61st Congress, 2d Session } HOUSE OF REPRESENTATIVES { Document No. 913

SPECIAL AGENTS SERIES—No. 34

MACHINE-TOOL TRADE

IN

AUSTRIA-HUNGARY, DENMARK, RUSSIA, AND NETHERLANDS

WITH SUPPLEMENTARY REPORTS ON ITALY AND FRANCE

By

GODFREY L. CARDEN

Captain, U. S. Revenue-Cutter Service

SPECIAL AGENT OF THE DEPARTMENT OF COMMERCE AND LABOR

Transmitted to Congress in compliance with the Act of March 4, 1909, authorizing investigations of trade conditions abroad

MAY 14, 1910.—Referred to the Committee on Ways and Means and ordered to be printed

WASHINGTON

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DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, May 13, 1910.

SIR: In compliance with the act making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ending June 30, 1910, approved March 4, 1909, I have the honor to transmit herewith a report by Capt. Godfrey L. Carden, of the United States Revenue-Cutter Service, detailed as a special agent of this department, entitled "Machine-Tool Trade," in which is contained the results of his investigations in Austria-Hungary, Denmark, Russia, Netherlands, Italy, and France. There is also transmitted a supplementary report by the same officer on the Machine-Tool Trade in Russia.

Respectfully,

BENJ. S. CABLE,
Acting Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

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DEPARTMENT OF COMMERCE AND LABOR,
BUREAU OF MANUFACTURES,
Washington, January 31, 1910.

SIR: I have the honor to submit herewith for transmission to Congress and publication a special report on the machine-tool trade of Austria-Hungary, Denmark, Russia, and Netherlands, with supplementary reports on Italy and France, by Special Agent Godfrey L. Carden, of the United States Revenue-Cutter Service, who was detailed for this work. Two reports, similar in character, have previously been submitted by Special Agent Carden and published. The first dealt with Germany, France, Switzerland, Italy, and the United Kingdom, and the second with Belgium. This third report completes his investigations in the European field.

Respectfully,

JOHN M. CARSON,
Chief of Bureau.

To Hon. CHARLES NAGEL,
Secretary of Commerce and Labor.

MACHINE-TOOL TRADE IN AUSTRIA-HUNGARY, DENMARK, RUSSIA, AND NETHERLANDS.

INTRODUCTION.

The reports comprising this monograph, part of which have been published by the Bureau of Manufactures in Daily Consular and Trade Reports, are observations based on a personal inspection by the writer of manufacturing plants in the countries visited, and on conferences with the active managers of these establishments and prominent commercial men. Owing to the limited time available it was impossible to inspect more than the representative establishments, which include not only plants for the manufacture of machine tools, but such concerns as are large users of them.

All reports have been carefully viséed in advance, and no reports have been forwarded except with the written consent of the directors of the several works visited. This statement is made in order that the writer's attitude with reference to these inspections may be thoroughly understood. His position is, and has been, that when an American officer is admitted to inspect one of these foreign plants he is for the time being the guest of the establishment and is in honor bound to make no mention of what he observes without the sanction of the directors.

The writer has found the greatest readiness, as a rule, to furnish all information as requested in the various instructions of the Department of Commerce and Labor. He can not speak too highly of the cordiality extended on all sides, and avails himself of this opportunity to make acknowledgment of the many courtesies received at the several plants.

There is an undeniable appreciation throughout the countries visited of the merit of American machine tools, and the reasons why there is not more American equipment in service are set forth in the views of the directors and managers of the various plants, as will be found in the respective reports.

This monograph is the third written by the author on the machine-tool trade in European countries and completes his work in that field. The first monograph, which was issued in January, 1909, gave the result of his inspection of establishments in Germany, France, Switzerland, Italy, and the United Kingdom, and the second, issued in August, 1909, contained a report on the trade in Belgium. The three monographs together give a survey of the entire field, and contain not only suggestions as to possible markets for American machine tools but an idea of the character of competition manufacturers and exporters in the United States must meet.

AUSTRIA-HUNGARY.

INTRODUCTION.

In 1908 Austria-Hungary imported machine tools from Germany to the extent of 9,216,100 kilos in weight (kilo=2.2 pounds), as compared with 6,526,200 kilos in 1907, an increase of 2,689,900 kilos. For these two years the German exports of machine tools to Austria-Hungary were greater than to any other country, with the exception of Italy. Italy, Austria-Hungary, and France have been the largest buyers of German machine tools during the past few years, but while the Austro-Hungarian market has shown an increase, there has been a falling off from 1907 to 1908 in purchases by both Italy and France. The following table, compiled from German statistics, shows the destination of the exports of machine tools from Germany in 1908:

Whither exported.	Kilos.	Whither exported.	Kilos.
Italy	9,562,900	Norway	405,100
Austria-Hungary	9,216,100	Brazil	392,700
France	5,705,700	Finland	351,700
Russia in Europe	3,141,800	United States	250,800
Belgium	2,894,400	China	227,500
Switzerland	2,154,900	Turkey in Europe	219,800
Sweden	1,379,100	Dutch Indies	158,700
United Kingdom	1,314,000	Chile	145,800
Netherlands	1,169,800	Portugal	96,700
Denmark	950,800	Australia	94,200
Japan	917,200	Bulgaria	93,300
Spain	872,300	All other countries	691,200
Argentina	665,500		
Roumania	557,400	Total	43,629,400

MANY LANGUAGES SPOKEN IN MONARCHY.

There is probably no country in Europe, with the exception of Russia, that is less understood by Americans than the Austro-Hungarian Monarchy. When one considers that the Monarchy is made up of 17 crown lands, in which practically 20 different languages are spoken in everyday life, it is not surprising that the knowledge of this territory is largely gleaned from foreign sources. The various divisions of the Austro-Hungarian Monarchy, and the languages spoken in these several districts as they are apparent to the practical man of business, are as follows:

Division.	Principal city.	Prineipal languages spoken.
Lower Austria	Vienna	*German*, Bohemian, Polish, Hungarian, French, Italian, English, Russian, Servian, Bulgarian, Turkish, Greek, Roumanian, Croatian, Slavonian.
Upper Austria	Linz	*German* and Bohemian.
Moravia	Brunn	*German* and Bohemian.
Silesia	Troppau	*German*, *Bohemian*, and Polish.
Bohemia	Prague	*Bohemian*, *German*, and Polish.
Galicia	Lemberg	*Polish*, *German*, Roumanian, Ruthenian, Bohemian, Hungarian, and Russian.

Division.	Principal city.	Principal languages spoken.
Hungary	Budapest	*Hungarian, German, Croatian, Slavonian,* Freneh, Roumanian, Servian, Polish, Bulgarian, and Italian.
Bosnia and Herzegovina.	Sarajevo and Mostar.	*Cyrillish, Turkish, German,* Greek, Italian, Croatian, Bulgarian, Slavonian, and Freneh.
Istria	Triest	*Italian, German, Slavonian,* Croatian, Hungarian, Greek, Turkish, and Freneh.
Krain	Laibach	*German, Slavonian,* and Italian.
Gorz and Gradisea	Gorz and Gradisea	*Slavonian, Italian,* and German.
Karnten	Klagenfurt	*Slavonian, German,* and Italian.
Tyrol	Innsbruek	German and Italian.
Salzburg	Salzburg	German.
Voralberg	Bregenz	German.
Steiermark	Graz	German.
Dalmatia	Zara	*Italian, German, Cyrillish,* Greek, Turkish, and Freneh.

In the above table the words italicized indicate the principal languages spoken in the several districts, as apparent to the stranger. The designations are fairly accurate, although it is often impossible to say which tongue is spoken the most by the inhabitants. There are also a number of dialects that are practically languages for these several sections. Gorz is half in Austria and half in Italy, and, generally speaking, Italian is used there more than any other tongue, except when it comes to business dealings with the outer world. In Siebenburgen, or Transylvania, there is spoken a Sachsen-German dialect, which neither a German nor any other than a native, it is declared, can understand. This is one of the instances where a dialect might be termed a "language." In Fiume business is carried on in Hungarian, Italian, Croatian, and German. Ruthenian is a variation of Russian, and Cyrillish a variation of Servian. It must be borne in mind that Austria borders on Germany, Poland, Russia, Roumania, Servia, Turkey, Montenegro, Italy, and Switzerland, and with the exception of the first and last, where German is spoken, the languages of these border countries are not only spoken in Austria, but, in consequence of the bordering influence, there have arisen during many centuries dialects which can only properly be described as a mixture of the bordering tongues.

MANUFACTURING DISTRICTS—TRANSPORTATION ROUTES.

In this great monarchy the three principal divisions, so far as manufacturing is concerned, are Austria proper, Hungary, and Bohemia. In the observations on the industrial works of Austria-Hungary the writer has visited, so far as possible, representative plants. An effort has been made to give some idea of the character of the manufacturing work in progress and the requirements of the various shops. It will be observed that the Austro-Hungarian plants are for the most part engaged in the production of high-class machinery and exact mechanical appliances, in the manufacture of which there is a demand for machine tools of the first quality.

Austria-Hungary has direct sea transportation with the United States, while the north of Austria can be reached more readily by canal routes, and the practice is followed, in Bohemia especially, of exporting and importing by way of Hamburg on the Elbe. Many shipments for Moravia, Silesia, Galicia, Upper and Lower Austria, and even Hungary, come by the Elbe to the boundary at Teschen, where they are put through the customs and forwarded by rail.

The writer has been impressed with the apparent indifference of American selling houses to the business possibilities offered in Austria-Hungary, and when one considers the facilities for transportation between the United States and Austria-Hungary on both the north and the south, the wonder is that this territory is not treated with the same concern as interstate trade at home. The economic and political conditions are all favorable to imports from America. Bohemia has been referred to as a "continent within the European Continent," and the visitor in Bohemian territory very early recognizes that Bohemia has a distinct individuality of its own. The same statement applies to Hungary, and of all countries in Europe there is probably not one in which an American is more welcome.

The American representative who enters this territory can do so free from the prejudices that exist toward many Europeans. The question of the languages is always an important one, but it is the writer's experience that when dealing with the heads of plants, English, French, and German will suffice for this territory. There are very few directors of the leading Austro-Hungarian works who do not speak English, and those few almost invariably speak French. Especially is this true of the technical directors and those officials who have had engineering training.

Bohemia ranks second in area in the Austrian Empire, but is regarded as first in industry and commerce. According to census figures for 1900 the total Austro-Hungarian population was 45,405,267. An estimate in 1906 places the population, including Bosnia and Herzegovina, at 49,965,259. According to the 1900 figures the total population of Austria proper approximated 26,000,000, and Bohemia had a population of less than 7,000,000. The total number of industrial commercial firms in Austria in 1902, according to one authority (Dr. F. Peroutka), was 1,051,172, of which number 322,261 were established in Bohemia. The industry and mining of Bohemia, from this same authority, represented 37.2 per cent of that in the whole of Austria, and included 1,166,020 persons.

LOCATION AND PRODUCTS OF MANUFACTURING PLANTS.

In the mechanical lines the Bohemian industries comprise manufacturing plants for general lines of machinery and especially works for the manufacture of locomotives, railway rolling stock in general, equipment for mines, sugar refineries, distilling works, power stations, engines of all descriptions, bridge building and transport machinery, gas-motor plants, turbines, waterworks plants, and refrigerating and other forms of machinery. As a rule, spinning and textile machinery is imported from Germany and from the United Kingdom.

In Hungary mechanical industries are largely centered in and around Budapest, but it will be observed from the reports that there are important plants in other parts of Hungary. The great Resicza Works of southeastern Hungary are described in a separate report.

The Austro-Hungarian Monarchy is independent of outside countries so far as raw material is concerned for manufacturing in mechanical lines. The steel produced at Witkowitz and at Resicza is of an exceptionally high order, and the building of the new ships of the Austro-Hungarian navy is accomplished wholly within the Monarchy. The great Skoda Works of Pilsen undertake to produce prac-

tically all artillery required for the new ships, and the Skoda plant relieves the Government to a great extent from the maintenance of arsenals similar to the Watervliet and the Washington gun foundry in the United States. In other words, Skoda is to Austria-Hungary largely what Krupp is to Germany. The armor plate for the Austro-Hungarian war ships is being built at Witkowitz, and plates are under construction at that works up to 300 millimeters thickness.

The Government has from time to time been taking over former private-owned railways, and these acquisitions by the State have led to the improvement and development of locomotive works.

Austria-Hungary has enjoyed, and is enjoying, considerable export trade in the direction of the Balkans and Southern Russia, and this business very materially contributes to the prosperity of the manufacturing plants of the country.

FINE FIELD FOR AMERICAN MACHINE TOOLS.

The general impression that German influence is predominant in Austria-Hungary may have held true some years ago, but to-day this view must be largely considered in an academic sense. It is the writer's observation, based on personal intercourse with the directors of representative plants and men high in authority, that there is a great field in this territory for American machine tools and American equipment. Government regulations require that the preference shall be given to Austro-Hungarian material wherever possible, but it is recognized in high official quarters that the best grades of machine tools are not always obtainable in this territory, and that in such cases machinery must be purchased from the outside. In fact, it has been the practice always to buy from the outside, and mostly from German sources. Under such circumstances as now exist there is every reason to believe that American machine tools are in position to claim first consideration.

There are a number of Austro-Hungarian plants engaged in the manufacture of machine tools, and at several of these works excellent machines are being built. It is recognized that Austro-Hungarian works do not offer to-day in sufficient quantities medium-sized tools of the highest grades, and it is in this particular field that American opportunity lies.

It is interesting to note that in the Bohemian territory there were sold during the past year a number of American machines of the larger sizes, in direct competition with German equipment, and the writer was informed that these American tools were bought because of their superior merit.

The Austro-Hungarian territory, in common with other European fields, undoubtedly offers at this time special inducements to American manufacturers. There are numerous Austro-Hungarian works where high-grade tools are regarded as an essential, and it is to these plants that American attention can advantageously be directed.

FREIGHT RATES FROM THE UNITED STATES.

The sea freight on machine tools from the United States to Austria does not vary much with reference to the different lines.

The Cunard Steamship Company advises that the rate f. o. b. Liverpool to Trieste on American machine tools will be 20 shillings

($4.87) and 10 per cent per ton, gross weight, or measurement, prepaid. The rate from London to Liverpool is 10s. 6d. ($2.55) per ton, quay to quay, and Liverpool expenses 3s. 6d. (85 cents) per ton. The same company advises that the rate on American machine tools from New York to Trieste would be 21s. ($5.11) in full on small quantities, but for larger quantities 20s. per ton and 5 per cent, weight or measurement, ship's option. These rates, however, are subject to alterations without notice.

The station chief of the Südbahn or Southern Railway, between Vienna and Trieste, advises that iron machines and parts thereof, with the exception of sewing, knitting, writing, and adding machines, pay rates as follows per 100 kilos (220 pounds), the crown being valued at 20.3 cents:

Haul.	Up to 5,000 kilos.	Not under 5,000 kilos.	Not under 10,000 kilos.
	Crowns.	*Crowns.*	*Crowns.*
Vienna to Trieste	2.90	2.38	2.22
Trieste to Vienna	4.37	3.36	2.87
Vienna to Trieste, for export	2.90	2.15	1.68

A shipping office in Vienna states that the freight rates on iron lathes f. o. b. New York to Trieste (on board, not unloaded) are 17s. 8d. ($4.30) and 5 per cent per English cubic foot. This company states that the sea freight varies according to choice of steamer. The same company quotes from Trieste station to Vienna station 3.10 crowns per 100 kilos (63 cents per 220 pounds). The unloading expenses from steamer and loading on car in Trieste will vary for such machines from 2 to 2.50 crowns per 100 kilos (40.6 to 50.7 cents per 220 pounds). These rates are approximate and not binding.

The Austrian Lloyd of Trieste quotes the following freight rates per ton f. o. b. New York to Trieste on machine tools: For machines of 120 cubic feet per ton, 15 shillings ($3.65); 1 to 1½ tons each, 20s. ($4.87); 1½ to 3 tons each, 22s. 6d. ($5.47); from 3 to 4 tons each, 27s. 6d. ($6.69); plus, in each case, an addition of 5 per cent for every 40 cubic feet, and with choice of steamer.

VULKAN WORKS.

The most important machine-tool works in Austria-Hungary are the Vulkan Works, located in Vienna. The full name and address of this plant is Vulkan Maschinenfabriks-Actien-Gesellschaft, Wien, XVI, Wattgasse 30. There is a branch establishment located in Budapest. I have observed Vulkan tools in foreign countries to a limited extent. As a rule, however, Vulkan is doing very little export business. The demands of the home market are sufficiently great to absorb the greater part of the output, and, so far as my observations go, Vulkan has been drawn upon by all the leading Austro-Hungarian manufacturing plants.

Every facility was afforded for inspecting the works, under the escort of Engineer-in-Chief Heinr. Ast, while a comprehensive talk was had with Director Fluss, of the commercial department. The

technical director at Vulkan is Mr. W. Schuster. It was stated that the Vulkan Works were working about 500 men, or about two-thirds force. The greatest number of men which Vulkan has employed at any one time in Vienna was 800.

The situation at the Vulkan Works is a peculiar one, and in one sense the firm may be said to enjoy subsidy benefits. All government plants in Austria-Hungary are called upon to make limited expenditures in the home market. One plant under government control stated that it was not necessary to make a definite per cent expenditure in the home field with reference to every item purchased, but rather a certain percentage of the sum total of the appropriation awarded the plants by the Government. It would seem that the majority of Austrian plants under government control feel it incumbent to purchase at least one-third of the machine-tool equipment in the home territory. The same statement applies with equal force to Hungarian works under state control. The Vulkan Works apparently profit by this situation, and in order to avail of the Hungarian territory have established a branch in the Hungarian capital, in which they employ 400 to 600 men.

I was informed that the Vulkan Works undertake to build no less than 200 different types and sizes of machine tools and accessories. The Huré Works in Paris build 152 different types of machines, and the necessity of building so many different designs is strongly deprecated by Mr. Huré. He would much prefer to confine his efforts to the building of two or three designs only, but owing to their limited territory he was compelled to take advantage of every available order. To judge from conversation with the Vulkan officials, a similar opinion is held by the latter. Mr. Ast, in reply to an inquiry as to what line of machines he would rather confine his attention to were it possible to limit the types of output, replied, "Planers."

MAKING LARGE SIZES.

The Vulkan Works appear to be making special efforts along the lines of the larger sizes of machine tools. If there is any one type of tool which Vulkan is laying stress upon, it is apparently the larger size of planers. The firm does not hesitate to go in for large dimensions and undertakes to build planers ranging in width of table up to 4 meters (13.12 feet). Vulkan has actually made planers up to $5\frac{1}{2}$ meters (18 feet) width. This special size was built for ironworks and was designed for handling heavy armor plates. The latter planers are designed to cut either one way or both ways, longitudinally and transversely, and also vertically. For the heavy planers three or four speeds are supplied and at least two speeds are always given when an electro-clutch is used. The Vulkan establishment emphasizes the advantage of the electrically driven clutch-controlled planer. The firm builds its own motors, which are adapted for slow speed and several rates of speed. One planer in service had a length of 15 meters (49.2 feet) and was electrically driven by a Vulkan motor. The speed of this machine can be regulated at the tool in proportion of 1 to 6. There are two open belts for the cutting speed with step pulleys. The electro-clutch attachment makes it possible to advance the table by millimeter degrees if so desired.

MACHINE TOOLS IN USE.

The Vulkan Works were making some very fine large-sized radial drills. These machines resemble very closely the Bickford American type, and, like the Bickford, the Vulkan drills are universal in operation. Several of these Vulkan radial drills were in process of building, having arm lengths of 2½ meters (7.6 feet). One very early receives the impression on visiting the Vulkan Works that these shops are confining their attention largely to the building of large-sized tools especially adapted for locomotive works and similar machinery plants. There is hardly a machine tool required by locomotive builders which is not undertaken by the Vulkan firm. This line of construction must necessarily be profitable in a country where so many of the locomotive shops are under government control or regulation. The smaller machine tools are apparently only undertaken by Vulkan,

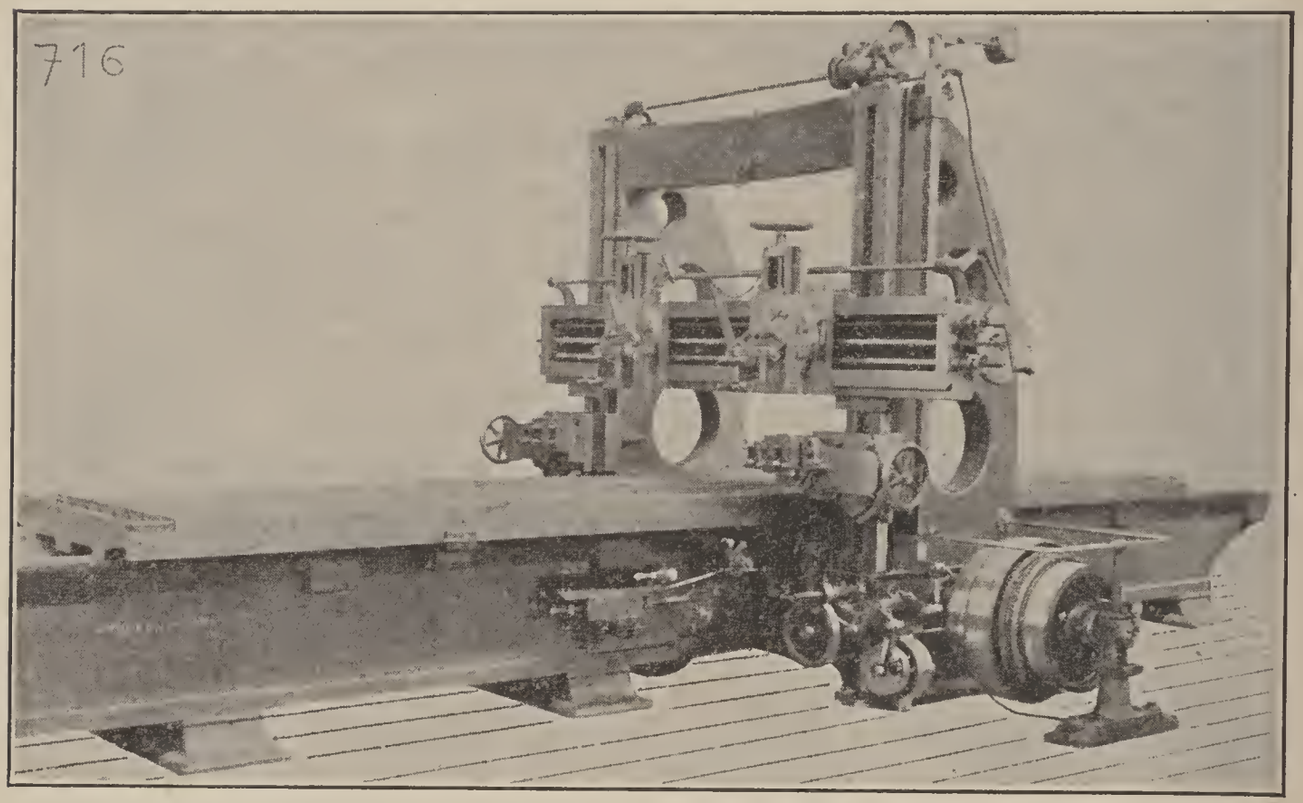

FIG. 1.—Vulkan quick-return planer, belt-driven, two cutting speeds, fitted with electro-clutch.

as a rule, to fill the general demand of their clients. Some beautiful turning and boring machines were in process of construction, designed especially for working up axles and car wheels. These tools are electrically equipped. It was stated that the Vulkan Works formerly made many electric cranes, but that very few were now being built. The cranes which have been turned out are, in general, of the Shaw electric crane type. The Austrian firm of Petravic, it was said, is the principal plant now making a specialty of crane building in Austrian territory.

The number of American machine tools in use in the Vulkan shops is very small. There are several American-type machines on the floors, but minus the names of builders. One of these nameless tools could very readily pass for a Brown & Sharpe universal miller. Two Brown & Sharpe grinders were in use and a Millers Falls saw. These were the only American tools coming under my notice. Technical Director W. Schuster informed me that he had previously suggested the advisability of Vulkan connecting up with several American

machine-tool building firms, and that he was still of the opinion that Vulkan could advantageously handle several types of American machine tools for the Austrian territory. The types of machines which Director Schuster has in mind are the smaller and medium sizes of lathes, drills, millers, grinders, and all sorts of special machinery.

LEADING TYPES TURNED OUT— WAGES PAID.

The principal work in the Vulkan shops is confined to the manufacture of the following line of tools: Lathes of every kind, size, and description (over 120 different patterns); planers, shapers, slotters (about 70 different patterns); drilling and boring machines (about 100 different patterns); horizontal, vertical, and special milling machines (about 50 different patterns); screw-cutting, tapping, sawing, and grinding machines (about 60 different patterns); punching, shearing, plate, beam, rail, angle, bending, and straightening machines (about 80 different patterns); eccentric and friction presses, steam hammers, pneumatic hammers, hydraulic presses, blowers, and miscellaneous tools (over 100 different patterns); wood-working machines (about 50 different patterns).

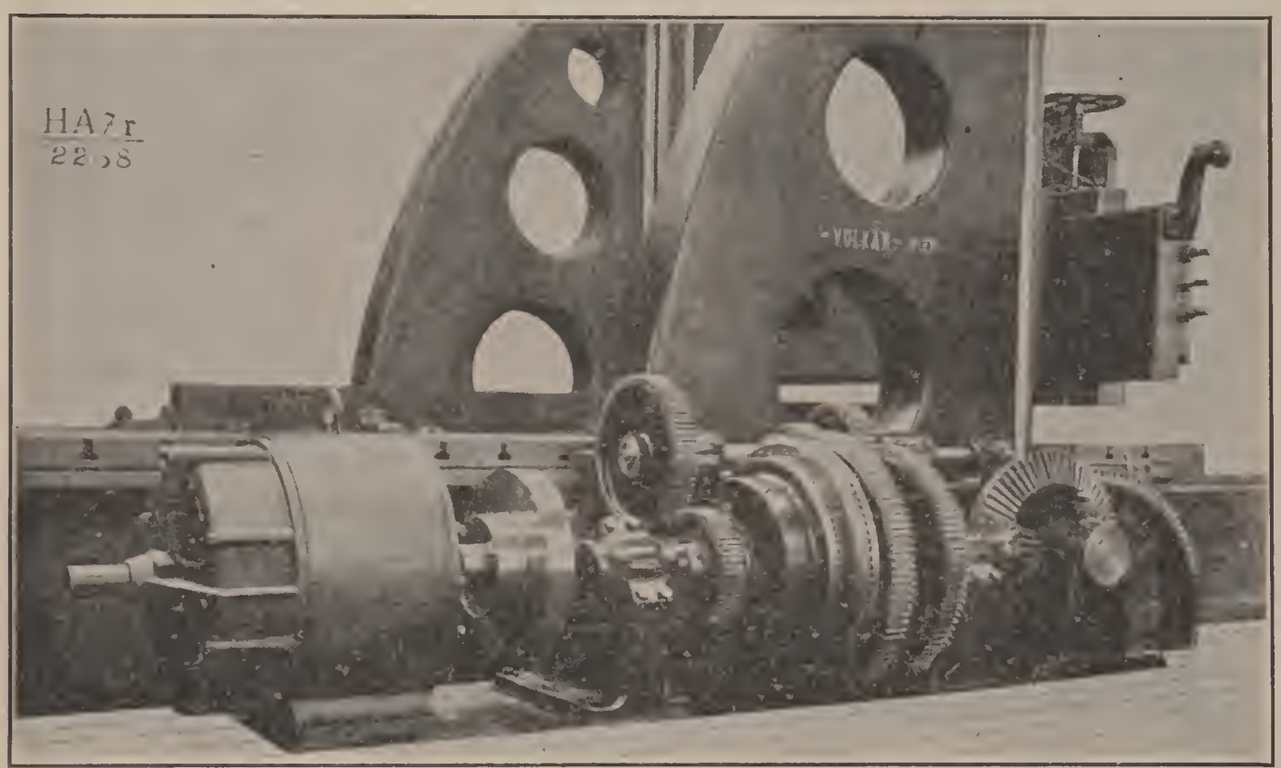

FIG. 2.—Heavy motor-driven planing machine with three cutting speeds and quick return, under test at Vulkan Works. Shows driving gear with electro-magnetic clutches, Vulkan patent.

The Vulkan Works in several instances are turning out tools of more than ordinary merit, the planer work and the large-sized tools for locomotive building being deserving of special consideration. The electric control as imparted to the Vulkan planers makes these machines exceptionally high grade in working properties.

The Vulkan Works were formerly known as R. Fernau & Co., Ottakring-Wien. The present shops are at the same locality as the parent works. The new company was organized in 1893. The workmen are paid according to the amount of work performed. For each piece there is a fixed valuation, and the workman is paid whenever the work is completed. In case the task extends over a pay-day period advances are made. I was informed that some of the very best workmen

receive as high as 10 crowns ($2.03) per day. The average rate of pay for good machinists varies from 6 to 8 crowns ($1.22 to $1.62) per day. Apprentices receive 1.7 crowns (34.5 cents) per day. A day's work at the Vulkan shops comprises 9 hours and 20 minutes. The shops open at 7 a. m. and close at 6 p. m. (Saturdays at 4 p. m.), with an interval of 10 minutes for breakfast and 1½ hours for dinner.

ERNST DANIA WORKS.

The Ernst Dania Works at Vienna were employing in July, 1909, less than 200 men in the manufacture of machine tools. Many Dania machine tools have been observed in Austrian shops, and especially tools of the lathe type. This firm does not undertake to specialize as is understood in the American sense, but will undertake to build to order any one of nearly 200 varieties of tools. The inspection of the Dania plant was made with Mr. Ernst Dania. The shops are not extensive, but the work turned out is in many instances of high merit. Dania builds largely to government orders, and especially for locomotive works. When running full, about 300 men are employed. A day's work here comprises 9½ hours. Dania in July had considerable orders in hand, and relatively was doing more business than other Austrian machine-tool shops. The only tools built to series, so far as could be learned, are lathes, drills, planers, and shapers, and it was stated that these tools are turned out in lots of either six or twelve, according to size.

AUSTRIAN VERSUS GERMAN TRANSPORTATION RATES.

There are a number of machine-tool building plants in Austria, but the most conspicuous are the Vulkan Works, Dania Works, and Joh. Müller. I have seen more medium-sized Dania tools in Austrian shops than from any other firm in this territory. When one considers the enormous demand for machine tools in Austria, the wonder is that Austrian firms are not able to profit more largely by the situation. In 1907 the German exportation of machine tools to Austria-Hungary was greater than to any other territory. Apparently, the Austrian manufacturers realize the conditions under which they labor, and Mr. Dania advised that a shipment can be made of machine tools from England to Trieste for 80 hellers per 100 kilos (16.2 cents per 220 pounds), whereas a shipment from Vienna to Trieste by rail, he states, costs 4.8 crowns (97.4 cents) per 100 kilos.

Mr. Dania stated that it is impossible to compete in Russia with German machine-tool builders by reason of the heavy transportation rates across Austria to the Russian frontier. These rates, he declared, are far greater than German rates for export, even as against the shorter Austrian haul. Recently a new road has been opened from Salzburg to Trieste, but Mr. Dania states that there will be no advantage for Austrian manufacturers, since it was proposed to raise the freight rates on January 1, 1910. At present the road from Vienna to Trieste is in private hands, but eventually the State, it is understood, proposes to control the important roads of the country. The opinion prevails that the new road from Salzburg to Trieste will only serve as another advantage in furthering German exports.

ECONOMIC CONDITIONS—AMERICAN TOOLS—OUTPUT.

The economic conditions surrounding the manufacture of machine tools in Austria are not as favorable, it would seem, as in Germany. Higher wages have to be paid to Austrian workmen, and there is no more freedom from strikes in this territory than in France or Germany. In this connection it is the writer's observation that few countries in Europe afford the manufacturing advantages, from the employers' standpoint, given by Belgium.

Naturally in works like those of Dania's it is hardly to be expected that one would find many American machine tools, since Dania undertakes to build almost every type of tool. There was, however, one planer from the G. A. Gray Company, Cincinnati, Ohio, and one grinder from the Landis Tool Company, Waynesboro, Pa., apparently the only American tools in the works. Dania is running planers on both spindle and gear drives. The opinion was expressed that the tendency now in planer designs is to increase the cutting speed. Dania is employing cutting steel from Böhler and from Schoeller & Co.

Dania is turning out double-tooth shapers, is building planers after the Gray type, and is also turning out machines for cone-gear cutting. The firm prides itself on being able to undertake the largest gear-cutting work that can be handled in Vienna. Dania is cutting gears for his tools on machines of his own make and on Biernatzki hobbers.

The Dania Works are turning out an excellent type of steam hammer, the special design of Mr. Ernst Dania, and these shops have built steam hammers having a maximum capacity per tool of 12 metric hundredweight (2,640 pounds). The works are run by an 80-horsepower Brunn-Konigsfelder steam engine and a 30-horsepower gas engine of Dania's own make.

Dania has a large supply of machine tools now in stock, and is selling from his stock supply. Notwithstanding that business is at present good, Mr. Dania declared that conditions are much quieter than in 1907 and 1908. While Dania is making a number of excellent tools, it is evident that these shops can lay special claim to excellence in lathes, shapers, drilling machines, and special tools for locomotive work.

JOH. MÜLLER WORKS.

The Joh. Müller Works are one of the three leading machine-tool houses of Vienna, the other two being the Vulkan and the Dania works. At the Müller Works it was stated that only 75 men were employed in the manufacture of machine tools. Ordinarily, when times are good, 250 men are carried on the pay rolls. The Joh. Müller Works carry the name of the elder Müller. Five brothers, sons of Joh. Müller, are now actively connected with the firm. The shops were inspected under the guidance of Mr. Christian Müller. The full address of this establishment is Erste Wiener Werkzeug-Maschinen-Fabrik und Eisengiesserei Joh. Müller, Vienna, Austria.

The Müller Works are making a specialty of lathes and are building the ordinary engine type. The largest size turned out has a height of 640 mm., and to this height any length can be built. The

smallest lathe has a height of center of 150 mm. The Müller lathes are designed especially for locomotive works, and the writer found many lathes of this firm's make in Austrian locomotive shops. Müller is building lathes in series of 4, 6, or 8 for the large sizes and 20 and 24 for the small sizes. Müller employs phosphor bronze for bushings, Bessemer steel for spindles, and cast steel for shaft of cones. The lathes have 5-step cones.

The Müller Works have undertaken to build vertical millers, and attention was called to a new vertical miller which, it was stated, is the first one built by the Müller Works. This particular tool has been designed for milling the eccentrics of Diesel motors. This new miller is now undergoing experimentation, and, when found satisfactory, 8 machines will be built.

In all, about 15 types of machine tools are manufactured in the Müller Works. The list includes lathes, planers, radial drills, vertical millers, horizontal millers, horizontal borers, multiple spindle machines, turret lathes, shapers (5 types), screw-cutting machines, vertical drills, keyway cutters, slotters, plate-bending machines, and shearing machines. Aside from the lathes, Müller probably makes more radial drills than any other single type of machine.

OUTPUT DISTRIBUTION.

Mr. Christian Müller states that the majority of their tools go to private works. I gathered from his remarks that the impression exists at Müller's that German sources are largely drawn upon to furnish machine tools for private shops. In addition to machine tools, Müller is building hydraulic presses, and one press was seen which, it was stated, affords a maximum pressure of 600 atmospheres. Generally these presses are mounted on three pillars, but for the small presses four pillars are employed. In a few instances Müller has built presses with two pillars. The press cylinders are made of cast steel.

The Müller shops, while not large, are doing good work. The lathes turned out appear to possess more than ordinary merit. As a rule, nearly all the tools in the shops are of fair quality, though not a single American machine tool was seen in the works. I have heard Müller's lathes spoken of in complimentary terms, and to the visitor it is difficult to understand why a shop such as this should not enjoy a large share of Austrian business. But it was stated that very little encouragement is extended. Prices are not maintained, and the price of a tool to-day may be wholly at variance with the price quoted a few months hence. A sort of cutthroat policy exists, and prices are jockeyed to meet individual cases. Machine-tool manufacturers have stated that they wish it were possible to follow the American practice of announcing prices in advance and maintaining those quotations.

WORK IN THE MÜLLER SHOPS.

All work in the Müller shops is on a piecework basis. This piecework system has been introduced by Müller during the past year, and it has been found that under the present arrangement 50 men are turning out as much work as was formerly obtained from 90 men. The shop drive throughout is afforded by steam power. In the foundry electric power is used in connection with ventilation. The only American feature found in Müller's was a 3-pair scroll (No.

153) from the Union Manufacturing Company, of New Britain, Conn., ordered by a customer for one of Müller's lathes at the time the lathe was purchased. The lathe was standing in the stock room, being made ready for shipment, and the scroll box was going out with it. The lathe was 185 mm. height of center of tool.

The different sizes of the lathes made by Müller are as follows: Height of centers, 150 mm., 160 mm., 185 mm., 210 mm., 230 mm.; SSD, very heavy, 230 mm. and 240 mm.; heavy, 220 mm.; light, 265 mm.; heavy, 250 mm.; heavy, 285 mm.; heavy, 320 mm.; heavy, 350 mm.; heavy, 420 mm.; heavy, 510 mm.; heavy, 640 mm.

A week's work in the Müller shops comprises 54 hours; under normal conditions Saturday is only a half day. The half-day work on Saturday is a general practice followed in and about Vienna. The unions endeavor to enforce these hours. Strikes are frequent in the Vienna district, and at all times it is difficult to secure good men. Machinists earn as a rule 6.2 crowns ($1.25) per day. Mr. Müller states that if a man earns below that wage on the piece schedule he is not deemed desirable and is discharged.

STATE RAILWAY LOCOMOTIVE WORKS.

One of the oldest locomotive plants in Austria is known as the Privileged Austro-Hungarian State Railway Works. The establishment is located in the city of Vienna, and it was in the shops of this firm that the old locomotive "Philadelphia" served as a prototype in the early building of Austrian railway engines. This locomotive was brought over from the United States in 1838.

The leading spirit in the early development of the Vienna Locomotive Works was John Haswell, a Scotchman, born in 1812. Haswell received a fine technical training in the Glasgow University and saw much practical service in both Scotland and England. In 1838 Haswell undertook the establishing of the locomotive works in Vienna, and his energy and spirit of initiative soon stamped him as the pioneer of locomotive building in Austria. The technical knowledge and rich instruction which Haswell had brought with him were potent forces, and soon the influence of his construction and designs of new locomotive types were felt throughout and beyond the borders of Austria.

In 1839 the greater part of the establishment was made ready, and the energy of Haswell was further seen by the large amount of tool equipment turned out. From the very first Haswell undertook to build passenger coaches mounted on eight wheels, after the American principle. In the short space of one and a half years Haswell was enabled to create a great industry, and this industry had scarcely a peer in all Austria. Many of Haswell's ideas as to construction methods have remained through the years that have intervened, and are almost unchanged, for the ideas were, for the most part, ahead of the spirit of the times. After the lapse of years one can go back, it is declared, to these same inventions of Haswell, and they appear even now as new and epoch making.

PRESENT MANAGEMENT AND OUTPUT.

Haswell retired in 1882 from the direction of the locomotive works, but up to the time of his death, in 1897, he was interested in all that was new in locomotive building, which to him had been so fruitful a work field.

The control of the plant is at present in the hands of Director Anton Martinek, and Mr. S. Nevole is the superintendent. The writer visited the plant on July 14, 1909, and was shown over the shops by Mr. V. Sádek, and every facility and courtesy was extended. The location of the works is close to the Staats and Süd Bahnhöfe (State and Southern Railway stations). At the time 1,500 men were employed in the Vienna shops, a night force of 150 men also being kept going. A week's work at the Vienna shops comprises 53 hours. The average rate of pay to good machinists is 6 to 7 crowns ($1.22 to $1.42) per day. The administration of affairs has been, it is said, most liberal in its treatment of the workmen, and the relations existing between employer and employees have, on the whole, been most satisfactory.

The output of these works is practically limited to locomotives, the maximum number of which per year has heretofore been 138, but for 1909 it is necessary to build 140. Practically all of these orders are for the Austrian State Railways. During the present year there is no export work in hand, but in the past exports have been sent to Roumania, France, Italy, and Russia. The Vienna shops have also built for Hungary. Mr. Sádek called attention to the high freight rates imposed in Austria, and thinks it militates against industrial development.

The general designs of the locomotives built here follow, for the most part, the Gölsdorf types. The designer of these locomotives, Mr. Gölsdorf, is regarded to-day as one of the leading locomotive authorities in Europe. This gentleman is at present attached to the Austrian State Railway administration. Many of the features apparent in the locomotive output from the Vienna shops are essentially from Gölsdorf plans, but it was stated that Schmidt superheaters are used when the designs call for superheaters. In addition to Gölsdorf locomotives both the Atlantic and Prairie types of American engines are built.

The locomotives turned out are of an extraordinarily fine type, and the attention to detail and finish is of a most exacting character. The greatest care is manifested in every feature of the work, and it is because of the high standard which has been set that shops like this one can afford to purchase only the very best grade of machine tools. The work which John Haswell inaugurated and which has since been modernized by Mr. Martinek and Mr. Nevole has left an indelible impression upon these shops, and nowhere in all Austria has the writer seen greater initiative in evidence or more originality in methods.

FINE EQUIPMENT OF AMERICAN TOOLS.

