-short-ton forging presses at the US Navy Yard, Charleston.*** Some of these are used for steel rather than light metal forging. 68/

In addition to beginning the production of forging and extrusion presses, the USSR has consistently sought to import large metalforming machines, presently under embargo, from the UK, the US, and other Western nations. The extent of the desire of the USSR to import metalforming machinery from the UK is indicated by a recent list of possible Soviet orders for 456 large and critical metalforming machines to be obtained during 1956-60 "under proper conditions for normalizing Soviet-British trade."**** 69/

Although the list probably is overstated as part of the continued attempt to disrupt US-UK relations, analysis of Soviet production indicates that the list represents, at least in part, real

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* P. 29, above.

** See Appendix G, p. 51, below.

*** These presses are not intended to represent a complete inventory when taken with those listed in Table 8 but rather to indicate the existence of large presses other than those built under US Air Force auspices in the 1950's.

**** For a list of types of metalforming machinery which the USSR would like to purchase from the UK, see Appendix F.

and important Soviet requirements. As noted above, the USSR has only recently begun to produce many heavy machine types, and some items on the list (such as impact hammers, 10- to 15-ton rail-type manipulators, and 15,000- to 25,000-ton extrusion presses) have never been produced in the USSR.

In summary, although the USSR has had little experience in the construction of large presses, the Soviet leaders have begun a program to build heavy presses, including a 30,000-ton press currently under construction and erection. The experience gained in assembling, testing, and operating the Bitterfeld presses probably proved valuable to the USSR in the design and construction of the 30,000-ton press and in the design, construction, and erection of other heavy presses. The errors made in the erection and operation of these presses probably will not be repeated. In addition, Soviet technical publications have followed very closely the US program for building heavy presses. The 220-ton casting completed at Novo-Kramatorsk confirms the existence of casting capacity capable of producing the cast parts necessary for large presses, and it is known that the USSR has produced large milling machines and other large machine tools for the necessary machining operations. Any necessary large forgings can be produced on existing presses. Given time to work out the problems of valving, control, lubrication, and the like, the USSR can erect the 30,000-ton press and build a number of heavy presses. In addition, the USSR would like to purchase heavy presses from advanced Western nations such as the US, the UK, and West Germany.

The construction and attempted imports of heavy forging and extrusion presses probably reflect a move toward greater use of forging and extrusion techniques in aircraft production to replace the older methods of fabrication. This move is in line with the growing appreciation of the benefits of metalforming techniques in the USSR and with the attempt to use the most advanced of these techniques available throughout Soviet industry.

D. Fulfillment of the Original Sixth Five Year Plan.

Fulfillment of the original Sixth Five Year Plan (1956-60) posed still another problem for the USSR. The 1960 goals, as stated previously, called for increased unit production (25,800 units of metalforming machinery to be produced in 1960 at plants formerly controlled by all-union and union-republic ministries), improvements in the product mix and increases in the range of type-sizes produced, and elimination of the forging shop bottleneck by replacement of old, low productive types with new equipment. To accomplish these tasks, construction of 4 primary metalforming machinery producing plants,

already in partial production, was to be completed, and 7 plants were to be built during the period of the original Sixth Five Year Plan. Of these plants, one was to be built in Syzran' and the others were to be built in Siberia and the Urals. The building of a new research institute at Voronezh and the establishment of new centralized forging shops also were designed to aid in the fulfillment of Soviet plans for production and use of metalforming machinery.

Although centrally controlled production probably can be increased from 13,900 units (1955) to 17,000 to 18,000 units without extensive investment in new plants and equipment, success or failure in reaching the original 1960 goal probably will depend on the progress of new plant construction and operation. Difficulties in coordination and specialization of production, which existed under the old ministerial framework, probably will continue to exist under the new organizational system and will continue to affect adversely the number and types of machines produced. It is felt, however, that the fulfillment of the original 1960 plan both in unit production and in product mix will depend on the building of new plants and on the development of new types of metalforming machines at ENIIKMASh, TsNIITMASh, and the various design bureaus.

Soviet production of metalforming machinery in 1955 admittedly failed to meet the needs of the Soviet economy 70/ according to all available information on Soviet unit production and product mix. If plans for unit production and product mix are fulfilled, it is probable that the requirements of the Soviet defense and heavy industries will be met adequately from domestic production as a result of the priorities granted to these industries. These industries will therefore accomplish a degree of inventory modernization and replacement by 1960. The total inventory in 1960, however, probably will still contain much low productive machinery and/or machinery of diverse origins, especially in light industry, local industry, and other low priority branches of the economy.

APPENDIX A

DEFINITIONS

1. Metalforming Machinery.

The Russian term kuznechno-pressovyye mashiny, literally translated as "forge-press machines" or "forging and pressing machines," has been translated here as "metalforming machinery." As a statistical classification used by the USSR, this category is narrower than its US statistical counterpart, the Metalworking Machinery (Except Machine Tools) Group -- Standard Industrial Classification, No. 3542. 71/ Although the Soviet category includes hot and cold forging machines, mechanical and hydraulic presses, straightening and bending machines, punching and shearing machines, and riveting machines, 72/ it excludes the rolling mill equipment, wire-drawing machines, die-casting machines, and acetylene welding and cutting apparatus included in the US classification.* In publishing production statistics, the USSR excludes hand-powered equipment, unlike the US, which collects and publishes statistics on both hand- and power-driven machines.

2. Major Types of Metalforming Machinery.

The following definitions describe major types of metalforming machines. Photographs of selected Soviet models are shown in Figures 4 through 11.** 73/

a. Straightening and Bending Machines.

Mechanically or hydraulically driven machines used for bending sheets, plates, bars, pipes, tubes, and other metal forms, including the following types: sheet and plate bending rolls; vertical and horizontal bending rolls for angles, bars, and shapes; bending brakes and folders; straightening machines; rotary bending and forming machines; pipe, tube, and bar bending machines; and miscellaneous types.

b. Forging Machines.

Machines designed for the forging of metal under pressure (except hydraulic and mechanical forging presses), including the following types:

* In the USSR this equipment presumably is classified as metallurgical equipment, foundry equipment, or miscellaneous equipment.
** Following p. 34.

steam, air, gravity-drop, spring, and helve hammers; hot and cold forging machines; forging rolls; swaging machines; and miscellaneous types.

c. Hydraulic Presses.

Machines which perform some forcing, forging, or pressing operation by means of power transmitted through confined fluid under pressure, including the following types: vertical and horizontal presses, multidie slide and die spotting presses, forging presses, and miscellaneous types.

d. Mechanical Presses.

Machines which perform some forcing, forging, or pressing operation through power transmitted by mechanical means, including the following types: presses for punching, blanking, forming, and embossing with straight-sided, arch, gap, or C-frame; horning presses; forging presses; bulldozers; and miscellaneous types.

e. Punching and Shearing Machines.

Machines utilizing pressure for punching, perforating, or shearing actions, including the following types: punching machines; plate, sheet bar, angle, and alligator shears; nibbling machines; combination punching, shearing, and copying machines; and miscellaneous types.

f. Riveting Machines.

Machines used for rivet setting, except hand-held, portable types.

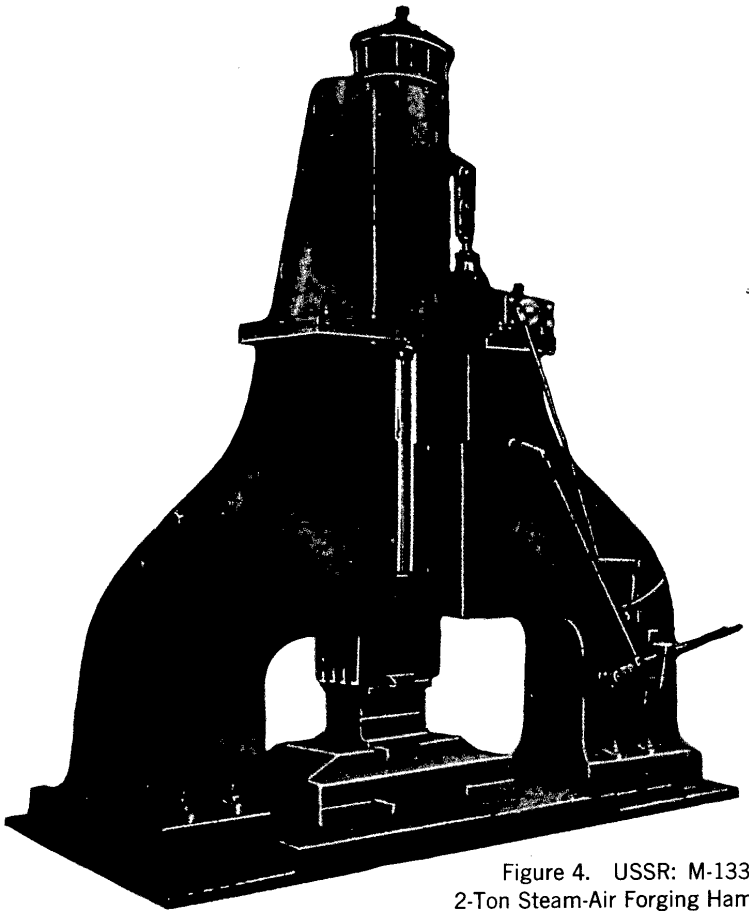

Figure 4. USSR: M-133
2-Ton Steam-Air Forging Hammer.

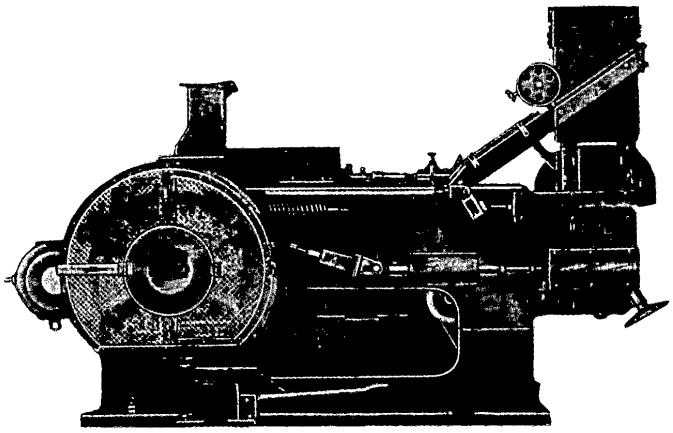

Figure 5. USSR: A-231
Automatic Bolthead Trimming Machine.

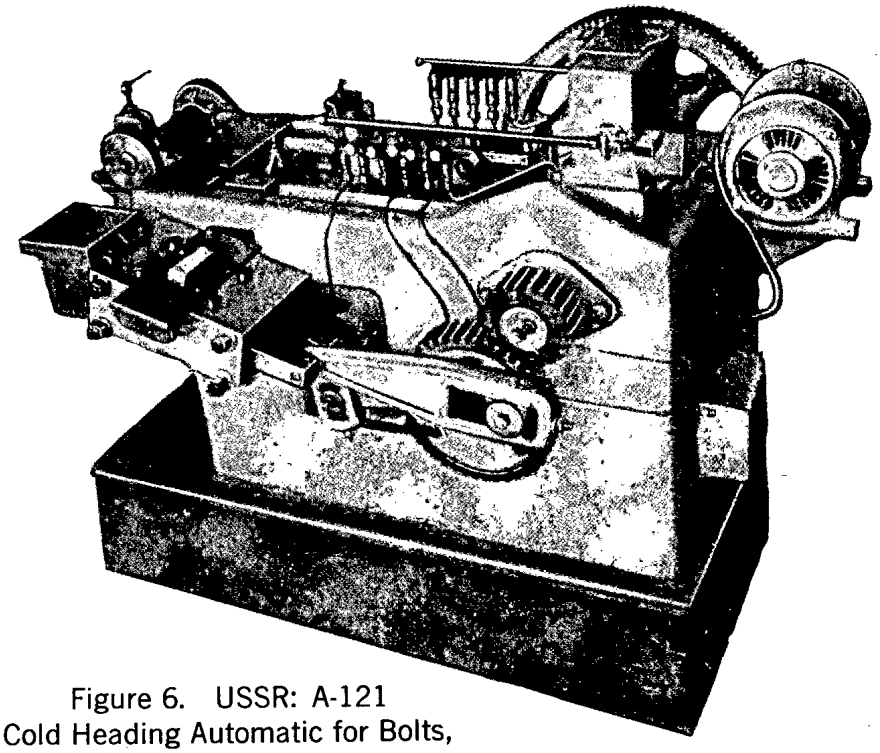

Figure 6. USSR: A-121
Cold Heading Automatic for Bolts,
Screws, and the Like.