Exclusive locomotive shops permit the employment of many varieties of tools of the rougher sort, and as many of these tools are heavy and ponderous, they are not so readily affected by age as the finely adjusted medium-sized machines. But, even taking into consideration these conditions, one is impressed with the great number of high-grade modern machine tools in use, showing clearly that the direction of this establishment is alert in the procurement of the best lines of machines.

One of the first groups of American tools noticed was an assemblage of Brown & Sharpe grinders. There were six tools in all of various

types, and Mr. Sádek, in commenting on these machines, said: "We know of none better." Brown & Sharpe millers are also in evidence, and there are a number of Gray planers and Pratt & Whitney tools. More Sellers planers were found in service here than had been seen in any one shop in Austrian territory. Several of these Sellers planers are very heavy tools. Particular attention was attracted to one Sellers machine (No. 1057) planing off locomotive cylinder bearing faces, and working on iron having a tensile strength of 26 kilos per square millimeter, which is equivalent to 36,980 pounds per square inch. This Sellers planer was equipped with Sellers's patent spiral gear, having six-time return speeds and single belt. To use Mr. Sádek's expression, "The working of this Sellers machine is little short of wonderful." Mr. Sádek visited America at the time of the World's Fair in Chicago and inspected the Sellers works. He states that the managers of the Vienna works buy direct from the Philadelphia firm.

In addition to the Sellers planers, a Sellers boring mill (No. 276) and a Sellers cylinder borer were in use. With reference to the boring mill, Mr. Sádek said that it had never called for any repairs, was very strong, and he knew of none better. The Sellers cylinder boring machine was declared to be an excellent tool, and is especially liked because of the fact that the head is fixed in the boring bar and is not removable. This machine was No. 731. Mr. Sádek stated that he can finish up all boring work on one locomotive cylinder in eight hours' time with the Sellers tool. This includes face cutting, reaming, and boring.

There is a Gray 520-millimeter table planer in service, the construction of which is considered exquisite, but the machine itself is said to be too light. It is probably a case of too small a tool for the work imposed.

Other American machine tools in evidence include a Bickford radial drill, Gisholt turret lathes, Gould & Eberhardt shapers, Pratt & Whitney millers, Hillis & Jones punch, and Brown & Sharpe planer grinders. One of these Brown & Sharpe tools came from the Paris exhibit lot of that company. Undoubtedly the tools which are in the highest favor in these works are those of Brown & Sharpe and of the Sellers company. As previously stated, the purchase of the Sellers tools is made direct from America, and it is significant that a close connection has been established in the relationship between the Vienna and Philadelphia firms.

Transportable electric drills are used to a considerable extent, but there are no pneumatic tools in service.

EUROPEAN MACHINE TOOLS IN USE.

Austrian machine-tool works have been drawn on and have furnished a number of very fine machines, especially the Vulkan Works and the Dania Works. There are German tools in evidence, and also many English tools. Collett & Engelhard, of Offenbach-on-the-Main, have supplied a 4-spindle drill for boiler-head work, and Vulkan has built a tool for milling the edges of boiler hoods. Dania, of Vienna, has supplied planers, lathes, and several special tools. Fairbairn, Naylor & Co., of Leeds, England, have a slotter in service which was working on 12 layers of locomotive frames, each of 30

millimeters thickness. Ducommun has supplied lathes, but there was some criticism of these tools. Some boring mills are in service, built after the Richards system, and there are some Vulkan horizontal cylinder borers in use. Vulkan has also supplied radial drills and a large combined vertical and horizontal driller. A Dania miller was seen at work milling the blanks in the sides of connecting rods, the steel in the rods having a tensile strength of 70 kilos per square millimeter (99,563 pounds per square inch). Still other foreign tools in use comprise lathes from Reska, of Prague; vertical miller from Kendall & Gent, which is spoken of highly because of its gear movement; a planer from Zimmermann; grinders from Schmaltz and from Grafenstaden; vertical grinder from Bayer, Peacock & Co.; an automatic slot-drilling machine from Smith & Coventry, England; a band saw from Noble & Lund, of Newcastle-on-Tyne; double vertical drills from Sharp, Stewart & Co., of Manchester; and a hammer from Schultz & Goebel, of Vienna. The Grafenstaden vertical miller was milling down the heads on all connecting rods, and was doing good work.

FLORIDSDORF LOCOMOTIVE WORKS.

The Floridsdorf Locomotive Works, a private concern, are located on the outskirts of Vienna. In July, 1909, about 1,200 men were employed, about 1,200 short of maximum. The full name and address of the Floridsdorf Works is Wiener Locomotiv-Fabriks-Actien-Gesellschaft, Floridsdorf-Vienna, Austria.

I was personally shown over the plant by Director Hermann Gussenbauer. The machine-tool installation is one of the best seen in any locomotive establishment in Austria-Hungary. The very latest tools are sought for, and among the most recent purchases was observed a No. 4 vertical miller from the Cincinnati Milling Machine Company. This machine had been in place only eight days, and is the first tool of the type seen in any Austrian shop. Director Gussenbauer states that he paid for it 12,000 crowns ($2,436).

Close to the Cincinnati machine is a Reinecker tool from Chemnitz, Germany, of practically the same size and type. The price paid for the Reinecker machine was 7,800 crowns ($1,583). The latter tool has been in service six months. The Cincinnati machine was purchased because the Floridsdorf Works wanted a stronger tool than the Reinecker, and Director Gussenbauer stated that he believes he secured what he wants in the No. 4 Cincinnati. However, he says, the latter tool has not been in service long enough to permit making a definite statement. The foregoing is mentioned to show the readiness of the Floridsdorf management to purchase tools wholly on merit, even when the price is in excess of what is asked for similar tools on the Continent.

THE SHOPS AND THEIR OUTPUT.

The Floridsdorf shops are building, on an average, 120 locomotives per year. For 1909 the number of engines under contract is 100. These works, founded in 1870, are the most recent of the three locomotive-building shops in Lower Austria, and are the outcome of a constantly increasing demand for locomotives and rolling stock,

dating from that period. The company was organized on a limited liability basis, the actual date of the document of authorization being September 6, 1869. The president of the council of administration is Mr. Jules Herz, and the administration of technical and commercial affairs, Mr. Hermann Gussenbauer, who succeeded the late Bernard Demmer.

The ground covered by the Floridsdorf Works comprises 16½ hectares (40.76 acres), of which 8½ hectares (21 acres) are actually occupied by buildings, the remaining portion being given over to gardens and the habitations of the workmen. The location of the works is in close proximity to both the Northeast and the Northern railways. The construction of the buildings was commenced in April and finished in November, 1870. In January, 1871, the Floridsdorf shops commenced the actual building of material for railways. The first locomotive left the works on June 10, 1871, and 146 locomotives and 120 tenders had left the shops by the end of 1873. Of this number 6 locomotives, with tenders, were destined for railways of Alsace-Lorraine.

EFFECT OF A FINANCIAL CRISIS.

The financial crisis of 1873 was naturally felt at these recently organized works, and it required every effort to weather the storm. This crisis, which lasted from 1873 to 1879, so retarded work at Floridsdorf that only 118 locomotives were built, and of this number 35 were for export. In the following years the situation cleared somewhat, but at the same time slowly. One order was secured for 31 locomotives, with tenders, for the Chemin de Fer du Nord of France. In 1882 the Floridsdorf Works secured an order for 60 locomotives, with tenders, for the Chemin de Fer Paris-Lyon-Méditerranée. On March 8, 1896, engine No. 1000 was completed, and this occasion was celebrated by the presence of the Minister of Railways and many eminent persons. This was a compound engine.

By 1908 the Floridsdorf Works had built 1,830 locomotives and 1,070 tenders, together with many separate parts, boilers, stationary steam engines, locomobiles, machine tools, and various other products. At the end of the same period there had been delivered to the railways of Austria-Hungary 1,671 locomotives, while 159 engines had been supplied to foreign roads. In all, 117 different types have been developed.

Between 1893 and 1908 the Floridsdorf shops built 645 compound locomotives. These same works brought out the first 10-wheel freight engines for the Austrian state railways. This engine was designed by the eminent Austrian government engineer, Charles Gölsdorf. The Floridsdorf shops build, as a specialty, locomotives for rack railways, which include among others the system Abt. The most powerful of these engines weighs, in working order, 72 tons. Still another specialty is crane locomotives, designed in particular for steel casting in steel works.

MACHINE TOOLS IN USE.

There are many machine tools in use at Floridsdorf which were built at the locomotive works, but these tools are necessarily of early date. Practically all recent acquisitions are purchases from well-

known machine-tool houses or agents. Director Gussenbauer intimated that it would be to the advantage of American manufacturers if firms like Floridsdorf could deal directly with houses in the United States instead of through agents. There are quite a number of tools at Floridsdorf from William Sellers & Co., of Philadelphia. These machines were bought direct, and Director Gussenbauer adds that he would buy more American machines if he could treat at first hand, as with Sellers. In this connection attention is called to the practice of the Staats-Eisenbahn-Gesellschaft Works, of Vienna, in buying machine tools direct from the Sellers firm.

In all, there are 624 machine tools on the Floridsdorf floors. The majority of these tools are of foreign origin. Among the American machine tools in use are the following:

Becker Milling Machine Co., Hyde Park, Mass---Vertical miller.
Hendey Machine Co., Torrington, Conn---Lathes.
Bement, Miles & Co., Philadelphia, Pa---Boring mill and slotters.
William Sellers & Co., Philadelphia---Planers and grinders.
Landis Tool Co., Waynesboro---Grinders.
Warner & Swasey Co., Cleveland, Ohio---Hexagonal turret lathes.
Acme Machinery Co., Cleveland---Threaders.
Cleveland Automatic Machine Co., Cleveland---Automatic machines.
G. A. Gray Co., Cincinnati---Planers.
Springfield Machine Tool Co., Springfield---Shapers.
Cincinnati Shaper Co., Cincinnati---Shapers.
Lodge & Shipley Machine Tool Co., Cincinnati---Engine lathes.
Bickford Drill and Tool Co., Cincinnati---Radial drill.
Morton Manufg. Co., Muskegon Heights, Mich---Back shaper.
Gisholt Machine Co., Madison, Wis---Turret lathes and vertical turret lathes; boring mill.

Chicago automatic time recorders are in service. In the tempering room the gas furnaces in use are from the American Gas Furnace Company, Elizabeth, N. J. There are at least six Warner & Swasey machine tools in use; three of these are hexagonal turret lathes, purchased about two years ago, and are pronounced good machines.

Director Gussenbauer states that he paid 12,000 crowns ($2,436) for the Bickford radial drill. The features of this tool are: Drills holes up to 90 millimeters maximum; reach of spindle, 1,990 millimeters maximum, 810 millimeters minimum. Three planers from the G. A. Gray Company, of Cincinnati, Ohio, were at work.

The back shaper from the Morton Manufacturing Company has been supplemented with an attachment for cutting the teeth of cone gears. The Morton machine was at work cutting cone gears.

PRICES OF VARIOUS TOOLS.

The Cincinnati Shaper Company has supplied one double shaper in addition to the standard machine. The prices paid and the sizes of the machines are as follows:

Description.	Length of stroke.	Length of bed.	Price paid.
	Millimeters.	*Millimeters.*	
One head shaper	460	2,440	$1,928
Double head shaper	560	4,880	3,796

For a No. 3 Cincinnati Milling Machine Company miller Floridsdorf paid 7,900 crowns ($1,604); this is a universal tool. Grafenstaden has supplied a horizontal miller of about the same size for 3,500 crowns ($710), and J. E. Reinecker, of Chemnitz, made delivery of a similar machine for 3,400 crowns ($690). The numbers and sizes of the Grafenstaden and Reinecker tools furnished at the above figures are as follows: Grafenstaden miller, working surface of table, 1,400 by 315 millimeters; J. E. Reinecker miller, working surface of table, 1,250 by 350 millimeters.

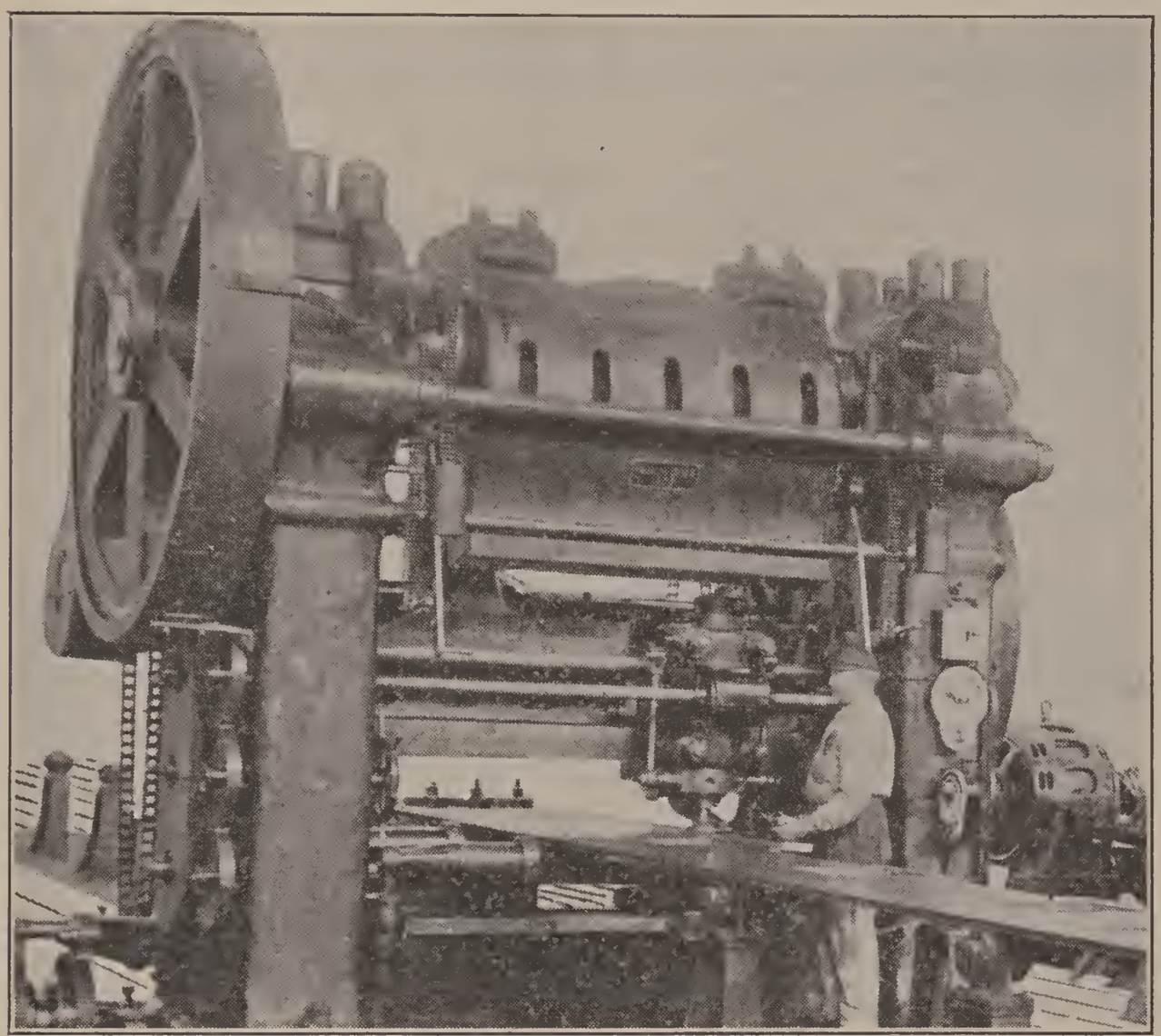

FIG. 3.—Motor-driven locomotive frame plate punching machine (Vulkan, Vienna, make). The price paid by Floridsdorf for this tool was 60,000 crowns (crown=20.3 cents).

Three heavy Lodge & Shipley engine lathes were observed in service. These tools were pronounced "very good." There is a line of Sellers grinders here for point drilling. I understand that these Sellers grinders were bought at the time of the Vienna Exposition. Some alterations have been made in the Sellers designs. When the spiral tool grinder patents were brought out they were bought by Floridsdorf for use in Austria.

EUROPEAN TOOLS IN USE.

The English firm of Alfred Herbert (Limited) has supplied a number of tools of the hexagonal turret lathe and turret lathe types.

Many of the horizontal borers in use have been supplied by Grafenstaden. In Italy, Ernault horizontal borers were found doing a great part of the cylinder work, but at the Austrian shops the cylinder borers are mostly German tools.

Richards & Co., of Broadheath, England, have supplied one long shaper. The standard shapers in use comprise many tools, the make of the Floridsdorf shops.

The only French tool observed was from Bouhey, of Paris. This firm supplied a vertical miller. Most of the gears are being cut on tools furnished by Schiess and by Ducommun.

Collett & Engelhard have supplied a heavy double vertical miller. This tool was at work milling fire-box foundation frames. The metal under service was soft Martin steel of the following quality: Tensional strain, 32–38 kilos per millimeter; percentage of elongation, 30; percentage of contraction, 60. These Collett & Engelhard tools are very much in use in Continental locomotive works.

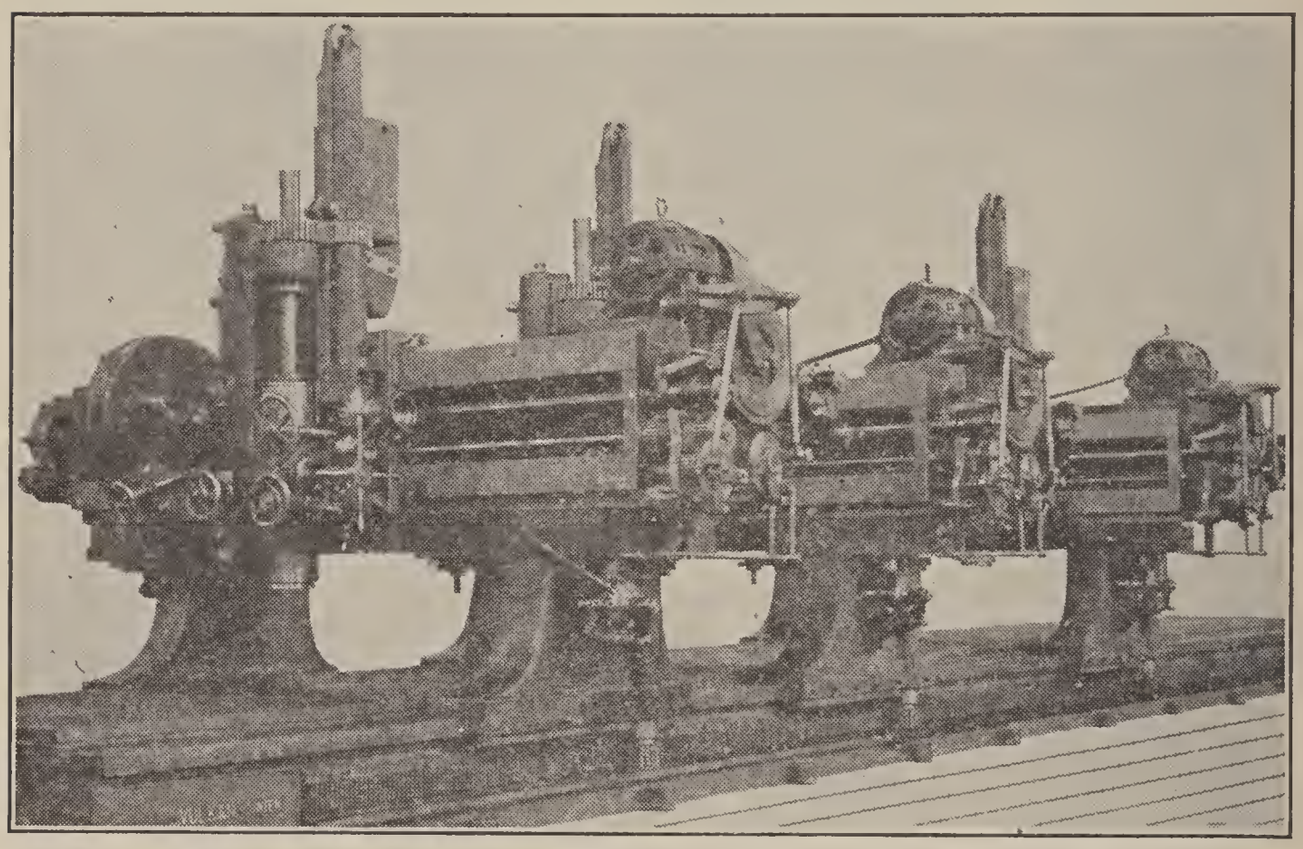

FIG. 4.—Motor-driven locomotive frame slotting, boring, drilling and milling machine (Vulkan, Vienna, make). The price paid by Floridsdorf for this machine was 70,000 crowns.

The Vulkan Works, of Vienna, have recently supplied a heavy punch tool for locomotive framing, which is shown in the illustration. This machine is capable of handling plates 12 meters long, 1,400 millimeters wide, and 40 millimeters thick. The tool was at work punching plates of 40 millimeters thickness. This was iron plate of 40 kilos tensile strength per square millimeter. The diameter of the blanks after punching was two inches.

MOTOR-DRIVEN MACHINE.

A very fine motor-driven 3-frame slotting, boring, drilling, and milling machine from the Vulkan Works, of Vienna, was observed, which is shown herewith. This tool is designed for working up locomotive frames in sets, and is capable of handling frames having maximum dimensions of 12 meters long, 1,600 millimeters wide, and

350 millimeters high. This machine has replaced a heavy slotter which was formerly used on plate frames, the make of Fairbairn, Kennedy & Naylor, of Leeds, England. The price paid for the Vulkan punch machine was 60,000 crowns ($12,180), and the price paid for the slotting, boring, drilling, and milling machine was 70,000 crowns ($14,210).

The locomotive frames are handled in the Floridsdorf shops from tool to tool by electric cranes, and no hand labor is used in transporting these frames.

Many of the small lathes in service at Floridsdorf were built at these shops. Böhler tool steel seems to be in general use at Floridsdorf. Pfaff, of Chemnitz, has supplied a number of lathes. It was also observed that Vulkan planers are fitted with electro-magnetic couplings.

It is the practice in the Floridsdorf shops to use a roller press on shaft bearings, as the use of emery is not permitted on axles. A number of heavy Whitworth lathes are installed in these shops.

There are many Grafenstaden millers in use, and heavy Grafenstaden horizontal milling machines are used in milling shoe boxes

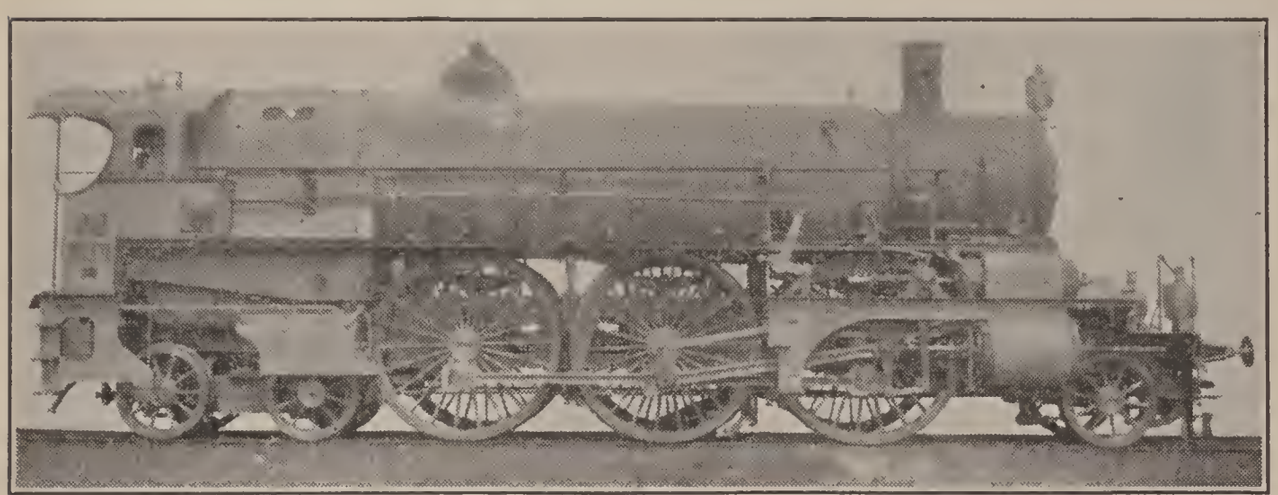

FIG. 5.—Series 210 locomotive built by the Wiener Locomotive Fabriks-Actien-Gesellschaft, Floridsdorf, Vienna.

and connecting rods of locomotives. Reinecker supplied one large 4-spindle vertical miller, and also a number of tool grinders. Smith & Coventry, of Manchester, are also in evidence with tool grinders. All tool grinding is intrusted to a tool-grinding gang and individual workmen are forbidden to grind their own tools.

LATEST TYPE LOCOMOTIVE.

In 1908 Floridsdorf brought out its latest type of locomotive, pictured herewith, known as series 210, built to the design of the well-known engineer, Charles Gölsdorf. This is a really superb machine and represents the very highest type in design, workmanship, and finish. The opinion is held at Floridsdorf that the general tendency is to increase boiler pressure, and Floridsdorf is operating series 210 under 15 atmospheres pressure. The total length of boiler barrel is 4,280 plus 1,450 millimeters, the latter representing the length of superheating room. The length of the fire box is 2,700 millimeters. The total amount of heating surface is 292.4 square meters; the grate surface is 4.62 square meters. This engine is a 4-cylinder machine, the dimensions of cylinders being: Two high-pressure cylinders,

diameter 390 millimeters; 2 low-pressure cylinders, diameter 660 millimeters; common stroke, 728 millimeters. The diameter of the driving wheel is 2,140 millimeters, and the diameter of the trailers and pilot wheels 1,034 millimeters. The fixed wheel base of this heavy engine is 2,220 millimeters. The total distance between the axle of the pilot wheel and the rear trailers (total wheel base) is 10,450 millimeters. The total weight of the engine in working order is 84.5 tons.

The 210 series locomotive is capable of hauling, upon a gradient of 1 per cent, 400 tons at a speed of over 60 kilometers (37.3 miles) per hour, and on a straight road 400 tons at a speed of over 100 to 105 kilometers (62.1 to 65.2 miles) per hour. This engine develops about 1,800 horsepower.

HOURS OF LABOR AND WAGES.

A week's work at Floridsdorf involves 54 hours, a day being made up of 9 hours' work. There is no overtime work. On a 9-hour-day basis the output at Floridsdorf is at present 10 locomotives per month. Good machinists receive on an average 65 hellers (13.2 cents) per hour. Ventilation and attention to sanitation are exceptionally good throughout the shops. Overhead heating is employed, and the tool drive, almost without exception, is electric.

The Floridsdorf engines are held to be among the best turned out in Europe, and the attention to detail and high finish is of marked character. The discipline at the Floridsdorf shops forcibly impresses one at the outset, and nowhere else in Austria-Hungary have I observed more evidence of welfare work for employees than at this plant. The company owns not less than 19 dwelling houses (180 quarters), which are rented to the workmen. The prices at which these quarters are let are as follows, per week: For two rooms and kitchen, 5.2 crowns ($1.02); for one room and kitchen, 3.8 crowns (77 cents). From the founding of the company up to 1908 the Floridsdorf Works have paid out in salaries and wages 37,500,000 crowns ($7,612.500).

WIENER-NEUSTADT LOCOMOTIVE WORKS.

The Wiener-Neustadt Locomotive Works are one of the important private locomotive plants in Austria. The shops are located in Wiener-Neustadt, a city of some 28,000 inhabitants, and distant about one hour's time by fast train service from Vienna. In June, 1909, 2,200 men were employed. General Director Richard Heindel afforded every facility to inspect the shops. The full name of this establishment is Actien-Gesellschaft der Locomotivfabrik vormals G. Sigl in Wiener-Neustadt. During the summer of 1909 business was so good that foreign orders could not be accepted because of the heavy demands of the Austrian State Railways. Ordinarily, the Wiener-Neustadt shops are active bidders for locomotive work for the Roumanian, Servian, and Italian railways.

CAPACITY AND OUTPUT.

The total output capacity of the Neustadt plant is about 120 locomotives of all sizes per year. This is not a very heavy output when one considers the five locomotives per day capacity of one of the American works, but in making comparison of this sort it is necessary to

reckon on the types of locomotives built. Wiener-Neustadt, in common with other European shops, constructs copper fire boxes, and uses copper stays and bolts. Great care and attention are given to finish and appearance, and the idea prevails that a machine must operate for 20 years or more. These views are opposed to American practice in so far as they subordinate immediate work capacity to longevity, and by work capacity I mean bar pull. Naturally in a shop where care

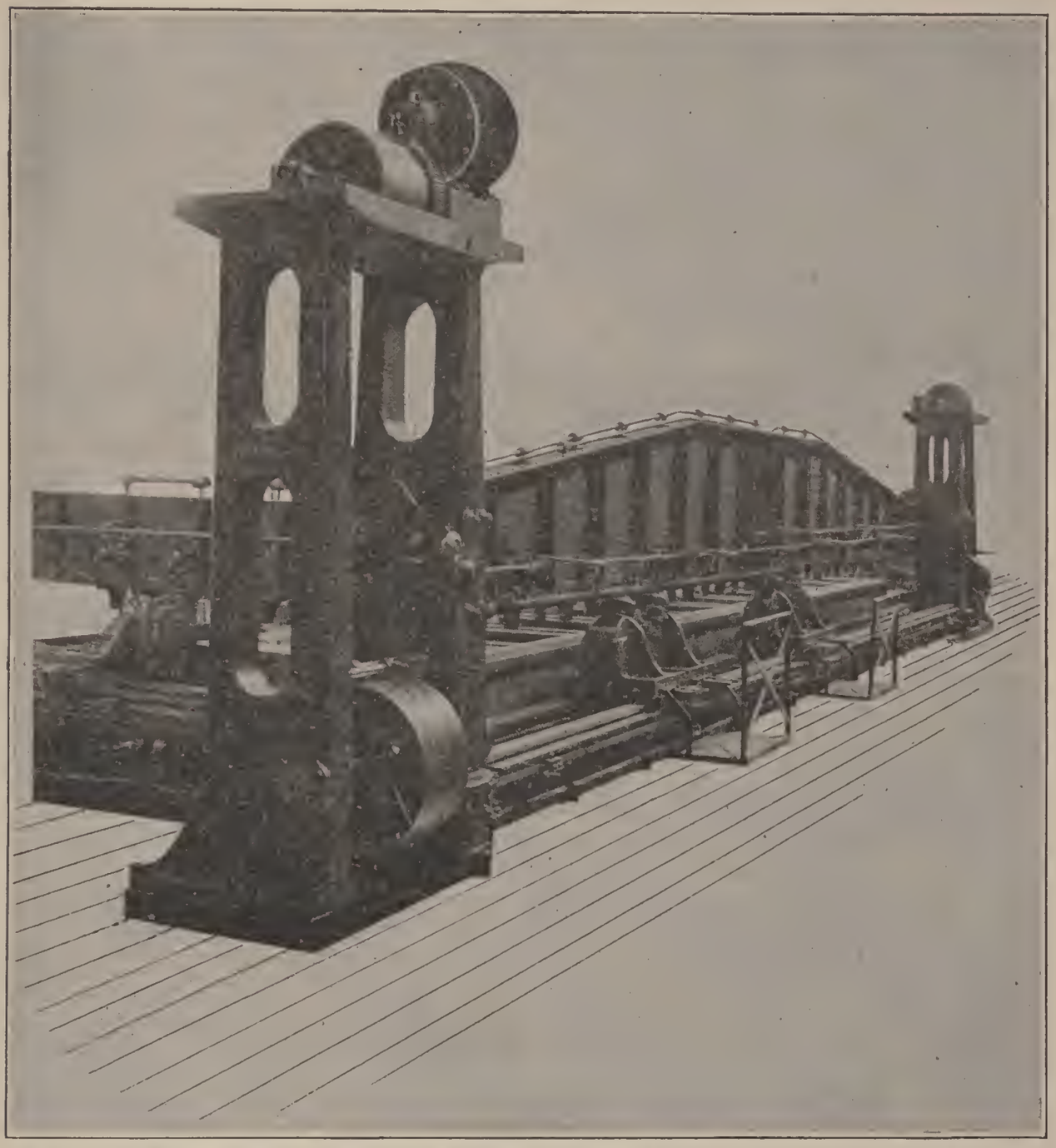

FIG. 6.—Double plate-planing machine. This machine planes a length of 11 meters with one tool head and 6 meters with the second tool head. The side tool planes a length of 3 meters and can be set out of right angle to front of machine. The Vulkan Works also make this machine without belt drive on uprights, with direct motor drive, and gearing with Vulkan clutch. Each of the 3 motors are of 20 horsepower.

and attention to detail are of paramount consideration one expects to find good workmanship, and it may be stated that the work which came under my observation is of as high a standard as I have seen on the Continent of Europe. Observations of this sort are of course relative, and are based on comparisons. In visiting different shops one finds, perhaps, special aptitude in some particular detail more highly evinced at one rather than at several works. At Wiener-Neustadt the boiler work was especially noticeable, and aside from

the good workmanship there this part of the establishment is the most modern and interesting. Locomotives of all sizes up to 1,200 horsepower are built. The latter figure may not sound large compared with the 2,000-horsepower engines used on several leading railways in the United States, but for Continental work 1,200-horsepower engines are very large engines. In the building of locomotives, when called upon to supply superheaters for the Austrian State Railways, recourse is had to the Gölsdorf type.

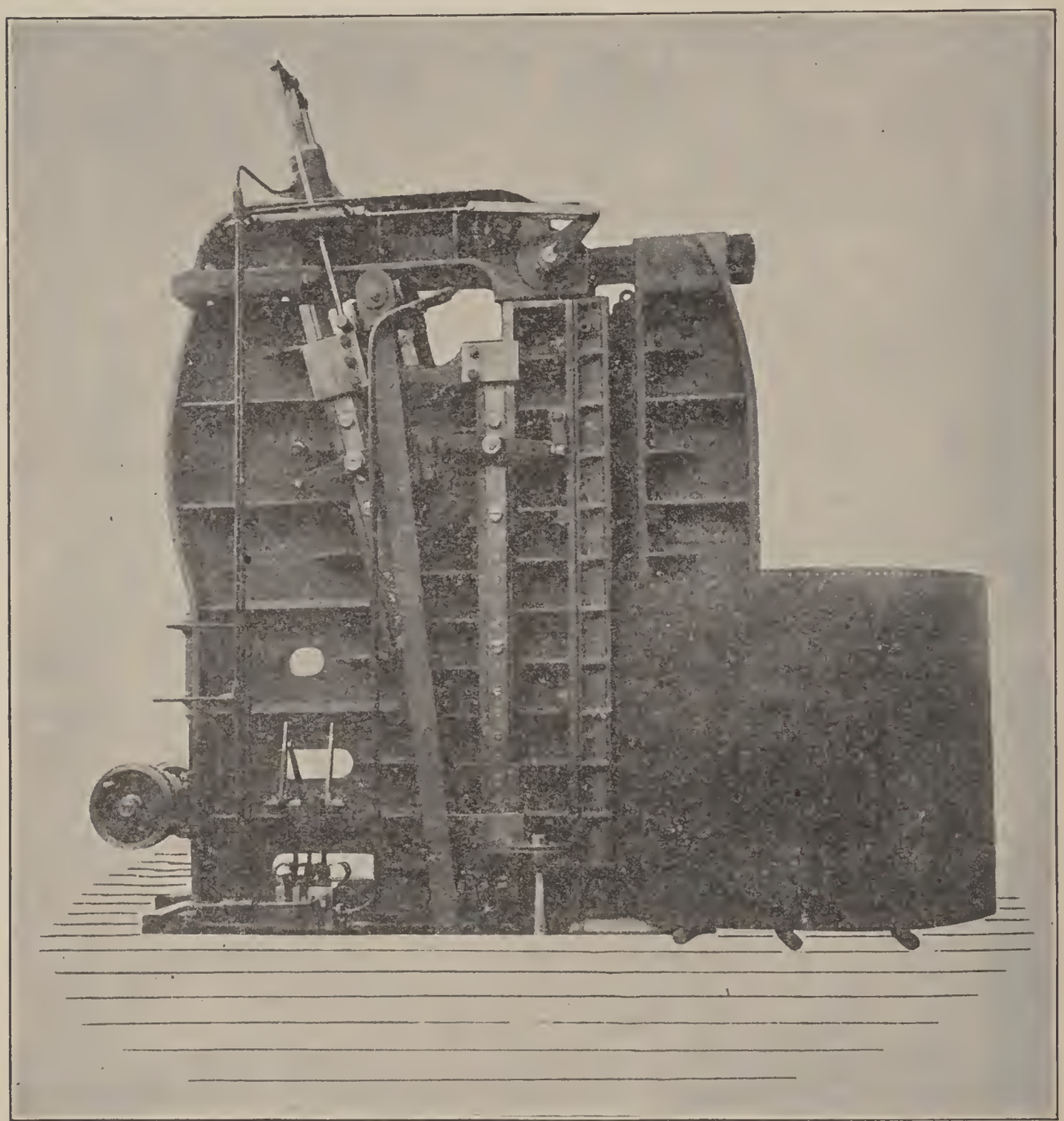

FIG. 7.—Hydraulic plate-bending machine. This tool can be utilized for bending boiler plates up to 10 feet in width and 1¼ inches thick.

The Wiener-Neustadt Works have been in existence for about 50 years. Tools are in service to-day in the shops which have been used for upward of 40 years. One man stated in my presence that he had been working steadily at the same machine for 28 years. The tool was a Sigl lathe for turning down crank shafts. This man receives between 8 and 9 kronen per day (1 krone=20.3 cents).

EXTENSION OF WORKS.

At the outset the efforts of the plant must have been devoted in part to machine-tool construction, for many tools were observed bear-

ing the name of Sigl, the originator of the works. The history of the establishment was not without vicissitudes, and in recent years several changes have been made in the management. General Director Heindel has been in control during the past two years, and the busy appearance of the shops gives every indication of prosperous conditions. New additions are constantly being made, and during the year 1909 a sum approximating 2,000,000 kronen ($406,000) was expended on new boiler and machine shops. The new machine shops are quite apart from the old works, and while the buildings are completed and machine tools are being installed, the equipment is not complete. It is very apparent the management contemplates many important additions to the machine-tool equipment, both to meet the demands of the new shops and to modernize the older portions of the works. This is seemingly the policy that is planned, and one which should be borne in mind by manufacturers possessing high-grade machine tools especially adapted to locomotive work. The entire spirit of the Wiener-Neustadt administration is eminently progressive, and it is my opinion that manufacturers producing machine tools of more than ordinary merit will find that any representations they make on the subject will be welcomed at this establishment.

MACHINES EMPLOYED.

The Wiener-Neustadt Works are building all locomotives on the plate-frame form. These plate frames are cut out with oxygen gas. In this respect the Wiener-Neustadt shops follow the Borsig practice. Practically all material entering into the locomotive construction comes from Austrian territory. In all, there are about 1,300 machine tools in service in the works. In the original shops, in fact in all the buildings except those erected during the past two years, one finds many old tools. The name "Sigl" is on many of these tools, yet Sigl, as a machine-tool maker, no longer exists. In the new shops there are many German tools, although a Bullard boring mill was noticed in one of the latest-installed sections. The Vulkan Works, of Vienna, have supplied a number of machines of a varied sort. The lathes used in general are very old, but it was gratifying to observe that in recent additions an American tool was on the ground in the shape of a heavy 20-inch Lodge & Shipley engine lathe. There were quite a number of unmistakable American-made tools on the floors, but with the names of the makers missing.

The planers used are, for the most part, as old as the general run of the lathes. There are only two modern planers, so far as could be observed, in the entire plant. These two were from the G. A. Gray Company, Cincinnati, Ohio.

AMERICAN AND OTHER FOREIGN TOOLS.

Four slotters from Bement, Miles & Co., Philadelphia, were seen. The name and numbers of the machines were cast in the framing and had not been effaced. The numbers were 680, 712, 713, and 715. Prentice Brothers Company, of Worcester, Mass., are represented by a greater number of tools than any other American firm. The Prentice machines are for the most part upright drills. There was one unmistakable Gisholt turret lathe, but with the name missing.

The shaper line at this works is also old. There is one line of crank-shapers in service emanating from Vulkan which was installed fully 30 years ago.

Some of the more recent German-made tools in use are heavy machines, and nearly all, or the more conspicuous, are to be found in the new shops. Grafenstaden has supplied several tools for cylinder boring. Sondermann & Stier, of Chemnitz, have supplied several heavy vertical drills, and D. G. Diehl, of the same place, has also been drawn on extensively.

There are very few English tools in service. I saw only Kendall & Gent radial drills and some slotters from Maclea & March.

A Mayer & Schmidt vertical grinding machine was present, but was criticised. In previous reports it has been mentioned that the opinion prevails that American grinding machines are not equaled by the best grinding machines of European make.

All tools in the Wiener-Neustadt Works are to be operated by electric power, either from motor attached or by overhead shafts driven by electric motors placed at various points throughout the shops. Two Parsons turbine engines have been installed and furnish collectively about 1,600 horsepower.

The Saechs Maschinenfabrik vorm. Rich. Hartmann, of Chemnitz, and Ernst Schiess, of Dusseldorf, have supplied some heavy tools for Wiener-Neustadt. Schiess is represented by a heavy tool for turning off locomotive wheel tires, and Hartmann has supplied a heavy turning and boring machine.