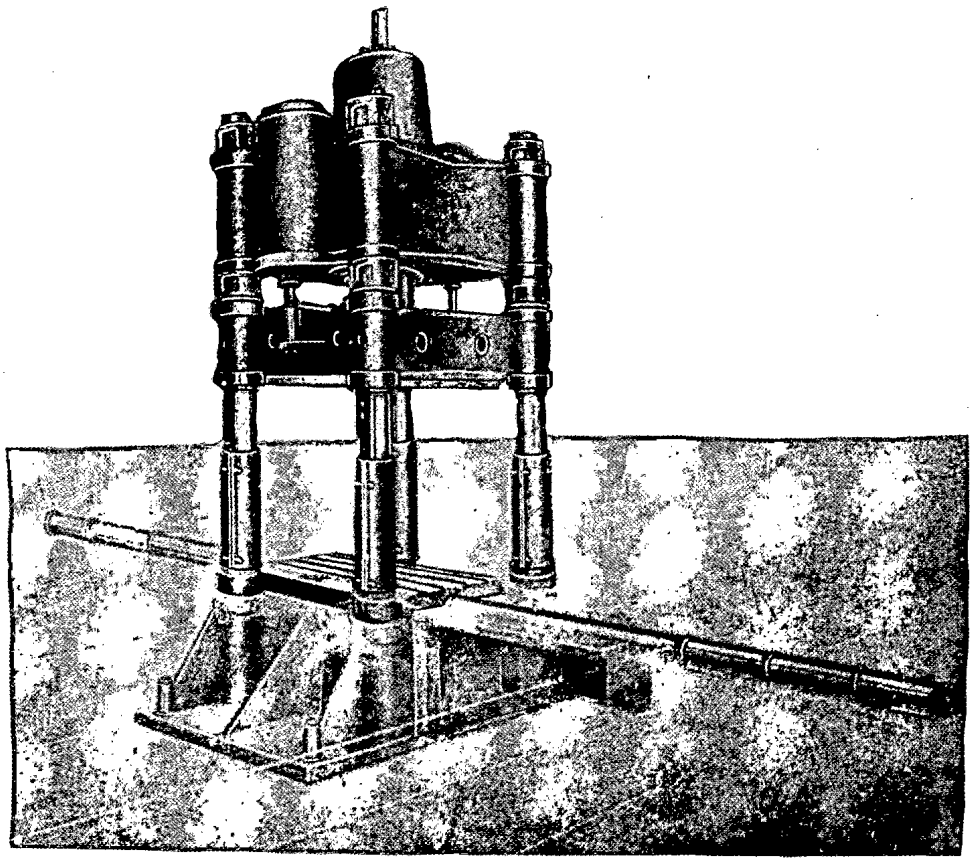

Figure 7. USSR: P-142 800-Ton 4-Column Steam-Hydraulic Forging Press.

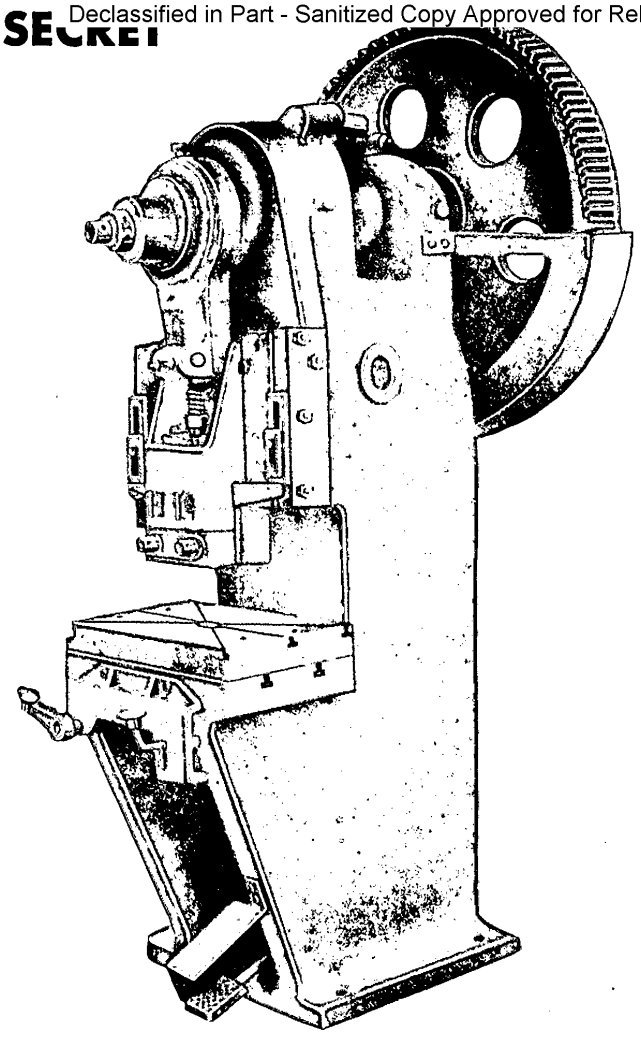

Figure 8. USSR: K-115 50-Ton Gap-Frame Crank Press.

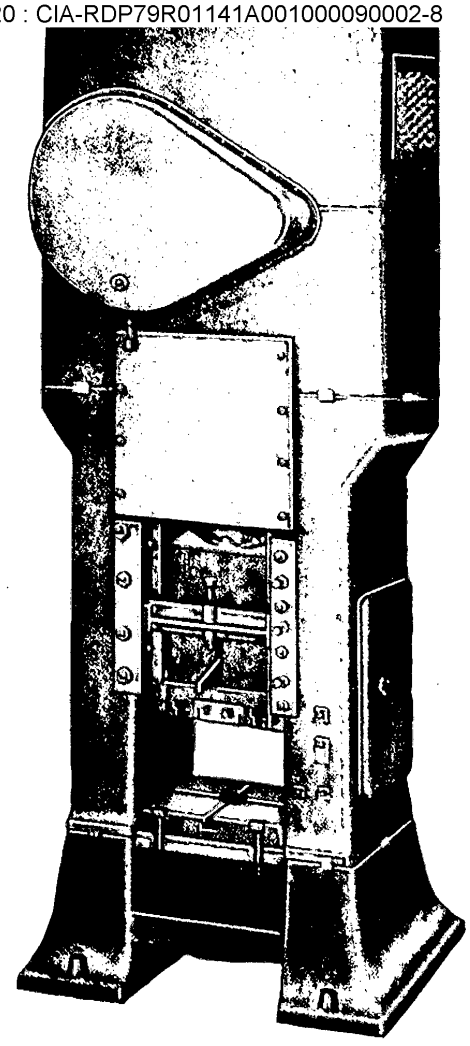

Figure 9. USSR: K-273 200-Ton Straight-Sided Crank Press.

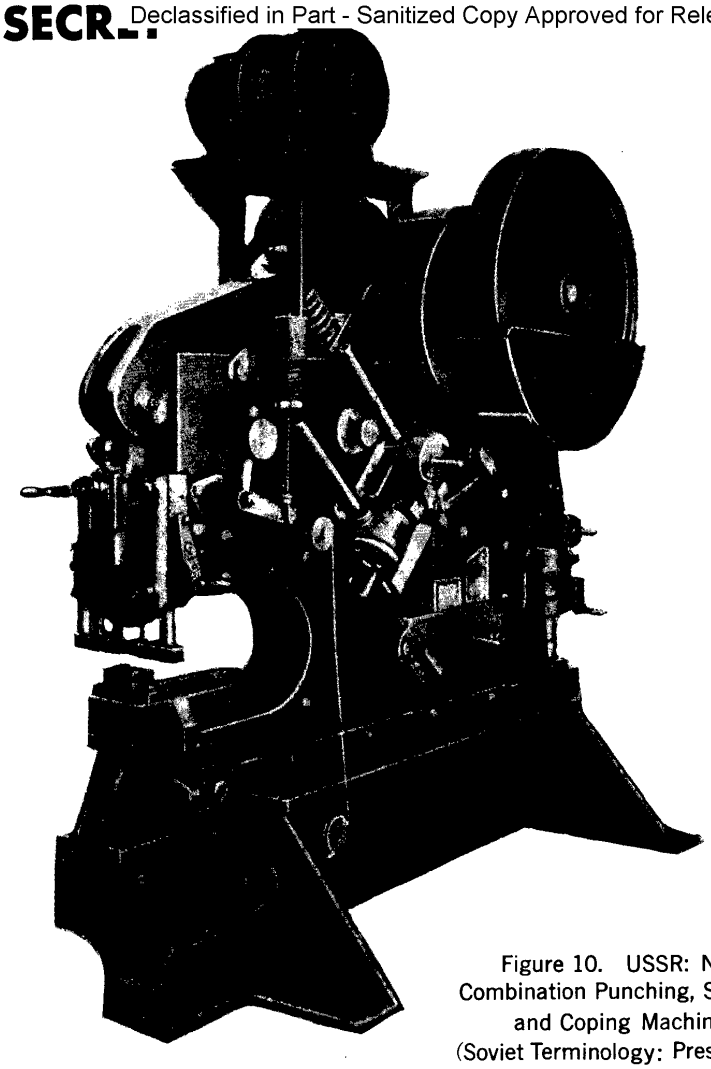

Figure 10. USSR: N-633
Combination Punching, Shearing,
and Coping Machine.
(Soviet Terminology: Press-shear)

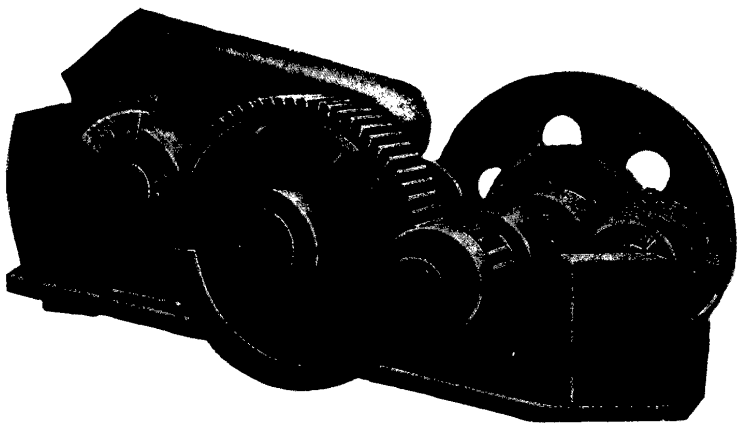

Figure 11. USSR: N-313
50-Millimeter Alligator Shear.

APPENDIX B

PRINCIPAL AND MAJOR SECONDARY METALFORMING MACHINERY PLANTS IN THE USSR AND THEIR PRIMARY PRODUCTS a/*

* Footnotes for this appendix follow on p. 39.

Table 7

Plants	Location	Region b/	Primary Products	First Year of Production of Metalforming Machinery
Principal plants				
Azov Press and Forging Equipment Plant	Azov	IV	Hydraulic press production begun. c/	Still under construction. Began production in 1956.
Barnaul Mechanical Press Plant	Barnaul	IX	Mechanical crank presses of various sizes up to 800 metric tons (mt) in hot and cold stamping, deep drawing, and forging. Automatic multiposition stamping presses. d/	1943-44
Chimkent Press and Automatic Plant imeni Kalinin	Chimkent	Xa	Cold headers, friction presses, gap frame crank presses up to 100 mt, and alligator and combination shears. To produce V-112 and V-113 horizontal forging machines. e/	Approximately 1944. Being expanded in 1956.
Chkalov Hydraulic Press Plant "Metallist"	Chkalov	VIII	Universal hydraulic presses and pumps. f/	1943-44
Dnepropetrovsk Medium Hydraulic and Heavy Mechanical Press Plant	Dnepropetrovsk	III	Platen presses. To produce universal crank presses and hydraulic presses. g/	Still under construction. Began production in 1955.
Odessa Press Plant	Odessa	III	Hydraulic presses for briqueting and bending. Mechanical presses for deep drawing and automatic bolt headers. h/	1953
Odessa Forge and Press Equipment Plant imeni 16th Party Congress	Odessa	III	Cold headers. i/	1934
Ryazan' Heavy Forge and Press Equipment Plant	Ryazan'	VII	Has produced a few cold headers. To produce horizontal forging machines and pumps as well as hydraulic and mechanical presses. j/	Still under construction. Began production in 1956.
Serpukhov Forge and Press Equipment Plant imeni 8th Anniversary of the October Revolution	Serpukhov	VII	Cold headers, multipunch machines, and small hydraulic presses. k/	1940

Table 7
(Continued)