In the boiler shops there is a 15-meter long machine from the Vulkan Works, of Vienna, designed for drilling plates. Sondermann & Stier have furnished a 4-spindle machine for drilling boiler heads, a tool not unlike that made by the Foote-Burte Company, Cleveland, Ohio. There is also a 5-spindle machine in service for the same character of work from the German firm of J. A. Maffei, Munich. Practically all the heavy tool orders seem to have been taken by the Germans. The American tools in service at the Wiener-Neustadt Works include the following:

Prentice Brothers Company, Worcester, Mass	Drills.
Bullard Machine Tool Company, Bridgeport, Conn	Boring mill.
Bement, Miles & Co., Philadelphia	Slotters.
American Tool Works Company, Cincinnati	Lathe and drills.
G. A. Gray Company, Cincinnati	Planers.
Lodge & Shipley Machine Tool Company, Cincinnati	Lathe.
Bickford Machine Tool Company, Cincinnati	Radial drill.
Gisholt Machine Company, Madison, Wis	Turret lathe and vertical turret lathe.

The pneumatic tools in use in the boiler shops are of German make. There are in use also tools made in England, Austria-Hungary, and Switzerland.

A day's work at Wiener-Neustadt embraces 9½ hours. Work commences at 7 a. m. and stops at 6 p. m., with an interval of 1½ hours at midday. On Saturdays the shops close at 5 p. m. The men are paid on the basis of a fixed valuation for work performed. If the work is not completed by the week end, the workmen are given advances on the final price for the work. Good workmen at Wiener-Neustadt receive wages varying from 8 to 9 kronen ($1.62 to $1.83) per day. In exceptional cases sums as high as 12 kronen ($2.44) per day are earned.

DAIMLER WORKS.

The installation of machine tools at the Austrian Daimler Works is one of the best I have seen in Europe. This statement applies with special reference to automobile plants. The Austrian establishment is located in Wiener-Neustadt, a city distant about one hour's railway ride south of Vienna. The full name of this Austrian concern is Oesterreichische Daimler-Motoren-Gesellschaft. In visiting the Daimler shops I expected to see an up-to-date plant, but was not prepared to find one of the first shops in Europe. The works fairly bristle with high-grade American machine tools. At the entrance of the main building the first tools encountered were three Gleason gear planers. "Those Gleasons have never been idle," said Doctor Horovitz. "They have been running steadily for two years, and always accurately."

A little farther on was a line of five Gisholt vertical turret lathes doing a greater variety of work than I have seen them put to in any

FIG. 8.—Armored cars.

European shop. They have good workmen here, but I suspect that special instruction has been given, for the "wrinkles" of the Gisholts are apparently thoroughly understood. In the vertical milling line it is all Becker-Brainard machines. I know of no one American machine tool in higher favor among European shops than the Becker vertical miller, and time and again the writer has been asked why it is that Becker does not increase his sizes. In the Becker group there was observed one No. 4 B, one No. 3, four No. 5, and three No. 6 machines. In the horizontal, plain, and universal miller line, Cincinnati milling machines are alone in use. No other American millers of this class, so far as I could see, are present. I estimate that there are in service at least ten Cincinnati millers of the No. 2 and No. 3 universal types.

Hendey, Prentice Brothers, and Bradford lathes of the medium sizes divide all honors in the engine-lathe class. Warner & Swasey have on the floors a couple of fine hexagonal turret lathes of the No. 2 size, and Gisholt also is in evidence with turret lathes. There is a

Gould & Eberhardt gear cutter in service, but between the Gleason and the Gould & Eberhardt machines is a group of four hob machines supplied by Schuchardt & Schütte. These hob machines are devoid of manufacturer's name. The same firm of agents supplied two shapers, but the shapers are without the name of the maker. There are several foreign lathes in use, but they are of the heavier types. Hessemuller is one of the German makers who has been drawn upon for lathes. It being noticed that a couple of Potter & Johnston automatic machines were lying idle, Doctor Horovitz stated that work was too slack to use these machines to advantage.

FIRE ESCAPE AND MILITARY AND TRANSPORT VEHICLES.

The Daimler Works operate the Daimler patents, but with the exception of the patent interests invested the company comprises only Austrian capital. In addition to a line of automobiles, the company is turning out a number of important military wagons, and is also building as a specialty a type of fire-escape vehicle. The

FIG. 9.—Military transport wagon.

latter is in service in Berlin and Vienna. These fire-escape vehicles are electrically driven by means of motors directly attached to the wheel hubs. This arrangement does away with chain drives and permits of instant dispatch of the vehicle. Holland has drawn on Austrian Daimler for these fire-escape machines.

Transport wagons of all descriptions are undertaken by Daimler, and it was clearly evident that there was more originality in this line than at any shop I have visited on the Continent. Daimler draws largely on Chillingsworth, of Nurnberg, for chassis frames, and on Firminy, France, for springs. Poldihütte, of Austria, also furnishes some of the springs, and Bielefelder Press & Ziehwerke, of Brackwede, Germany, also supply chassis frames.

The differential boxes as turned out here are made of pressed steel. All ball bearings in use are purchased and come for the most part from the Loewe Ammunition Works in Berlin, Fichtel & Sachs, Schweinfurth, and Oest. Kugellagerwerke, Vienna.

My attention was called to two 90-horsepower 6-cylinder machines building for the Austrian Government, designed to carry guns up to

20 tons weight. I was advised that as many as 30 special gun-wagon machines had been built. All four wheels are driven, and the machines are built with special reference to mountain service. These machines, I was informed, will negotiate under a 20-ton gun load a very high per cent grade. The steel for the wheels for the military wagons is furnished by Georg Fisher, of Schaffhausen, Switzerland, who gives a 5-year guaranty.

ELECTRICAL, BENZOLE, AND PETROLEUM POWER.

Daimler is manufacturing engines to use benzole as well as petroleum. In the electrically driven machines the Daimler practice favors building the motors directly in the hubs, and thereby avoid all transmission system. The accumulators for these electrical machines are carried between the chassis frames partly in a built-in box, partly under the bonnet.

The traffic wagons building by Daimler are electrically driven and are designed to cover 100 kilometers (kilometer=0.62 mile). These

FIG. 10.—Military transport wagon using winding gear on grade.

cars have a 30-kilometer-per-hour speed. Still another specialty of Daimler is an electric omnibus designed to move by overhead wire, but without rails. Systems of the latter sort are recommended for extension of trolley lines in the country where good roads are available. Motors for boats are also built at these works.

The leading technical engineer at the Daimler Works is Herr Porsche, who is also director of the works. He was originally of the firm of Lohner-Porsche. A combination of the old Austrian Daimler Works and the Lohner-Porsche firm was effected, and the electrical patents of the latter were purchased for the new firm.

In connection with the electrically driven engines and vehicles for fire service, the Daimler system is equally suitable for adoption on the front wheels and on the rear wheels, but the standard type is front driven. A standard design has been adopted for carrying weights as high as 5,800 pounds. The weight of the batteries is from 1,600 to 2,000 pounds. The battery consists of 80 or 84 lead cells, the rated charging being 220 volts. The whole of the cells are distributed in four boxes. The capacity is commonly 120 to 160 ampere-hours. A

radius of 38 miles is claimed, the consumption current remaining below 90 watt-hours per 1 ton-mile.

The motor has inner magnetic poles. The magnetic "star" is fastened on the axle when rear wheels are driven, or on a hollow axle stump, turning round pivots, when the chassis is front driven. The anchor is an outer one. The coils are manufactured of flat copper ribbon. The collectors are of plain type and are disposed on the outer side of the motor wheels. Five speeds forward and three

FIG. 11.—Military transport wagons.

speeds backward are obtained. There are three positions for electric breakings. Solid rubber tires are used on these vehicles.

AMERICAN TOOLS IN SERVICE.

The American machine tools in service in the Daimler Works include the following:

Lapointe Machine Tool Co., Hudson, Mass	No. 3 machine.
Waltham Watch Tool Co., Springfield	No. 2 Van Norman duplex miller.
Becker-Brainard Milling Machine Co., Hyde Park	Vertical milling machines.
Hulbert-Rogers Machine Co., South Sudbury	Cutting-off machines.
Prentice Brothers Co., Worcester	Lathes, drills.
Millers Falls Company, Millers Falls	Saw machines.
Potter & Johnston Machine Co., Pawtucket, R. I	Automatic turret lathes.
Hendey Machine Co., Torrington, Conn	Lathes.
Gould & Eberhardt, Newark, N. J	Gear cutter No. 640.
American Gas Furnace Co., Elizabeth	Gas furnaces.
John L. Bogert, Flushing, N. Y	Machine for turning down crank pins.
Gleason Tool Co., Rochester	Gear planers.
C. C. Bradley & Son, Syracuse	Hammer.
Landis Tool Co., Waynesboro, Pa	Grinders.
Springfield Machine Tool Co., Springfield, Ohio	Shapers.
Baker Brothers, Toledo	Keyseaters.
Fosdick Machine Tool Co., Cincinnati	Radial drills.
Tucker Machine Co., Cincinnati	Grinders.
Cincinnati Machine Tool Co., Cincinnati	Vertical drills.
Bradford Machine Tool Co., Cincinnati	Lathe.
Cincinnati Milling Machine Co., Cincinnati	Millers.
Bickford Drill and Tool Co., Cincinnati	Radial drills.
Acme Machinery Co., Cleveland	Bolt cutter.
Cleveland Automatic Machine Co., Cleveland	Seven machines.
Warner & Swasey Co., Cleveland	Hexagonal turret lathes.
Gisholt Machine Co., Madison, Wis	Vertical and horizontal turret lathes.

The total number of machine tools in the Daimler Works is 360, nearly all of which were bought within the past 3 years. The total cost of this installation—that is, the total cost of the machine tools laid down in Wiener-Naustadt—was approximately 1,200,000 kronen (1 krone=20.3 cents).

COST OF MACHINES—WILLINGNESS TO ADOPT IMPROVEMENTS.

The prices paid by Daimler for various machine tools in use, including spare parts and accessories, were as follows:

John L. Bogert, machine for turning down crank pins, No. 22, $2,060. Prentice Brothers Company, lathe, 255 by 1,600 by 3,050 mm., $860; vertical drills, w. p. 1d. $111. Hendey Machine Company, lathe, 205 by 760 by 1,830 mm., $688. Gisholt Machine Company, turret lathe, No. II, $2,647; vertical turret lathes, No. 0, $1,631. Landis Tool Company, grinders, No. 1½, $926. Warner & Swasey Company, hexagonal turret lathes, No. II, $1,760; hollow hexagon revolver lathe, $1,535. Potter & Johnston Machine Company, automatic turret lathes, No. II, $2,619. Cleveland Automatic Machine Company, 51 mm. automatics, 3-spindle, $1,208; No. 1¼ automatics, 5-spindle, $2,660. Gleason Works, gear planers, No. I, $2,033. Becker-Brainard Milling Machine Company, vertical milling machines, No. IV, C, $935. Cincinnati Milling Machine Company, milling machine, No. 2, $805. Lucas Machine Tool Company, press for 30 atms., $545. C. C. Bradley & Son, hammers, A No. IV, $1,133. Yahley, pneumatic hammer, II, 1h. IV, $1,789.

The Daimler Works may be regarded as a fixture among Austrian industrial plants. Whereas conditions were quiet at this establishment at the time of my visit in June, this state of affairs is held to be temporary. The men who are now at the head of the Daimler shops may be expected to be on the outlook at all times for the best machine tools obtainable regardless of origin, and no American manufacturer should hesitate to make known to the Daimler management the availability of tools possessing merit. American machine tools are at present in high favor at the Daimler Works, and it behooves manufacturers to keep this firm advised of all developments in machine-tool lines. American directors who pass through Vienna may well spend a day by dropping down to Wiener-Neustadt and visiting both the Daimler Works and the Neustadt locomotive shops. By fast train the time is about one hour.

The foreign machine tools in the Daimler Works include the following:

Friedr. Schmaltz, Offenbach, Germany	Vertical grinder.
Ludwig Loewe, A. G., Berlin	Lathe, shapers, and turret lathes.
Werkzeugmaschinenfabrik Ludwigshafen, H. Hessemuller	Heavy lathe.
Billeter & Klunz, Aschersleben, Germany	Hammer.
Maschinenfabrik Lorenz, Baden, Germany	Slotters, and vertical drills.
Schuchardt & Schütte, Berlin, Germany	Hob machines and shapers. (No name of makers on machines.)
Joh. Müller, Vienna, Austria	Planer.

BUDAPEST LOCOMOTIVE WORKS.

The Budapest Locomotive Works are turning out several types of locomotives more nearly approaching American standards than will probably be found in any other European shops. The writer bases this statement on personal inspections of leading locomotive establishments in Germany, Switzerland, Belgium, France, and Austria. It may be said further that the Prairie and Atlantic types of locomotives, which the Hungarian State Railway shops are now turning out in Budapest, are unexcelled on the Continent. These Prairie and Atlantic types are complete American locomotives. Imagine one of the most modern of the big Prairie class of engines of the Chicago-Denver lines, equipped with copper fire boxes and copper stay-bolted throughout, with a valve gear of the highest efficiency, with a machining on all engine parts fit for exposition display, and one has a picture of the new Hungarian locomotive. There is still another feature which should be mentioned: These Hungarian locomotives are designed and built to do service for 20 years and more.

There is undoubtedly a strong American sentiment among the Budapest engineers, and recently the Budapest locomotive officials suggested that it might be advisable to follow the American practice and substitute steel fire boxes for the very expensive copper equipment. It is said that the question was not discussed officially, but was more in the nature of a suggestion in case copper prices should advance materially.

EUROPEAN VERSUS AMERICAN LOCOMOTIVES.

Attention has been repeatedly called to the exacting attention to detail and high finish demanded in the European trade. European locomotive builders have repeatedly stated that they wished it were possible to escape from many of the seemingly unnecessary conditions imposed upon them by designs and specifications. It should be understood, however, that many of these designs emanate from government sources, and throughout Europe in general a very large part of the locomotive building is for government-owned railways. The standard set by these government requirements has a marked influence on locomotive building, even to private orders. The pace has apparently been set in Europe which admits of competition only on the part of engines of the highest design and finish. Here is one of the principal reasons why American-built locomotives are practically excluded from the European field. This does not imply that our own locomotive shops can not meet European requirements. The distinction is one of conditions attending the building of locomotives. The requirements in Europe and the United States are not the same.

OPENING FOR AMERICAN EQUIPMENT.

The Budapest Locomotive Works are owned by the Hungarian State and controlled by the Ministry of Finances. The correct name and address of the plant is Magyar Királyi Államvasutak Gépgyára, Budapest, Hungary. In English, these works may be properly referred to as the Machinery Works of the Royal Hungarian State Railways.

Under the personal escort of Engineer-in-chief Béla Kanitzer every facility was afforded to see both the work in progress and the machine-tool installation. The number of men employed in June, 1909, was not less than 4,200, and the machine-tool installation comprises more than 2,000 machines of every design and make. The most exacting work is conducted in the building of not only locomotives, but gas engines, engines for motor cars and locomobiles, and yet, throughout this entire plant, the entire lot of American machines in service does not exceed 16 tools.

In all Europe there is probably no field so open to American machine-tool manufacturers as Hungary. There are other countries which readily buy American machine tools. France, for example, has long been an excellent customer of the United States, but the French buy American machine tools largely because of the merit of the machines. In Hungary there is a strong pro-American sentiment. The very word "America" appeals to the Hungarian mind, and the cordiality and hospitality accorded to visitors from the United States is usually of a marked character. The Hungarians may be expected to be prejudiced in favor of American products. Why, then, are there not more American machine tools in these great Hungarian plants? The answer received from one prominent Hungarian official was a query in return, "Why is it that Americans do not come to us in person?"

Many machine tools from Alfred Herbert (Limited), of Coventry, England, were found in the Budapest locomotive shops. Mr. Kanitzer said that Herbert's engineers paid periodical visits to Budapest and personally instructed the locomotive workmen in the management of Herbert machines. An inspector from Coventry comes to Budapest at varied intervals and personally takes notice of the running of the tools. Herbert has gone further, and induced the locomotive works authorities to send over to Coventry five of the leading workmen from the Budapest shops. These men will be instructed at Coventry and will undoubtedly learn much regarding the varied lines of machines as manufactured for modern-day requirements.

The language which Americans should speak in Hungary is English; if not English, then French.

FOUNDING AND DEVELOPMENT OF THE WORKS.

The present Budapest Locomotive Works may be said to date from 1868. In that year a Belgian firm, A. & E. Gillain, established The Hungarian-Belgian Machine and Ship Building Company. The Gillains formerly possessed machine works in Brunn, which they gave up for the new shops in Budapest. The Gillain firm was forced into liquidation in 1870, and the works passed into the hands of the Hungarian Government. Incidental to the failure of the Gillain company was the liquidation of the Swiss Carriage Works at Budapest. The Hungarian Government likewise secured the latter plant and united it with the Gillian works. The combined shops were turned over to the Engine and Carriage Works of the Royal Hungarian State Railways.

It would seem as if the Hungarian authorities were not desirous of maintaining the shops under government administration, so in 1871 both of the shops incorporated and submitted to a separate adminis-

tration. Director Frederick Zimmermann was intrusted with the locomotive shops, under the inspection of the council of administration of the Hungarian State Railways. Largely due to Mr. Zimmermann's energy, the works developed, but the growth of the plant was a most uncertain one. Between 1874 and 1878 the shop was compelled to undertake almost any order that was obtainable to insure keeping the workmen employed. On one occasion the finances were in such a precarious state that it was found necessary to separate the original factory as a works chiefly for new locomotives and to assign the administration to the Royal Hungarian State Railways. In 1880 the administration of the Royal Hungarian Iron Works in Diosgyor was united with the Budapest Locomotive Works, the combination being known as The Machinery Works of the Royal Hungarian State Railways and The Diosgyor Iron and Steel Works. This arrangement existed until 1900. Since that time the shops have had their own chief (at present Royal Counsellor Paul Roth), but with other state iron works are under General Director Charles Vajkay, head clerk of the Ministerial Department, otherwise the Central Direction of the Royal Hungarian State Iron Works, Budapest.

At the Paris World's Fair in 1878 the Budapest shops entered a locomotive and a 200-horsepower steam engine, the latter fitted with a special patented valve motion. The building of locomotives, however, may be said to date from 1877. In 1879 the shops undertook to build steam thrashing machines. Prior to this time Hungary had been dependent almost wholly on England for steam thrashers.

In 1896 the combined organization made a most notable exhibit at the Budapest Exposition. The main machinery hall at that exposition was built at the Budapest Locomotive Works. It was a superb arched steel construction, having a length of 62 meters (203 feet), a width of 26 meters (85.3 feet), and an extreme height of 20 meters (65.6 feet). At the close of the exposition this main machinery building was removed and reerected on the ground of the Budapest Locomotive Works, and is to-day, in the main newly built and considerably enlarged, one of the principal erecting shops of this plant.

MACHINERY DEPARTMENT AND MACHINE TOOLS.

The very general recourse to shaping machines was first in evidence. All sorts of jobs are handled in the Budapest shops on shapers, and the regret is that there is not one American shaper, at least so far as one could see, anywhere in the works. The presence of a couple of high-class American shaping tools on the Budapest floors might effect a very material change in the situation. There is a boring mill in service which was supplied about fifteen years ago by Bement, Miles & Co., of Philadelphia. The same company furnished a planer. The boring mill, it was stated, has done very good work. There was a machine from the Lodge & Davis Machine Tool Company, of Cincinnati, and also a Niles horizontal boring machine. There was only a mere handful of tools of American origin, and it was very evident that American machine tools are not reaching the Budapest locomotive shops.

Among the foreign and Hungarian tools present were many lathes and shapers from the Vulkan Works; this firm has a new plant at Budapest. Still another Hungarian firm, viz, the Hungarian Gun and Machine Works, has supplied a number of tools. Zimmerman,

of Chemnitz, has supplied numerous radial drills. Other foreign makers represented included such names as Ducommun; Joh. Müller, of Vienna; Gebrüder Böhringer; Alfred Herbert; Maclea & March, of Leeds; Sondermann & Stier; Werkzeugmaschinenfabrik A. G., Cologne; Heinrich Ehrhardt; Oerlikon; Webster & Bennett; Kirchner; J. & C. J. Bollingers, and special tools from Maffei, of Munich, and from Bechem & Keetman, of Duisburg.

There was a comparatively larger number of boring mills and vertical turret lathes in service than one is accustomed to see in Continental shops of this character.

ELECTRIC POWER—PLANING AND FINISHING.

At the present only a portion of the Budapest Works is provided with electric power for machine tools. There is one 1,000-horsepower Zoelly turbine in the central station. This turbine was built by Láng. It is understood that it is the intention to afford electric drive for all the shops.

Ludwig Loewe, of Berlin, and the Karlsruhe firm of G. Schwindt & Co. have supplied a large number of planers. The Austrian firm of Vulkan has also supplied planers. Some of these Vulkan planers are fitted with an electric controlling gear, which is well spoken of. Practically all engine parts are machined on shapers. Zimmermann and Vulkan are most in evidence with this last type of tool. Engineer-in-Chief Kanitzer states that he prefers to finish off the edges of all plate framing with slotters; he does not care to mill the edges. Vertical millers and horizontal millers are used to some extent in machining engine parts, but as a rule shapers are called upon to do the greater part of the work. There is a type of slotters in service, as supplied by the Cologne Works, which is not unlike an American slotter. The Vulkan shops have installed several very large planers, and the Munich Locomotive Works have recently furnished a special and very large machine for plate punching. Martin steel is used for locomotive frames.

The wheel castings for the railway equipment come from Diosgyor, and the tires from Resicza. All the drills used by the Budapest shops have been supplied by Vulkan and by Zimmermann, of Chemnitz. German pneumatic tools are for the most part in use, although Mr. Kanitzer states that there are American and English pneumatic tools in service. A great many old screw machines are in operation, and quite a number of these are of German make. Such new screw machines as are going in appear to have been supplied by Herbert, of Coventry. There is at least one Worthington pump in service, but the valve-gear construction was criticised, and the pump in general, it was claimed, was badly made. On the locomotives, Ashton safety valves are used.

OUTPUT OF THE BUDAPEST SHOPS.

The Budapest shops have turned out 173 locomotives in one year. For 1909 the output, it was stated, must be 208, and for the year 1910 the orders in hand require an output of 250 locomotives.

The Budapest shops are building 4-cylinder compound locomotives designed for service under 16 atmospheres pressure. Schmidt superheaters are employed when the design calls for superheaters. The valve gear is of the Heusinger type modified for a 4-cylinder

machine. This valve gear is of the piston type. The practice is followed of casting in one piece the pair of cylinders required for compound locomotives. The two cylinders are bored at the same time. A fine new boiler shop, modern in every respect, is being erected and a number of new tools are now going in. Two new machines for the boiler shops were recently received from Maffei, of Munich, for drilling boiler heads.

The Budapest locomotive shops are allowed a credit by the Hungarian State Railways of 1.8 crowns per kilo (36½ cents per 2.2 pounds) on new locomotive construction.

The Budapest Works have undertaken a notable share of the most important of the bridge work in Hungary. Of the six bridges at Budapest across the Danube, five were built by these works. One is a suspension bridge with an arch 293 meters (961 feet) in length. The sixth bridge is also a suspension bridge, constructed in 1848 by the English engineer, William Clark.

In addition to locomotive and bridge work, the Budapest shops are now building agricultural machines and will shortly take up in

FIG 12.—High-speed locomotive, type In, built by the Budapest Locomotive Shops for the Royal Hungarian State Railways.

earnest the building of automobile traffic cars. The Orion type will be employed. It is found possible to sell about 400 thrashing machines per annum. The capacity of the shops is about 700 of these machines per year.

The Hungarian State Railway is operating a fast train service between Budapest and Pozsony. The writer traveled on one heavy train hauled out of Budapest by an Atlantic-type locomotive. The engine was coupled to a Vanderbilt form of tender, and, save for a few local features, one might have thought the engine had been taken from a New York Central roundhouse. The Hungarian engineer carried his heavy train up the steep grade leading into Pozsony in a manner that would do him credit in the United States. These powerful Prairie and Atlantic locomotives are fully proving their traction qualities in this territory. The Hungarian railway gage is 1.435 meters (4.706 feet). The Prairie type of engine, as built at Budapest, has nearly reached the limit of height permissible on the Hungarian railways, and whatever further increase is found possible must necessarily be slight.

DETAILS OF CONSTRUCTION.

In point of general finish and appearance there are no better locomotives in Europe than those turned out from the Hungarian shops. The general dimensions of the leading types are as follows:

Description.	Dimension.
TYPE IN.—*High-speed locomotive* (shown in illustration).	
Diameter of high and low pressure cylinders ....mm..	360,620
Stroke of both pistons....do....	660
Diameter of:	
Driving wheels....do....	2,100
Fore truck wheels....do....	1,040
Back truck wheels....do....	1,220
Working pressure, per square centimeter ....kilos..	16
Greatest power of traction ....do....	7,820
Length of boiler ....mm..	9,500
Diameter of boiler....do....	1,600
Grate surface....m.²..	3.9
Tubes....number..	291
Length of tubes over tube sheets, mm	5,250
Diameter of tubes outside ....mm..	52
Heating surface:	
Of tubes....m.²..	249.63
In fire box....do....	12.95
Total	262.58
Highest pressure upon the brake shoe ....kilos..	46,704
I and II wheel base....mm..	2,400
II and III wheel base....do....	1,850
III and IV wheel base....do....	2,200
IV and V wheel base....do....	3,330
Total wheel base ....do....	9,780
Gage ....do....	1,435
Length ....do....	12,934
Width ....do....	3,100
Height ....do....	4,570
Weight of locomotive:	
Empty....tons..	67.06
In working order....do....	74.36
Rail pressure:	
I wheel....do....	13.155
II wheel....do....	13.705
III wheel....do....	15.875
IV wheel ....do....	15.810
V wheel ....do....	15.815
TENDER.	
Water capacity ....liters..	18,000
Coal capacity....tons..	8
Diameter of wheels....mm..	875
Total base ....do....	5,050
Weight of tender:	
Empty....tons..	21,430
In working order....do....	48,095
Ratio of brake level	13
Pressure upon the brake shoes.kilos..	26,000
TYPE III S.—*For high-speed freight and passenger trains.*	
Diameter of high and low pressure cylinders ....mm..	360,620
Stroke of both pistons ....do....	660
Diameter:	
Driving wheels....do....	1,606
Truck wheels ....do....	1,040
Working pressure per square centimeter ....kilos..	16

Description.	Dimension.
TYPE III S.—*For high-speed freight and passenger trains*—Continued.	
Greatest power of traction ....kilos..	10,200
Length of boiler....do....	9,150
Diameter of boiler....do....	1,600
Grate surface ....m.²..	3.92
Tubes....number..	291
Length of tubes over tube sheets, mm	5,150
Diameter of tubes outside....mm..	52
Heating surface:	
Of tubes ....m.²..	243.84
In fire box....do....	12.95
Total ....do....	256.79
Highest pressure upon the brake shoe....kilos..	29,754
I and II wheel base....mm..	2,550
II and III wheel base ....do....	1,850
III and IV wheel base....do....	1,750
IV and V wheel base....do....	3,000
Total wheel base....do....	9,150
Gage ....do....	1,435
Length ....do....	12,294
Width ....do....	3,100
Height ....do....	4,570
Weight of locomotive:	
Empty....tons..	64.370
In working order....do....	71.205
Rail pressure on:	
I wheel....do....	12.345
II wheel....do....	15.645
III wheel....do....	15.240
IV wheel ....do....	15.600
V wheel....do....	12.375
TENDER.	
Water capacity....liters..	26,000
Coal capacity....tons..	8
Diameter of wheels....mm..	1,050
Total base....do....	4,770
Weight of tender:	
Empty....tons..	22.780
In working order....do....	56.140
Ratio of brake level	6.9
Pressure upon brake shoes...kilos..	27.300
TYPE TV.—*For secondary lines.*	
Diameter of high and low pressure cylinders....mm..	390,590
Stroke of both pistons....do....	600
Diameter of:	
Driving wheels....do....	1,180
Truck wheels ....do....	950
Working pressure, per square centimeter ....kilos..	14
Length of boiler....mm..	6,860
Greatest power of traction....kilos..	6,660
Diameter of boiler....mm..	1,300
Grate surface ....m.²..	1.85
Tubes ....number..	153
Length of tubes over tube sheets, mm	3,800
Diameter of tubes outside ....mm..	52
Heating surface:	
Of tubes ....m.²..	95.00
In fire box....do....	8.50
Total heating surface ....do....	103.50

Description.	Dimension.
TYPE IV.—*For secondary lines*—Continued.	
Highest pressure upon the brake shoe ..... kilos..	11,748
I and II wheel base ..... mm..	2,495
II and III wheel base ..... do....	1,425
III and IV wheel base ..... do....	1,400
IV and V wheel base ..... do....	2,330
Total wheel base ..... do....	7,650
Gage ..... do....	1,435
Length ..... do....	10,930
Width ..... do....	3,050
Height ..... do....	4,000
Water capacity of tank ..... liters..	5,600
Coal capacity of tender ..... $m.^3$..	4
Weight of locomotive:	
Empty ..... tons..	37.675
In working order ..... do....	51.195
Rail pressure on:	
I wheel ..... do....	10.130
II wheel ..... do....	10.200
III wheel ..... do....	10.280
IV wheel ..... do....	10.285
V wheel ..... do....	10.300
TYPE VI M.—*For freight service on heavy grades.*	
Diameter of high and low pressure cylinders ..... mm..	400,620
Stroke of both pistons ..... do....	610
Diameter of driving wheels .... mm..	1,220
Working pressure per square cm., kilos	16
Greatest power of traction .... kilos..	11,520
Length of boiler ..... mm..	9,380
Diameter of boiler ..... do....	1,550
Grate surface ..... $m.^2$..	3.61
Number of tubes	272
Length of tubes over tube sheets, mm	5,000
Diameter of tubes outside ..... mm..	52
Heating surface:	
Of tubes ..... $m.^2$..	221.27
In fire box ..... do....	13.93
Total ..... do....	235.20
I and II wheel base ..... mm..	1,350
II and III wheel base ..... do....	1,350
III and IV wheel base ..... do....	2,600
IV and V wheel base ..... do....	1,350
V and VI wheel base ..... do....	1,350
Total wheel base ..... do....	8,000
Gage ..... do....	1,435
Length ..... do....	12,882
Width ..... do....	3,100
Height ..... do....	4,570
Weight of locomotive:	
Empty ..... tons..	64.500
In working order ..... do....	71.460
Rail pressure on:	
I wheel ..... do....	12.100
II wheel ..... do....	12.100
III wheel ..... do....	12.070
IV wheel ..... do....	11.920
V wheel ..... do....	11.660
VI wheel ..... do....	11.610
TENDER.	
Water capacity ..... $m.^3$..	14.500
Coal capacity ..... do....	8.200
Diameter of wheels ..... mm..	1,036
Total base ..... do....	3,160
Weight of tender:	
Empty ..... tons..	15.320
In working order ..... do....	36.700

GANZ WORKS.

The Ganz Works, of Budapest, Hungary, have long been recognized as one of the first electrical plants in the world. For originality in design and for boldness in execution this plant has probably been unexcelled in the past in the electrical field. The names of such men as Bláthy, Déry, and Zipernowsky are associated with much of the best work that has been brought out in electrical development in Europe, and all three of these engineers have been members of the staff of the Ganz Works. It was Ganz who brought out the first transformers with closed magnetic circuit, and also the first to connect these in parallel, representing a complete and thorough solution of working electric devices independent of each other. This solution aided largely in making long line power transmission possible by using high-pressure current for transmitting electric power and low-pressure current for distributing this power through the medium of economical stationary devices. The method of operating transformers connected in parallel was demonstrated at the Budapest National Exhibition in 1885.

Every facility was afforded to inspect the shops, and seldom have I visited any manufacturing works in Europe where a greater cordiality was evinced or a more ready desire manifested to assist an inspection than at this plant. The correct name of this concern is The Ganz Electric Company (Limited). The present organization dates

from 1906. Formerly the electrical works constituted only a department of this firm. The statement that there were about 1,200 men at work, as well as subsequent statements in this report, must be understood as referring to the electrical shops only or, in other words, to the Ganz Electric Company. Director Szuk stated that it would be necessary to increase the shop force to 1,500 men. He based this statement on the rapid accumulation of orders and declared that the force at the time was not equal to current demands.

A NOTEWORTHY LABORATORY—MANY INSTALLATIONS.

When one compares the works with other electrical plants in Europe, the Ganz plant creates the impression of being primarily a wonderful laboratory. This statement does not detract from the manufacturing end of the establishment, for there is as fine work turned out from the Ganz shops as can be seen elsewhere. The executive

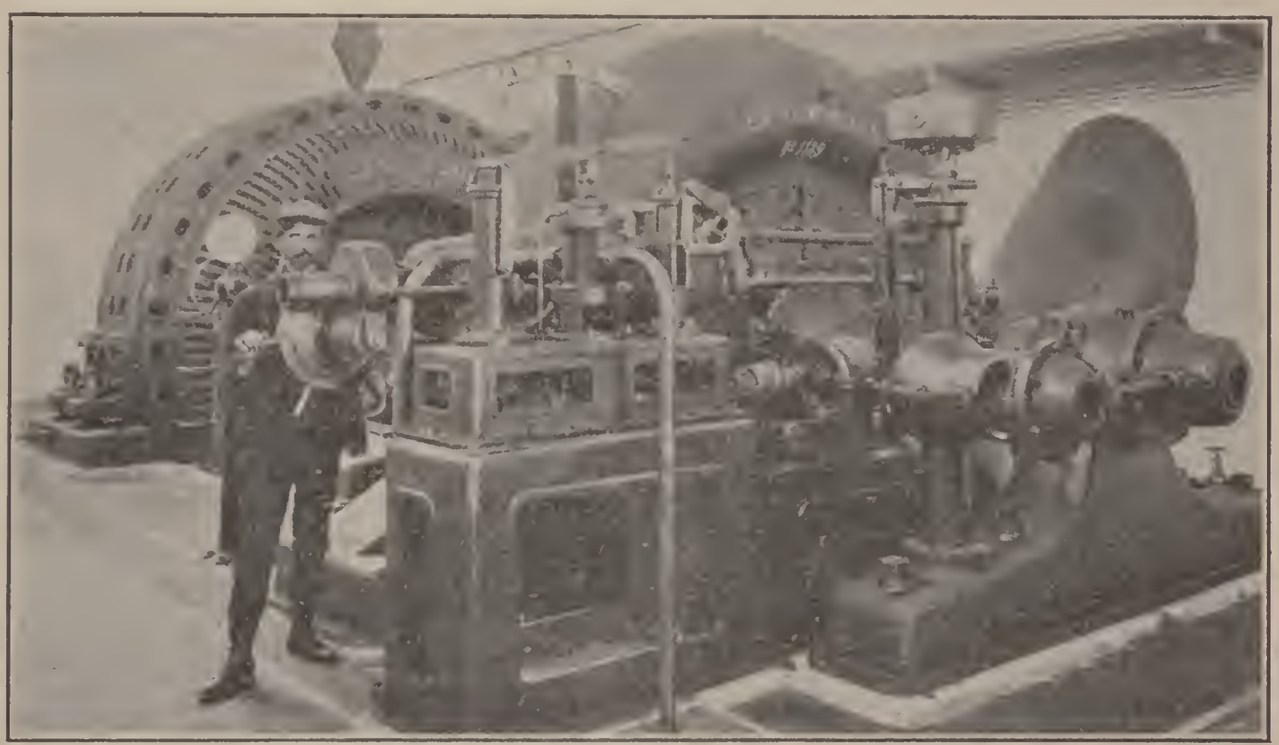

FIG. 13.—Generators in the Manojlovac (Ganz) power plant, wound directly for 30,000 volts, 42 cycles; total output, 24,000 horsepower.

control is excellent, many of the machine tools in service are of high grade, and there was notable workmanship displayed on all of the material inspected.

As might be expected, these works are confining their attention largely to power plants and to electric traction work. A number of the noteworthy power installations in Europe are the work of this firm. The first great plant based on the transformer principle was undertaken by Ganz in connection with the power transmission of 8,000 horsepower from Tivoli, Italy, to Rome. This service was rapidly followed by the installation of similar plants, power and light, including 20,000 horsepower at Vienna, and installations at Montevideo, Budapest, Venice, Tsarkoye-Selo, and elsewhere. One of the most recent installations is known as Manojlovac, in Dalmatia, involving 30,000 volts, 3-phase, 4 generators of 6,000 horsepower each. This is a turbine-driven plant. The turbines are of the Francis type. The village nearest this plant is Puljane. The name Manojlovac belongs to a flour mill close to the power installation.

At the Manojlovac plant Ganz is transforming 30,000 volts to 50 volts at one step. It is doubtful if any other firm has ever under-

taken such a feat. The 30,000 voltage is generated directly without the use of step-up transformers. The current from Manojlovac is used in Sebenico, Dalmatia, in connection with chemical processes for manufacturing calcium carbide. The current operates electric furnaces. In this installation 42 cycles, 6,000 horsepower, 3-phase generators are wound directly for 30,000 volts—this being the line voltage—without any step-up transformers. In Sebenico, which is 20 miles away, the current is transformed down to 50 volts at one step, so that the 1,500 kva. transformers have a ratio of transformation of 30,000 to 50 volts. Sebenico is a port on the Adriatic in Dalmatia. The Manojlovac power plant has been in operation for two and one-half years, and the Ganz Works report that it has given no trouble.

LOCOMOTIVE CONSTRUCTION.

Ganz is well known to the popular mind in connection with electric locomotives. There are Ganz electrical locomotives in actual

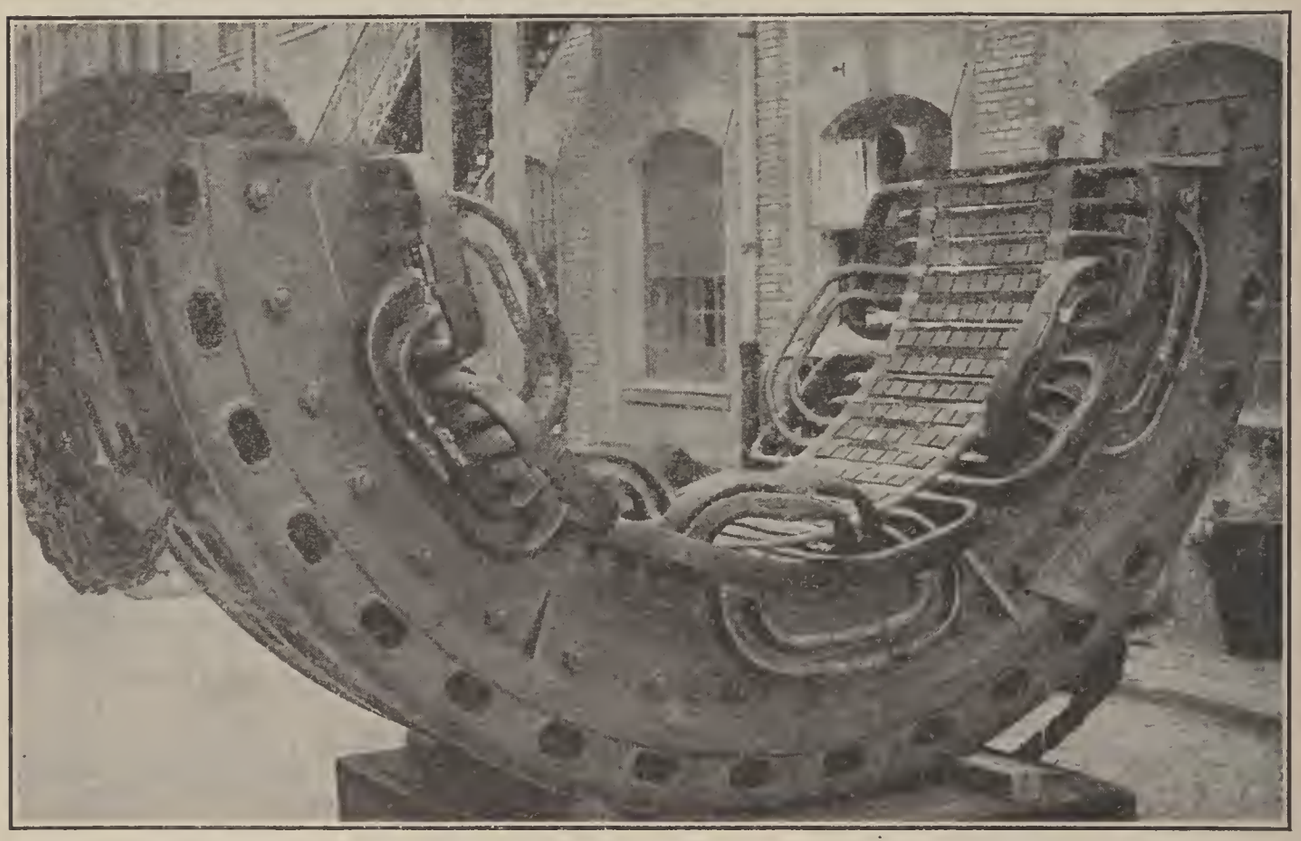

FIG. 14.—Stator and coils of the 3-phase, 6,000 horsepower, 42 cycles, Monojlovac (Ganz) generator.

service having a total rated output of 2,000 to 2,800 effective horsepower. These motors, according to Ganz, would give a maximum bar pull of about 42 tons. This capacity, it is pointed out, is only theoretical consideration, since no bar could stand the strain, and the adhesive weight at 42 tons is not sufficient for executing more than 9 to 10 tons under favorable conditions.