Plants	Location	Region b/	Primary Products	First Year of Production of Metalforming Machinery
Principal plants (Continued)				
Slavgorod Mechanical Press Plant imeni 8th Anniversary of the October Revolution	Slavgorod	IX	Small inclinable presses, small vertical forging machines (V-311), pumps, M-611 30-kilogram spring hammer. l/	1943-44
Syzran' Heavy Forge and Press Equipment Plant	Syzran'	VI	Plant will produce hydraulic stamping (probably forging) presses up to 100,000 mt, extrusion presses up to 20,000 mt, steam-air hammers, and other large mechanisms. m/	Preparations for construction under way.
Taganrog Forge and Press Equipment Plant "Metallist"	Taganrog	IV	Swaging machines and gap frame presses. n/	1934
Taganrog Forge and Press Equipment Plant "Vpered"	Taganrog	IV	Plate, guillotine, lever, and other types of shears including nibbling machines and a 10-mt double-sided inclinable press (1950). o/	Probably in early 1940's.
Voronezh Heavy Mechanical Press Plant	Voronezh	VII	To build mechanical forging and stamping presses of 630, 1,000, 1,600, 2,000 and 4,000 mt and coining presses of 1,250, 1,600 and 2,500 mt pressure. p/	Still under construction. Began production in 1953-54.
Voronezh Forge and Press Equipment Plant imeni Kalinin	Voronezh	VII	Pneumatic and steam-pneumatic hammers, straight-sided crank presses, hydraulic bending and straightening presses, hydraulic cold extrusion presses, and other products. q/	1934
Secondary plants				
Gor'kiy Milling Machine Plant	Gor'kiy	VII	Machine tools. Also produces A-166, A-413, and A-415 nut and bolt heading machines. r/	1951
Kolomna Heavy Machine Tool Plant	Kolomna	VII	Heavy machine tools. Also produces hydraulic presses, both universal and special types, including pipe forming presses from 2,000 to 12,000 mt, 2,000-mt extrusion presses, and a 9,600-mt rubber pad forming press (1955-56). s/	N.A.

Table 7
(Continued)

Plants	Location	Region b/	Primary Products	First Year of Production of Metalforming Machinery
Secondary plants (Continued)				
Minsk "Automatic Line Plant"	Minsk	II	Will produce automatic lines, including hydraulic presses for stamping and straightening intermediate parts. t/	Under construction.
Novosibirsk Heavy Machine Tool and Hydraulic Press Plant imeni Yefremov	Novosibirsk	IX	Heavy machine tools and universal and special hydraulic presses, including forging and extrusion presses and pumps and accumulators. u/	1941-43. Being expanded.
Novosibirsk Machine Tool Building Plant imeni 16th Party Congress	Novosibirsk	IX	Machine tools. Also produces the A-453, a cold header. v/	Before 1949.
Ryazan' Heavy Machine Tool Plant	Ryazan'	VII	Heavy machine tools. Also built hydraulic strength testing presses of 150 mt. w/	1954
Irkutsk Heavy Machine Building Plant imeni Kuybyshev	Irkutsk	XI	Drawing machines and metallurgical equipment. Also to produce presses in the next 5 years. x/	1956-60
Novo-Kramatorsk Heavy Machine Building Plant	Kramatorsk	III	Metallurgical equipment, vertical and horizontal forging machines, large ingot shears, straightening machines, and embossing presses. y/	N.A.
Staro-Kramatorsk Heavy Machine Building Plant	Kramatorsk	III	Metallurgical equipment, cranes, large ingot shears, straightening and bending machines, forging rolls, small stamping presses, and 3- and 5-mt steam-air hammers in the late 1940's. z/	Prerevolution
Ural Heavy Machine Building Plant imeni Ordzhonikidze	Sverdlovsk	XIII	Metallurgical equipment, walking excavators, heavy petroleum drilling equipment and similar items. Also produces hydraulic presses of large sizes. To produce rubber pad forming presses. aa/	N.A. Under expansion.

Table 7
(Continued)

Plants	Location	Region [b]	Primary Products	First Year of Production of Metalforming Machinery
Secondary plants (Continued)				
Izhora Metallurgical Plant imeni Zhdanov	Kolpino (near Leningrad)	I	Steel and various types of equipment including hydraulic presses. bb/	First reference, 1934. Next references, 1956.
Dnepropetrovsk Metallurgical Equipment Plant	Dnepropetrovsk	III	Metallurgical equipment, alligator shears, and fagoting presses. cc/	First reference, 1955
Moscow Motor Vehicle Plant imeni Likhachev (formerly Plant imeni Stalin)	Moscow	VII	Motor vehicles, including trucks and passenger cars. Also produces stamping presses. dd/	1950-53
Leningrad Construction Machinery Plant	Leningrad	I	Cement unloaders, other construction machinery, and bending machines and shears. ee/	N.A.
Slavyansk Construction Machinery Plant	Slavyansk	III	Construction machinery, including bending machines. ff/	N.A.
Kusa Construction Machinery Plant	Kusa	VIII	Construction machinery, including bending machines. gg/	N.A.
Stryy Machine Building Plant imeni Kirov	Stryy	III	Small mechanical presses. hh/	1945-48 (known)
Kishinev Machinery Plant imeni Kotovskiy	Kishinev	III	Pneumatic hammers, ball mills, stone cutting machines, spare parts for tractors, and agricultural machinery. ii/	Late 1940's. Under expansion.
L'vov Power Press Plant	L'vov	III	Guillotine shears and small mechanical presses. jj/	First reference, 1951
Kuybyshevka-Vostochnaya Motor Repair Plant	Kuybyshevka	XII	Pneumatic hammers, fuel tanks, car and tractor motors, and various agricultural machines. To build small mechanical presses in 1957. kk/	1950

a. Although this list is not exhaustive of secondary plants which have produced metalforming machinery from time to time, the more important secondary plants have been included.

b. The term region refers to the economic regions defined and numbered on CIA Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.

c. 74/
d. 75/
e. 76/
f. 77/
g. 78/
h. 79/
i. 80/
j. 81/
k. 82/
l. 83/
m. 84/
n. 85/
o. 86/
p. 87/
q. 88/
r. 89/
s. 90/
t. 91/
u. 92/
v. 93/
w. 94/
x. 95/
y. 96/
z. 97/
aa. 98/
bb. 99/
cc. 100/
dd. 101/
ee. 102/
ff. 103/
gg. 104/
hh. 105/
ii. 106/
jj. 107/
kk. 108/

APPENDIX C

SUMMARY OF "RAID" ARTICLES*

The Soviet Promyshlenno-ekonomicheskaya gazeta (Industrial Economic Newspaper), acting as the official organ of Gostekhnika, sent its correspondents to "raid" various plants of the Ministry of Machine Tool Building and Tool Industry that made metalforming machinery. The reports of this team concerning the unsatisfactory situation at these plants were published in a series of newspaper articles from 16 May to 27 July 1956. In retrospect, this campaign of pressure or persuasion by an agency of the Council of Ministers, USSR, was an interesting and informative prelude to the reorganization of industry and the abolition of the machine building ministries, including the Ministry of Machine Tool Building and Tool Industry.

The following excerpts provide examples of the conditions which have existed at these plants and highlight the major areas of difficulty.

These areas are as follows:

1. Inadequate or sporadic deliveries of raw materials and semifinished products and lack of coordination between plants and between ministries.

> "The Novosibirsk Tyazhstankogidropress Plant ... regularly fails to deliver forgings and castings to the /Barnaul Mechanical Press/ plant, but the main administration and ministry take no action to rectify the situation."
>
> "It took the Novosibirsk Tyazhstankogidropress Plant 1-1/2 years to fulfill the order for casting the /press/ frames /for the Chimkent Press and Automatics Plant/."

* [redacted] The deplorable situations outlined in this appendix should be regarded as the worst conditions rather than typical or average conditions in plants making metalforming machinery. Nevertheless, the existence of such conditions in a number of large metalforming machinery plants emphasizes the inertia of the Ministry of Machine Tool Building and Tool Industry in the production of metalforming machinery. 50X1

"The Sverdlovsk Industrial Rubber Products Plant of the Ministry of Chemical Industry was supposed to supply five rubber cushions /to the Kolomna Heavy Machine Tool Plant/ for P 307 presses in 1955 but has not produced a single one to this day. In 1956 it was given the /task/ of producing 11 more cushions, but only 3 have arrived at Kolomna /by 15 July 1956/, and even these turned out to be useless."

2. Poor production planning and managerial inertia.

"The 1956 plan, which called for the /Voronezh Kalinin/ plant to turn out over 1,200 machines of various types, ... was based on the utilization of production facilities which are not yet completed."

"Although the /Kolomna Heavy Machine Tool/ plant had received a preliminary plan for 1956 during the middle of /1955/ and had begun preparations, this plan was almost completely changed the following December."

"Although the foundry is the worst bottleneck at the /Voronezh Kalinin/ plant, the plant management turns a deaf ear to requests for needed equipment which would improve the operation not only of the foundry, but also of the plant as a whole."

3. Technical problems (such as inadequate utilization of facilities, design difficulties, and a low level of technology).

"The equipment for production of the K 117 press /at the Dnepropetrovsk plant/ was completed much later than scheduled, and then it was of such poor quality that 70 tools and devices had to be made again."

"The /Barnaul/ plant's low level of technology is another factor hindering the plan fulfillment. Gears, which, by the way, are not heat treated, are set on shafts in the following manner: the unit (shaft and gear) is suspended on ropes, set into a swinging motion, and beat against a heavy object. Bronze inserts are pressed into large gears by dropping a 5-ton

platform onto the part from a height of several meters. Can there by any question as to the quality of such production?"

"Chernyak /a designer/ went and determined that it is necessary to make 56 essential design changes in /the/ presses."

"It is enough to say that, in the first quarter of 1956 alone, the down time of equipment /at the Barnaul Plant/ exceeded 120,000 machine tool hours."

"Owing to mistakes in the blueprints of the I 337 press, designed by engineers of /the Central Bureau of Press and Forging Machine Building/, the /Novosibirsk/ plant has lost over 100,000 rubles just in setting up the machine."

"In the first half of 1956 the /Chimkent/ plant's reject losses amounted to 700,000 rubles. The foundry reject rate for iron castings increased in this period 5.9 percent above the rate for the first half of 1955 ... . When the assembly shop was checking a completed A 124 machine, it discovered that 52 parts had to be made over and 80 parts required additional processing."

4. Incomplete or faulty construction.

"Although the /Voronezh Heavy Mechanical Presses/ plant is considered to be in operation and has a production program, it is still not a plant in the usual meaning of the word. The iron foundry, steel foundry, and press shop have not been completed, nor have the main building, rail siding, laboratories, and other facilities."

"When the shop /press shop at the Kolomna Heavy Machine Tool Plant/ was erected, the nature of the site was not studied ... subterranean waters are located under the shop. These waters ooze out in little depressions around the foundation of heavy machine tools ... . /In/ the past winter ... water froze in the shop ... bonfires had to be built ... . Spring brought little joy. Although it got warm in the shop, the

roof began to leak, and it was necessary to build canopies and drapes over the unit-type machine tools. To this ... day the construction of skylights has not been completed in the shop. Although the proper document concerning this and other problems was drawn up, ... the situation remains unchanged."

APPENDIX D

METHODOLOGY FOR ANNUAL PRODUCTION OF METALFORMING MACHINERY IN THE USSR 1932-56

Soviet production of metalforming machinery for the years 1932, 1937, 1940, 1945, and 1950-55 was reported in Industry, USSR, A Statistical Handbook. 110/ In addition, a Soviet newspaper reported that 6,000 units were produced during World War II. 111/ This wartime production was distributed by year, based on known Soviet plants and the extent of German penetration into the USSR.

Soviet annual production of metalforming machinery for the years 1933-36, 1938-39, and 1946-49 were estimated by linear interpolation. Production for 1956 was reported in The National Economy of the USSR, 1956. 112/

Additional information on Soviet production and planning was reported in The National Economy of the USSR, A Statistical Compilation, 113/ in two statistical series. One series included total annual production by years -- obviously the same series as that reported in Industry, USSR, A Statistical Handbook. The second, including the 1960 Plan figure, apparently referred only to production in plants under central planning and control -- that is, those plants which had been subordinate to all-union and union-republic ministries.