When 3-phase current was first considered the Ganz company interested itself in the subject with marked success and installed many 3-phase plants in Hungary and abroad. Perhaps the greatest achievement was the adapting of the 3-phase system for heavy traction on main railway lines. The first railway on which 3-phase traction was employed is the one known as the Valtellina line, in the north of Italy. The electrical equipment for this road was built for the Italian Government in 1902, and consisted of 10 motor cars,

each supplied with four 250 horsepower motors and 9 locomotives. Five of these locomotives are of the power above mentioned. Three of these Valtellina locomotives were loaned for some time for the Simplon Tunnel service.

FIG. 15.—The electric power installation in Manojlovac (Ganz), Dalmatia; water head, 330 feet, 24,000 horsepower.

The control for the Ganz locomotives is by means of the Cascade connection. This system, it is declared, permits of a most economical means for regulating the speed. Many of the railway lines in north-

ern Italy, it is understood, will pass to electric working under the 3-phase system, and already the Savona-S. Giuseppe line is in process of transformation. The 3-phase traction was originated, according to Mr. Ganz, by Mr. Koloman de Kandó, late a director of the Ganz Works and now of the Italian Westinghouse Company.

A PROGRESSIVE CONCERN.

Ganz was the first, it is asserted, to do away with belt and chain drives and to couple electric generators directly to steam engines. Ganz claims to have utilized direct connection since 1883. Likewise it is claimed that Ganz was the first to design alternating-current meters based on the induction principle. This was done, it is said, at a time when the principle was by no means known to the public; that is, as early as 1889. Ganz also claims the distinction of bringing out the first device for measuring accurately A. C. power, namely, the wattmeter, based on the electro-dynamometric principle. This was in 1885. Both of the foregoing devices are inventions of Mr. Otto Titus Bláthy. It is stated that Ganz was the first to bring out the single-phase commutator motors, embracing those which are compensated. Many of these single-phase motors are said to be still in service.

The material turned out by Ganz embraces all kinds of electrical machinery, but does not include telephone and telegraph apparatus. Among the equipment manufactured are large transformers, turbo-dynamos, electric traction outfits, controlling apparatus, and arc lamps. Ganz originated the system of placing arc-lamp carbons obliquely side by side, and has also brought out oil switches, lightning-arresting devices, of which quite a line has been developed, an oscillograph, based upon an original principle, and dynamometric ampere and wattmeters for research work.

MACHINE-TOOL INSTALLATION.

The lathes in service in the Ganz machine shops comprise many Flather (American) make. In addition, F. E. Reed Company, Worcester, Mass., Lodge & Shipley, Cincinnati, Ohio, Bradford Machine Tool Company, Cincinnati, and Hendey Machine Company, Torrington, Conn., are represented by lathes, but the Flather machines are undoubtedly the most numerous. Both Director Szuk and Engineer-in-Chief Toth spoke in the highest terms of the American machine tools in use. Only one American machine in the Ganz Works was criticised, and this particular tool, it was asserted, not only gave much trouble, but did not work accurately. Director Szuk expressed regret that Americans did not call in person at the works, for he believed it would be advantageous if a better acquaintanceship existed between representative manufacturers and the heads of the Ganz plant. The American machine-tool representation, he stated, is largely in the hands of German agents, and the Ganz Works would like to be in a position to treat directly with the heads of some American representative plants and not feel that their communications will necessarily be turned over to importers.

There is a strong pro-American feeling in Hungary, and the situation is one which demands the direct and personal attention of manufacturers of the United States. This will not interfere with agents,

provided the agents are conducting the business on correct lines. It may help some of those agents who already recognize what a handicap it is to hail from countries against which national prejudice exists.

AMERICAN MACHINE TOOLS IN USE.

The Ganz firm states that the prices paid by it for American machine tools were as follows:

Name of maker, and type and dimensions.	Year of purchase.	Price.
Mark Flather & Co., Nashua, N. H.:		
1 lathe; length of bed, 2,300 mm.; height of spindle, 210 mm. (through Lud. Loewe A. G., Berlin)	1897	$514
1 lathe; length of bed, 1,850 mm.; height of spindle, 180 mm. (through L. Kornblüh, Vienna)	1891	483
Jones & Lamson Machine Co., Springfield, Vt.:		
1 turret lathe; length of bed, 2,000 mm.; maximum height for material, 50 mm.	1898	1,019
1 turret lathe; length of bed, 2,000 mm.; maximum height for material, 50 mm.	1900	1,264
F. E. Reed Co., Worcester, Mass.:		
1 lathe; length of bed, 1,950 mm.; height of center, 180 mm. (through L. Kornblüh, Vienna)	1894	397
Prentice Brothers Co., Worcester, Mass.:		
1 lathe; length of bed, 1,900 mm.; height of center, 165 mm. (through Schuchardt & Schütte)	1907	597
Diamond Machine Co., Providence, R. I.:		
1 grinder; diameter of carborundum disk, 370 mm. (through the Washburn shops)	1892	102
Becker-Brainard Milling Machine Co., Hyde Park, Mass.:		
1 gear wheel grinder (through Ormai & Co., Budapest)	1895	1,108
Hendey Machine Co., Torrington, Conn.:		
1 planer; length of table, 1,300 mm.; for maximum, 800 mm. material (through L. Kornblüh, Vienna)	1893	589
Bullard Machine Tool Co., Bridgeport, Conn.:		
1 vertical turret lathe; length of bed, 900 mm. (through H. Dreyer)	1907	2,692
Pratt & Whitney Co., Hartford, Conn.:		
1 vertical miller (through Ormai & Co., Budapest)	1895	585
Pond Machine Tool Co., Plainfield, N. J.:		
1 boring mill; diameter of table, 3,000 mm.; for maximum, 1,500 mm. material	1900	4,924
Ferracute Machine Co., Bridgeton, N. J.:		
1 stamp machine No. 84	1900	1,165
1 stamp machine No. 31 (Nos. 31 and 84 machines were made to order according to data supplied by Messrs. Ganz)	1894	743
Newton Machine Tool Co. (Inc.), Philadelphia, Pa.:		
1 horizontal borer; height, 1,600 mm.; for maximum 850 mm. material	1897	3,631
Landis Tool Co., Waynesboro, Pa.:		
1 grinder No. 16 (through Schuchardt & Schütte)	1904	1,720
J. Morton Poole Co., Wilmington, Del.:		
1 boring mill; bed, 2,000 mm.; for maximum 3,000 x 1,600 mm. material (through Schuchardt & Schütte)	1907	5,583
Detrick & Harvey Machine Co., Baltimore, Md.:		
1 side planer; table, 4,400 x 2,000 x 1,500 mm	1897	4,268
1 side planer; table, 4,000 x 1,050 x 850 mm	1897	1,927
Niles Tool Works, Hamilton, Ohio:		
1 horizontal boring machine (without frame) No. 8 (through F. G. Kretschmer, Frankfort)	1908	4,388
National-Acme Manufacturing Co., Cleveland, Ohio:		
Automatics No. 1½ (through Schuchardt & Schütte)	1906	1,386
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio:		
1 lathe; bed, 3,600 mm.; height of spindle, 270 mm. (through Schuchardt & Schütte)	1907	1,638
1 lathe; bed, 5,700 mm.; height of spindle, 340 mm. (through Schuchardt & Schütte)	1907	2,644
1 lathe; bed, 2,450 mm.; height of spindle, 240 mm. (through Schuchardt & Schütte)	1907	1,077
Acme Machinery Co., Cleveland, Ohio:		
1 bolt cutter; 2 inches maximum (through Schuchardt & Schütte)	1899	949
Bickford Drill and Tool Co., Cincinnati, Ohio:		
1 radial drill; stroke of spindle, 400; for 70 mm. drills (through Schuchardt & Schütte)	1907	2,178
Bradford Machine Tool Co., Cincinnati, Ohio:		
Lathe; bed, 2,500 mm.; height of spindle, 205 mm. (through Schuchardt & Schütte)	1907	888
Ingersoll Milling Machine Co., Rockford, Ill.:		
Miller	1897	4,046
Gisholt Machine Co., Madison, Wis.:		
Turret lathe; bed, 2,700 mm.; height of spindle, 380 mm. (through Schuchardt & Schütte)	1897	2,400

Ingersoll tools were at work milling keyholes in some heavy turbo-dynamo shafting. There are two of these Ingersoll machines in the Ganz Works. The Bradford machine has been in service in the shops 10 years, and Director Szuk said that it had given every satisfaction. One of the Flather lathes works with a turret attachment. The turret was built and fitted to the lathe by Ganz.

The Becker millers were referred to by Director Szuk as excellent machines. There are two 36-inch Becker machines in service. There is a Bullard turret lathe in service which has been in use by Ganz for 12 years. The two Lodge & Shipley lathes were working with European tool holders. It is understood that this type of tool post was supplied by the Cincinnati firm. The Poole double-boring mill has been in service about two years. It has a diameter of table about 2 meters (6.56 feet) and a height to crossbar from table of 2.22 meters (7.3 feet). The distance between uprights is 2.20 meters (7.2 feet). The Niles horizontal boring machine is quite new.

All the stamp machines in use at the Ganz Works have been supplied either by Ferracute, of Bridgeton, N. J., or by the Vulkan Works, of Budapest. The Ferracute machines were made to order, according to the data supplied by Ganz.

FOREIGN TOOLS IN USE—WAGES PAID.

Among the foreign tools in use are a double-vertical miller from the Deutsch-Niles Werke, a saw cutter from Seidler Vilmos, Budapest, three grinders and several lathes from Reinecker, one turret lathe from Pittler, and also turret lathes from Ludwig Loewe. Still other foreign makes present included a turret lathe from Vulkan, which might be termed a reproduction of a Jones & Lamson machine, coil-winding machines from the Oerlikon Works, Schiess lathes, Vulkan lathes and boring mills, planers from Joh. Müller and from Ludwig Loewe, a turning and grinding machine from Friedr. Schmaltz, sensitive drills from Smith & Coventry, and vertical drills from Ludwig Loewe. Hasse has supplied turret lathes, and Sponholz & Wrede sensitive drills. The Schmaltz grinder is criticised as being too light.

A day's work at the Ganz plant comprises 10 hours. The better grade of workmen receive about 1 crown (20.3 cents) per hour. Apprentices receive 50 hellers (10.2 cents) per day. These apprentices serve 3 years. During this period the apprentices attend school from 4 to 5 hours a day.

The buildings of the Ganz Works are of steel construction throughout. In the main machinery building there are two 25-ton cranes. All shop wages paid by Ganz are on the basis of a fixed valuation for each assigned piece of work.

LÁNG WORKS.

The most important engine-building plant in Hungary is that of L. Láng, located in Budapest. The correct title and address of this firm is Láng L. Gépgyára, Budapest, Hungary. It will be noticed that the initial of the Christian name of Láng follows the surname. This is in accordance with the Hungarian language. The card of a Hungarian firm and the visiting card of a Hungarian gentleman show, when written in Hungarian, the Christian name following the surname. Every facility was afforded for inspecting the shops.

The Láng Works were employing about 650 men and were very busy, full time and overtime work being in progress. The principal construction work in hand was in connection with the building of both steam and turbine engines. Láng controls the Zoelly steam turbine rights for Austria-Hungary. These rights also include the privilege of building for the Austro-Hungarian navy. There were several Zoelly turbines building for marine purposes, and my attention was attracted to a turbine-electro lighting system for an Austro-Hungarian naval vessel comprising 450 horsepower, voltage 105, direct current. The motor for this marine installation was furnished by A. E. G. Kolben, Prague, Bohemia. The turbine is of the Zoelly type. Preparations were being made at the Láng shops for an extensive test of the Zoelly turbine system by an Austro-Hungarian navy commission, with a view to a possible greater use of this type of turbine in the Austro-Hungarian service. Up to 1909 Láng has built for the Austro-Hungarian navy three turbines of 300 kw. and two of 150 kw. These five turbines are being utilized for lighting purposes and for ammunition hoists. For the wheels of Zoelly turbines Láng employs Krupp steel. The blades are made of nickel steel of German origin.

INCREASING SIZE OF TURBINES—FOUNDRY WORK.

One 3,000-horsepower Zoelly turbine in course of construction was the largest engine of the Zoelly type which Láng had undertaken. Orders, however, have been received for Zoelly turbines rating as high as 4,000 horsepower. [A full description of this type of turbine will be found on page 167 of the monograph issued by the Bureau of Manufactures entitled "Machine Tool Trade in Germany, France, Switzerland, Italy, and United Kingdom."]

Láng is working about 80 men in the foundry department, some beautiful castings being in evidence. Attention was particularly drawn to a single casting of about 25 tons weight for a double-acting gas engine. Láng uses compressed air in connection with molding work, Naxos-Union grinders (German) being in service in the molding department for grinding down castings. The foundry men are paid by piecework at a stipulated rate per ton. As a rule the average rate of wages earned in the foundry department is 35 crowns ($7.10) per week. Many of the steam and air hammers in service have been made at the Láng shops. These hammers were built both on the Sellers (American) and Arns (German) systems. The majority of the blacksmith tools were obtained from Hungarian sources. The plate shears in the blacksmith shop were supplied by Wagner & Co. (German).

FINISH ON ENGINES—ACTIVE DEMAND.

Láng is paying marked attention to the finish on steam engines. One generally expects to find in European engine plants highly finished products, and in this respect the Láng engines are fully up to the best Continental practice. One Láng engine of 250 horsepower in service in the shops, directly connected to a Ganz generator, was running at 125 revolutions per minute and using superheated steam at 11 atmospheres pressure. Láng uses Russian iron for lagging. This so-called "Russian iron," which is used extensively on the

Continent for lagging purposes, is supplied in large part by Bohemian firms. The Láng laggings come from Schuster, of Prague.

Director Braun stated that he fully agreed with the views expressed by General Director Boner, of the Tosi Works, that the steam consumption for a 2,000-kw. turbine installation is more economical than a reciprocating engine for the same power. This statement did not hold good below 2,000 kw. Mr. Boner's remarks referred to the Parsons turbine which the Tosi Works are building in Italy. [See p. 190, Machine Tool Trade in Germany, France, Switzerland, Italy, the United Kingdom, 1909.] Director Braun explained that engine building in Hungary is very active just now, owing to numerous orders coming in from newly established cement factories. The cement business in Hungary is especially good, and many new mills are going up. Láng is turning out some very large hemp-rope turning fly wheels for some of these new cement mills, and one wheel of 7 meters' (22.96 feet) diameter was designed to carry on its circumference no less than 27 ropes. This fly wheel is being built in four sections.

The Láng Works were founded about 40 years ago by the present owner, Mr. Ladislaus Láng. To-day Láng's Works are looked upon as the representative engine-building plant of Hungary. The present active head is a son of the founder.

SOME AMERICAN MACHINE TOOLS IN USE.

The principal line of work at Láng's is the building of steam engines, steam turbines, condensers, condenser plants, steam economizers for boilers, transmission equipments, gas engines of the Nurnberg type, and steam pumps for waterworks purposes. Practically all the lathes at Láng's are from Joh. Müller, of Vienna. These lathes are very old. Only three American lathes were in use; two were of the Hendey type and the third was a Young. The contrast was very striking. Seldom are shops found where such high-class work is undertaken with so few American tools. Shops like Carels, of Gand, ascribe much of their success in engine building to the very modern character of machine tools employed, and it appeared that Láng's plant would readily use more American machines were the facts regarding the more advanced types brought prominently forward. Director Braun stated that he had never known, during his connections with the Láng plant, any representative American manufacturing official to call.

The Chicago Machine Tool Company has a small milling machine in service at Láng's, and there are a couple of Becker-Brainard vertical millers there, one being a No. 4 C machine. The Cincinnati Milling Machine Company is represented by a No. 2 machine. There was an undoubted Bickford radial drill, but no name was showing. Gisholt is represented by a turret lathe. Prentice Brothers Company have three tools in service, and there is one drill from Hamilton, Ohio. Still other American features include two American Gas Furnace Company furnaces, one giant groove shaping machine, one Cincinnati Milling Machine Company grinder, and one Gisholt grinder. Including the two Hendey and one Young lathes, the total American tools at Láng's number 15. There are also a couple of Worthington pumps present. Counting tools, furnaces, and pumps, the total American pieces of equipment in these shops number 19.

The machine-tool installation comprises the following: Lathes, 60; turret lathes, 7; surface lathes, 10; centering lathe, 1; vertical shaping machines, 4; planers, 7; female-screw shaping machines, 2; groove shaper, 1; horizontal shapers, 3; bevel wheel planer, 1; carussel lathes, 3; long drill machine, 1; milling machines, 13; horizontal turning machines, 8; boring machines, 12; cylinder boring machines, 5; screw-cutting machines, 4; transportable drills, 4; friesing tool, 1; grinding machines, 5; gas furnaces, 2; steam hammer, 1; air hammer, 1; punching and shearing machine, 1; cold saw machines, 3.

NEW TOOL PURCHASES.

Láng is buying new tools from time to time, but many of his acquisitions are German. Among the foreign makers, Collet & Engelhard have provided transportable radial drills, and Vulkan is represented by turning and boring machines and a great quantity of lathes. Deutsche-Niles Werke have provided some vertical turret lathes, and Reinecker is represented by vertical millers. The Werkzeugmaschinenfabrik vorm., J. Zimmermann, of Chemnitz, has provided a combined planer, milling, and boring machine having a length of table 7 meters (22.96 feet) and a height of 3 meters (9.84 feet). This machine is equipped with three motors, and was recently purchased for turbine casing work. From Breuer, Schumacher & Co. there has been obtained a heavy horizontal boring machine.

Despite the number of milling machines installed there is not as much recourse to milling as one would expect, and considerable work is done on lathes which might otherwise be handled on millers. Practice differs in this respect in different countries among the best shops, and where American shops might be inclined to use milling machines the practice is not always the same in Europe.

PRICES OF MACHINE TOOLS.

The price paid by Messrs. Láng, as reported by them, for machine tools were as follows:

Name of maker, and type and dimensions.	Year of purchase.	Price paid.
Schuchardt & Schütte, Vienna:		
1 Gisholt universal grinding machine, with usual accessories	1901	$365
1 Norton No. 3 spindle lathe, height of center 230 mm., length of bed 2,440 mm., including accessories	1901	639
Waffen und Maschinenfabriks A. G., Budapest:		
1 complete B. F. C. 646 right and left hand cylinder boring and milling machine	1901	2,777
Vulkan Maschinenfabrik A. G., Budapest:		
1 complete vertical milling machine, model F. V. C e	1902	1,472
Schuchardt & Schütte, Vienna:		
1 center-bore universal grinding machine, including 4 emery wheels and accessories	1902	43
1 twist drill grinder machine No. 1, for drills of 6 to 50 mm., with Norton emery wheel and overhead gear without supports	1902	62
Vulkan Maschinenfabrik A. G., Budapest:		
1 BC_2 cylinder-boring machine for 1,100 mm. diameter cylinder, 760 mm. height of center	1903	1,076
1 revolving spanning table	1903	284
Ernst Dania, Vienna:		
1 armature lathe with universal elastic chuck	1903	380
Deutsche-Niles Werkzeugmaschinenfabrik:		
1 turning and boring machine, "Tec," of 750 mm. diameter maximum, with overhead gear, 1 set of cranks and service key, 1 set of drill pivots, and 1 movable drill indicator, without counterweight	1904	605
1 horizontal drilling, boring, and milling machine, "Oc," of 130 mm. diameter spindle, normal, no counterweights, axle spindle feed 1,250 mm., vertical sledge feed 1,500 mm., horizontal feed 2,500 mm	1904	2,618

Name of maker, and type and dimensions.	Year of purchase.	Price paid.
Schuchardt & Sehütte, Vienna:		
1 surfaee grinding maehine No. 10, Gardner, disk diameter 450 mm., with all accessories, 1 additional reserve steel disk 450 mm., and rocking table	1904	$315
1 tool grinder, "Cincinnati"	1904	333
1 universal milling attachment No. 1[a] for Norton No. 3	1904	175
1 universal milling machine, "Cincinnati" No. 2, with automatie longitudinal and cross aetion	1905	840
Fontaine & Co. G. m. b. H., Boekenheim, Germany:		
1 automatic saw-sharpening machinc, Model No. 13, without pedestal, with fixed and loose disk and gear, ineluding emery wheel, attaehment for saws under 100 diametcr, also attachment for tapesaws up to 40 mm. width	1905	59
Brüder Seherb, Vienna:		
1 eeeentric press, A. P. 3, with wheel transmission	1905	216
J. E. Reinecker, Chemnitz, Germany:		
1 miller, parallel No. 1, table area inelusive of galley 920 mm. x 200 mm., with round table	1905	608
Kirchner & Co., A. G., Leipzig, Germany:		
1 saw, pendulum for saw blades up to 500 mm. diameter, with iron frame and truss, with saw blade of 500 mm	1905	76
1 drill, rapid 23 mm. Hamilton (Amerieau) typc, with table 16 inehes square	1905	73
1 lathe, with grinding spindle, height of eenter 130 mm., length between eenters 750 mm	1905	162
Deutsche-Niles Werkzeugmasehinenfabrik:		
1 lathe, carussel G. a. a. 1,000 mm., with 1,000 mm. diameter of planing disks, height 750 mm	1906	1,466
Naxos-Union, Frankfort:		
1 grinding and polishing machine, model VII/D, including Naxos-Union polishing belt, 2 pieces 2,500 x 60 x 3 mm. coated with emery No. 60	1906	87
1 emery grinding machine, Model T. D. 500 mm. with steel shaft of 40 mm. diameter, steel disks of 500 mm. diameter, each	1906	152
Ernst Dania, Vienna:		
1 lathe, beveling with raek and milled wheels, Model H. B., 260 mm. height of center, 2,500 mm. length, exclusive of molding with pierced head spindle	1906	365
1 lathe, planing P. B. 5 a, with 1,750 mm. planing disk diameter, 2,500 mm. cross bed	1906	865
1 lathe, Special S. T. 450, built to design; height of center measured from base 1,250 mm., and from table 450 mm., length 1,670 mm.; total length 3,500 mm	1906	1,074
Köpings Mekaniska Verkstads Aktiebolaget:		
1 lathe, complete 2,000 mm. x 3,000 mm. M 2,250	1906	536
1 horizontal boring maehine H. B. fr	1906	931
Kohn Adolf, Budapest:		
1 planing lathe, diameter of planing wheel 1,500 mm.; with 1 gear and 4 universal grip traps	1906	609
Masehinenbau vorm. Ducommun, Mulhausen:		
1 milling maehine G, with overhead gear	1906	165
Sehuchardt & Sehütte, Vienna:		
1 Fowler automatic miller No. 3, for worms and screws, with normal tools	1906	2,085
1 circular saw machine No. 5, with normal aeeessories, pedestal, 6 emery wheels.	1906	263
1 Hisey grinding maehine A No. 3 for 110 volt, direct current, magnetie spindle.	1906	98
1 Hiscy grinding maehine, Model No. A 2, for 110 volt direct current	1906	75
Rauseher & Anders, Vienna:		
1 hand drilling maehine, eleetric drivc, Model S, II, No. 12391, 110 volts direct eurrent	1906	52
Selig, Sonnenthal & Co., London:		
1 Dudgeon's magnetie support	1906	42
1 transportable grinder with No. 6 spindle, and emery wheel 8 x 1¼ inehes, and	1906	.....
2 steel brushes	1906	82
Collett & Engelhard, Offenbaeh a/M.:		
1 transportable horizontal drill and milling maehine, Model D. 2. 2 e, and a boring	1906	.....
and milling machinc built to design, 25765	1906	2,240
Ernst Dania, Vienna:		
2 lathes, beveling H. B. 260 mm. x 2,500 mm., eaeh kronen 2073.65	1907	842
Schuchardt & Sehütte, Vienna:		
1 Hisey grinder No. 3, for direet current, 110 volts	1907	95
Leipsiger Werkzeugmasehinenfabrik, Wuhren near Leipzig:		
1 Pittler revolving lathe, Model E R A., No. 5, low 246, with overhead gear, and complete aeeessories ineluding speeial tools	1907	1,112
Vulkan Masehinenfabrik, Budapest:		
1 ribbon saw, Mark B S 750	1907	183
1 lunette stand on bed with support 2,500 mm. long	1907	406
1 cast-iron boring shaft 4,000 mm. diameter and 5.000 mm. length, including a boring head fitted to shaft and a pile support with eounterweight	1907	1,130
1 lathe, Mark D. 150, 1,000 mm. length	1907	203
1 eylinder boring machine, Mark B. C. G., for boring cylinders of 2,000 mm. diameter and 4,000 mm. length; also for flange work	1907	1,181
1 heavy support lathe, Mark D., 600 x 6,500 mm. length, complete	1907	3,512
1 electric attachment	1907	142
1 10-horsepower motor, 220 volts	1907	274
Waffen und Maschinenfabriks A. G., Budapest:		
1 half universal radial drill maehine, Mark B. R. 3	1907	1,288
Henrieh Dreyer, Berlin:		
1 American "Giant" wedge machine No. 3	1907	489
1 "Burr" vertical spindle milling machine, No. 5	1907	566

Name of maker, and type and dimensions.	Year of purchase.	Price paid.
Joh. Müller, Vienna:		
1 horizontal planing lathe, with gear wheel 1,750 mm. diameter	1908	$1,056
Ducommun, Mulhausen:		
1 horizontal support lathe with straight bed, Model C, 200 x 2,000 mm., with attachments	1908	487
1 horizontal support lathe with straight bed, Model C, 200 x 1,500 mm., with attachments	1908	528
Collett & Engelhard, Offenbach a/M.:		
1 transportable universal radial drilling machine, Model G. F. 11 c, with direct current motor of 3 horsepower, 220 volts, 1,450 revolutions and with reversible gear	1908	1,401
Becker-Brainard Milling Machine Co., Hyde Park, Mass.:		
1 vertical miller No. 4 C, with gear attachment and support	1908	924
Naxos-Union, Frankfort:		
1 grinder, Model B N M 400, with 3-horsepower motor, and gear, including 2 "Rapid Korund" emery wheels 400 mm. diameter, 500 mm. width, and 40 mm. drill	1908	278
Chemnitzer Werkzeugmaschinenfabrik, Chemnitz:		
1 planer, 7,000 mm. length of plane, 3,500 mm. width, and 3,000 mm. height, including direct current auxiliary circuit motor by Bergmann, 50 horsepower, 500 turns, 220 volts	1908	14,372
1 vertical turning and drilling machine, B. W. J., for work up to 2,000 mm. diameter, 1,100 mm. height, 1,700 mm. diameter of disk and 800 mm. depth of drilling; with independent switch for the left support, two speeds, including packing, freight, and duty, to Budapest	1909	3,010
Blau & Co., through Robt. Kern, Budapest:		
1 traveling universal radial drill machine, Model G. H. 7 c, with electric motor power from a motor of 2 horsepower, 110 volts, type K. 05½, 1,450 revolutions, with reversible A. F. U	1909	680

WORKMEN'S CAPACITY AND WAGES.

The average rate of wages paid at the Láng Works for good machinists is 62 hellers (12.6 cents) per hour. Foremen receive 1 crown (20.3 cents) per hour. Apprentices receive 12 hellers (2.4 cents) per hour. With reference to welfare work or the caring for the workmen, the practice at the Láng Works is to pay a certain amount in cash to workmen who are ill. Accident insurance also forms a feature. Láng is building lodgings for workmen. A day's work comprises 10 hours. The shops open at 7 a. m. and close at 6 p. m. Having in mind the practice customary in many American shops of keeping a record of the production per man per year, it was suggested to Messrs. Láng that it would be of interest to know the rate of capacity per man in their shops, and they stated that their per-man capacity, figured on a year's basis, is 5,468 crowns ($1,110). During 1909 the force employed comprised 392 workmen, 129 day laborers, 96 apprentices, and 12 foremen. The foundry utilized 44 day laborers and 63 foundry men.

BUDAPEST ELECTRIC PLANT.

Following the visit to the Láng Works, the power station of the general electric plant of the city of Budapest was visited. The current generated is of the alternating type, and three beautifully finished Láng engines are in service in this station. These engines are of the triple-expansion, vertical type, directly connected to generators. The cylinder diameters are, respectively, for high, intermediate, and low pressure, 600, 925, 1,400 mm. by 800 mm. stroke. The engines are operated at 112 revolutions per minute. The practice now is to build the Zoelly complete in one casing. The exciter for each of these Zoellys was running on the same shaft with the motor.

There are a number of important additions going up at the Budapest central station, and in one of these additions six new boilers have been installed, of the Babcock & Wilcox type. These boilers were built by the Danubius Works of Budapest. Láng is building a 3,000-horsepower Zoelly turbine for this new installation. The turbine will be connected to a Siemens-Schuckert motor. The pumps are from Weise & Monski, of Halle, and are of the direct-acting type, steam driven. There is a Parsons turbine in this central station which has been furnished by the Austrian firm, Erste Brünner Maschinenfabrik, of Brunn. This firm has the Parsons rights for Austria-Hungary. In addition to the foregoing there are several marine-type steam engines in service, furnished by Schichau. The central plant is a private works, and supplies lighting and power to plants and other customers. The capital employed is all Hungarian.

RESICZA WORKS.

In the mountains of southeastern Hungary, in the V indicated by the Servian and Roumanian frontier lines, is Resicza. It is a small place, so far as cities go, but it represents in its population one of the most interesting iron and steel works in Europe. What Krupp is to Germany and Le Creusôt to France, so Resicza is to Hungary. A grade of steel is being turned out in these Hungarian works the equal, it is claimed, of the best in the world.

From Vojtek, where a change of cars is made, one travels toward Resicza through a magnificent stretch of farming country. Portions of this section can only be compared with some of the finest land in Nebraska. As far as the eye could reach there was a magnificent vista of waving wheat and corn fields.

Approaching Resicza a valley was observed, rockbound in its mountain fastness, but alive with furnaces and chimneys of a great modern steel plant. In Budapest I had met General Director Béla Veith, through whose courtesy every facility was accorded me to make an inspection at Resicza. On arrival at Resiczabanya, which is the works station of Resicza, I was received by General Manager Georg Marton and Engineers Moritz Weiss and Alexander Lám. I later met the engineer in chief of the machinery department, Mr. Mikles Bálint, and in company with him and Engineers Weiss and Lám the machine-tool installation was inspected. The force actually employed at Resicza numbers about 6,000 men. The total force employed in all the shops and works of the company, having in mind only Hungarian territory, is 18,000.

THE COMPANY AND ITS HOLDINGS.

The correct name of the concern controlling the Resicza Works is The Privileged Austro-Hungarian State Railway Company. The address of the firm is Budapest, Hungary. At present the organization is that of a limited company and is the outcome of a gradual acquisition of stock originally controlled largely by French capital. In 1855 the Austrian Government sold the property, which had been a state holding, to a private company, which at that time controlled a line of railway running across Hungary from north to south. The land purchased from the Austrian Government approximated 330,000 acres. More than two-thirds of this area is covered by forest. Within this great holding are numerous mines furnishing

all the essentials for the making of iron and steel, save the nickel and chrome used for mixture in producing special metal. Close to the iron mines are great lime deposits, while the clay at Resicza is probably unexcelled for the manufacture of fire bricks. The greatest care is exercised for the conservation of the forest land, and where portions of land are cleared provision is made for new growths. The trees are generally cut down when between 40 and 80 years old. At the present time there are flourishing forests of fir, pine, and beech planted at periods of 80 to 120 years ago. As to the iron mines, the supply of ore, it is declared, is seemingly inexhaustible.

FURNACES, MACHINERY, AND OUTPUT.

Resicza is essentially a steel-making plant, although the manufacturing end of the business is an important one. At the present

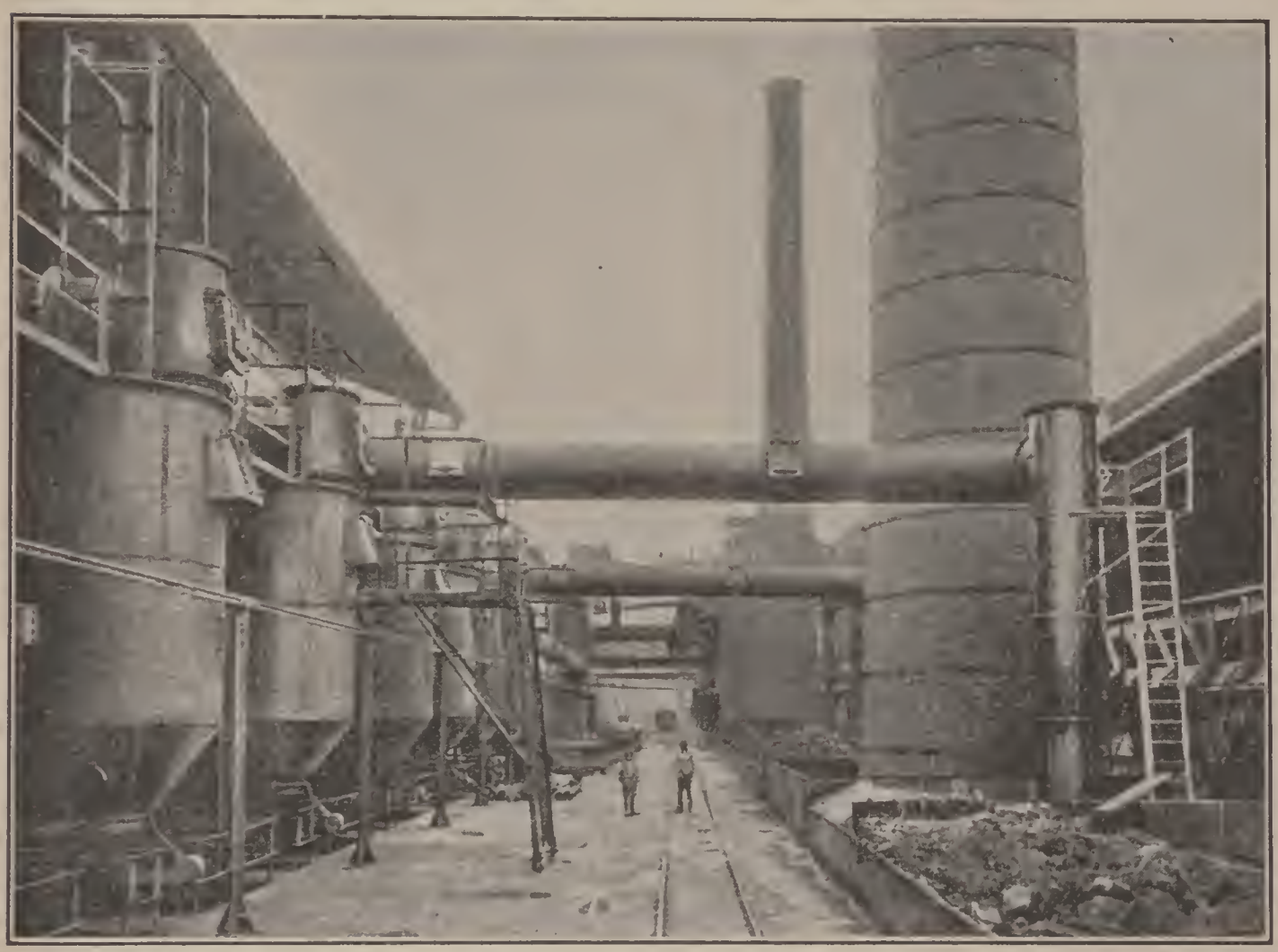

FIG. 16.—Gas-producer plant at Resicza.

time the annual production of steel is about 100,000 tons, the largest part of which is produced by the Martin-Siemens open-hearth process. The Bessemer plant produces 20,000 to 25,000 tons of Bessemer steel annually by means of three converters, each of 10 tons capacity. Fluid pig iron is cast in these converters direct from the smelting works, and the steel produced is largely used for rails.

The annual output capacity of raw iron at Resicza is about 65,000 tons, but this production, it is stated, will shortly be increased to 110,000 tons. The iron ore at Resicza is worked up at present in three blast furnaces, one having a capacity of 120 tons per day and two having a capacity of 70 tons each per day. A new blast furnace, now in process of building, is designed for a capacity of 250 to 300 tons per day. This new furnace is the design of Julien Kennedy, of Pittsburg, Pa. Arrangements for the building of this Kennedy

furnace were effected, I am told, through Kennedy's European representative located in Brussels. There are five open-hearth furnaces in the steel works.

It is the practice at Resicza to fill 35 small ingot molds at one pour, the entire 35 molds being carried in a frame, the design of Mr. Georg Marton. One of the furnaces handles 36 molds.

Resicza has been utilizing blast-furnace gas for the past 35 years, and to-day a large proportion of the power employed is furnished by gas engines. Both blast furnace and producer gas are used. The gas-producer system employed is of the Kerpely design. In all there are 14 gas producers in service for the steel-making plant. In one central station there are four gas engines, each of 1,650 nominal horsepower, running at 97 revolutions per minute. The engines were built by Láng, of Budapest, after the Ehrhardt system. The generators are by the Union A. E. G., Vienna. These electrical generators are generating alternating 3-phase current of 20.8 periods, 5,500 volts, 1,100 kilowatts. All four engines are running in parallel, and parallel with a second hydro-electro central station of 6,000 kva. capcity. These gas engines are running more smoothly than any gas engines I have seen in service on the Continent. It was stated to me that they are giving little trouble and are very economical.

WASHING THE GAS.

Resicza employs the Veith system for washing gas, supplemented by an additional washing through the medium of the Theisen system. From the Theisen washers the gas goes direct to the gas engines without recourse to gas reservoir. In case the blast-furnace gas gives out at any time the gas engines can be run on producer gas, but ordinarily the producer gas is utilized only for the furnaces. The producer gas, when used for power-generating purposes, must naturally first be washed.

There are eight Bellville boilers in service and, in addition, there are ten boilers in use similar in type to the Babcock & Wilcox. The latter boilers were made in Resicza. Blast-furnace gas is used for firing in connection with these boilers. With the exception of three Worthington pumps, all the pumps in service have been built at Resicza. The air compressors, furnishing the air for the blast furnaces, are supplied with motors from Siemens & Halske. There are four of these motors attached to as many compressors, of 280 horsepower each. There are also two horizontal compound steam-driven blowing engines of 650 horsepower each. A turbo-compressor, with a capacity of 1,000 cubic meters (35,316 cubic feet) per minute, and directly driven with a 2,000-horsepower electrical motor, will furnish the necessary air to the new blast furnace.

ROLLING AND OTHER MILL PLANTS.

In the Resicza rolling-mill plant the heavy mills, such as blooming mill, the structural-iron mill, and the heavy-plate mill, are driven by two sets of electric motors, each capable of yielding a maximum of 10,000 horsepower. There is also a steam engine of 4,000 horsepower which is held in reserve. The electrical engines permit of reversing from maximum to maximum in eight seconds. The maxi-

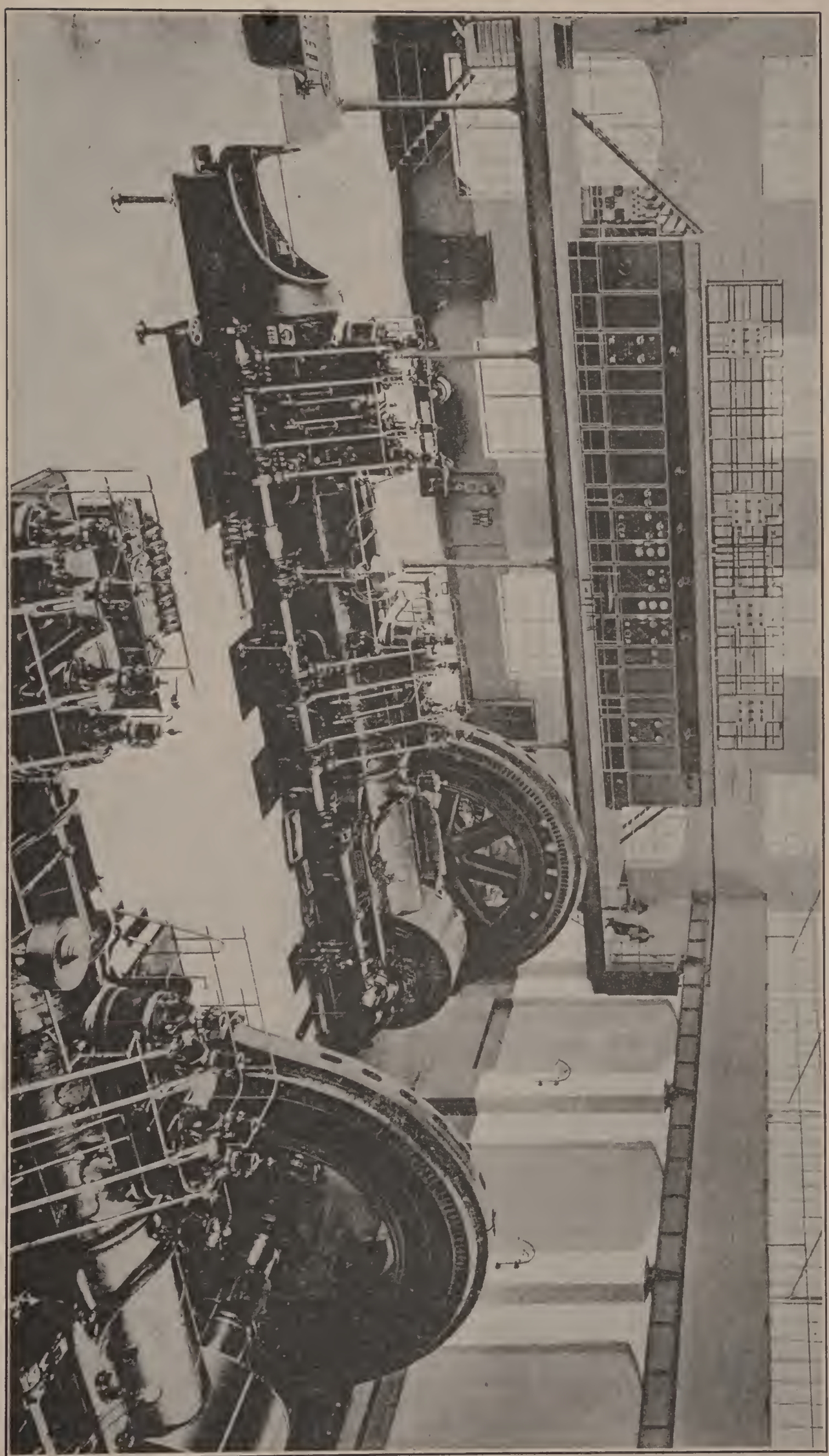

FIG. 17.—Gas-motor plant at Resicza.

mum number of revolutions is 150 per minute. These engines are used in connection with the manufacture of rails, plates, and blooms. The diameter of the largest roll in the blooming mill is 1 meter (3.28 feet), and the ratio of gears is one to two. The mills are all reversible from both sides of couplings. The motors yield 2,000 horsepower effective, and give 10,000 horsepower through the help of a fly wheel, after the Ilgner system. The speed of the fly wheel is 90 meters (295 feet) per second. This is the circumferential speed. The speed of the motor generator, which gives energy for the reserving motors, is 410 revolutions per minute.