APPENDIX E

US WARTIME DELIVERIES OF METALFORMING MACHINERY TO THE USSR

Under both lend-lease and private sales, 1,715 units of metalforming machinery were shipped from the US to the USSR from the beginning of lend-lease through 31 January 1944, totaling $28,605,405.* Price per unit therefore averaged $16,680. Available evidence concerning requirements for deliveries after 1 July 1944 shows an average value of approximately $14,800. 113/ By dividing the various average values into the value figures (minus parts) as shown in Foreign Commerce and Navigation of the United States published by the Bureau of the Census, the following estimates were derived:

Year	Value of US Shipments of Metalforming Machinery to the USSR 114/ (US $)	Divided by (US $)	Estimated Number of Units Shipped**
1940	4,174,112	16,700	250
1941	1,462,127	16,700	100
1942	6,557,979	16,700	400
1943	24,886,727	16,700	1,500
1944	38,586,403	15,700	2,450
1945	10,053,227	14,800	700
1946	3,442,812	14,800	250
1947	3,950,041	14,800	250
1948	1,896,818	14,800	150
1949	25,270	14,800	Negligible
Total	95,035,516		6,050

Although there were some losses resulting from sinking or from some diversions to other destinations, these losses constituted only about 1.5 percent by value from 22 June 1941 to 20 September 1945. 115/ Because of the large amount of rounding involved in the estimating procedure, it is felt that no adjustment for these losses or diversions is necessary.

* These data were collected on a day-to-day basis and probably represent an underenumeration compared with the figures of the Bureau of the Census listed below. However, the average unit price is felt to be sufficiently representative for this type of analysis.
** Rounded to the nearest 50 units.

APPENDIX F

METALFORMING MACHINERY SOUGHT FOR PURCHASE IN THE UK BY THE USSR

The items which the USSR wished to purchase in the UK included the following metalforming machines and ancillary equipment as well as other industrial equipment and supplies:

Item	Number of Units
Mechanical maxipresses, capacity of 6,000 tons	30
Steam and air double-acting drop hammers, falling weight of 4,000 to 6,000 kilograms	50
Straight-sided mechanical presses, working capacity of 500 to 2,000 tons	70
Hydraulic presses for stamping plastics with top pressure of 200 tons and side pressure of 500 tons	10
Hydraulic forging presses, capacity of 3,000 to 15,000 tons complete with pump and accumulator station	10
Forging manipulators with rubber wheels, capacity of 1 to 10 tons	100
Forging manipulators on rails, capacity of 10 to 15 tons	20
Plate-straightening and section-straightening machines	16
Impact hammers, capacity of 100,000 kilogram-meters	5
Equipment for cold heading, trimming, and threading bolts of one-half inch diameter and over	70
Nut-forming machines	70
Extrusion presses, capacity of 15,000 to 25,000 tons	2
Steam or air drop hammers with falling weight of 15 tons	3
Total	456

APPENDIX G

HEAVY PRESSES CONSTRUCTED UNDER THE HEAVY PRESS PROGRAM OF THE US AIR FORCE a/
1951-57

Table 8

Type and Size of Press	Operator and Location	Builder
Forging Presses		
50,000 short tons	Wyman-Gordon, North Grafton, Mass.	Loewy Hydropress Co.
50,000 short tons	Alcoa, Cleveland, Ohio	Mesta Machine Co.
35,000 short tons	Wyman-Gordon, North Grafton, Mass.	Loewy Hydropress Co.
35,000 short tons	Alcoa, Cleveland, Ohio	United Engineering and Foundry Co.
25,000 short tons	(Completed parts stored as part of the Air Force Industrial Reserve Program)	E.W. Bliss Co.
Extrusion Presses b/		
14,000 metric tons	Alcoa, Lafayette, Ind. c/	Schloemann Engineering Co.
12,000 short tons	Curtiss Wright, Buffalo, N.Y.	Loewy Hydropress Co.
12,000 short tons	Harvey Aluminum Co., Torrance, Calif.	Lombard Corporation
8,000 short tons	Harvey Aluminum Co., Torrance, Calif.	Loewy Hydropress Co.
8,000 short tons	Kaiser Aluminum, Halethrope, Md.	Loewy Hydropress Co.
8,000 short tons	Kaiser Aluminum, Halethrope, Md.	Loewy Hydropress Co.

a. 116/
b. In addition, there is a 12,000-ton Hydraulic-Duisburg extrusion press located at the Dow Chemical Co., Madison, Illinois, which was funded differently from the presses under the program.
c. Alcoa is purchasing an additional 14,000-ton Schloemann extrusion press to be installed in 1958.

APPENDIX H

EXTENT OF REMOVALS OF METALFORMING MACHINERY FROM CONQUERED AREAS

Although it is impossible to ascertain the actual removals from Germany, Hungary, Rumania, Austria, Korea, and Manchuria, the following information indicates that removals were substantial -- perhaps as much as 80,000 to 100,000 units.

1. East Germany.

The US Strategic Bombing Survey reported metalworking machinery inventory figures for Germany from 1939 through 1944. 117/ The 1944 figure for all metalworking machinery equalled 2,266,000 units, of which 1,737,100 units were metalcutting machine tools and about 2 percent (45,300) combined special-purpose machines. After the machine tools and the combined special-purpose machines were subtracted from the total, the estimated 1944 inventory of metalforming machinery was computed to be 483,600 units.

Approximately 30 percent of the machine building industry in Germany was located in East Germany, 118/ and this percentage of the total was used to estimate the approximate number of metalforming machines located in East Germany.

This method was applied to the 1939 and the 1944 figures as follows:

1939	1,498,000 - (1,177,600 + 29,960) = 290,400 units (rounded)
	290,400 x 0.30 = 87,000 units (rounded)
1944	2,266,000 - (1,737,100 + 45,300) = 483,600 units (rounded)
	483,600 x 0.30 = 145,000 units (rounded)

No exact census or count of removals from East Germany has been made. Various persons, however, have estimated the total industrial capacity remaining in East Germany after dismantling. From one source, these estimates range from 95 percent to 5 percent in various industrial sectors, with heavy industry in 1945 estimated to be at approximately 35 percent of its 1938 capacity. 119/ In a 1951 book, J.P. Nettl estimated 1946 capacity in terms of that of 1936. 120/ Nettl's figures ranged from 10 to 80 percent of 1936 capacity by industry, averaging 40 to 50 percent.

On the assumption that the removals of metalforming machinery would be in somewhat the same proportion as that of reduction in industrial capacity and on the basis of a conservative figure of slightly more than 50 percent of the 1939 total, the East German inventory of metalforming machinery after the removals was estimated to be 45,000 units.