In addition to the central power station, operated by gas engines, Resicza is availing of 4,000 horsepower electric power from a hydro-electric station, distant not more than 3 miles from the center of the works. The waterfall at this station is 217 meters (712 feet) in length. Three turbines are installed, each yielding 2,500 horsepower, working in connection with Pelton wheels, and equipped with automatic regulators. The generators yield 5,500 volts 3-phase current of 20.8 periods per second, running at 312.5 revolutions per minute. The generators were built by the Siemens-Schuckert Works in Berlin.

In addition to the foregoing rolling mill, mention should be made of the sheet-plate mill which is being operated with Ganz motors of 500 horsepower, 500 volts 3-phase current. These motors are coupled direct to roller shafts and afford a speed of 50 revolutions per minute.

There is also at Resicza a 3-high rail mill, equipped with three sets of rolls, steam driven. This mill is German built, but, I was assured, it is in reality English in design. The reversing mills above referred to were also built by Germans; that is to say, the mechanical part of the mill is German in all respects except the electrical equipment. There is at present at Resicza an old rolling mill which is referred to as the Merchant Mill, the equipment of which is to be entirely torn out and replaced with new mills, operated by steam and electric drive. There is required for the new equipment 4,000 horsepower. I understand that Resicza is desirous of receiving this millwork from American sources. With this object in view, inquiries were recently made of one American firm.

THE RAILWAY-TIRE MILL—MISCELLANEOUS MACHINES.

The tire mill at Resicza produces tires from 500 to 2,500 mm. interior diameter, and is turning out probably as fine work as can be found anywhere in Europe. In the United States, Bethlehem, Midvale, Chrome, and Latrobe may be said to be doing work similar to Resicza, but in Hungary, Resicza is the only source for steel tires. There is no denying that the tire work at Resicza is most skillfully handled. The equipment for the tire shop is practically all English. On entering the tire mill I heard what appeared to be an unmistakable sound of many wonderfully toned bells. The sound, I later found, came from workmen knocking off heat scales from numerous locomtive tires, but the ring from the hammers gave evidence of the splendid quality of the steel. Resicza supplies practically all tires used in high-speed equipment on the Hungarian railways.

In the car wheel molding department German molding machines are used. The loading cranes for loading rails have been supplied by Simmering, of Vienna. I observed two heavy cold saws in the

rail department which have been furnished by Heinrich Ehrhardt, of Dusseldorf. Wagner & Co., of Dortmund, have supplied a heavy punching machine for splice bars, one double punch of 400 tons pressure, and five rail milling machines. Sack, of Rath, has supplied one very heavy double punch of 500 tons pressure. The frame for this punch was made at Resicza. Schultz & L. Goebel, of Vienna, have supplied a punch machine, and I was informed that the last-mentioned Austrian tool is liked better than the Wagner or Sack punches.

BRICKWORKS.

Resicza is making all its own fire brick and has a very complete plant for this industry. There is a Robbins type of belt conveyor in service in the brickworks. The gas used for drying the bricks comes from two producers of the type of the Morgan Construction Company. These producers were built by Resicza. Women are employed to a large extent at the brickworks. I observed that blast-furnace slag is being worked up into brick. The slag is granulated by water and is mixed with lime and pressed into brick. These slag bricks are air dried for a period of about six months and later are used for building purposes. They are cheaper than burnt brick, but naturally are not as good, since the mechanical strength is inferior. I observed one Worthington pump at the brickworks, but aside from this pump the equipment is largely German. Most of the brickworks' equipment came from Osnabruck. Beyond the brickworks, and nearer to the water-power plant, are a number of dwellings which have been erected by Resicza for the use of the workmen. These houses are mostly provided with three rooms and kitchen, and are rented, I understand, for about 12 crowns ($2.44) per month.

ANINA COAL, CHARCOAL, IRON FOUNDRY, ETC.

Not far from Resicza is the town of Anina, where the Resicza company has important mines and an iron foundry for general castings, but especially for pipes. Anina is distant about 14 miles to the south of Resicza and may be said to be a complete plant in itself. Here is a blast-furnace installation, a very large coal-washing system, and complete works for making screws and bolts. A little to the west of Anina the Resicza company possesses a complete flour mill. This mill is located at Oraviczabanya. At Roman-Bogsan the Resicza company conducts the manufacture of agricultural implements.

The best coal in Hungary is reputed to come from Anina. Resicza undertakes to manufacture its own charcoal, and for this purpose does not have to go beyond its own forests for wood. The annual output capacity of the charcoal plant is 15,000 tons. This charcoal plant is producing wood alcohol, which is sold for the most part to German dye works. The alcohol capacity per day is 800 liters (845 quarts). The coal mined in Anina is rich in lyas. A remarkable property of the lyas coal of Anina is its suitability for the production of coke. There is an annual output of about 300.000 tons of this lyas coal. The products of the Anina mine, as well as those of Resicza, are treated for the most part in the company's furnaces, the remainder being sold. For the purpose of converting the various coal mined into coke there are 60 furnaces in Resicza and 84 in Anina.

OUTPUT AND MACHINE TOOLS IN USE.

The manufacturing works at Resicza are concerned largely with equipment for railway bridges and iron construction, ship and engine parts, and in June, 1909, there were extensive orders in hand for field-artillery equipment. Resicza has been called upon during the past five years to supply stem and stern frames and other pieces for the Armstrong Works of England, and for Ansaldo, of Genoa, Italy, for use in war-ship construction. In the machinery department the number of machine tools approximates 350. These machines are almost without exception driven by electric power derived from overhead shafting. This electric-drive is by induction motors of 20.8 per second alternations and 500 3-phase voltage.

In a great plant like Resicza I fully expected to find a first-class showing of American machine tools. There are some excellent tools of American make in evidence, but the number is very small. I observed three Gisholt turret lathes. These machines are working up and finishing off projectiles. I understand that a Gisholt representative visited Resicza and spent some time in the works giving instructions relative to these machines, and, so far as is known, Gisholt's engineer is the only American machine-tool man whom the Resicza officials can recall having visited that establishment. The Gisholt machines are liked in principle, but I gathered that the size of the machines in use is regarded as somewhat light for the heavy duty imposed.

I counted four grinders from the Landis Tool Company, of Waynesboro, Pa. These Landis machines are highly appreciated. There are two vertical drills in use from Prentice Brothers Company, Worcester, Mass., and one No. 2 and one No. 3 milling machine from the Cincinnati Milling Machine Company, Cincinnati, Ohio. Pratt & Whitney, of Hartford, Conn., are represented by a thread-milling machine, and Gould & Eberhardt, of Newark, N. J., are in evidence with a gear cutter.

So far as my observation goes the foregoing comprise all the American machine tools in service at Resicza. In the forge department I observed plate-cutting shears from Sack, of Rath, Germany. Resicza has made all rolls for its rolling-mill installation. In the forge department there is one hydraulic press of 600 tons power, furnished by Breuer, Schumacher & Co., of Kalk, near Cologne. The same German firm has supplied the horizontal hydraulic press employed in forming the larger sized projectiles.

ORDNANCE WORK—THE FORGE DEPARTMENT.

At the present time Resicza has in hand an order for projectiles of 21, 24, and 32 centimeters. These shells are built of open-hearth steel, Martin process. The furnaces in the forge department are blast operated. Resicza is making both cast-drawn and forged-steel projectiles. All projectiles which are hardened are also drawn as a preliminary to the operation. Breuer, Schumacher & Co. pumps are in use in connection with the projectile drawing machines. The pumps are electrically driven. This same German firm has also supplied accumulators.

Resicza is also building for the Government the steel work required for a recent type of field-kitchen wagons adopted by the Austro-

Hungarian services. The kitchen wagons contract was divided up among a number of Austro-Hungarian firms, but Resicza secured most of the steel work because of its facilities to undertake the complicated conditions involved in the design.

In the forge department are two steam hammers built by Resicza, four English hammers, without name of maker, and two German steam hammers. The heating furnaces of this department have been built by Resicza. In addition to the hammers just mentioned, the forge department contains three German-made hammers, each of a capacity of five tons. I observed in this forge department some forged-steel rudder-frame work in hand for the Austro-Hungarian service.

In the forge department there is considerable work being turned out in connection with car-hook couplings, and these couplings are hydraulically pressed in one operation. Resicza is building shields for field artillery. I witnessed five of these shields under Mannlicher fire delivered at about 50 paces, and in every case the shields were effective. Resicza is so certain of its artillery shields that the plates are very frequently machined and finished to the last stage before being subjected to gun fire. All shields in the Austro-Hungarian service carry the test marks of the rifle fire. In connection with the artillery orders, Resicza was turning out in June, 1909, an apparently good-sized order for field-gun projectiles.

In all there are about 400 men in the forge department. The best forge hands receive on an average 10 crowns ($2.03) per day. One foreman receives 300 crowns ($61) per month, and two foremen receive each 200 crowns ($40.60) per month. Forge helpers receive from 5 to 6 crowns ($1.02 to $1.22) per day. A day's work comprises 10 hours. The shops open at 7 a. m. and close at 6 p. m. Resicza is now working on night shifts. The night work extends from 6 p. m. to 12 midnight, and from 2 a. m. until 7 a. m. Two hours are allowed for sleep—that is, from 12 midnight until 2 a. m.

ROOM FOR AMERICAN TOOLS—GUN WORK—MACHINERY BUILDING.

The gun department at Resicza is executing some very exact and high-grade work. This department undertakes to turn out much of that class of material which would ordinarily devolve on a precision laboratory. The requirements call for the very best grades of accurately working machine tools. There is a field in this particular department for the best grades of American medium-sized machine tools. There are a number of makes of American tools which would serve to economize, without much doubt, various work in this department and enhance both the present speed and accuracy. Much of the equipment in the gun department is old, and this is especially true of the drills, both as to the sensitive and the radial drills. The great majority of the lathes are of Vulkan make. Resicza is making its own files. The gun shields which are being worked up in the gun department are of chrome steel. The gun wheels are not built by Resicza, but are supplied by the war department authorities. In addition to the Vulkan lathes in the gun department there were two lathes from Fegyver Gèpgyàr R. I., Budapest.

The main machinery department was employing about 1,400 men. The greatest number of machine tools from any one firm in this building is probably from Vulkan. Vulkan has furnished a great

variety of machines, but the Vulkan lathe is the one type of tool most in evidence. There were a number of vertical millers of Vulkan manufacture, closely resembling the Becker design. There were some German vertical millers in evidence which also seemed to be built on Becker lines. Alfred Herbert (Limited), of Coventry, England, has placed some sensitive drills, and Zimmermann, of Chemnitz, has provided a number of heavy lathes. One heavy tool of the lathe type was noticeable, apparently English in build, but without the name of the maker showing. Whitworth, of Manchester, England, has supplied a heavy lathe, and Ernst Schiess has installed a large-sized planer. Vulkan has supplied some cold-steel saws, as have also De Longdoz and Deneffe, both of Belgium.

VARIETIES OF WORK AND TOOLS.

There was a quantity of railway-carriage bearing boxes and bearings in process of construction. Resicza uses cast iron for these boxes, filled in with white metal, and forms the bearing with a cold mandrel. There is no machine work on these bearings. Among other foreign tools in use were slotters from Loewe and Vulkan; heavy vertical millers from Kendall & Gent, Manchester, England; shapers, vertical millers, boring mills, planers, and gear cutters from Vulkan; traveling cranes from Ganz; vertical miller from Fairbairn, of Leeds; a heavy vertical miller from De Fries; thread cutters from Zimmermann; milling machine from Buckton, of Leeds; and a radial drill from Whitworth. Both the Deutsche-Niles Werke and the Globe Pneumatic Engineering Company (Limited), the latter of London, have supplied pneumatic tools.

Vulkan has furnished a small grinder, which is in use in the machinery department. The workmen at the Gisholt turret lathe in this department are earning on an average of 5 crowns ($1.01) per day. Considerable machining work was in progress on locomotive wheels and rolling-mill equipment, and attention was called to some fine casting work for screw presses. All tires are flanged on hot to the wheels by transmission hammers, this process being equivalent to riveting. Practically all work in the machinery shops is piecework.

There is much bridge construction work now in progress at Resicza, and I observed that oxygen-gas cutting machines are employed. Mr. Bálint has designed a guide pointer for the burner of this device which makes it possible to run the tool close to the metal and to guide more accurately the cutting operation. This oxygen-gas machine is cutting nickel chrome steel 5 mm. thick at a rapid rate. Schultz & Goebel have supplied some heavy shearing machines for use in the bridge-building shops.

OUTPUT OF ORES AND OF IRON AND STEEL.

The annual output of iron ore from all the mines of the Privileged Austro-Hungarian State Railway Company is about 200,000 tons. The manganese ore used in the manufacture of raw iron is produced from the company's own mines, the annual output being about 10,000 tons. In addition to iron ore, sulphurous siliceous deposits are found in the southern parts of the mining district, while considerable quantities of cuprum ore are found in scattered masses in the

district of Csiklova. The products of the mines are sold for the purpose of being smelted and further worked up.

In the working up of raw iron, gray Bessemer and Martin raw, half white, are produced in Resicza, while Anina affords gray cast iron and white wrought iron. The refineries of the company are the Bessemer, Martin, and crucible furnaces at Resicza and a puddling plant at Anina. Resicza produces about 1,000 tons of crucible steel per annum. This crucible steel is used for hoops, wheels, armor plate, and other special castings. The crucibles are made in the company's brick kilns.

The particular ingredients of the different kinds of steel produced are as follows:

	Bessemer steel.	Acid.	Basic (hard).	Basic (soft).	Crucible.
Carbon	0.343	0.272	0.245	0.07	0.650
Silicon	.040	.1570	.080	.02	.164
Manganese	.150	.198	.300	.12	.507
Copper	.06	.056	Trace.	.....	.....
Phosphorus	.080	.087	.048	.....	.....
Sulphur	Trace.	.....	Trace.	.....	.....

The Resicza and the Anina rolling mills turn out on an average about 100,000 tons of rolled iron yearly. Of this quantity about 25 per cent is in railway rails, 10 per cent in rough and fine plates, 5 per cent in hoop iron, 20 per cent in girders, and 40 per cent in various kinds of rolled iron.

MISCELLANEOUS OUTPUT.

The machine and forging shops combined afford a yearly output of about 10,000 tons of material, consisting in the main of railway car wheels, mounted on axles, steel forgings, rough and machined, and steel castings. The bridge shops are producing annually about 4,000 tons of varied iron construction, railway switches, and crosses. The nail and screw factory at Anina produces as high as 2,500 tons of finished nails and screws annually.

The building of agricultural implements at the Roman-Bogsan plant is confined principally to iron plows and field implements. The present annual output is about 12,000 iron plows, 5,000 skeleton plows, and from 200 to 300 tons of other agricultural machines. It is proposed to extend the Roman-Bogsan plant so as to include a tool-making shop.

The annual output at the brick kilns in Resićza is 1,800 tons of tile and nearly 1,000 tons of fire bricks. As high as 4,000,000 bricks are made annually from the granulated blast furnace slag. In addition there is a brick kiln which the company is operating in Roman-Bogsan, annually producing an average of nearly 3,000,000 building bricks.

The company's limekilns in Kolcza and Oravicza have an annual output, respectively, of 6,000 and 8,000 tons of burnt lime.

In Oravicza a cement factory of the same company is producing annually about 2,500 tons of cement, and there is a petroleum refinery and machine factory having an annual output of from 6,000 to 8,000 tons. In Bogsan and Oravicza the flour mills have a grinding capacity of about 10,000 tons of flour annually.

There are about 100 kilometers of railway, part of which has three-rail tracks, with 1,436 and 650 mm. gage, respectively. In all there are 15 locomotives and about 500 trucks and cars utilized for transport service in hauling raw material and finished products.

For the protection of the mines, forests, and factories, there is a guard force of not less than 700 men. This force is additional to the total force of 18,000 workmen carried on the pay rolls of The Privileged Austro-Hungarian State Railway Company. No other company in Hungary occupies so important a position in the economic development of the country, and its prosperity may well be taken as indicative of conditions generally in the Hungarian territory.

BOHEMIA-MORAVIA MACHINE WORKS.

The machine-tool installation in the Bohemia-Moravia Machine Works (Prvni Českomoravská Továrna na Stroje v Praze) is one of the best in the Prague district. Upon visiting this establishment the writer was received by Director B. Mařik, who accorded every facility for the inspection of the works, and to whom, as well as to the officers of the engineering staff, acknowledgments are due for the courtesies extended.

In all there are about 520 machine tools in service in the various shops, and of this number fully 102 are of American origin. The merits of American machine tools appear to be well understood at this plant, for the engineers were not only conversant regarding the tools in use of American build, but were more than usually well posted regarding the general run of American types. Following a two-hour inspection the engineer in charge of the machinery department was asked for his general views regarding American machine tools, and his reply was that they were easily first. He furthermore gave as his opinion that the time would not come when American machine tools, generally speaking, would be equaled by Continental makes.

The Bohemia-Moravia Works hold one of the leading positions among Austrian plants in the building of high-grade machinery. It is because the material turned out is of first-quality that the best machine tools are demanded. This plant was founded in 1871. Its organization was from the beginning a stock company, and the occasion for its existence was largely the heavy demand in the early seventies for sugar machinery—a demand so great that it was with difficulty that machinery could be obtained to meet the requirements of the many new plants springing up. The Bohemia-Moravia Works completed the erecting of buildings rapidly, and by March, 1872, were able to begin the construction of machinery. By the end of 1872 sufficient business had been undertaken to make possible the payment of a 15 per cent dividend.

VARIED LINES OF MANUFACTURE TAKEN UP.

From 1873 until early in the eighties the new works suffered from the general business depression which at that period existed in Europe. Many of the recently built sugar factories became bankrupt, and this new establishment was not only subjected to heavy losses, but was even obliged in one instance to take over a factory. In order to counteract the depression in sugar machinery it engaged in building a

general line of mining machinery, and this adjunct was favored by the springing up of new coal-mining companies in north Bohemia. Notwithstanding the fact that unfavorable conditions lasted until the close of 1879, the new company had recovered largely from its losses through excellent management, and had favorably sold the sugar plant which had been taken over.

With the introduction of the mining machinery department, the new company inaugurated the building of steam engines, pumps, and other machines belonging to power installation equipments, and the sale of machinery was pushed into Russian territory. At the same time an export trade was built up for the disposal of sugar machines. Connections were formed in India, South America, Italy, and Sweden, and the new company established a permanent office in Kiev, Russia. But the sugar machinery business diminished toward 1884, and in order to supply additional working sources, the building of central heating installations and ventilation systems was undertaken, as well as drying plants and cooling machinery. The increase of the Russian customs made it eventually necessary to abandon the Kiev office.

In 1889 machinery fittings and equipment necessary for bridge building were acquired from the Prague Iron Industry Company. This acquisition also involved the transfer of about 200 experienced bridge-building workmen to the Bohemia-Moravia Works. The bridge-building department has gained renown for the firm.

The sugar industry having lost in stability by 1890, the Bohemia-Moravia Works decided to substitute for that line of manufacture the building of locomotives. Ground for the locomotive shops was made ready in 1899, and on April 28, 1900, the first locomotive was delivered to the Austrian State Railways. Immediately following the building of the first engine, there were received a number of important orders from the state railway authorities, and to-day the locomotive department is one of the important adjuncts of manufacture at this plant.

NATURE AND VOLUME OF PRESENT OUTPUT.

The general lines of manufacturing work undertaken at the Bohemia-Moravia Works comprise steam engines of all sizes, gas motors, suction gas plants, furnace gas motors, gins, cranes and elevators, transmission systems, steam conduits, steam and gas motor plants, Francis turbines, waterwork plants for town supply, pumping plants, refrigerating machines, ice-making plants, cooling systems for breweries and abattoirs, stone and coal breakers, stamps, graphite mills, steam road rollers, iron construction for waterworks, sluices, movable weirs, air sluices, caissons, air compressors, pile drivers, sorting plants for sand work, and various disintegrating machines. By 1906 this firm had turned out steam engines representing a total of 101,075 horsepower. This included the engines for the Prague central electric establishment. It had also, up to the same date, produced, exclusive of locomotive boilers, 1,010 steam boilers of varied systems.

In the mining and smelting department the firm undertakes to build complete fittings of shaft plants and the various equipment for elevators and winding engines, mine ventilators, and air compressors. In central heating the firm has effected about 200 installations, inclusive of schools, hospitals, and theaters. In the bridge-building

line, during the 38 years of its existence, the Bohemia-Moravia Works have delivered and mounted a total of 2,061 bridges, of which 1,518 were for railway purposes.

LOCOMOTIVE CONSTRUCTION.

The locomotives built by the firm are after the Gölsdorf design, and are intended to make fast time. The system employed is the 4-cylinder compound, and the cylinder disposition is in accordance with the Atlantic type, as known in the United States. The first engine built by the Prague works of this type was finished in July, 1901, and this engine showed a speed of 140 kilometers per hour. The principal dimensions of the engine are:

	Millimeters.
Piston stroke	680
Driving rod lengths	1,915
High pressure slide valve, light length	162
High pressure slide valve, outside length	288
High pressure slide valve, outside covering	31
High pressure slide valve, inside negative covering	8
Low pressure slide valve, light length	146
Low pressure slide valve, outside length	286
Low pressure slide valve, outside covering	30
Low pressure slide valve, inside negative covering	3
Streaming in channel, width, high and low pressures	40
Streaming on channel, width, high and low pressure	76

The Bohemia-Moravia Works are turning out between 60 and 70 locomotives per year. Schmidt superheaters are employed, and also Gölsdorf superheaters. These locomotives are designed to work under steam pressure of 12 to 15 atmospheres. It has been noted in other reports that the general tendency on the Continent is to lower steam pressures. The Breda Works of Milan were adhering to 16-atmosphere pressures as late as May, 1908. All locomotives from the Prague shops are given at least three coats of paint. This is exclusive of the filling-in coats.

MACHINE DEPARTMENT—AMERICAN TOOLS.

During 1909 a number of fine tools were purchased from the Niles-Bement-Pond Company, of New York, at figures said to be considerably lower than Continental quotations. The purchases include two heavy boring mills and one heavy lathe. This same firm has supplied additional lathes and also a steam hammer. The last-mentioned machine is a type not frequently seen on the Continent. It is the writer's observation that there has been a very limited sale in Europe of American steam hammers. The machine furnished by Niles-Bement-Pond, however, is probably the best of the lot of steam hammers in this Prague plant, and so long as European prices can be met there is no reason why steam hammers from the United States should not enter the European market to full advantage. Broadly speaking, European prices can be met by American machine-tool manufacturers, but the writer has repeatedly asserted that it is not necessary to go below prevailing prices in the United States. European buyers of machine tools, and by the word "buyers" is meant the directors of works and not importers, have repeatedly told the writer that they would welcome an opportunity to buy American machine tools in Europe at American prices.

PRICES PAID FOR AMERICAN MACHINES.

The Bohemia-Moravia Machine Works give the following as the prices paid in recent years for some American machine tools:

Name of maker, and type and dimensions.	Shop number.	When purchased.	Price delivered in Prague.
F. E. Reed Co.:			
Lathe, 255 x 1,930 mm	653	1908	$1,096
Lathe	519	1900	386
Bullard Machine Tool Co.:			
Vertical boring mill, 30″	634	1908	1,099
Pratt & Whitney Co.:			
Turret lathe, 2″ x 26″	650	1908	1,349
Turret lathe, 3″ x 36″	596	1906	2,537
Niles-Bement-Pond Co.:			
10″ vertical boring mill	655	1908	8,278
6″ vertical boring mill	654	1908	4,826
1,100-pound steam hammer	652	1908	929
Lathe, 24′ x 12′	651	1908	1,053
Lathe, 32″ x 14′	597	1906	1,685
Wm. Sellers & Co.:			
Planer, 10′ x 75″	644	1908	9,819
Bradford Machine Tool Co.:			
Lathe 470 x 1,975 mm	600	1906	2,313
Lodge & Shipley Machine Tool Co.:			
Lathe, 350 x 3,380 mm	598	1906	1,827
Cincinnati Shaper Co.:			
1 double shaper V. F. 1	629	1907	2,990
Bickford Drill and Tool Co.:			
Radial boring mill H. B	645	1908	1,388
Acme Machinery Co.:			
1 screw cutter No. 6	601	1906	1,237
1 screw cutter No. 3	602	1906	804
Cincinnati Milling Machine Co.:			
1 universal milling machine No. 2	513	1900	796
1 universal milling machine No. 3	646	1908	1,743
Cleveland Automatic Machine Co.:			
1¼″ Cleveland automatic	626	1907	1,257

The following-named American machine tools, in addition to those already mentioned, were seen on the Bohemia-Moravia floors:

Flather & Co., Nashua, N. H.—Lathes.
Mark Flather Planer Co., Nashua, N. H.—Planers.
Jones & Lamson Machine Co., Springfield, Vt.—Turret lathe.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.—Vertical miller.
Wm. Powell Planer Co., Worcester, Mass.—Planers.
Whitcomb Machine Tool Co., Worcester.—Planer.
Prentice Brothers Co., Worcester.—Vertical drill.
J. E. Snyder & Co., Worcester.—Vertical drill.
Universal Machine Co., Providence, R. I.—Grinders.
Gould & Eberhardt, Newark, N. J.—Gear cutters, shaper.
Bement, Miles & Co., Philadelphia.—Horizontal miller and slotter.
Landis Tool Co., Waynesboro, Pa.—Grinders.
G. A. Gray Co., Cincinnati.—Planers.
American Tool Works Co., Cincinnati.—Planers, radial drill.
Warner & Swasey Co., Cleveland, Ohio.—Nut-facing machine, hexagonal turret lathes, and turret lathes.
W. F. & J. Barnes Co., Rockford, Ill.—Vertical drill.

The demand now at the Bohemia-Moravia Works is for good milling machines, but there is always a demand, as the engineer in charge of the machine shops remarked, for good lathes. This same official stated to the writer that he would like to obtain a good strong machine to grind off bearing boxes and crosshead guides for locomotive work.

EUROPEAN-MADE MACHINE TOOLS IN USE.

Among the foreign tools in service the following were noticed:

Ducommun, Mulhausen, lathes; Sondermann & Stier, Chemnitz, lathes, horizontal borers, and slotters; Schubert & Salzer, Chemnitz, lathes; Zimmermann, Chemnitz, lathes; J. E. Reinecker, Chemnitz, nut-facing machine and two grinders; Vulkan, Vienna, vertical drills; Grafenstaden, vertical millers; Schuchardt & Schütte, Vienna, vertical drill and hob machines; Fairbairn, Naylor, Macpherson & Co., Leeds, heavy slotter; Biernatzki & Co., Chemnitz, cutting-off machines; Geo. Richards & Co., Limited, Broadheath, England, facing planer; Ludwig Loewe, Berlin, vertical miller and lathe.

There is a large line of radial drills installed which are the manufacture of the Bohemia-Moravia Works. The Schuchardt & Schütte vertical drill is without name of maker. This machine is regarded as the best vertical drill in the shops. The Richards facing planer is referred to as a machine of exceptional merit. The hob machines installed by Schuchardt & Schütte are said to be the manufacture of Pfauter, of Chemnitz.

The planer supplied by Wm. Sellers & Co. is No. 1332. This machine was bought direct from the Philadelphia firm. There is an Ingersoll-Rand Company air compressor drive on this Sellers planer (Imperial type 11).

The drive in the shops is electric power, generated by steam turbines. One 900-kilowatt turbine was observed in service of the Zvoniček system. A new 3,000-kilowatt turbine is in process of building.

The work turned out is of an exceptionally high character, and is unexcelled, in the writer's opinion, in Austrian territory. The workmen employed are unusually intelligent, and on all sides one is impressed with the skill and handiness of the machinists.

The Bohemia-Moravia Works in August, 1909, were employing about 1,500 men. A day's work comprises nine hours and a good man at a machine will earn about 70 hellers (14⅕ cents) per hour, or, say, 6.30 crowns ($1.28) per day; but he must be a good man, it is declared, to make these wages.

BREITFELD, DANĚK & CO.

The works of the Maschinenbau-Actiengesellschaft, Breitfeld, Daněk & Co., at Prague-Karolinenthal, Austria, are among the first engineering establishments in Bohemia. At the present time 2,000 men are actively employed in the Karolinenthal shops in Prague, although, when business conditions are at the best, this figure is greatly augmented. The total number of men carried on the rolls in August, 1909, was 4,500, the 2,500 above the number engaged in Prague being scattered among the branch works in Aussig and Schlan, Bohemia, and Blansko, Moravia.

The present firm is the outcome of a union of Breitfeld & Evans, of Prague (a firm founded as early as 1832), with Daněk & Co., of Karolinenthal (founded in 1854), together with the branch establishment of the latter firm located in Aussig. The union of these two undertakings was accomplished in 1872, and in 1882 the plant of Fr. Reska, of Prague-Bubna, was absorbed by the combination. A still further acquisition was made in 1897 through the purchase of Prince

Salm's Iron Works located in Blansko, Moravia, and in 1899 the engineering works of Bolzano, Tedesco & Co., of Schlan, Bohemia, were similarly acquired. The capital of the present company is 10,000,000 crowns ($2,030,000).

The location of the shops in Karolinenthal is in a somewhat crowded district, owing to the growth of the town, but the main erecting shops are modern and finely constructed buildings. They are built of steel and concrete throughout, and afford plenty of light and good air.

LINES OF MANUFACTURE.

The business of this firm includes the manufacture of a varied line of engineering outputs, including many details, under the following

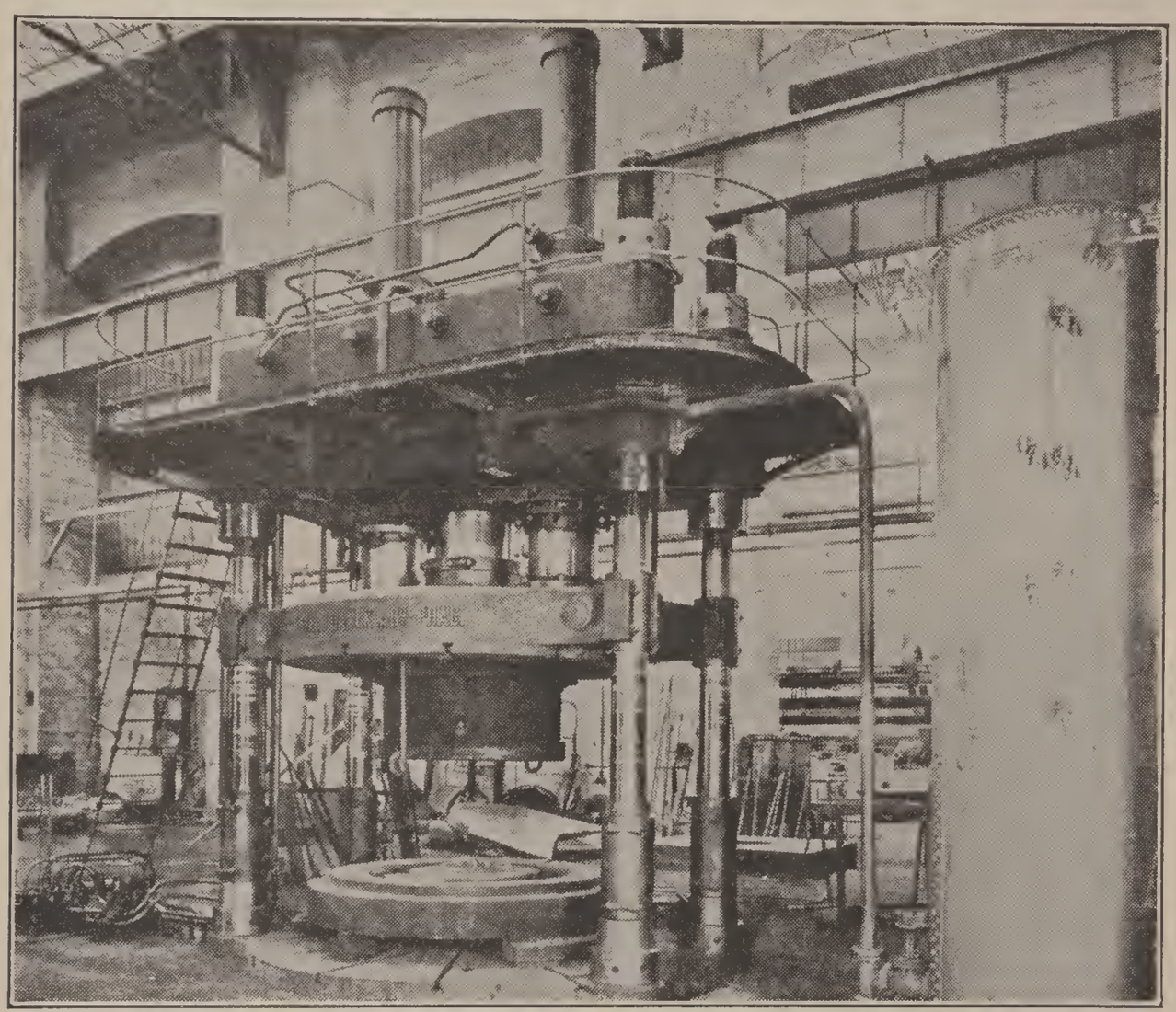

FIG. 18.—Hydraulic flanging press, 600 tons pressure. Built by Breitfeld, Daněk & Co.

principal heads: Mining-plant equipment; installations for iron and steel works; blowing engines; steam engines of all types and descriptions; gas engines; gas-engine plants; steam and water turbines; ice-manufacturing plants; waterworks plants; bridge building and general structural ironwork; cranes; lifts; conveyors; steam, hydraulic, and pneumatic presses; pumping engines; complete equipment for sugar factories and refineries, breweries, and starch and yeast factories; boilers; sawmill machinery; equipment for potteries and brickyards; cement-making machinery; flour-mill equipment; and railway signal and safety apparatus.

The Breitfeld, Daněk & Co. works have always catered to the foreign trade, and the list of their installations shows that they have sent equipment to far distant parts of the world. The writer has

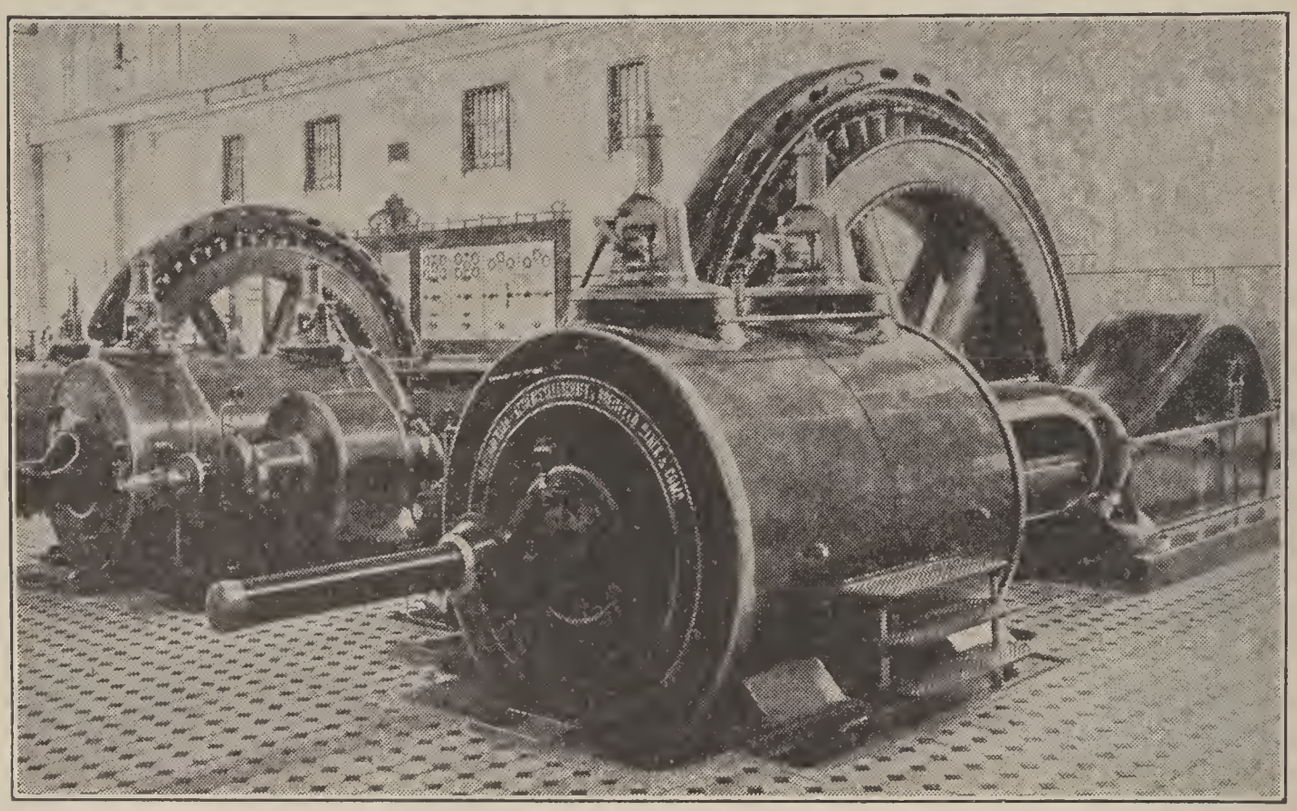

FIG. 19.—Cross compound engine using superheated steam; 1,200 indicated horsepower at 107 revolutions per minute. Built by Breitfeld, Daněk & Co.

observed numerous Breitfeld-Daněk engines in Austrian plants, and has been impressed with the high grade of workmanship and finish displayed.

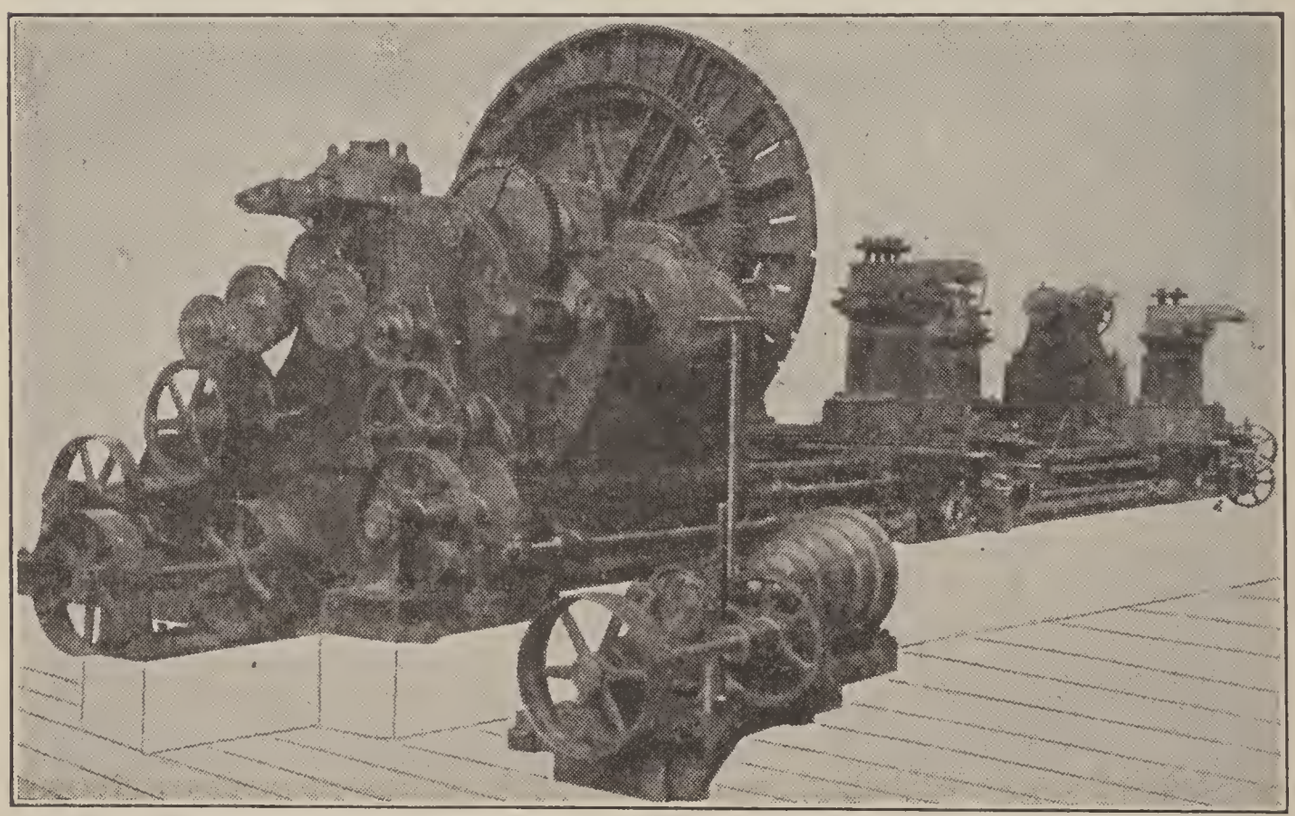

FIG. 20.—Lathe in machine-tool department of Breitfeld, Daněk & Co.'s works. Height of centers, 1,500 mm. (59 in.); length between centers, 8,000 mm. (315 in.); length of bed, 12,500 mm. (492⅛ in.). Built by Vulkan Works, Vienna.

The fact should not be lost sight of that sugar-making and refining machinery constitute the chief export of Breitfeld, Daněk & Co.;

next in importance comes hydraulic machinery, and perhaps third place is taken by mining machinery. The export of mining machinery, it is stated, is chiefly confined to Russia.

CIRCUMSTANCES PREVENT SPECIALIZING.

These works illustrate in a very forcible way the peculiarity of machinery manufacturing in Europe. The varied lines of products which the firm undertakes to handle are indicative of the nature of the market. Little opportunity is found to specialize, and in order to keep the works fully employed it is found necessary to avail of varied lines of orders. The Francis type of turbine and also Westinghouse high-speed steam engines and Pelton wheels are built. The firm has probably done more in the building of sugar factories and refineries, steam engines, hydraulic and mining-machinery equipment than in any other line of product. In other words, the demands have probably been greater in these directions than in any other. Many of the finest installations on the Continent for coal sorting and washing are the work of this company, and numerous washing plants built by it, having capacities of 750 tons of coal in 10 hours, are in service in Austria.

The building of sugar machinery was commenced in 1870 and deliveries at that early period were made in India and in Brazil. In 1903, 1904, and 1905 the Prague firm turned its attention to Belgium, Netherlands, and France and their colonies, and in 1904 a complete plant was erected on the island of Santa Cruz. Since 1880 this firm has erected about 30 sugar factories and refineries in Austria-Hungary alone. An entire series of factories was built in Russia, 17 in Italy, and 8 in Sweden.

Naturally, in a plant such as this, one expects to find a fine installation of machine tools, and in this respect is not disappointed. There were found, however, many English tools of not recent date, showing that when the Breitfeld, Daněk & Co. works first started they drew largely on English sources.

AMERICAN MACHINE TOOLS WELL REPRESENTED.

The following American machines are in service there:

Jones & Lamson Machine Co., Springfield, Vt	2 turret lathes (1 of old and 1 of new type).
Becker Milling Machine Co., Hyde Park, Mass	1 No. 5 and 1 No. 6 vertical miller.
Hendey Machine Co., Torrington, Conn	14 engine lathes.
Bullard Machine Tool Co., Bridgeport, Conn	Vertical turret lathes and 2 double boring mills.
Gould & Eberhardt, Newark, N. J	Gear cutter No. 727 and 1 No. 2 grinder.
Gleason Tool Co., Rochester, N. Y	Heavy bevel gear planer.
Stamp "C. F." New York	1 horizontal metal saw cutter.
Colburn Machine Tool Co., Franklin, Pa	Boring mill.
Landis Tool Co., Waynesboro, Pa	1 No. 3 grinder and 1 grinder 6 millimeter head.
Cleveland Automatic Machine Co., Cleveland, Ohio	Threaders.
National-Acme Manufacturing Co., Cleveland	Automatic machine No. 52.
Warner & Swasey Co., Cleveland	2 horizontal turret lathes (1 No. 2 and 1 No. 5).
Acme Machinery Co., Cleveland	3 nut head making machines.

American Tool Works Co., Cincinnati—1 standard 24-inch lathe, 2 16-inch Challenge, and 2 18-inch Challenge lathes, supplied by De Fries & Co.
Lodge & Shipley Machine Tool Co., Cincinnati—3 18-inch engine lathes and 6 large lathes.
Baker Brothers, Toledo—Vertical cutter.
Bickford Drill and Tool Co., Cincinnati—Radial drills.
G. A. Gray Co., Cincinnati—Planers.
Cincinnati Milling Machine Co., Cincinnati—3 No. 2 and 1 No. 3 millers, and 1 grinder.
Morton Manufacturing Co., Muskegon Heights, Mich—1 heavy horizontal shaper and 1 traveling vertical slotter.
Gisholt Machine Co., Madison, Wis—Turret lathes and 3 double boring mills.
Kempsmith Manufacturing Co., Milwaukee, Wis—Plain miller.

In the wood-working department there is one No. 3 universal trimming machine from the American Machinery Manufacturing Company, of Boston. As a rule, the majority of the tools in the wood-working department are from Kirchner & Co., of Leipzig, Germany.

The opinion was expressed by the shopmaster that the new Jones & Lamson turret lathe was preferable to the older type manufactured by that company. The shopmaster declared that the new tool gives more accurate results for large work.

A mechanic working at the new Jones & Lamson machine receives about 80 hellers (16¼ cents) an hour. Nine hours constitute a day's work.

In the Hendey group of lathes is a tool bearing the name of Schuchardt & Schütte, which so closely resembles the make of the Torrington tool that it is difficult to distinguish them apart. A distinguishing feature, however, was pointed out by the shopmaster, who also advised that the lathe was built in Europe. The American lathes in service are all spoken of highly. Lathe men at the American tools receive, as a rule, from 60 to 70 hellers (12⅕ to 14⅕ cents) per hour, working on a nine-hour basis.

Breitfeld, Daněk & Co. state that the prices paid within recent years for American machine tools have been as follows:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Prague.
Cincinnati Milling Machine Co.	1 No. 2 miller, long U cross-feed table	1906	$969
	Universal tool grinder No. 2	1906	869
Lodge & Shipley Machine Tool Co.	High-speed lathe, 345 mm. x 6680 mm. bed	1906	2,505
Do	High-speed lathe, 350 mm. center, 7910 bed with patent head.	1907	2,946
National-Acme Manufacturing Co.	Automatic turret lathe with one set of tools	1907	1,355
Bickford Drill and Tool Co., Cincinnati.	Simple radial drill, initialed "W. B. 3. C." for electric drive.	1907	2,117
Cleveland Automatic Machine Co.	3-spindle 2-inch automatic drill, 3 speeds	1907	1,292
Gisholt Machine Co	Vertical turret and boring mill, 64-inch, 2 tool holders.	1906	4,169

FOREIGN MAKES OF MACHINE TOOLS.

Among the foreign tool manufacturers represented at the Breitfeld-Daněk works are the following:

Kirchner & Co., Leipzig, woodworking machine; J. E. Reinecker, Chemnitz, horizontal and vertical grinders, planer, double millers, and heavy lathes; Ateliers Ducommun, Mulhausen, Germany, turret lathes and grinders; Ludwig Loewe, A. G., Berlin, double millers for facing heavy bolts, lathes, machines for milling tooth wheel rims, vertical drills, and shapers; Drehbank-Fabrik und Eisengiesserei H. Wohlenberg, Hanover, Germany, lathes; Praecisions-Werkzeugmaschinenfabrik Auerbach & Co., Dresden, milling machines; Ernst Schiess, Dusseldorf, Germany, heavy vertical miller and heavy horizontal boring tool; Collett & Englehard, Offenbach-on-the-Main, Germany, radial and vertical drills; Hartmann, Chemnitz, slotters; Joh. Zimmermann, Chemnitz, shaper; Frederick Schmaltz, Offenbach-on-the-Main, grinder; Burton, Griffiths & Co., London, lathe; Smith, Peacock & Tennent, Leeds, England, numerous and varied lines of tools of many years' installation; Maclea & March, Leeds, numerous lines of tools of early installation, comprising lathes, planers, slotters, and crank shapers; Walker Brothers, Sheffield, heavy lathes; Robey-Smith Company, Manchester, bevel-wheel planer; John M. Smith & Co., Manchester, lathe; Selig, Sonnenthal & Co., London, grinder; Greenwood & Batley, Leeds, shapers; Vulkan Maschinenfabrik A. G., Vienna, a large line of medium size and heavy machine tools, comprising lathes, radial drills, boring mills, bevel-gear shapers, slotters and planers, and heavy lathes; Breitfeld, Daněk & Co., Prague, numerous tools of home make; K. Jockel, Prague, Austria, planers.

One Vulkan planer in service has a length of table of $7\frac{1}{2}$ meters (24.6 feet), a width of 3 meters (9.8 feet), and a working height of 3 meters. There are numerous transportable electric drills and slotters in service. The early tools installed are largely of English origin. Latterly, however, the purchase of machine tools appears to have been largely confined to Austrian, American, and German sources.

PRICES PAID FOR FOREIGN TOOLS.

The managers give the following as the prices paid for foreign machine tools which rightly can be compared with medium-class American machines in service:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Prague.
Billeter & Klunz	Yeakley hammer, L. H, 9, 450-kilo tap, 600-mm. stroke.	1906	$2,013
J. E. Reinecker, Chemnitz	No. 4 miller, automatic table 500 x 2,350 mm	1906	1,757
Do	Screw-cutting lathe, 300 x 1,500 mm. L. De	1906	670
Do	Screw-cutting lathe, 210 x 1,000 L. De	1906	362
Do	Screw-cutting lathe, 240 x 1,500, all gear head SLD III.	1908	893
Do	Screw-cutting lathe, 340 x 1,500, SLD VII	1908	1,508
Do	Screw-cutting lathe, 650 x 7,000, CLD VIII, all gear head.	1908	4,564
Ludwig Loewe, A. G., Berlin.	Fosdick radial drill, standard No. 6	1906	1,672
Do	Automatic miller No. 12	1908	8,181
Do	Screw-cutting lathe No. 3 B, model II	1908	6,883
Do	Screw-cutting lathe No. 3 B, model I	1908	6,680
Vulkan Maschinenfabrik, Vienna.	Screw-cutting lathe, 250 x 1,850 mm. centers	1906	712
Do	Planer, 2,500 x 1,000 x 1,000, including electric clutch.	1908	2,539

RINGHOFFER WORKS.

The Ringhoffer Works, of Prague, are among the oldest and most noted of the many important machinery plants in Bohemia. The correct name and address of this establishment is F. Ringhoffer, Smichow-Prag. Portions of the plant were founded as early as 1771, but the works proper, as they stand to-day, date from 1848. From the earliest period the family of Ringhoffer has retained possession of all parts of the plant. Baron Ringhoffer personally received the writer and accorded him every facility in connection with his visit. All parts of the establishment were open to inspection.

These works are engaged in the manufacture of a diversified line of equipment, but by far the most important branch has to do with railway-carriage building. All kinds of cars of the European type for railroads and street railways, from freight to complex car specialties, and from the third-class passenger car to imposing royal salon carriages, are built. In addition, the output embraces motor cars, tenders, and snowplows. The Ringhoffer Works have built the imperial train of Austria, the royal trains of Hungary, Roumania, and Bulgaria, and various salon cars for members of the imperial Austrian family. Among the countries to which Ringhoffer cars have been exported are Roumania, Servia, Turkey, Asia Minor, Egypt, Argentina, Algeria, Tunis, Italy, Switzerland, and Spain.

In all, about 3,000 men are employed in the car shops. The total number of men necessary to run all departments is 5,200. This latter figure comprises the maximum force employed; that is to say, the force necessary when all departments are running full time. In August, 1909, the number of men engaged was 4,000.

NATURE OF OUTPUT, MATERIAL, AND METHODS.

It is the practice at Ringhoffer's to employ Krupp steel for axles for cars destined for foreign railways. On cars built by Ringhoffer for Austrian railways axles from the Austrian works of Ternitz or Witkowitz are used.

The carriages built by Ringhoffer are essentially European in type. Generally speaking, a modern Continental restaurant car is built and sold for 70,000 crowns ($14,210), while a typical corridor passenger coach fetches from 50,000 to 60,000 crowns ($10,150 to $12,180).

The wood-working department in connection with the carriage building comprises a very fine shop, but the tools installed are mostly of German origin. In the hammer shop it was observed that all car hooks are pressed under steam presses. The installation in the hammer shop includes many steam hammers and hydraulic presses, and the Ringhoffer Works have built quite a number of the important tools in this shop.

Other equipment built by Ringhoffer includes complete machinery for sugar works, breweries, and works for making alcohol; steam engines of all types, steam turbines, oil motors, mining machinery, railway rolling stock, etc. Ringhoffer controls the Zoelly turbine rights for Austria.

In building Zoelly turbines the Ringhoffer Works employ Krupp metal for the body of the wheels. It is explained that, inasmuch as steam is admitted at from 10 to 15 atmospheres, the best material obtainable must be utilized in order to insure the wheels standing rigid under the temperature and pressure involved. Any deviation of plate, it is pointed out, will affect the life and safety of the turbine. The material used is nickel steel.

Ringhoffer is employing a packing ring on steam turbines formed of pressed coal. This packing requires no oil or lubricant, and is referred to as being very satisfactory. He is also building crude-oil machines ranging from 8 to 200 horsepower. These machines are declared to be very economical.

Steam engine construction at Ringhoffer's is exceptionally fine. I have had occasion to observe these engines in various Austrian installations, and have been impressed with both the beauty of the workmanship and the fine running qualities. The Ringhoffer shops have built many steam engines for power installations of both vertical and horizontal types, and the work turned out by this firm is in keeping with the latest and most up-to-date methods in recognized steam practice.

HOURS AND WAGES—OUTPUT PER MAN.

A working day at the Ringhoffer plant involves nine hours, less two pauses of one-half hour each. This makes the actual working time eight hours, although the men are present at the shops for nine hours. The best workmen receive from 6 to 7 crowns ($1.22 to $1.42) per day, and laborers 3 to 4 crowns (61 to 81 cents) per day. In the hammer shop foremen receive 8 to 10 crowns ($1.62 to $2.03) per day, and the same statement applies to foremen in other departments. A workman who has been in the employ of the company for ten years receives a certificate to that effect and can not be discharged. In the event of slack conditions arising, the situation is met by first reducing the number of hours of work, followed, if need be, by the discharge of short-time men. There have been, it is stated, practically no strikes at the Ringhoffer Works, and it seems to be well recognized that the management of this fine plant has always endeavored to do the utmost for the welfare of its employees. Instances of welfare work at Ringhoffer's embrace a sick fund, a superannuation fund for the official help, an old-age pension for workmen, and a loan society.

The statement was submitted to the Ringhoffer management that it is the practice in many American machine-tool establishments and other works to keep a record of the production per man per year, basing the same on a record of all material produced within a given 12 months, taking the value at the net price received by the manufacturer and dividing this sum by the total working force, exclusive of the office help. The management was requested to give a similar computation regarding shop efficiency at Ringhoffer's; in other words, the quotient which represents the production per man for one year. The figure supplied was 1,784 crowns ($362).

MACHINE TOOLS IN USE.

Naturally, in a plant such as Ringhoffer's, one expects to find the very best grades of machine tools. In many instances the machines were of a noteworthy character, although it must be admitted that there are a number of old tools doing service which, from the American standpoint, could with advantage be replaced by several later types.

The machine tools on the Ringhoffer floors have been drawn largely from American and German sources. About 25 years ago nearly all the tools bought were obtained from English sources. Many of these old English tools are now in service, but, relatively speaking, few English tools are being purchased to-day. The Ringhoffer floors show the situation in the machine-tool trade of to-day. The main competition is between American and German tools, and here, as at nearly every other point outside of Germany, the writer has heard overwhelming opinions in favor of the American products. There are German tools of exceptional merit, but always, broadly speaking, the general run of German machine tools are outclassed by the best grades of American machines. It is selling considerations which are largely responsible for the presence of German tools in certain markets. Possibly 10 years ago German trade conditions were exceptionally favorable in Austria by reason of political circumstances. But, if the opinions of many Austrian directors are to be considered, German merchants can not to-day expect any preferential treatment.

AMERICAN MACHINE TOOLS COMPARED WITH GERMAN.

Mr. T. Polan, the shopmaster of the screw-making shop, was asked if he found any features to criticise in the American machine tools in use by him, and if he agreed with German criticism that many American tools were too light. Mr. Polan replied that his best tools were of American origin, that the American tools were not too light, and that he made this statement by reason of the fact that he, as superintendent of the shop, had imposed very heavy work on the American machines. To emphasize his remarks, Mr. Polan asked the writer to accompany him to a group of tools in another part of the building, and called attention in particular to a planer from the G. A. Gray Company, of Cincinnati. The Gray tool, he declared, had been in service in the Ringhoffer shops for five years and worked to-day with all the accuracy it possessed when first purchased. It was kept constantly going and gave the most accurate results, and he did not hesitate to impose upon it very heavy work. For comparison, he next called attention to a German planer working close by and quite evidently possessing more metal than the Gray of the same size. The German tool, Mr. Polan declared, notwithstanding its greater dead weight of metal, possesses neither the strength nor the accuracy of the American machine.

The only fault that could be found with American machine tools, the shopmaster remarked, was in the prices demanded. Practically all purchases of American tools, it was declared, were perforce made through German sources; in other words, the Bohemian firms were

largely compelled to apply to Germans to fill their requirements for American machine tools. American selling houses, it would seem, have not yet undertaken to enter this great territory and offer machine tools as they would do in California or other distant States, and yet the Austrian territory has direct sea freight connection with the port of New York.

AMERICAN MACHINE TOOLS AND PRICES PAID.

The following are among the American machine tools on the Ringhoffer floors, with prices and descriptions:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Prague.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.	Vertical miller, No. 6, distance from center of spindle to face of column 610 mm.	1908	$1,963
Niles-Bement-Pond Co., New York.	Slotters, stroke (hub) 400 mm., distance from center of spindle to face of column 700 mm., diameter of table 850 mm.	1906	2,071
Garvin Machine Co., New York.	Shapers (800 mm.), stroke 600 mm	1907	627
Gould & Eberhardt, Newark, N. J.	Shaper (700 mm.), stroke 500 mm	1906	404
Bement, Miles & Co., Philadelphia.	1 vertical boring machine No. 574, distance from center of spindle to face of column 455 mm., diameter of holes up to 57 mm.	1907	1,216
Landis Tool Co., Waynesboro, Pa.	1 grinder, for material up to 57 mm. diameter	1904	1,478
Baker Bros., Toledo, Ohio	Drills, distance from center of spindle to face of column 305 mm., diameter of holes up to 38 mm.	1907	832
Lodge & Shipley Machine Tool Co., Cincinnati.	1 lathe, 280 mm. x 2,490 mm	1907	1,533
Do	1 lathe, 180 mm. x 800 mm	1907	623
Do	2 lathes, 208 mm. x 1,855 mm	1908	829
G. A. Gray Co., Cincinnati	2 planers, 660 mm. width, 660 mm. height, and 1,830 mm. length of table.	1908	1,407
Do	2 planers, 900 mm. wide, 910 mm. high, and 3,050 mm. in length.	1905	1,854

There were also a vertical drill from Prentice Brothers, Worcester, Mass.; two boring mills from Bullard Machine Tool Company, Bridgeport, Conn.; one borer from the Pond Machine Tool Company, Plainfield, N. J.; and turret lathes from Gisholt Machine Company, Madison, Wis.

PRICES PAID FOR FOREIGN TOOLS.

Among the foreign tools in use at the Ringhoffer Works the following were noted:

Grafenstaden, milling machine, vertical millers and lathes, double horizontal miller, heavy horizontal boring mills; Schuchardt & Schütte, Berlin, horizontal millers (no name), vertical drill (no name, bought three years ago for $1,218, and thought to be an American tool); Ducommun, Mulhausen, lathes; Colett & Engelhard, Offenbach, lathes; Karl Jockel, Prag-Weinberge, small double lathe; Wagner & Co., Dortmund, heavy double horizontal boring machine; Guillet et fils, Auxerres, woodworking planer; Sköfde Mekaniska Verkstad, two woodworking filleting machines; Kendall & Gent, Manchester, heavy lathes; Smith, Peacock & Tennent, radial drills and triple shapers; Ernst Schiess, Dusseldorf, shapers, keyway cutters, lathes, and heavy planers; Frederick Schmaltz, Offenbach, tool grinder; Campbell & Hunter, Leeds, radial drills; Vulkan, Vienna, lathes; E. Lebrun, Albert (Somme), lathes; Maclea & March, planers; Habersang & Zinzen, Dusseldorf, 4-spindle multiple drills.

The prices paid for various foreign tools were as follows:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Prague.
E. Bendel, Magdeburg	Buffer lathes, 1,300 mm. length	1905	$853
		1908	926
Do	Buffer rod lathe (buffers to 450 mm.)	1906	719
Maschinenfabrik Königsfeld, Brunn, Austria.	Wood planer, size 400 mm	1905	1,143
Krebs, Halle a. S	Plug miller	1906	633
Hasenclever, Dusseldorf	Bulldozer (Acme) material up to 75 mm. diameter	1906	3,547
		1909	3,547
Schuchardt & Schütte, Vienna.	Landis threading machine, ⅜ to 1¼ inches	1906	528
		1907	528
Brüder Scherb, Vienna	Friction press, diameter of spindle 280 mm., 560 tons	1907	4,791
Habersang & Zinzen	Borer, up to 30 mm. diameter	1907	560
Buck & Hickmann, London	Swage miller, distance from center of spindle to face of column 450 mm.	1908	1,009
Hasenclever	Screw press, stroke (hub) 300 mm. for screws up to 30 mm. diameter.	1908	1,839
Frankfurter Maschinenfabrik, Frankfort.	Band saw, diameter of rolls 1,200 mm	1908	440
Vulkan, Vienna	Punching machine, up to 60 mm. diameter by 10 mm. thick.	1908	792

WITKOWITZ WORKS.

The Witkowitz Works in Moravia, Austria, in August, 1909, were working about 28,000 men. At the close of 1907 the actual number of employees was 27,844. This is one of the largest iron and steel establishments in all Europe. The correct name and address of the firm is Witkowitzer-Bergbau und Eisenhütten-Gewerkschaft, Witkowitz. In organization and in the general conduct of affairs the Witkowitz Works resemble the Krupp Works at Essen. They differ from Essen principally in the fact that gun construction is not undertaken. The output of the Essen shops is confined practically to gun building, armor-plate construction, railway material, and iron and steel forgings. At Witkowitz the output embraces pig iron for castings and puddling, cast-iron parts, tempered castings, molded steel castings for machinery and for shipbuilding, nickel steel of all kinds, wheels for locomotives and tenders, armor plates, crucible steel blocks, boilers, material for bridge construction of all descriptions, railway material, pipes, iron plates, fireproof bricks and tiles, and complete plant installations for mines, foundries, and coke and gas works.

The following observations are based on a two days' inspection of the Witkowitz Works. The general director, Frederick Schuster, accorded the writer every facility in visiting the various shops. The works are the property of S. M. von Rothschild and Gebrüder Gutmann, of Vienna.

LOCATION AND FOUNDING OF THE WORKS.

The location of these works is in the northeast of Moravia. Portions of the holdings extend into the adjacent territory of East Silesia. The East Silesia properties comprise mines, which constitute the southwestern tier of the coal fields of Prussian Silesia. Coal deposits were discovered in Moravia by an iron worker as far back as 1770 to 1780, and coal mining in the Ostrau districts dates from that time. In 1782 it is said that there was an output of 1,200 tons,

and in 1872 the output had reached the figure of 1,200,000 tons. In the year 1907 the output amounted to 7,548,620 tons. This last figure includes the output of the Witkowitz shaft, situated in the adjoining Prussian territory. In 1907 the production of coke figured at 1,767,420 tons.

The Witkowitz Iron Works were established in 1829. The originator was Archduke Rudolph, the then Archbishop of Olmutz, who was also at the time owner of the Friedland Iron Works in Moravia. The Witkowitz Works were the first in Austria to erect a coke furnace and to adopt the puddling process. On the death of the archduke, in 1831, the property passed into the hands of the Prince Archbishop Count Chotek, who, in turn, leased it to a syndicate. In 1843 the banking house of Rothschild, located in Vienna, purchased the property. From the early founding of the works there has been continuous progress, development, and enlarging of the plant; but the chief impulse was given in the latter part of the forties by the adoption of steam power in place of the water power which had been formerly used.

The construction of the Kaiser Ferdinand Railway, traversing the Austrian district, established a connection between the Vienna district and Prussian Silesia and the East and resulted in a further development of production, chiefly in railroad material. This new railway connection afforded increased outlet facilities for the Witkowitz products, and with wider outlets there came a quickening in the growth of the works. The introduction of the Bessemer process in 1865 made the production of steel on a large scale feasible, and up to the present year the growth of the Witkowitz plants has been uninterrupted.

STATISTICS OF DEVELOPMENT.

In 1848 the Witkowitz Works comprised 55 officials, 31 foremen, and 1,001 workmen; in 1880 there were 127 officials, 125 foremen, and 6,393 workmen; and in 1908 the records show 929 officials, 450 foremen, and 28,652 workmen. As remarked above, these figures include the employees in the various shops and mines, as well as in the strictly iron and steel departments. The total production of the works, exclusive of mining output, was, in 1848, 14,969 tons; in 1880, 82,052 tons; and in 1907, 606,221 tons. In 1908 the Witkowitz railway, located wholly within the works, handled 4,568,000 tons of material. At the present day the consumption of water within these works during a 24-hour period is equivalent to the total consumption by the city of Vienna.

In the year 1908, 19,000 employees in the ironworks proper were paid in wages a total of 22,720,500 crowns (crown=$0.203). The average shaft wage is 4.34 crowns per day, or a rough average of 1,267 crowns per year. The very lowest wage paid to any adult workman is 2.60 crowns per day. In 1873 the Witkowitz Works succeeded in amalgamating the mining holdings to the eastward and the ironworks interests in Witkowitz, and it was at this period that the Gebrüder Gutmann interests were taken into the new organization. The present organization dates its name and being from the year 1873. The works comprise coke furnaces both for the production of coke and for the extraction of residual products, blast furnaces, iron

foundries, rolling mills, pipe-making shops, cast-steel works, forging mills, machine shops, shops for the construction of railway material, bridge construction and boiler-making shops, copper shops, and yards for brickkilns, and for the making of fireproof bricks. The central office is in Witkowitz, while the commercial direction is at No. 10 Fichtegasse, 1, Vienna.

The rolling mills manufacture plates for shipbuilding, boilers, and tanks, rails, girders, structural iron, strips for tool making, wire rods, railway sweepers, and armor plates. This department is fitted with 8 rolling trains, and the largest power engine develops 4,000 effective horsepower. To this rolling mill are added finishing workshops fitted with cold saws, shears, straightening machines, etc., and there is a roll-turning shop fitted with 23 roll-turning lathes. In a second rolling mill there is produced in 5 mills merchant iron strip for tool making, rolls for mines and small section, both of weld iron and mild steel. The refining of the material is effected in 10 revolving regenerative gas furnaces.

ARMOR-MAKING DEPARTMENT.

The Witkowitz Works are making all of the armor plates for the new ships of the Austro-Hungarian navy. This department possesses a most thorough and up-to-date installation, and the heaviest armor plates demanded in service to-day are undertaken. The manufacture of armor plates was taken up by the Witkowitz plant in 1893, and in 1901 an 8,000-ton press was installed for this department. In 1906 a second forging press of 4,500 tons was put in. In this department there are 7 furnaces especially designed for armor service. An elaborately constructed oil and water plate-spraying machine was also observed. There are three overhead traveling cranes, one of 50 tons, one of 30 tons, and one of 25 tons. The majority of the machine-tools in this department are from the Vulkan Works, of Vienna. Some very heavy Vulkan slotters were working on armor-plate slotting. The planing work on these armor plates is being handled by worm-thread planers. Two very stout Vulkan machines, one fitted with 8 and one fitted with 12 saws, were in service, sawing off side lappings of armor plates. Pneumatic tools of American make (Boyer) are utilized for scaling armor plates.

It is in contemplation to erect a new armor plant, which will increase the annual output capacity to about 7,000 tons. The practice in the armor-plate department is to lay down a sectional side of a battle ship and to fit all plates to this model side before forwarding to the shipyards. In the shops was seen the model of one of the Archduke Frederick class of ships, to which armor plate is being fitted.

At present about 1,000 tons of armor plate are being worked up in the shops. The heaviest armor plate under construction is of 300 millimeters (11.811 inches) thickness. The Krupp system of armor plate is manufactured for both side and turret installations. The bending of armor plates is mainly effected through the medium of an 8,000-ton press, the construction of the Andritz Works, near Graz.

In the wings of the armor-plate department, and in addition to the cranes previously mentioned, are three 30-ton cranes. It is calculated that in less than a year's time the new additions to the armor-

plate department will have been completed, and thus afford an output capacity double what is possible at present. The new shops are to be equipped with the most modern appliances, a fact which should not be overlooked by machine-tool manufacturers possessing machines especially adapted for armor-plate work.

EQUIPMENT OF FORGE AND HAMMER DEPARTMENTS.

Adjoining the armor-plate department are the forge and hammer departments. In the forge department it was noticed that all wagon axles are made from single ingots. In this department it is the practice to use double-tier traveling cranes, the light ones being higher up. Lauch hammer transporters are used here for placing and taking

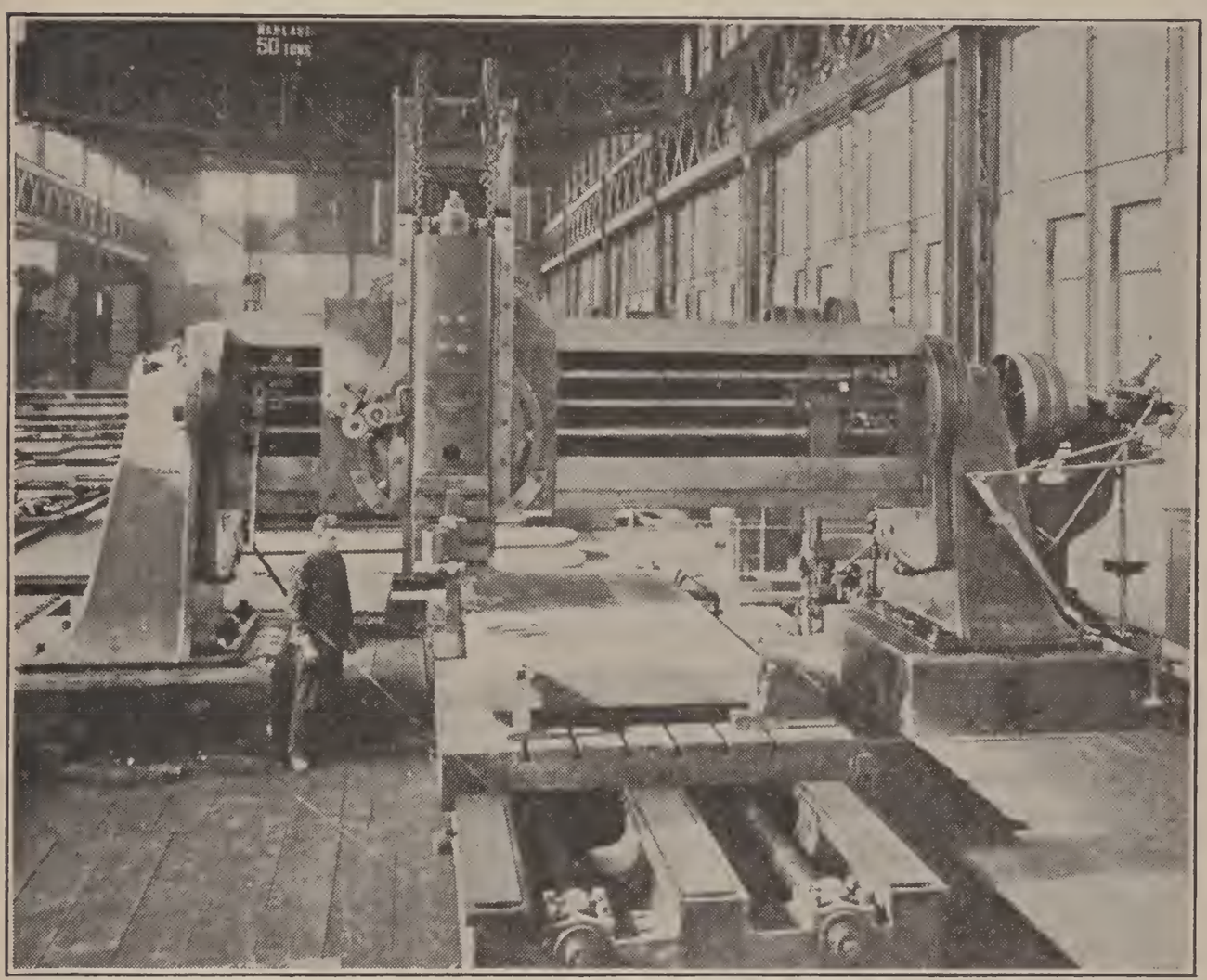

FIG. 21.—Universal armor-plate planing, cross-planing, and slotting machine, Witkowitz Works.

material from the ovens. The traveling cranes in service are all of German construction. In the forge department Martin steel is worked up, and two cranes are employed of 80 tons' capacity each. Single ingots are made up to 60 tons' weight. As a rule, however, the pieces forged are 35 tons in weight. A Floridsdorf type of transporter in service for handling the ladle loads was also seen.

A 4,500-ton Davy press is in service in this department. The overheat from the furnaces is utilized for steam production, there being a boiler overhead at each furnace. The boilers have each 180 square meters of heating surface.

In addition to the Davy press there is a 2,000-ton press from Tannett-Walker & Co., of Leeds, England; one steam hammer of 10 tons, four steam hammers of 5 tons, and one steam hammer of 2,200

kilos. There has recently been installed a new Davy press having a capacity of under 1,200 tons. From the Vulkan Works there is one press of a capacity of 1,200 kilos and also two presses of 1,700 and 1,500 kilos, furnished, respectively, by Wittau and Pamming. There is also one 20-ton Weller hammer, and Breuer, Schumacher & Co., of Kalk, have supplied a press for forming wheels. The same firm has supplied a horizontal hydraulic press for service in forming rings of tires.

In the forge department there is an average production per year of about 30,000 tires and the same number of railway carriage wheels. This, it is stated, is not the maximum capacity, but represents the number of tires which Witkowitz is handling. The railway wheels are being scaled with pneumatic tools. In ten hours' time there are turned out on an average 140 complete wheels. The machines for this work were made at Witkowitz. Tires for railway wheels are made of sizes varying from 300 millimeters interior diameter up to 2,000 millimeters interior diameter. It is the practice at Witkowitz to use Martin open-hearth steel for railway carriage tires and for locomotive tires steel, mixed with a chrome nickel alloy.

The number of men employed in the armor-plate department is 170. In the forge department the number is 364. This latter figure includes the hammer shop and all of the men employed in the manufacture of railway tires and wheels.

MODERN MACHINE SHOPS TO REPLACE OLD ONES.

There are complete machine shops adjacent to the armor-plate department and the forge and hammer shops, in which many heavy and rather old lathes were found in service. The majority of these tools seem to have been supplied by Vulkan, of Vienna, especially many planers and shapers that were noticed. Torpedo heads and torpedo tubes were seen under construction. Nickel steel is employed for these torpedoes, and the material was being turned down on Vulkan tools. There is an old Oerlikon double vertical miller in service here. The cutters in use are mostly of Witkowitz origin. Some very heavy railway frogs in course of building attracted attention. The Witkowitz Works employ very hard steel for these frogs, having only 1 per cent of carbon. Böhler steel is also used for the cutting points of tools, especially for planer teeth. There were counted in service 13 planers of Vulkan make. This machine shop is to be entirely replaced by a new one. In the forge department there are 4 steam engines, 9 steam pumps and accumulators, and 1 steam motor. Connected with the forge department are 14 annealing furnaces.

The entire work in the armor-plate, forge, and hammer shops is as fine as can be found, in the opinion of the writer, on the Continent of Europe. The workmen engaged here seem thoroughly to understand their various lines, and on all sides there is apparent able direction and a high grade of executive control.

CHARACTER OF CAST-STEEL PRODUCTS.

The cast-steel department covers an area of 110,000 square meters (square meter=10.764 square feet), of which 40,500 square meters

are occupied by buildings and 69,500 square meters by storage sheds. The subdivisions of the cast-steel department comprise the crucible foundry, the steel-molding foundry, polishing shop, forge, tire-rolling mill, finishing shops, armor-plate works, ammunition works, pipe-molding works, sheet-iron press shops, boiler-plate press shops, and the department for administrative control. The proving grounds are also included in this general department.

The Martin and crucible foundry contain seven Martin furnaces, five of a capacity of 20 tons and two of a capacity of 30 tons, six crucible furnaces, and also several smelting and reserve furnaces. These furnaces are charged by mechanical power. This section is also equipped with crucible drying sheds for 40,000 crucibles, a hydraulic plant, having 5 steam pumps and accumulators for hydraulic pressure, hydraulic revolving cranes and elevators, and various steam engines, centrifugal pumps, and auxiliary machines.

The products of the cast-steel department comprise section-steel castings, forgings for shipbuilding, open-hearth steel, crucible steel, and special steels for all kinds of axles and tires, locomotive steels, ingots for gun barrels, gun carriages and projectors, air chambers for torpedoes, and armor plates.

Attention was called to many rifle gun tubes, turned out for the Skoda Works. The Witkowitz plant furnishes gun forgings, but the machining work in final assembling is largely intrusted to the Skoda Works. The Skoda Works are to Austria-Hungary what the Washington gun foundry and Watervliet works are to the United States, and Witkowitz does not attempt to finish up gun work as does Krupp. Noble & Lund, of Newcastle-on-Tyne, have supplied a heavy cold saw for this department.

Witkowitz is making crank shafts for locomotives out of three separate pieces. This insures, it was said, homogenity, the pieces being expanded to fit. It is a Witkowitz patent.

In addition to the tools mentioned, there were observed heavy Vulkan radial drills, borers, and slotting machines. There is one heavy Schiess planer in service, and one Gisholt boring mill. Close to the Gisholt tool were four Vulkan boring mills. In a second finishing shop numerous torpedo flasks were under construction. Here, as in the shop visited just before, Schiess and Vulkan tools were seen. There is one heavy Schiess turning and boring mill here which is a little larger than the largest machine tool in the Skoda Works. There are also two Schiess rifling and boring tools here and one from Vulkan.

VARIED PRODUCT OF THE BLAST FURNACES—GAS-DRIVEN ENGINES.

The blast-furnace works at Witkowitz are properly divided into two groups, that at Witkowitz proper and a second group at Sofienhutte. There is a total of 7 blast furnaces with 30 stoves, 8 blowing engines driven by steam, and 3 blowing engines driven by gas motors. These blast furnaces are devoted to the production of pig iron for puddling, of steel for the foundry, hematite, Bessemer, phosphoric pig iron, iron, hard castings, ferromanganese, ferrosilicon, and silicon spiegel. The smelted spathic iron ore and brown iron stone are obtained from Upper Hungary; Swedish magnetite and apatite,

lixiviated copper pyrites, slags, manganese ores from Bosnia, Bukowina, Hungary, and other countries. In the Sofienhutte group there are three blast furnaces with capacities, respectively, of 260, 200, and 120 tons, or a total of 580 tons per day.

The gas derived from these blast furnaces is utilized for a power drive at a central station close by. In this central station there are two steam engines of 1,400 and 800 horsepower, respectively, and two gas engines of 1,200 horsepower each, making a total power available of 4,600 horsepower. The writer has had occasion to observe the running of many gas engines on the Continent of Europe, but nowhere has he seen, with the possible exception of Resicza, such excellent gas-engine work as at Witkowitz. Not only at the Sofienhutte station, but at a second station at Witkowitz proper, every opportunity was afforded to note the gas-engine service. Witkowitz builds gas engines only for its own use, and its gas engines are to-day being run by men familiar with every essential of their construction. This necessarily has much to do with their success. However, the writer is inclined to think that for large power gas engines it would be difficult to find in all Europe better engines than those which are made at Witkowitz. These engines run with all the smoothness and quietude of a beautifully adjusted steam engine. A 1,200-kilowatt 1,600-horsepower engine was seen at work in the new station running as smoothly as any steam engine. This was a double-acting tandem unit. These Witkowitz engines are of the Otto system, built under Witkowitz modifications. The engine referred to bore the numbers 33/34. This engine is working parallel with a turbine system (Curtiss) in the central station.

As an illustration of how effective these Witkowitz gas engines are, it is stated that 99 per cent of the working time is taken up by them; in other words, the engines are running practically continuously, since the work at Witkowitz is carried on night and day. Such slowing down as is necessary for the gas engines does not exceed 1 per cent of the entire period. This statement was made by the chief engineer himself. When the chief engineer was asked why they were not making gas engines for others, he replied that they had no time at present for outside orders.

At Witkowitz proper there are 4 blast furnaces, 2 having a capacity of 250 tons each, and 2 of from 150 to 200 tons each.

MANIPULATION OF GAS FOR USE IN ENGINES.