When 45,000 units were subtracted from 145,000 units (the 1944 inventory), estimated Soviet removals and war damage totaled 100,000 units. Although it is impossible to estimate the extent of war damage, general information concerning damage to metalworking machines in bombed plants published in the Strategic Bombing Survey indicates that these machines were relatively durable even under intense bombing. Of the total, therefore, war-destroyed machines probably were fewer than those removed to the USSR, and these removals from East Germany easily could have been in the range of 50,000 to 80,000 units.

2. Hungary, Rumania, and Austria.

There are numerous reports concerning dismantlings and removals of industrial equipment (including metalforming machines) from individual Hungarian, Rumanian, and Austrian plants, but totals are not available, and there is inadequate information on which to estimate the extent of these removals. If removals from these countries were in somewhat the same proportion as estimated removals from East Germany, however, total removals of 10,000 to 20,000 units would not be unlikely.

3. Manchuria and Korea.

It is reported that 14,500 units of metalworking machinery were removed to the USSR from Manchuria after World War II. No substantial removal of plant equipment was undertaken in Korea. 121/ Although the proportion of metalforming machinery to the total number of metalworking machines is not known, a figure of 20 percent, or approximately 3,000 units, would not appear to be unrealistic or exaggerated.

APPENDIX I

ESTIMATED VALUE OF SOVIET PRODUCTION OF METALFORMING MACHINERY

A preliminary estimate of the value of Soviet production of metalforming machinery was made possible by the acquisition of a 1955 price list 122/ and by the publication of more detailed information on production in the statistical handbook USSR Industry. 123/

The USSR has neither reported data on production of metalforming machinery in value terms nor published any clues as to the value of production, such as average value figures for total production or for various categories, the percent change in the average value over a period of time, and the like.

Given the prices of various Soviet models in the price lists, total value of production could be computed by multiplying the number of each model produced by its respective price. Available data, however, do not permit a breakdown of production by model, although unit production has been reported in major categories, such as hammers, presses, forging machines, shears, bending and straightening machines, and other metalforming machines, as shown in Table 2.* Because of the lack of data on production by model, numerous methods were used to estimate the mean price per unit in each major category. Among the methods tried was the use of implicit price weights based on the average price per ton of models in the various categories. Unfortunately, insufficient similarity existed between the prices per ton of the various models within and between categories, and there was insufficient information on the average weight of Soviet metalforming machines to provide satisfactory results from any method based on price per ton.

The method used in this estimate includes the following steps:

1. In each category, selection of a model which has a price believed to be representative of the average price of the machines produced in that category during 1955.

2. Multiplication of the selected mean price in each category by the number of units produced in each category in 1945 and in each year during 1950-55.

3. Summation of the estimated values of production of the various categories to obtain the total value of production for each year in

* See Table 2, p. 11, above.

1955 rubles and according to the estimated 1955 product mix.

Selection of representative hammers, presses, forging machines, and the like was made by assuming that the mean price in the various categories would approximate the median price of the models included in the 1955 price list in the smaller categories and would fall below the median model price in the larger categories. Because it is probable that the large and therefore expensive machines in each category are produced individually or in small series whereas the smaller machines are produced in far greater numbers, this assumption appears to be defensible. Although use of the median price or a close approximation thereto in the smaller categories probably overstates the unit mean value in these categories, such a median price is more conservative than the mean of model prices and appears to be the best measure available. Table 9 shows the mean model price, the median model price, and the representative model price for each category.

Table 9

Prices of Metalforming Machinery in the USSR a/

Type of Machinery	Mean Model Price	Median Model Price b/	Representative Model Price	Number of Models
Hammers	80,289	51,125	35,340	14
Presses	84,687	33,200	24,260	85
Forging machines	449,285	123,300	123,300	7
Shears	32,011	20,500	18,000	20
Straightening and bending machines	11,320	9,412	9,365	10
Others	26,420	26,420	26,420	1

a. All value figures are in 1955 rubles.
b. In cases where no one model represented a median (categories possessing an equal number of models), a simple averaging of the two surrounding model prices was used to compute an unweighted median.

Table 10* shows the actual calculation of the estimated value of production. A similar calculation based on 1950 prices and estimated

* Table 10 follows on p. 57.

Table 10

Estimating Method for Computing the Value of Production of Metalforming Machinery in the USSR a/
1945 and 1950-55

Category	Representative Model	1955 Price (P55)	Price x Quantity 1945 (P55 Q45)	Price x Quantity 1950 (P55 Q50)	Price x Quantity 1951 (P55 Q51)	Price x Quantity 1952 (P55 Q52)	Price x Quantity 1953 (P55 Q53)	Price x Quantity 1954 (P55 Q54)	Price x Quantity 1955 (P55 Q55)
Hammers	MPN 300	35,340	9,188,400	82,236,180	167,087,520	168,077,040	158,923,980	137,967,360	90,894,480
Presses	A 121 A	24,260	59,825,160	110,674,120	85,104,080	99,466,000	149,659,940	201,915,980	292,842,460
Forging machines	V 111	123,300	1,356,300	1,479,600	1,726,200	1,356,300	3,329,100	4,315,500	4,562,100
Shears	NA 633	18,000	2,304,000	22,734,000	20,052,000	18,846,000	19,764,000	23,742,000	39,726,000
Straightening and bending machines	LGV 1800/12	9,365	56,190	7,482,635	7,716,760	7,061,210	8,072,630	15,864,310	23,318,850
Other metalforming machines	3 C 1	26,420		739,760	792,600	1,136,060	1,426,680	1,400,260	1,188,900
Total			72,730,050	225,346,295	282,479,160	295,942,610	341,176,330	385,205,410	452,533,000
Index number b/			32.3	100.0	125.4	131.3	151.4	170.9	200.8

a. All values are given in 1955 rubles.

b. $\frac{\text{P55 Qn}}{\text{P55 Q50}}$

1950 product mix was made. The index of value production resulting from this calculation, however, was not sufficiently dissimilar from the one based on 1955 prices and 1955 product mix to warrant its inclusion.

The estimates of value of Soviet production included in this appendix represent a first approximation subject to refinement and reflect the methodological problems discussed above. As more data become available, these estimates will be further refined. Because there is inadequate information on which to compute acceptable ruble-dollar ratios for production of metalforming machinery in 1955, all conversions into US dollars were at the official rate of exchange of 4 rubles to $1 US.

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