At the Sofienhutte station the power derived from the combined steam engine and gas engine installation is utilized for operating blowing engines at this point. A new building is now going up alongside the present station, in which gas engines now building at Witkowitz will be installed. This new station will be furnished with from 15,000 to 20,000 horsepower, and the power will be used both for blowing engines and for electric-current development. At the Sofienhutte station the gas for the blast furnaces is passed into a washer of a Witkowitz design, comprising fans. Here it is roughly cleaned. The gas next passes into a second washer, also of the same Witkowitz design, where it is further washed, and thence

through a larger system of fans. These fans are all of the same Witkowitz type. The gas is then dried in a dryer. This is effected by giving the gas a slow velocity and thus enabling the washer to drop. From the first dryer the gas passes to the second dryer, and from the second dryer it passes direct to the engine. When there is too much gas available the overflow goes into the air.

The three furnaces at Sofienhutte have also supplied sufficient gas, but in case there should be an insufficient quantity from one or two furnaces, the gas from a third furnace is cut under. As a matter of fact, two furnaces have been found sufficient to supply all gas required. The 260-ton blast furnace at Sofienhutte has been in service only since April, 1909.

Close to Sofienhutte is a coke station known as "Koksanstalt Karolinenzchacht." The production of coke here is 1,100 tons per day. In addition, there are two other coke-oven plants, comprising in all 335 ovens. A day period must be understood as comprising 24 hours' service.

AMERICAN METHODS IN MACHINERY DEPARTMENT.

Naturally, at a great establishment such as the Witkowitz, the machinery department proper is one of the most important in the make-up of the plant. The chief engineer of the machinery department is Mr. William Leicht, a man of broad engineering experience and of keen knowledge regarding the merits of machine-shop equipment. The remarkable success of the Witkowitz gas engines is largely due, the writer is inclined to believe, to the superb engineering work evident on these machines, and for this result Chief Engineer Leicht is directly responsible. This gentleman afforded the writer every facility in connection with his inspection of the machinery works and discussed with him with the utmost frankness the general situation with reference to the machine tools, both American and European. He is an enthusiastic admirer of American methods, having visited the United States shortly before the opening of the St. Louis Exposition and traveled continuously for a period of about five weeks. He visited many plants, but did not hesitate to say that in his opinion the Allis-Chalmers Works at Milwaukee were the best, taking all facts into consideration, which he had visited. In going over the machinery department with Chief Engineer Leicht unmistakable American features were noticed in shop arrangement and methods of handling material. In nearly every instance Mr. Leicht stated that he owed the suggestion to what he had seen in America.

In the machinery department two pneumatic hoists are used. The writer has visited several hundreds of the leading and most important machinery works in Europe, but this is the first instance in which he has found pneumatic hoists of the type so familiar in many shops in America. Mr. Leicht said that he borrowed the idea from the United States and constructed the hoists in his own shops. In one great establishment in Germany some years ago car wheels were rolled up on railway trucks by hand. At Witkowitz they have learned to do work of this sort with the pneumatic hoists.

In all 2,100 men are at present employed in the machinery department. Good mechanics are receiving from 7 to 10 crowns per day.

CHARACTER OF MACHINE TOOLS.

The Witkowitz machinery department has in service probably the largest combined horizontal boring and turning mill in Austria. This machine was built by Collett & Engelhard, of Offenbach. The machine is 20 meters long and 8 meters broad. It would appear that the machines of this firm are in much favor in Continental shops. This tool was purchased about three years ago and is utilized to bore the cylinders and trim the edges of the heavy Witkowitz gas engines.

One of the first American machines noticed was a Gisholt boring mill working up car wheels. Close alongside of it was a Breuer, Schumacher & Co. newly designed machine for the same purpose. Bickford radial drills and also vertical drills from Ludwig Loewe were in service.

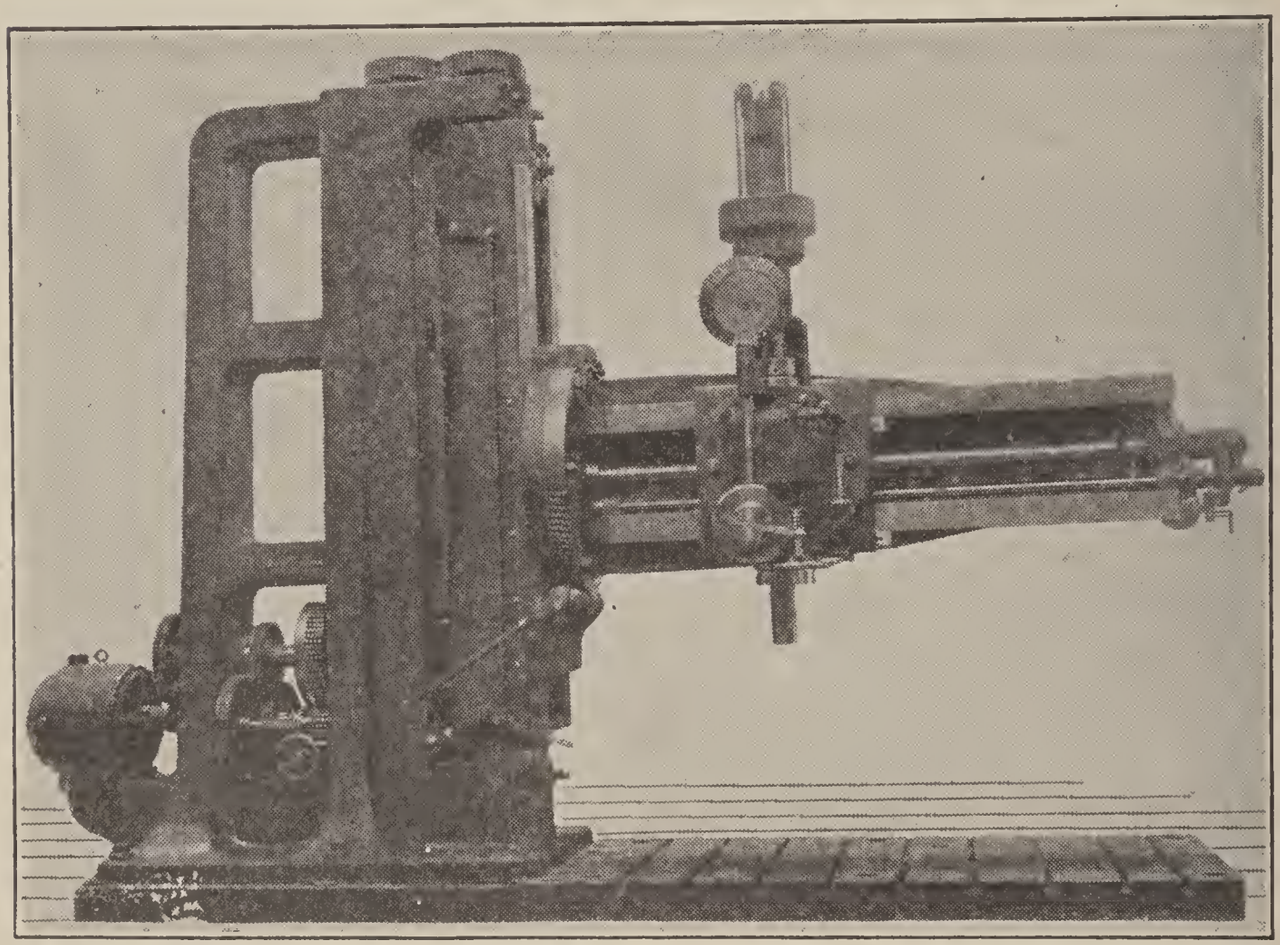

FIG. 22.—Universal radial boring, drilling, tapping, and screwing machine, Witkowitz Works.

In the machine-tool department is a complete overhead trolley system, making it possible to swing work over the middle of every tool in the shop. The material can be run by trolley from any one tool to any part of the shop. Two large Lodge & Shipley 24-inch engine lathes are in use. Mr. Leicht said that he was well satisfied with these machines. He also referred to the Gleason gear planers as excellent tools.

Jigs were being used in connection with the Collett & Engelhard tool in boring work on gas-engine castings. As a rule jigs are not utilized to the same extent in European shops as in American. The fact has repeatedly been mentioned in other reports that Continental shops do not, as a rule, specialize to the same extent as American establishments, and therefore the value of jigs is not so apparent as in home works.

The following are among the American machine tools in service in the Witkowitz machinery department, the names of the makers by whom supplied and the type of tool being indicated:

Jones & Lamson Machine Company, Springfield, Vt	Turret lathes.
Becker-Brainard Milling Machine Company, Hyde Park, Mass., by Schuchardt & Schütte, Vienna	4 vertical millers.
Brown & Sharpe Manufacturing Company, Providence, R. I., by Otto Diechmann, Berlin	Grinder.
Gleason Tool Company, Rochester, N. Y., by Schuchardt & Schütte, Vienna	Gear planer.
Landis Tool Company, Waynesboro, Pa., by Schuchardt & Schütte, Vienna	Universal grinder.
Colburn Machine Tool Company, Franklin, Pa., by L. Loewe & Co., Berlin	3 vertical boring and turning mills.
Bickford Drill and Tool Company, Cincinnati, by Schuchardt & Schütte, Vienna	Radial drill.
Cincinnati Milling Machine Company, Cincinnati, by Schuchardt & Schütte, Vienna	Universal milling machine.
G. A. Gray Company, Cincinnati, by Schuchardt & Schütte, Vienna	2 planers.
Lodge & Shipley Mahine Tool Company, Cincinnati, by Schuchardt & Schütte, Vienna	3 engine lathes.
Cincinnati Planer Company, Cincinnati, by Schuchardt & Schütte, Vienna	2 shaping machines.
Cincinnati Planer Company, Cincinnati, by L. Loewe & Co., Berlin	Planer.
Acme Machinery Company, Cleveland, by Schuchardt & Schütte, Vienna	3 screw cutters.
Baker Brothers, Toledo, by Schuchardt & Schütte, Vienna	5 high-speed drills.
Mills & Merill, Saginaw, Mich., by Heinrich, Dreyer, Berlin	"Giant" type machine.
Gisholt Machine Company, Madison, Wis., by Schuchardt & Schütte, Vienna	Turret lathe and 2 vertical lathes.

FOREIGN TOOLS MAINLY GERMAN OR AUSTRIAN MAKES.

The Continental tools in service in the Witkowitz Works comprise many machines from Germany and from the Vulkan Works in Vienna. There are a number of English tools and an occasional French machine, but all recent purchases are confined, as a rule, to American tools and tools from Vulkan and important leading German works. Collett & Engelhard, of Offenbach; Reinecker, of Chemnitz; Ludwig Loewe, of Berlin; and Hartmann, of Chemnitz, are largely represented in this department. There is one Hartmann vertical miller in service cutting heavy gears, and Mr. Leicht says that this is the only machine of which he has knowledge which affords a good form to gear teeth. This statement should be taken notice of by American manufacturers of machines adapted to this sort of work. It might be stated, parenthetically, that the writer knows of no works in all Europe more ready to adopt high-grade machines than the Witkowitz plant. American manufacturers possessing meritorious machine tools will do well to call the attention of this firm to such machines. It may be set down as a fact that the Witkowitz shops are in the market at all times for the highest grades of machines obtainable, regardless of price.

The illustrations accompanying this article are explained as follows: The universal armor-plate planing, cross-planing, and slotting

machine which is shown was built by the Vulkan Works in Vienna and is installed at the Witkowitz Works in Moravia, Austria. It is fitted with electro-magnetic Vulkan clutches, operated by 50-horsepower motors.

There is also shown a motor-driven, universal radial boring, drilling, tapping, and screwing machine in use in the armor-plate department at the Witkowitz Works. The spindle of this machine is 140 millimeters ($5\frac{1}{2}$ inches), the travel is 800 millimeters (32 inches), and the radius 3,500 millimeters ($11\frac{1}{2}$ feet). The motor for driving it possesses 15 horsepower. The machine was built by the Vulkan Works in Vienna.

A heavy duplex boring and turning lathe, built by the Vulkan Works, Vienna, and installed at the Witkowitz Works, is also illustrated. This machine is driven by a submerged motor, countershaft with electric clutches. These clutches can be controlled by small

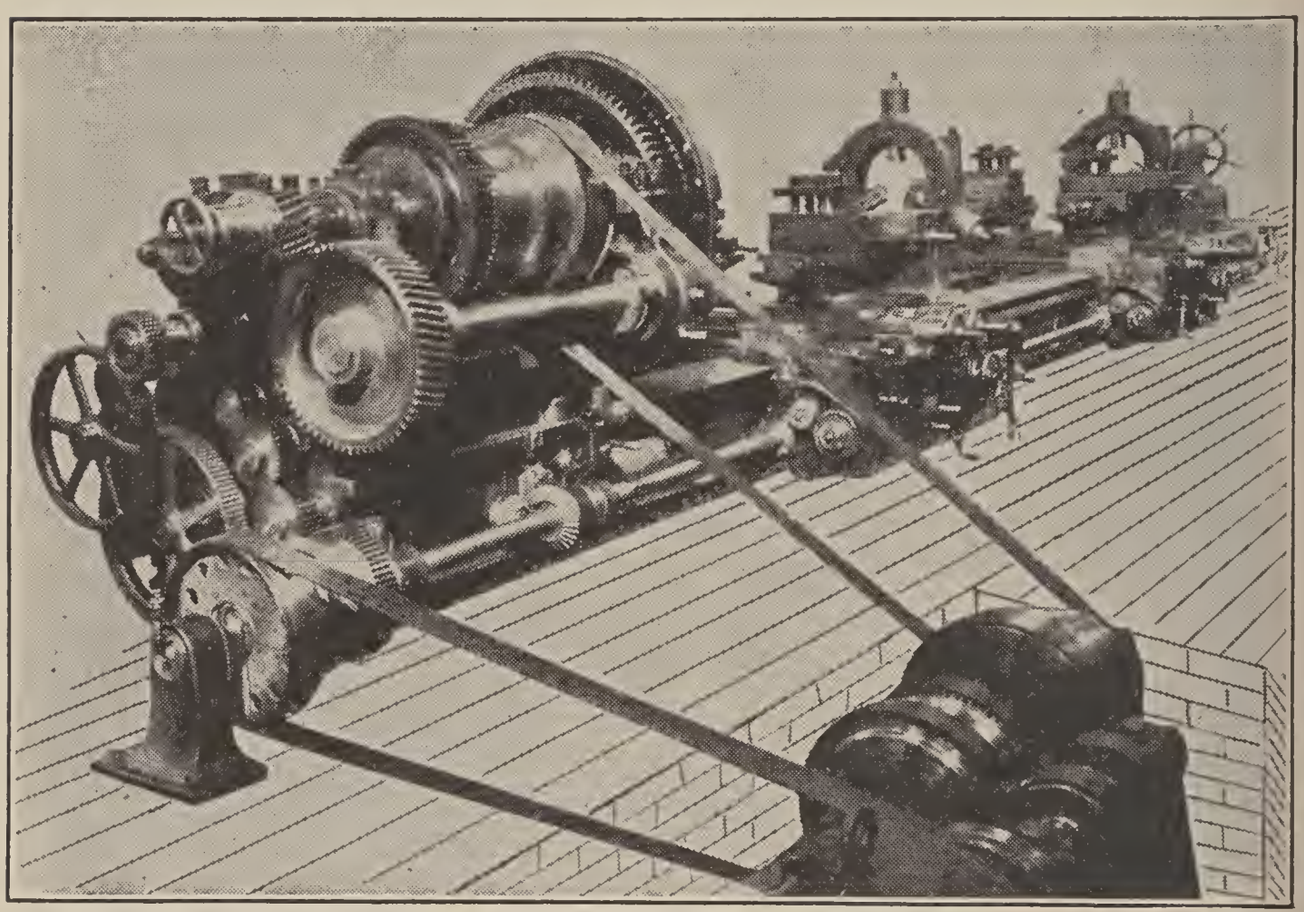

FIG. 23.—Heavy duplex boring and turning lathe, Witkowitz Works.

switches on either side of the carriage for stopping, starting, or reversing of the hand spindle, and for slow motion and rapid transport of the carriage.

The total number of machine tools in the Witkowitz machinery plant is approximately 520. The machine shop makes its own gages and cutters, and also makes many tools of special character. There are a number of special tools in use at the Witkowitz machine shops of a particularly meritorious nature, but at the request of the chief engineer mention is not made of these.

There are now four gas engines, each of 1,500 horsepower, under construction in the machinery department.

TUBE-MAKING PLANT AND ITS PRODUCT.

In the various observations on the Witkowitz plant no attempt has been made to make notes on all branches, but there is one depart-

ment which should be mentioned at all events, and this is the tube-making shop. In this branch of the establishment there are fully 1,000 men employed. In going over the tube shops the escort was Mr. Karl Wojtěchowský, assistant engineer, who was for 7 years in the United States and saw service as master mechanic at the National Tube Works and at Pittsburg.

In this tube-making department the methods are naturally in accordance with European requirements—that is to say, there is not that recourse to specialties as in the United States, for here at Witkowitz a great variety of work is undertaken. The one feature which impressed the writer was the methods in vogue for lap and seam welding. He remembers seeing some very fine work in this line at the Continental Iron Works, in Brooklyn, N. Y., but so far, in Europe, he has seen nothing better than the work carried on in this line at Witkowitz. The apparatus used for lap and seam welding comes from Augsburg-Nuremburg, but is modified in parts.

Witkowitz is using a water-gas system, the design of Dellwick-Fleischer, of Frankfort. Attention was called to some specially fine seam-welding work on a steam collector bed such as is superimposed on the box of tubular boilers. The workmanship was of a very superior character. In tube making the Witkowitz Works, out of 100 pounds of material, manage to make 95 pounds of tubes. The recourse of water-gas heating makes it possible to employ much thinner plates. If these tubes were run in furnaces heavier metal would be necessary to obviate collapsing.

The wages paid in the machinery department are, as a rule, 7 crowns per day. Furnace men receive from 5 to 7 crowns per day, although specially skilled men are paid as high as 12 or even 15 crowns per day.

BENEVOLENT FEATURES AT WITKOWITZ.

Witkowitz does much for the welfare of its employees. There are benevolent institutions comprising a pension institute for the staff and for the employees. There are stipends for the sons of members of the staff, foremen, and men, and scholarships are granted to the staff and supervisors located at the mines. There is a sick fund, and it is possible for children of workmen who are disabled to claim contributions for their education, and the money paid in by parents to the sick fund, in the event of death of the parents, is repaid to the children. At the end of the year 1906 the total sick fund amounted to 10,800,500 crowns. From a fund of 300,000 crowns the interest is utilized for workmen who have done long and good service and have become incapacitated for further work. From another fund of 300,000 crowns the interest goes toward the support of the families of those married men or widowers who are summoned for military service and who have been in the employment of the company for at least three years.

The directors also make monthly allowances to men who have served for 40 years, and in addition to the sick fund there is a general accident insurance association. A gewerkschaft alone bears the expense of these two institutions, and in the year 1907 the works paid out on this score the sum of 1,079,106 crowns.

On the occasion of the 50th anniversary of the Emperor Franz Josef the Witkowitz Works built an orphanage for 50 boys and 50 girls, at an expenditure of 154,000 crowns. The cost of maintenance

of this orphanage, which amounts to about 42,000 crowns, is met by the interest from two divisions made by the works, amounting to 920,000 crowns. The buildings were extended in the year 1905, so that at the present time 50 boys and 75 girls can be accommodated in the orphanage.

There is a hospital with 3 pavilions, 15 wards, and altogether 130 beds. There are separate waiting rooms and consultation rooms for outdoor patients, adapted to the different nature of the cases. There is one hospital for infectious diseases, with 4 wards and 26 beds, and one home for convalescents, with 26 beds.

The medical staff comprises 1 physician in chief, 5 physicians in ordinary, 2 specialists, and 7 district physicians. There are also 4 clerks, 20 sisters, 7 attendants, 6 nurses, 3 porters, and 1 house master.

SCHOOLS AND HOUSING FOR EMPLOYEES AND FAMILIES.

The schools maintained at Witkowitz comprise 1 German boys' school and 1 German girls' middle-class school, 3 German boys' board schools and 2 German girls' board schools, with a staff of 35 male and 34 female teachers for 1,698 boys and 1,627 girls. There is also 1 Bohemian girls' school and 1 Bohemian boys' school, both of which are upper schools, having 13 teachers for 580 children.

There are also 10 kindergarten schools, with 28 teachers for 950 children. In addition to the foregoing there is a German industrial training school for the education of supervisors, with 5 teachers for 70 pupils, and a general industrial training school for apprentices, with 15 male teachers and 595 pupils.

The members of the Witkowitz staff, the foremen and workmen employed in the works, are domiciled in 229 buildings with 347 flats. These domiciles are for members of the staff and teachers. In addition, there are 1,191 family dwellings for married men, 6,129 apartments in 34 barracks for single men and for those married men who do not live at the works. There are also 88 quarterings and 44 rooms for men who wish to live singly or two together.

A home is maintained for little children, a supply association, several baths, steam laundry electrically driven, stores, 5 soup kitchens, and a hospital for the works. In the year 1907 the consumption of the soup kitchens was as follows: 277,605 kilos of meat, 35,907 kilos of sausage, 705,006 pairs of small sausages, 45,194 liver sausages, 7,639 liters of beer, 4,230 gallons of wine, 293,868 bottles of soda water and lemonade, 106,000 gallons of coffee, 1,760 gallons of tea extract, 216,600 loaves of brown bread, and 418,990 loaves of white bread.

On the estates owned by the Witkowitz Works 242 acres of land are let to men at low rent. Board and lodging are provided by the company at a cheap rate—practically at cost price. Lodgings for single men cost 2.40 crowns per month; breakfast (coffee) costs 6 hellers (100 hellers=1 crown), dinner 24 to 30 hellers, supper 12 to 15 hellers, or a total cost per day of from 42 to 51 hellers. No less than 20,000 meals are served daily in the soup kitchens. Married men are able to rent apartments at from 3 to 14 crowns per month, or 18 crowns for larger dwellings.

Witkowitz is reached direct from Vienna and from Breslau. Leaving Breslau at 6 a. m. one arrives at Schonbrunn at about 10.40 a. m., whence a carriage or a tram car takes one to Witkowitz, the distance being about three miles.

DENMARK.

INTRODUCTION.

Denmark is generally regarded as an agricultural country, and this is, in the main, correct. The total population, according to recent statistics, is 2,605,268, or less than Greater New York, London, or Paris. Yet the individuality of the Danes is so marked and characteristic that the people have retained intact a distinct language. The agricultural products of Denmark find a ready outlet, and fast freight boats built especially for this service are utilized in reaching the English market. The general tariff on ordinary imports is not great.

Such manufacturing work as is carried on in Denmark is largely confined to the vicinity of Copenhagen, the capital. A notable exception is the Scandia Works, located in Randers (Jylland). This plant is engaged largely in the manufacture of tramway cars and railway material.

Probably the most important single manufacturing concern in Denmark is Burmeister & Wain. This firm does a general ship and engine building business. It is regarded somewhat as a national concern, rather than an individual enterprise. The only machine-tool building plant in Denmark of importance is the firm of Nielsen & Winther, and that establishment has already made a good beginning in the Continental export trade. Other prominent firms include the Atlas Works, the Titan Works, the Danish Rifle Works, the Government establishment known as Gevaerfabriken, and the Haerens Laboratorium.

All of these works are located in Copenhagen and are users of modern machine tools. Still other Danish firms which have been purchasers of American machine tools include:

Maskinfabriken, Akt., Copenhagen; Nordisk Cyclefabrik, Copenhagen; Copenhagen Cyclefabrik; The Copenhagen Cyclepumpefabrik, Soeminekorpset, Copenhagen; J. G. A. Eickhoff, Copenhagen; Tuxen & Hammerich, Copenhagen; J. G. Thygesen & Soen, Aarhus; Det Kgl. Danske Orlogsvaerft, Copenhagen; De Danske Statsbaner, Copenhagen; Thomas B. Thrige, Odense, Akt. Pasteur, Randers.

The writer has visited several important Danish works. Time did not permit a visit to all the plants here enumerated, but a sufficient number has been inspected to make it possible to reach a fair conclusion regarding the elements controlling the purchase and use of machine tools. Broadly speaking, the American competition in Denmark is largely with German firms. A few Swedish tools are found and an occasional English tool. The firm of Alfred Herbert (Limited), of Coventry, England, has placed a fair number of late type machines in this territory, but the majority of the English tools in use were purchased many years ago, and at a period antedating the development of American and German machine tools. The question of price is largely a controlling factor with Danish buyers, but the presence of numerous high-grade American tools would seem to indicate, on the other hand, that with the most progressive shops the question of price is not the first consideration. Messrs. W. Loewener & Co., of Copenhagen, have placed numerous American tools in Danish shops.

I feel justified in saying that there is a strong pro-American sentiment in Denmark, and this sentiment should not be ignored by American manufacturers. There is a direct line of steamers, the Scandinavian and American line, plying between New York and Copenhagen, and at Copenhagen a portion of the city fronting the water is set apart and is known as a free port. Storage and warehouse facilities can be secured here. The advantage of the free port is the increased facilities it affords in making shipments to all Scandinavian points.

TITAN WORKS.

The Titan Works, of Copenhagen, are a representative Danish machinery building plant. The full name and address of this establishment is Koefoed, Hauberg, Marstrand & Helweg, Aktieselskabet Titan, Tagensvej 32, Copenhagen. The directors are Messrs. R. Helweg, G. Garde, and S. C. Hauberg, who afforded the writer every facility in making an inspection of the shops, which are located within the city proper. About 450 workmen, besides the officials, were employed at the time of the inspection, September 17, 1909.

The company is a limited one and is the outcome of the union of two Danish plants known as Koefoed & Hauberg and Marstrand, Helweg & Co. A consolidation of these two Danish firms was effected in 1897. It was said that business was not as active in the fall of 1909 as in 1908, but the works seemed to be fairly busy. During 1908 night work was carried on to a considerable extent, but orders in hand are now fully taken care of by day work.

The output of the establishment comprises for the most part electromotors, dynamos, cranes, elevators and elevator apparatus, and a general line of the apparatus necessary for power installation and the handling of transporters and conveying machinery. In other words, the Titan Works may be referred to as the "Brown Hoist" of Denmark. This firm has been called upon to make many important installations throughout Scandinavia, and the great majority of the conveying systems at Copenhagen are its work. The mechanism for handling one of the fine swinging bridges at Copenhagen comes from this establishment. It also has works for mill separators, and exports much of this product.

ELEVATOR OUTPUT—THE TITAN APPLIANCES.

Probably the largest line of outputs is elevators for general stores and private dwellings. There is much recourse to elevators in private houses in modern Continental construction, and firms like this have, during the past few years, taken advantage of the heavy demands in this direction. The elevators installed in private buildings are usually of an automatic character, and the Titan engineers lay especial stress upon the safety device which they have inaugurated. Before the organization of the Titan Works proper one of the constituent firms engaged for a period of 20 years in the building of elevators.

Electricity is the motive power utilized, and it is so arranged that the elevators can connect with the electric power generally available in modern cities. The Titan elevator has the push-button system, where no attendant is needed. Electrical apparatus used in this service is mounted on the same bedplate as the lifting gear, and there is no apparatus in the lift well, it is declared, requiring at-

tention. The safety appliances will not permit the elevator being operated in case any landing door is open. A powerful brake is attached to the motor shaft and is connected with the starting mechanism in such a manner that it stands clear while the motor circuit is closed, but is immediately applied when the current is interrupted. A special circuit breaker is also attached to the gear which comes into operation whenever the descending cage is stopped by some hindrance or other, causing the carrying wire ropes to be slackened, also when the speed of the ascending or the descending cage goes beyond a certain limit, in which event a speed governor acts upon the circuit breaker. In case the cage passes its highest or lowest point the circuit breaker will function. Should the wire ropes of the cage break, provision is made to clamp automatically the cage fast to the guides. The electric safety lock is connected in such a manner with the operating mechanism that only the door before the cage at the time can be opened. The cage automatically releases a mechanical lock on reaching the landing place.

MACHINE-TOOL INSTALLATION.

The installation of the Titan Works comprises machine tools of Danish, American, German, English, and Swedish origin. Probably the greatest number of tools are from the Danish machine-tool works known as Nielsen & Winther. German machine tools are much in evidence, and it was stated that the question of price was largely a controlling element.

With reference to the American machine tools employed, the statement was made by Mr. E. Hansen that the tools were in general very much liked and that no fault could be found except on the subject of price. The duty on foreign tools entering Denmark, he stated, is 5 per cent. Among the machine tools in service the following were observed, the prices paid for some of them being also indicated:

Name of maker, and type and dimensions.	When purchased.	Price delivered in Copenhagen.
AMERICAN TOOLS.		
J. E. Snyder & Co., Worcester, Mass.:		
Heavy vertical drills		
One 25-inch vertical drill	1908	$295
Fifield Tool Co., Lowell, Mass.:		
Heavy lathes		
Brown & Sharpe Manufacturing Co., Providence, R. I.:		
One No. 2 and two No. 3 universal millers; one No. 3 keyway cutter		
One No. 3 vertical milling machine	1900	984
Potter & Johnston Machine Co., Pawtucket, R. I.:		
Shapers		
One 24-inch shaper	1900	536
Blake & Johnson, Waterbury, Conn.:		
One No. 3 keyway cutter	1900	643
Niles Tool Works, Hamilton, Ohio:		
Heavy double boring mills		
One 10-foot boring and turning mill	1900	4,650
Cincinnati Planer Co., Cincinnati:		
One planer, 36 x 36 inches x 12 feet	1900	1,876
FOREIGN TOOLS.		
Nielsen & Winther, Copenhagen:		
One lathe A. M. 2, 2,000 mm. long; weight, 1,000 kg	1907	590
One lathe A. M. 3, 2,450 mm. long; weight, 1,300 kg	1907	724
Deutsche-Niles Werke, Oberschoneweide, near Berlin, Germany:		
One double boring mill, factory marks G a a 1,000	1908	1,822
One vertical slotter, 350 mm	1900	1,311

Among the foreign tools in service are also the following:

Taylor Challen (Limited), Birmingham, stamp machine; Sponholz & Wrede, Berlin, stamp machines; Maschinenfabrik Oerlikon, Zurich, rifling machine for mill rollers; Nielsen & Winther, Copenhagen, heavy radial drill (length of arm 2½ meters), planers, lathes, turret lathes, slotters, vertical drill; Deutsche-Niles Werke, Oberschoneweide, near Berlin, radial drill, double boring mill, slotters; Breuer, Schumacher & Co., Kalk, near Cologne, radial drill, heavy lathe, slotters; W. S. Wilkinson, Leeds, planers; Werkzeugmaschinenfabrik, Leipzig-Pleynitz, gear cutters.

The Skoda Works, of Pilsen, Bohemia, supply many large gears which are used. The Titan Works do not undertake to cut any but rather small gears. The Gisholt turret lathe, it was noticed, is employed on pulley coupling work; a similar use of the Gisholt was found in the Brown, Boveri & Co. works, of Baden, Switzerland, where a reduction in price was effected by using these machines on this character of work.

GERMAN TOOLS IMPORTED.

The majority of the foreign tools used are of German origin, and it was explained by Mr. Hansen that the German tools were purchased mainly because of cheapness. The Deutsche-Niles Werke, for example, he said, are making not only an excellent tool but one that is cheap.

The total imports of German machine tools into Denmark for the years 1907 and 1908 were, respectively, 794,400 kilos and 950,800 kilos (1 kilo=2.2 pounds). These figures must not be understood as including forge or smithy equipment, inasmuch as the German imperial office undertakes to list separately the imports and exports of the latter. The German exports of machine tools are embraced under the heading, "Maschinen zur Bearbeiten von Metallen." The German official statistics available for 1908 do not show any imports into Germany of machine tools from Denmark.

WAGES AND WORKMEN.

Practically all labor in the Titan shops is paid for on a piecework schedule. Foundrymen receive on an average from 5 to 6 crowns ($1.34 to $1.61) per day. In the machinery department a good hand at the lathe will also average the same wages on the piecework system. The maximum in this department is 7 crowns ($1.88) per day. The wages paid to apprentices are 3.50 to 4 crowns ($0.95 to $1.07) per day. The day's work commences at 6 a. m. and ends at 5 p. m. in winter and 6 p. m. in summer. At 8 o'clock in the morning there is a stoppage until 8.30 for breakfast. Work then continues until 1.30 p. m. The afternoon period commences at 2 p. m.

The character of the work turned out by this plant is exceptionally good, and the establishment may be regarded as thoroughly representative of Danish industrial undertakings. The general intelligence of the workmen forcibly impresses one, and it was apparent that there was excellent direction and control.

BURMEISTER & WAIN.

Burmeister & Wain, of Copenhagen, form one of the prominent Scandinavian ship and engine building plants. In Denmark this establishment is regarded as typifying Danish engineering capacity, and it is not too much to say that a national pride exists with reference to the firm's undertakings.

In September, 1909, the number of men employed approximated 2,000; when business is good this force is as great as 3,000. The works were founded in 1846 by Carl Christian Burmeister, who formed a partnership with H. H. Baumgarten. In the beginning the firm was known as Baumgarten & Burmeister. In 1861 Mr. Baumgarten retired. In 1865 Mr. W. Wain, an Englishman, became associated with the original founder, and from that day the works have been known under the present name. Later it was found necessary to form a joint-stock company because of the rapid development of the business. Mr. Wain's death occurred in 1882, and in 1891 Mr. Burmeister retired, but continued his connection with the board of directors.

A STOCK COMPANY—CAPITAL EMPLOYED—PRODUCTS.

Burmeister & Wain became a stock company in 1872. The capital of the company at present amounts to 10,000,000 crowns (1 crown= 26.8 cents).

The engine works are located in the city of Copenhagen proper and have water frontage. The shipyards are on Refshale Island, facing the harbor, and comprise four building slips, three large patent repairing slips, and a dry dock measuring 470 by 76 by 24 feet. This is said to be the largest dry dock in Scandinavia. There is also a floating dock having a lifting capacity of 11,000 tons.

Ordinarily there is a turnover in business annually of about 14,000,000 crowns ($3,752,000). This assumes normal conditions. Up to the present date the number of ships built by this concern is 273. The vessels comprise freight and passenger steamers, fast mail steamers, ice breakers, cruisers, gun vessels, yachts, steam and sailing vessels, and seagoing lighters. The Russian imperial yacht Standart was built here in 1896.

The engine works proper are located in that part of Copenhagen known as Christianhave. Directors Martin Dessau and Ivar Knudsen were kind enough to receive the writer and afford him every facility in making a complete inspection of the plant. He was personally escorted by Mr. Otto Prollius, shop manager for the separator department. The last-named gentleman has seen considerable service in the United States, and has had a wide experience with various types of American machine tools.

The shops were found to be highly modern in character, and, judging from general appearances, were fairly busy. This firm makes a specialty of forgings. Denmark does not possess iron or coal mines. All coal is imported and comes, for the most part, from England. Coal exists in Sweden in sufficient quantities to supply the railways and to afford a reserve supply for the navy in case of war, but there is practically no export of Swedish coal to Denmark.

Burmeister & Wain, in common with other Danish firms, are compelled to import pig iron, and these imports are generally from England and Germany. Freight rates from Germany are from $3 to $4 per ton. This makes it difficult to export from Denmark to Germany, inasmuch as freight on material would have to be paid two ways. In producing forgings, however, the company is able to utilize a little more than 80 per cent of Danish scrap, leaving less than 20 per cent of material to come from foreign sources.

Forgings can be exported to advantage, and it is stated that numerous steel forgings are exported to the United Kingdom. For instance, the firm does an equally good business in finished crank shafts and in rough forgings, but it pays, it has been found, to finish the forgings before shipment from Copenhagen.

In the forge department hammers were observed from B. & S. Massey, Manchester; from the Rigby Steam Hammer Company, of Glasgow; and from Breuer, Schumacher & Co., of Kalk, near Cologne. The hammer installation comprises one of 50 tons, one of 200 tons, and one of 400 tons, besides several smaller ones. In addition, there are three forging presses—one of 500 tons, one of 1,000 tons, and one of 2,000 tons.

FOUNDRY DEPARTMENT.

The foundry department, which joins the forge shops closely, is fitted with two traveling cranes, supplied by the Morgan Engineering Company, of Cleveland. The number 1208 was seen on one of these cranes. The molding machines in use have been supplied mostly by Bopp & Reuther, of Mannheim. These molding machines are largely used on the castings necessary for the cream separators, and on small fittings work. The finishing-off work in the molding department is by means of pneumatic tools.

The principal output of the Burmeister & Wain plant comprises steam engines of all sizes and descriptions, waterworks systems, boilers for land purposes, cream separators, beer separators, tar separators, yeast-making apparatus, Diesel motors, ice-making machines, refrigerating plants, and bridges. This firm has built and shipped steam engines for power installations to such points as Bahia, St. Petersburg, Baku, Malaga, and Bangkok.

The manufacture of Diesel motors is one of the best undertakings of the firm at present. There is a general demand throughout Denmark for these small Diesel engines, and practically every small Danish village, it is said, is putting in a system of this character. The use of electric light is becoming very common, and the country Danes are now accustomed to use electric light in the stables and cow sheds. The Copenhagen firm is turning out these Diesel motors at a rapid rate, and the design is said to give general satisfaction throughout Denmark. The statement was made at the works that there had not been a single instance of breakdown reported from one of Burmeister & Wain's Diesel motors.

During the inspection a marine engine was being assembled. This was a vertical triple-expansion engine, designed for a fast freight

boat to run between Denmark and England. Scotch boilers were being put in. The valve gear on this engine bears the firm's name. Close beside this marine engine a Diesel motor engine was under test, and it was evident that the greatest care is exercised in adjusting these machines before they are sent out of the shops. The Danish orders for Diesel motors are just now exceptionally good. The Diesel engine is declared to be very economical.

The work in the boiler shops impressed the writer. In the course of many inspections in Europe, such high-grade work as is evident on these Burmeister & Wain boilers is seldom seen. He knows of no boiler works in the United States which are turning out better work than that seen here. The boilers under construction are of the Scotch type, and the material comprises plates of English origin and furnaces from Germany. Pneumatic tools are largely employed, and these came from Pokorny & Wiettekind, of Frankfort-on-Main. For the boilers it is necessary to use either English or German boiler plates, since there are no rolling mills in Denmark. In the boiler shop overhead cranes are in use, which have been supplied by the Titan Works, of Copenhagen. Messrs. G. & A. Harvey, of Glasgow, have furnished a number of tools for use in the boiler department for reaming and boring out manholes and furnace heads.

MAIN MACHINE SHOP—CENTRAL POWER STATION.

The main machine shop, which is also used as an assembling shop, is a beautiful modern structure, divided into three departments and having a total length of 106 meters and a width of 54 meters in all. Overhead traveling cranes serve all parts of the building. These traveling cranes are of both German and Swedish origin. One Swedish crane came from A. S. Elektriska. The flooring in this building is made of blocks laid over a cement foundation. The shop, in conjunction with the entire works, is heated and ventilated on the hot-air system, installed by the Buffalo Forge Company, of Buffalo, N. Y. All piping for this system was made in Copenhagen, but the blowers were imported direct from the United States. The installation was made about nine years ago.

In this main erecting shop are numerous American machine tools, and it was estimated that there are at least 50 lathes from Flather & Co., of Nashua, N. H. The Flather lathes in use were purchased several years ago, and before high-speed steel was generally in use. These lathes are very much liked, but Mr. Prollius expressed the opinion that in view of the introduction of high-speed steel, the tools are somewhat light for the general work of to-day, and in consequence it was necessary to buy a number of special lathes to do the rough work. After the roughing is effected the material is passed on to the Flather tools. In other words, it is a case of utilizing machines of early date rather than install a complete set of newer tools.

Brown & Sharpe tools are very much in evidence in the shops, as are also Pratt & Whitney machines. Mr. Prollius stated that he had seen service in both the Brown & Sharpe and the Pratt & Whitney works.

Much of the workmanship demanded is of a most exacting character. On the Diesel motor shafting, for example, all measurements are to one one-thousandth of an inch. This engine work, Mr. Prollius declared, must be of a most exact finish and careful adjustment, and it is only because of the exceptional care taken that the Diesel motors turned out by this firm have never yet broken down. Much of the small casting work, it was noticed, is of a softer iron than one generally finds in European shops, and it was explained that for these small castings gray iron from the United States is purchased because European iron is regarded by the firm as too hard. The opinion is held here that the United States material is not only softer, but at the same time is sufficiently tough to stand requirements. For the general run of castings, however, other than the small castings, recourse is had mostly to German sources.

The power for all shops is furnished from a central station, and here a 2,000-horsepower tandem compound steam engine was at work. This is said to be the largest single-power station engine in service in Scandinavia. There are two reserve engines in this station of 400 horsepower each. The building containing this engine is of beautiful design and construction throughout, and the main interior design includes a wall replica of the Viking ship.

OTHER AMERICAN TOOLS IN USE.

There are quite a number of tools in service from the Niles Tool Works, of Hamilton, Ohio, which have been purchased during the past few years. Many of these American tools have been secured through Messrs. Loewener, a Danish firm in Copenhagen. The statement was made that Burmeister & Wain have found by experience that they can buy these tools from Messrs. Loewener to greater advantage than from the United States direct.

Mr. Prollius was enthusiastic regarding the working of two radial drills received about six months ago from the Dreses Machine Tool Company, of Cincinnati. These two machines are of the Simplex type, and the shop manager declared that they were "beautiful machines."

Swedish manufacturers are largely drawn upon for chucks, although Danish sources are also called upon for supplies. A Swedish chuck for small-drill service that is much in favor is referred to as the Grönqvist chuck.

Grinding work is carried on here extensively, and the grinders in service are for the most part from the Brown & Sharpe Manufacturing Company, Providence, R. I. Diesel motor pistons were being turned down on Nielsen & Winther lathes, and are finished up on Brown & Sharpe grinders. The 50 Flather lathes in service have been in use for about ten years. These tools have done such good work that, notwithstanding their age, the firm has been reluctant to substitute for them newer tools. Other American lathes in evidence of a more recent purchase are from Lodge & Shipley, the American Tool Works Company, and Pratt & Whitney.

The average wages earned by a good machinist at a Flather lathe varies from 50 to 60 ore (13.4 to 16 cents) per hour. Practically all

the work at Burmeister & Wain's is on a piecework schedule. In winter time a day's work comprises nine hours and in summer time ten hours.

The machinery-erecting shops are naturally the largest at Burmeister & Wain's, but the department for the manufacture of separators and the tool department proper contain perhaps the greatest number of modern American machine tools. In the tool department were found machines from Brown & Sharpe, from Hendey, and from Flather & Co., but the greatest number of tools in evidence are from Brown & Sharpe.

CREAM SEPARATOR DEPARTMENT.

In the cream separator department the installation is very modern and comprises many tools of American make. The work here is carried on in series and permits of the use of automatic machinery. It is in this department that American tools show to great advantage. Here there are in use 11 Brown & Sharpe milling machines, and, in addition, gear cutters from the same firm. Messrs. Brown & Sharpe have supplied two No. 3 universal grinding machines, two No. 11 plain grinding machines, and two No. 2 universal grinding machines. These tools have all been placed by Messrs. Loewener, of Copenhagen, which firm has the control of Brown & Sharpe tools in Danish territory. This agency is highly spoken of by Messrs. Burmeister & Wain.

One Reinecker grinder is in use, but the statement was made that it is not as satisfactory by fully 50 per cent as the Brown & Sharpe grinder of the same size. Hobbing machines are resorted to largely, and these hobbing machines have been supplied by the Wanderer Works and by Biernatzki & Co., both of Chemnitz, Germany. The opinion was expressed in most positive terms that the American grinders are far ahead of European makes.

Four vertical drills from the Aurora Tool Works, of Aurora, Ill., were noticed. These machines were bought separately and were then thrown into multiple action by connecting up to a single plate. The machines are staggered or placed en échelon. This arrangement of the tools was necessary in order to effect belt connection to the same overhead shaft. It was stated that by buying these tools separately and then connecting them up at the shops an appreciable saving was made over the purchase of an out-and-out set of vertical drills.

Circular milling machines are extensively used in the separator shops, and these machines have been supplied largely by Ludwig Loewe. All the hobbing machines are furnished with up-take drafts, in order to clear the machines from chips. In addition to Wanderer and Biernatzki tools, there are two hobbing machines in use from Zimmerman, of Chemnitz.

In the separator tool room is a Cincinnati shaper, to which was fitted a German attachment for planing bevel gears. Jigs are in general use. This is because the work is turned out in series form.

The best foreign business in separators has been carried on with Russia and Australia; in other words, these two countries have afforded the biggest market. The Burmeister & Wain cream separa-

tors are said to have been among the first on the market. It would appear that the demand on the company for other undertakings claims so much attention that the firm has not devoted the amount of time to the separator as would otherwise have been possible.

METHODS EMPLOYED AND SPECIAL TOOLS IN USE.

Welding work is carried on largely by means of acetylene-gas machines. Haniel & Lueg, of Dusseldorf, have furnished a number of these special flanging presses.

American raw bone dust is used in connection with case-hardening work. For general work, cheaper stuff, it is said, would suffice, but the raw bone dust supplied from the United States is practically free from fat, and therefore commends itself. The hardening furnaces in use have been supplied by the Chicago Flexible Shaft Company, of Chicago. The American Gas Furnace Company has supplied several furnaces. The steel used is of either Vingo or Böhler make—Böhler for rapid and high carbons, and the Vingo for general soft carbons.

There are a number of Pratt & Whitney turret lathes in the separator works, and they are referred to as beautiful tools. Bardon & Oliver, of Cleveland, Ohio, are represented here by hand turret lathes. The machines are well liked. The R. K. LeBlond Machine Tool Company, of Cincinnati, have recently furnished two lathes, and the statement was made that Burmeister & Wain regard these LeBlond lathes as among the very best of American makes. They are particularly pleased because the tools have proved to be swift and strong. All steeple tool posts as furnished on American lathes are, as a rule, removed when received by Burmeister & Wain and European box posts substituted.

The Nielsen & Winther turret lathe, as manufactured in Copenhagen, is in high favor at these shops, and is especially fancied because the feeds permit of a wide range and a rapid return and advance of the turret. Direct comparisons were made between these Nielsen & Winther lathes and one American machine, as showing the European ideas of relative merit. Reference is made to the Nielsen & Winther lathe in extenso in a report on that firm. The writer inclines to the opinion, however, that the full value of some of the American lathes is not fully appreciated. Very frequently one finds American tools being operated in foreign shops in a manner which would lead one to suppose that the machine is not thoroughly understood.

The Cleveland Automatic Machine Company has supplied a number of screw machines. The only English tool observed in the separator department was a screw machine of Alfred Herbert, Ltd., of Coventry. Practically all gages in use are from Brown & Sharpe. There is in use, however, a standard measuring tool supplied by Pratt & Whitney.

LARGE PROPORTION OF AMERICAN MACHINE TOOLS.

An inspection of the Burmeister & Wain works very early develops the fact that this firm has been a large purchaser of American machine tools. It would appear that fully 50 per cent of the ma-

chine tools in use are of American origin. Among them, and including equipment, are the following:

Flather & Co., Nashua, N. H.	Shapers, lathes (50).
Brown & Sharpe Mfg. Co., Providence, R. I.	Grinders, universal millers, gear cutters, turret boring mill, gages.
Pratt & Whitney, Hartford, Conn.	Head-turret lathes (3), lathes (2), standard measuring tool (1).
Hartford Machine Tool Co., Hartford.	Automatic screw machines.
Hendey Machine Tool Co., Torrington, Conn.	Lathes.
Buffalo Forge Co., Buffalo.	Heating and ventilating system.
American Gas Furnace Co., Elizabeth, N. J.	Furnaces.
Pond Machine Tool Co., Plainfield, N. J.	Heavy lathe.
Bement, Miles & Co., Philadelphia.	Horizontal boring machine.
Niles Tool Works, Hamilton, Ohio.	Heavy planers (2), boring mills (2), boring machine, heavy crank shaft lathe and slotters.
Hamilton Machine Tool Co., Hamilton.	Heavy lathes (2).
Dreses, Muller & Co., Cincinnati.	Radial drills, Simplex radial drills.
Lodge & Shipley Machine Tool Co., Cincinnati.	Engine lathes.
American Tool Works Co., Cincinnati.	Lathes.
Cincinnati Milling Machine Co., Cincinnati.	Grinding machine.
Cincinnati Drill and Tool Co., Cincinnati.	Vertical drill.
Cincinnati Shaper Co., Cincinnati.	Shaper.
Bardon & Oliver, Cleveland.	Hand turret lathes.
R. K. Le Blond Machine Tool Co., Cincinnati.	Lathes.
Cleveland Automatic Machine Co., Cleveland.	Screw machines.
Chicago Flexible Shaft Co., Chicago.	Hardening furnaces.
Aurora Tool Works, Aurora, Ill.	Vertical drills.
Gisholt Machine Co., Madison, Wis.	Turret lathes.

The time recorders used throughout Burmeister & Wain's works are of the Simplex type, American origin.

FOREIGN MACHINE TOOLS INSTALLED.

Among the foreign machine tools in use are the following:

Hulse & Co., Manchester, England, radial drill and planers; Nielsen & Winther, Copenhagen, Denmark, bolt screw machines; Deutsche-Niles Werkzeugmaschinenfabrik, Oberschoneweide, near Berlin, head forging lathe, multiple drills; Joh. Moll, lathe for turning down crank shaft; J. Whitworth & Co. (Limited), Manchester, planers and slotters; Breuer, Schumacher & Co., Kalk, near Cologne, boring mill; Sharp, Stewart & Co., Manchester, England, heavy shaft lathe; Ernst Schiess, Dusseldorf, Germany, horizontal big swing lathe; Wm. Muir & Co., Glasgow, Scotland, heavy radial drills; Mekaniska Verkstad, Kopings, Sweden, lathes; Noble & Lund, Newcastle-on-Tyne, cold saw machines; Haniel & Lueg, Dusseldorf, Germany, flanging press; Zimmermann, Chemnitz, Germany, hobbing machines; Ludwig Loewe & Co., Berlin, circular milling machines; J. E. Reinecker, Chemnitz, grinding machine; Alfred Herbert (Limited), Coventry, England, screw machine.

The writer has no hesitancy in saying that these are works which not only turn out a high grade of material, but require machine tools of the first quality. The entire spirit at the plant is of a progressive sort, and there need be no doubt that the directors of this establishment will welcome their attention being called to machinery which will enable them to accomplish results either more effectively or more economically.

The business of the firm is largely of an export nature, and the situation is specially advantageous for dealing with Scandinavian requirements. During recent years advantage has been taken of many rush orders which could not be handled advantageously in Germany because of abnormal conditions there. Primarily, Burmeister & Wain's is a Scandinavian plant in organization, and is designed for Scandinavian requirements. Its development has been steady and sure, and has been so closely identified with the welfare of the state as to justify its being considered almost a national institution.

NIELSEN & WINTHER.

The machine-tool works of the stock company, Nielsen & Winther, located at Blegdamsvej, No. 60, Copenhagen, are known in Danish as Aktieselskabet Nielsen & Winther's Vaerktoejsmaskinfabrik. The directors are Capt. F. H. J. Rambusch and Mr. August Schmidt.

When the first buildings were erected there was considerable open ground about them, but owing to the building up of the city the plant now finds itself surrounded on all sides by buildings. Naturally, the value of the land has increased, and in consequence there is some disadvantage by reason of the increased congestion. The absence of water and rail connection enhances this disadvantage. Instead of being able to extend the ground space occupied, the management has found it necessary to increase the number of floors and to have considerable recourse to elevators.

These works were founded in 1873, and became a limited company in 1897. In September, 1909, the number of men employed was 160. When working full time 230 men are carried on the pay rolls. The company is at present capitalized at 650,000 crowns ($174,200).

FIRM NOTED FOR TURRET LATHES.

The present managers recognize that their success in machine-tool building lies largely in their ability to build in series. The firm is best known through its turret lathes, but milling machines and vertical drills are also built. Formerly a large variety of tools was built, but every effort has been made to cut down the output to turret lathes, millers, and vertical drills, the ordinary type lathes, many of which were formerly constructed, being no longer made. Director Schmidt states that from his observation Danish plants absorb more than 200 lathes per year, and it was found that the ordinary type of lathes could not be manufactured here to advantage. The competition from German sources was keenly felt, and German firms were offering lathes at prices which were unprofitable to meet. The German price here for ordinary lathes is about 21 pfennigs per pound (1 mark=100 pfennig=23.8 cents). Director Schmidt states that castings in Denmark cost 25 ore per kilo, or 28 pfennigs (1 kilo=2.2 pounds), and therefore it is quite impossible to build ordinary lathes, as the work can not be done for 14 pfennigs per kilo.

Director Schmidt says that the duty on machine tools coming into Denmark at present is 5 per cent of the value of the machine. This valuation is reckoned on the invoice figures, plus the freight charges. It is his opinion that the Germans are at present securing three-fourths of the lathe business in Denmark.

LATHE SELLING COMPETITION.

The cheap German lathe sells in Denmark largely because the question of price is paramount with Danish firms. Director Schmidt states that many of these German lathes coming into Denmark are copied attempts of standard American tools, and that they are manufactured by small German houses—oftentimes by firms having not more than 40 or 50 men. These small German plants, he says, are controlled by large German selling firms that sell the tools without the name of the manufacturers appearing on them. As these German houses control the small shops, the advantage to the agency in selling the cheap tools, Director Schmidt says, lies evidently in realizing the full benefit of the manufacturer's profit. With the turret lathes, however, Nielsen & Winther are able to meet the German and foreign competition, and the bulk of their output is for export.

About two complete series of big turret lathes are turned out by them in a year's time. Only a few of these tools are absorbed by Danish works. Great care is exercised in the matter of castings for the beds of the tools. These castings come from Danish establishments and are supplied at a cost of 25 ore per kilo (1 crown=100 ore=26.8 cents).

Nielsen & Winther tools in use in Continental shops have been observed from time to time by the writer, who has heard them referred to in high terms. A specialty is made of turret lathes of the Gisholt type. These tools are being built in series of 25, and the design and general workmanship are noteworthy.

Messrs. de Fries & Co., of Dusseldorf, purchased 26 of these turret lathes, presumably for sales on their part, and Messrs. Panhard & Levassor, of Paris, have in service 14 of them. The Skoda Works, of Pilsen, placed an order for 37 of them, and recently the Copenhagen firm has executed an order for 22 turret lathes and 14 special machines for the Government of Servia, to be used in the manufacture of fuses. These turret lathes were first seen by the writer in the Berliet Automobile Works, in Lyons, and since then have frequently been noticed in service on the Continent.

FEATURES OF TURRET LATHES.

The Nielsen & Winther semiautomatic turret lathe is being made in four sizes. The principal features of this machine are as follows: The head stock is cast in one piece with the bed, and both are made heavy to prevent all possibility of spring. The spindle, which is made of the best steel, is bored throughout its length, hardened and ground, and carries a 3-jaw universal chuck, with two sets of jaws. The spindle runs in conical phosphor-bronze bearings, adjustable for wear, and furnished with a thrust ring of Babbitt metal. The drive is by means of a 3-step cone and friction back gears, which can be operated while in motion. There is also a special back gear for work of large diameter; thus, with a 3-speed countershaft a range of 27 spindle speeds is obtained. The friction clutches are very carefully designed, having screw-actuated cylindrical contact surfaces obviating end thrust. Being unaffected by

centrifugal force, even at the highest speeds, these clutches are said to be perfectly reliable in action.

The dimensions of the parts of the various machines are given herewith in millimeters (1 inch=25.4 millimeters), and the weights in kilos (1 kilo=2.2 pounds):

	R. G. 2.	R. G. 2e.	R. G. 3.	R. G. 3e.
	Mm.	*Mm.*	*Mm.*	*Mm.*
Maximum swing over bed	550	650	700	800
Maximum swing over carriage	300	400	420	525
Length that can be turned	1,400	1,400	1,400	1,400
Diameter of hole through spindle	67	132	80	180
Diameter of holes in hexagon turret	57	57	76	76
Width of belt cones	100	115	115	130
Range of screw cutting	4–72 per 100	4–72 per 115	4–72 per 115	4–72 per 130
Friction pulleys of countershaft	115	130	130	145
Speeds of countershaft	90, 140	90, 140	90, 140	90, 140
Revolutions per minute	190	190	190	190
Floor space required	3,400 x 1,070	3,400 x 1,070	3,850 x 1,200	3,850 x 1,200
	Kilos.	*Kilos.*	*Kilos.*	*Kilos.*
Net weight	3,250	3,350	4,000	4,800

OTHER TYPES OF TURRET LATHES.

Besides these machines Nielsen & Winther are building a turret lathe, type R. H. 3, in three sizes. The principal features of this machine are as follows: The frame is formed in one piece, including head stock, bed, and foot, to avoid twisting; the bed has two leading prisms and is supplied with two large oil pans, besides a tool box and a box for the gearing wheels. The spindle, which is bored throughout its length, is of high-carbon steel and exactly ground on the bearing places. It runs in adjustable bearings of phosphor-bronze and has a step cone with two steps. The ordinary revolutions per minute are:

By R. H. 2.—450, 375, 300, 200, 167, 137, 100, 83, 67, 44.5, 37, and 30.
By R. H. 3 and 3e.—375, 300, 225, 167, 133, 100, 83, 67, 50, 37, 29.5, and 22.
By R. H. 4.—375, 263, 167, 150, 117, 67, 47, 34, 33, 24, 21, 19, 15, 14.5, 13.5, 10.5, 8.5, and 6.

On the left end of the spindle the machine can be fitted with a roller feed for bar work, and the right end is furnished with an automatic chuck for fastening the bar. The countershaft has oil-ring bearings and three pulleys with screw-friction clutches of the same construction as the spindle. The cutting-off rest, which is moved across the bed by means of a handwheel and screw, is used for cutting off and turning with a shape steel. The motion is limited by adjustable stops for both directions. In the lengthwise direction the cutting-off rest is moved by a second handwheel with rack and pinion for turning cylindrical planes; this motion is limited by a stop.

R. H. 2 is furnished with two adjustable tool holders, one in the front and one behind; the tools are very easily adjusted in the height by the step-formed support.

R. H. 3 and R. H. 3e are furnished with two double tool holders, one in the front and one behind; they are turned 180° on their vertical axis and may therefore be considered as small turret heads. In front, the cutting-off rest bears a slide, which by handwheel and screw is moved 50 mm. in the lengthwise direction of the machine, which in threading is considered to be a great advantage.

In R. H. 4 the principal tool holder is compensated by a four-edged turret head, which is turned by hand.

The four tools can be adjusted in height quite independently of each other.

SPECIAL FEATURES OF CERTAIN LATHES.

R. H. 3 and R. H. 3e have lengthwise feeding by lead screw, corresponding to turning, with a chip of 0.25 mm. thickness, and for boring 0.125 mm.

The R. H. 4 machine has four different lengthwise feedings, for 0.05, 0.1, 0.2, and 0.5 mm. chip.

Different feedings can be obtained by use of the gear wheels. Automatic feeding in direction of the head stock can be stopped automatically in any position wanted. The turret head is hexagonal in form and constructed to take tool holders of a special and strong construction. Each of the six tools has its own independent adjustable stop. The turret is effectively stopped in each of its six positions by a solid, hardened cylindrical pawl. By withdrawing a bolt, bar work can be led through the turret head.

The threading is done either by help of a die head, or especially in threading of large diameter, by help of the lead screw and the gearing wheels. Machine R. H. 2, however, has a threading attachment with bearings in one piece with the spindle. The lead screw in the case of R. H. 3, R. H. 3e, and R. H. 4 has four threads of 25.4 mm., which can be connected both with the cutting-off rest and with the slide for the turret head, as well for threading by help of the gear wheels as for automatic lengthwise feeding. R. H. 3 and R. H. 3e are provided with two, and R. H. 4 with four different feeds, which during the work can be changed from one to another by handle movement.

In all the machines the lead screw can be thrown out of working, when feeding by hand. Besides the usual gearing wheels a wheel with 127 teeth for metric threading is provided. The dimensions, weight, and floor space required are as follows:

	R. H. 2.	R. H. 3.	R. H. 3e.	R. H. 4.
	Mm.	*Mm.*	*Mm.*	*Mm.*
Maximum swing over bed	400	425	425	475
Maximum swing over carriage	200	210	210	250
Diameter of hole through spindle	52	60	85	105
Largest diameter of bars permitted	51	58.5	83	95
Largest distance between spindle and carriage	400	550	550	750
Largest distance between spindle and turret head	600	775	725	1,000
Diameter of tool holes in turret head	45	55	55	85
Width of step on cone steps	90	100	100	115
Countershaft pulleys:				
Width	105	105	105	115
Diameter	250	300	300	350
Revolutions per minute	200, 250, 300	150, 200, 250	150, 200, 250	100, 175, 250
Lead screw	No.	Yes.	Yes.	Yes.
Number of lengthwise feeding	2	2	2	4
Floor space required	2,400 x 900	2,800 x 1,000	2,800 x 1,000	3,200 x 1,200
Weight, inclusive of countershaft:	*Kilos.*	*Kilos.*	*Kilos.*	*Kilos.*
Net	1,200	1,800	2,000	2,400
Boxed	1,400	2,150	2,350	2,800
	Mm.	*Mm.*	*Mm.*	*Mm.*
Measure of box	2,300 x 1,200 x 1,450	2,650 x 1,250 x 1,400	2,650 x 1,250 x 1,400	3,350 x 1,400 x 1,750

SMALL TURRET LATHES—PRICES OF VARIOUS TYPES.

The small turret lathe, as manufactured for arsenal service, is made of three types, known as R. 1 C, R. 2 C, and R. 3 C. The following table gives the principal dimensions, floor space, and weights of these machines:

	R. 1 C.	R. 2 C.	R. 3 C.
	Mm.	*Mm.*	*Mm.*
Maximum swing over bed	250	300	350
Maximum swing over carriage	100	150	175
Length that can be turned	225	350	500
Diameter of hole through spindle	22	32	45
Diameter of holes in hexagon turret	14	25	35
Width of belt cones	45	65	80
Largest diameter of bore work permitted	14	31	44
Friction pulleys of countershaft	70	85	95
Speeds of countershaft, revolutions per minute	200	100, 200, 300	100, 200, 300
Floor space required	1,200 x 700	1,600 x 700	1,800 x 800
	Kilos.	*Kilos.*	*Kilos.*
Net weight	300	550	800

The prices at which the regular types of turret lathes are sold are as follows: R. G. 2, $2,010; R. G. 2e, $2,278; R. G. 3, $2,412; R. G. 3e, $2,814; R. H. 2, $536; R. H. 3, $1,072; R. H. 3e, $1,206; R. H. 4, $1,474; R. 1 C., $322; R. 2 C., $402; R. 3 C., $536.

HYDRAULIC PUMPS, ACCUMULATORS, AND PRESSES.

Nielsen & Winther are making hydraulic pumps, accumulators, and presses of various types, the last designed especially for making ammunition cases and shells. The pumps are built both vertical and horizontal in type and for all pressures and work, as required. The type Tr. P. is directly connected with a dynamo. Under a pressure of 200 atmospheres it is capable of pumping 100 liters per minute. Type D. P. is connected to a steam engine, and under a pressure of 250 atmospheres pumps 450 liters per minute; similar pumps are built to operate by electric power.

Accumulators are manufactured by this firm in various sizes. The weight of these is secured partly from an iron cylinder and partly from cylindrical cast-iron pieces. The iron cylinder is filled with cement, slag, or similar material. The cylindrical parts below the cylinder proper each weigh about 10 tons.

The establishment turns out presses especially designed for tapering cases and shrapnels, as well as for banding copper bands on projectiles. Under a maximum pressure of 140 atmospheres there are secured 70,000 kilos weight.

Still another type of press is designed for shaping shells and brass cases up to 210 mm. caliber. This type of press affords two distinct pressures for each pressure in the pipe and the filling is effected automatically, thus affording considerable economy as far as concerns liquid pressure. The principal dimensions of this press are: Length of stroke, 1,300 mm.; total pressure at 100 atmospheres, 100 and 180 tons; total pressure at 250 atmospheres, 250 and 450 tons; net weight, 19,000 kilos.

Yet another type of press is constructed for the fore-pressing and necking of brass cases. The principal dimensions of this press are: Length of stroke, 250 mm.; total pressure at 800 atmospheres, 1,650 tons; net weight, about 25,000 kilos.

In addition to the foregoing, Nielsen & Winther also undertake to manufacture hydraulic forging presses and build special machines for the manufacture of shrapnels and shells. The Copenhagen firm has filled a number of orders received from firms in Austria, Russia, Italy, Sweden, and other foreign countries, and Schneider & Co., of Le Creusot, France, have installed pumps and presses of Nielsen & Winther make.

SPECIAL AUTOMATIC MILLER IN USE—CHUCKS AND TAPS.

In a special chuck department there was observed a groove milling machine which is largely used on chuck work. There has been heretofore a large demand for these groove milling machines, but it is only recently that the firm has been able to undertake their manufacture for the outside market. The special features connected with this groove milling machine are as follows:

The machine is designed for milling the jaw grooves in chucks without the need of an operator except for setting the work. The milling is done in one cut. When the cutter feeds into work from the outside the slow feed is used, but on reaching the end of the slot it is automatically changed into the fast feed, and the center returns through the end at a very quick speed, leaving the groove in a good condition. As soon as the cutter has finished the work the feed is stopped automatically, the machine revolves the table, and places it in a proper position for the next groove. When the last groove has been cut, the main belt is thrown on a loose pulley, and the man is notified that the machine is ready for another piece of work.

The changing of the feed, as well as the revolving of the table, is very handily set to any point desired by means of a bracket and two bolts. The saddle support of the spindle is provided with a fine adjusting attachment for any desirable depth of the grooves. The machine can be arranged for milling any number of grooves wanted. The dimensions, floor space, and weight are as follows:

	M. 35a.	M. 35b.
	Mm.	*Mm.*
Largest size of chuck to be milled	310	625
Diameter of spindle	35	50
Vertical movement of spindle	100	120
Diameter of fastening chuck	500	600
Length of slide	700	700
Width of slide	570	570
Number of different feeding speeds	4	4
Diameter of stepcone	200–250	300
Width of step on cone	80	100
Number of steps	3	3
Speed of countershaft per minute	250	200
Diameter of countershaft pulley	320	350
Width of countershaft pulley	80	100
Floor space required	1,600 x 1,200	1,600 x 1,600
	Kilos.	*Kilos.*
Weight	1,200	1,800

The prices of these milling machines are as follows: M. 35a, $1,072; M. 35b, $1,501; M. 36, $536.

Quite a profitable business is done, the writer has been given to understand, by Nielsen & Winther, in the sale of chucks in all parts of Europe. There seems to be a general opinion that the chucks made by them are better than the general run of German chucks

offered to the Danish market, and in this line they appear to be fully able to meet foreign quotations. Besides the chuck department there is a tap department, the output from which is finding a good sale in Denmark and Germany. The taps are turned out on tools of their own build, and they are milling all taps with automatic machines of their own design and make. Naturally, where series work is undertaken jigs are employed, and this is the case here.

Vertical millers are built in series of 10 tools to a series. These vertical millers have tables measuring 18 by 9 inches. Besides this milling machine the firm builds some special wheel-milling machines and some special machines for the manufacturing of taps.

SPECIAL THREADING MILLER.

Recently a special type of milling machine for threading was built for a prominent factory in Italy, and it is stated that the question of future orders for this machine will largely depend on the working of the prototype. The principal characteristics of this machine are as follows: The machine is especially constructed for milling the threading in the head of shells. The headstock is formed in one piece with the bed and the oil pans, to avoid trembling and bending.

The spindle, which is made of steel of high carbon and exactly ground on the bearing places, is bored in its full length and runs in adjustable bearings of phosphor-bronze. The left end of the spindle is fitted with a changeable threading bush, which threads have the same pitch as the working piece is to have.

In connection with the headstock the machine is supplied with a nut, turned by help of a handwheel; this nut is fastened or unfastened by a pawl. If the pawl is in activity the spindle moves lengthwise with exactly the same gage as the threading bush; if the pawl is out of activity the spindle moves backwards by turning the handwheel until the pawl meets the hole which corresponds with the original positions of the spindle.

The milling support is placed on a slide movable in both directions—in the cross direction by handwheel and screw, and lengthwise by another handwheel rack and pinion. Both movements are limited by an adjustable stop. From the milling spindle, which is started from a countershaft with a fast and loose pulley, the working spindle gets its movement by a worm and worm wheel, two changeable wheels, two sets of conical wheels, and again a worm and worm wheel. By the help of this combination it is possible through the changeable wheels to alter the revolving of the working spindle in proportion to the revolving of the cutter.

When the working piece is chucked the milling support is moved far enough to the left to bring the cutter into the right position for milling; then the machine is started and the cross slide is moved far enough forward to give the right gage. The milling then goes on until the working spindle has gone a little farther than one revolution; it is then released automatically and the milling support is removed by hand to give room for a new working piece. In front of the headstock is a lever by which the clutch for the conical wheels on the back side is regulated, and by which the working spindle can be turned right or left if it is to cut the gage right or left.

By cutting the inner threading in the shells a rest in which the chucking attachment runs is used. The dimensions, etc., of this machine are as follows: Largest diameter for cutting, 120 mm.; largest length of the working piece, 340 mm.; pulleys on countershaft, 80 by 230 mm.; revolutions per minute, 200; floor space required, 700 by 1,200 mm.; net weight, 450 kilos.

The greater part of the gears cut in the shops are being turned out, it was noticed, on machines of the firm's own make. For cone gears four Warren tools are in service and one Reinecker gear planer.

The measuring tools employed are from the Brown & Sharpe Manufacturing Company, Providence, R. I.

For cutting steel, recourse is largely had to material furnished by Gebrüder Böhler, of Austria.

All gearing work on the turret lathes is milled; in fact, there is much recourse to milling work in these shops.

The castings for the machines are mainly supplied by the United Foundry Company, of Copenhagen; that is to say, from the Aarhus branch of this firm.

FIRM MAKES MOST OF ITS MACHINE TOOLS.

There are not many American machine tools in service in these works. The American representation, so far as observed, is limited to the following:

Name of maker, and type and dimensions.	When purchased.	Price delivered in Copenhagen.
Jones & Lamson Machine Co., Springfield, Vt.:		
Turret lathe	1903	$714
Brown & Sharpe Manufacturing Co., Providence:		
No. 2 universal grinding machine	1901	813
Metropolitan Manufacturing Co., New York:		
2 gem lathes, 14 inches x 6 feet	1900	217
Cincinnati Milling Machine Co., Cincinnati:		
No. 2 universal miller	1906	914
Dreses, Muller & Co., Cincinnati:		
Radial drill, 48-inch	1898	568

The tools in use are for the greater part of Nielsen & Winther's own make. A Reinecker gear planer, a Reinecker backing-off cutter, and one crank shaper from Smith, Peacock & Tennent, Leeds, England, were noticed; also a horizontal boring machine from Messrs. de Fries, Dusseldorf, Germany.

The Nielsen & Winther works may be regarded as essentially first class, and it is evident that every care and attention is exerted to turn out only the best class of work. The firm intends, it is said, to give more of its attention to sales abroad in Europe than heretofore, and, judging from the reports regarding its tools in foreign shops, it will probably not have much difficulty in obtaining a fair share of Continental business.

The actual performance of work is paid for in these shops on a piecework schedule. A day's work comprises nine hours in summer. The shops open at 6 a. m. and close at 5 p. m. At 8 o'clock there is a cessation of work for a half hour, and there is also a cessation of work from 12.30 to 1 p. m.

GOVERNMENT SMALL-ARMS FACTORY.

The Danish Government factory for the manufacture of military small arms is located in Copenhagen. This establishment is known as the Gevaerfabrik. The administration and control of the plant is under the War Department, and in many respects the works are similar in character to the United States arsenal at Springfield, Mass. Through the good offices of Hon. Maurice Francis Egan, United States minister to Denmark, permission was granted the writer by the Danish authorities to make an inspection of this plant. Every courtesy was extended, and for these acknowledgments are due to Col. M. Nørresø, director of artillery; to Capt. Carl L. Brandt, of the war office; and to Capt. W. Th. Bohn, chief of the Gevaerfabrik.

This factory is a characteristic government small-arms plant. It is well equipped with many modern types of machine tools, and the buildings and internal fittings are fully what one would expect to find in a government establishment. The work of the Gevaerfabrik is largely confined to the manufacture of the standard Danish military rifle. This is a gun of 8 mm. caliber, and is of the Krag-Jörgensen type.

THE WORKING FORCE AND AMERICAN TOOL EQUIPMENT.

In September, 1909, 150 men were working, but when the full facilities of the shops are availed of it is necessary to employ about 450 men. A working day comprises 10 hours. Judging from the work, the machinists here are capable of turning out material under very close requirements. Scandinavian machinists are proverbially good tool men, and this fact is well known in the United States, where so many men from Denmark, Norway, and Sweden find their way into the best shops.

There are a number of American machine tools in service, but not so many as one would expect to find. Brown & Sharpe, of Providence, R. I., are in evidence with several tools, the lot comprising two No. 1 universal milling machines, two No. 11 plain milling machines, and two No. 13 plain milling machines, one centering machine, and one grinder. These tools were supplied through Messrs. Loewener, of Copenhagen. Pratt & Whitney, of Hartford, Conn., have installed several slot milling machines. These were obtained, it is stated, about three years ago. In addition to the American tools mentioned, only one other was seen in service. This was a saw machine from the Diamond Saw and Steam Works, Buffalo, N. Y.

FOREIGN MACHINE TOOLS IN USE.

The French machine-tool works of Bariquand & Marre have supplied a number of excellent machines, mostly of the vertical drill type. Loewe has also supplied drills of this same character, and the same statement applies to the Swedish machine-tool works known as Mekaniska Verkstad, located in Koping. The last-named firm has also supplied lathes and milling machines.

Ludwig Loewe, A. G., of Berlin, has been drawn on to supply gun-barrel drilling machines and rifling machines. There are nine of these Loewe rifling tools in service, and five gun-barrel drilling

machines. Aside from Loewe, other makers of rifling machines in evidence are Nielsen & Winther, of Copenhagen, and Greenwood & Batley, of Leeds, England.

The Greenwood & Batley turning machine in use is spoken of as being somewhat better than the Loewe machine for preparing work, but the Loewe tool is preferred at the Gevaerfabrik for finishing.

The majority of the tools in the Gevaerfabrik are from the Nielsen & Winther works. Other foreign makers represented are: Ludwig Loewe, A. G., of Berlin, gun-barrel drilling machines, rifling machines, vertical drills; J. & G. Hulse, Manchester, England, lathes and slotter; Ateliers Ducommun, Mulhausen, grinder; T. H. Munktell, Eskilstuna, Sweden, vertical millers and horizontal millers; Fairbairn, Kennedy & Naylor, Leeds, circular drilling machine; J. Whitworth & Co., Manchester, England, milling machines; Alfred Herbert (Limited), Coventry, England, turret lathes.

Among the foreign tools in service, there are at least 37 machines from Nielsen & Winther, of Copenhagen, there being in one group no less than 14 of their millers. This firm has also supplied many lathes, planers, and other machines. There was in evidence a gang drill and six sensitive drills, but without name of maker showing on any of the tools; these machines were obtained from Messrs. Karlson.

In addition to the machine-tool equipment there is a first-class forge shop and the requisite complement of casehardening ovens.

CAPACITY OF THE PLANT—MATERIAL EMPLOYED.

The rate of output at the Gevaerfabrik is four barrels per rifling tool per day, or a total output of 36 rifled barrels every 24 hours. The gun-barrel reamers are able to ream about one barrel per hour, or 10 in a day, and as there are five of these reaming machines, the daily output capacity is 50 barrels. The rifling machines are kept more steadily at work than the reamers. This is done in order to keep the rifling work abreast of the reaming output. Since the original purchase of these Loewe rifling machines improvements have been introduced in connection with the cutting steel, which afford an output capacity in excess of what was originally expected from these tools. Colonel Nørresø calls attention to the fact that the rifling machines, by means of an alteration of the cutting steel, can be brought up to at least the same output capacity as the gun-barrel drilling machines.

Practically all of the material used in the construction of the Danish rifles is obtained from Swedish sources. Throughout the shops the cutting steels used are for the most part of English origin, although a considerable quantity of Böhler, Austrian, steel is also used.

The gunstocks for the Danish rifles are largely made of German walnut. This material comes for the most part from the Baden district.

The factory is also turning out the bayonets for the Danish rifles. Formerly it was the practice to draw largely on Solingen, Germany, for bayonets. The bayonets are at present fitted with wood handles, the former practice of using leather handles having been discarded. The wooden handles are said to be cheaper, and to be regarded as practically as good as the leather ones.

BICYCLE AND RIFLE-MITRAILLEUSE BUILDING—SHOTGUNS.

In addition to the rifle work, the Gevaerfabrik is building bicycles for army use. It is admitted that these bicycles can not be built as cheaply as in private works, but it is maintained that the Gevaerfabrik bicycle is much stronger than the general run of bicycles on the market. It was found that the bicycles purchased from private sources were constantly breaking down in the frame. The bicycle made at the arsenal is very carefully machined and adjusted, and it was stated that there have been no cases of breakdown of any of these government-made machines.

The factory is building for the Danish army the rifle-mitrailleuse of the Madsen system. The Danish army is being equipped rather extensively with this rifle-mitrailleuse, and the reports concerning the serviceability of the weapon are of a highly satisfactory nature. The cavalry, as well as infantry and artillery attachments, are equipped with it.

Besides the outputs above referred to, automatic shotguns are manufactured, it is stated, for a Swedish firm known as Svenska Vapen og Ammunition Aktiebolaget, of Stockholm. The guns are built after the Sjögren system.

PROVISION FOR ADDITIONAL DEFENSES.

It is expected that considerable additions will soon be made to the Danish army equipment. The new budget provides for about 30,000,000 crowns ($8,040,000) for defense purposes. Inquiry was made as to whether it would be deemed necessary, in view of these new appropriations, to increase the arsenal equipment, and the opinion was expressed that it would not be necessary to make any machine-tool additions out of the ordinary. At both the Gevaerfabrik and the ammunition laboratory it is felt that the equipment in hand will be sufficient to take care of all demands.

Danish defense measures are largely centered on the protection of the capital, and these defenses take on the nature of land fortifications.

The heaviest rifle in the Danish service is the 40-caliber 12-inch gun. Krupp's breech system is used, and also the screw fermeture is employed for some guns. Denmark has its own powder works and is therefore independent of outside sources, but the majority of the heavy guns are purchased abroad. It is understood that the reason for making these purchases abroad is because the necessary equipment does not exist in Denmark for the fabrication of heavy ordnance.

Every opportunity was accorded the writer to observe the workings throughout, and he left the plant strongly impressed with the high efficiency of the executive control and the excellence of the workmanship in vogue.

DANISH RIFLE WORKS.

The Danish Rifle Works are building a pneumatic pistol after the designs of Lieutenant Schouboe of the Danish service. The weapon has a rate of fire of five shots per second. The principal dimensions and characteristics are as follows, the meter (1 m. = 1,000 mm. = 39.37 inches) and the kilo (1 kilo = 1,000 grams = 2.2 pounds)

being the basis of measurement and weight employed: Bore of pistol, 11.35 mm.; total length, 203 mm.; length of barrel, 130 mm.; length of aim, 225 mm.; initial velocity, 500 m.; weight of pistol without magazine, 0.890 kilos; weight with empty magazine, 0.965 kilos. The magazine holds 6 cartridges; weight of bullet, 4.1 grams; weight of charge, 0.46 gram.

GOVERNMENT AMMUNITION FACTORY.

The manufacture of rifle ammunition for the Danish army is conducted at works located in Copenhagen. This plant is referred to as the Härens Laboratorium. It is, in other words, a government arsenal, and the output embraces not only small-arm cartridges, but projectiles for land-fortress guns, sea-fortress guns, and field artillery. The officer in charge of the laboratorium, Lieutenant Falgren-Schäffer, served as a personal escort at that establishment and every facility was accorded for an inspection.

In the Härens Laboratorium about 160 people were employed during September, 1909, of which number fully 60 were women and girls. The minimum wages earned per hour per man are 37½ ores (100 ores=1 crown=26.8 cents). The minimum wages earned per hour for women and girls are 25 ores. The maximum wages per hour for men are 45 ores.

The shops were working on an eight-hour per day schedule. These hours were maintained because there was not sufficient work in hand to warrant longer running. The working time is shorter by two hours than at the Gevaerfabrik.

EQUIPMENT AND OUTPUT.

The installation and equipment of the ammunition works are of high order throughout. Great care and attention are bestowed on the manufacturing features, and the high executive control at this plant impresses one. The majority of the tools in service are of German origin. Not even one American tool was seen in use. The Danish firm of Nielsen & Winther, manufacturers of machine tools, has supplied the greater part of the equipment.

There is one cartridge-filling machine from the Deutsche Metal-Patronenfabrik, of Karlsruhe, and there are two machines of the same general design which were built at the laboratory. The capacity of these three machines is 1,000,000 cartridges per week, working on a 24-hour per day schedule. The ammunition turned out is for the 8 mm. caliber gun.

Ludwig Loewe, A. G., of Berlin, has furnished many cartridge-making machines, but, in general, Nielsen & Winther and, more recently, F. Werner, of Berlin, have been drawn upon to meet the requirements of this plant. About the only exceptions noted were some machines from the Oerlikon Works, of Zurich.

There are several heavy presses in use, the largest having a press capacity of 1,650,000 kilos (kilo=2.2 pounds). This equipment is utilized in the manufacture of projectiles and cases of the heavier sort.

The Härens Laboratorium undertakes to manufacture various sizes of shrapnel shell and to fit the necessary fuses. The shrapnels in hand are for field artillery and for the lower calibers of land fortress rapid-fire guns.

ATLAS WORKS.

The Atlas Works, of Copenhagen, are one of the best steam-engine building plants in Denmark. The full name and address of this establishment are Aktieselskabet Atlas, Nørrebrogade 193, Copenhagen L. Mr. H. Martens, secretary of the company, was kind enough to show the writer personally over the plant on September 20, 1909, and every facility for a full inspection was afforded him.

The works were founded in 1898. The directors at present are H. H. Schou, O. Madsen, and E. Vöhtz. The capitalization of the firm is 800,000 crowns ($214,400) in shares and at present about 400,000 crowns ($107,200) in debentures.

There need be no hesitancy in saying that the engine building here ranks among the very best in Europe. The greatest care and attention are paid to details, and there is technical skill evident on all sides. The workmen impress the observer as men of more than ordinary capacity, and it appears that this firm is capable of handling work of the most exacting character.

The erecting shop of the works is two years old and is of iron and cement construction throughout. Overhead traveling cranes are in service, and these cranes are of both the electric and hand-working types.

HIGH-SPEED ENGINES BUILT.

The works are engaged in building high-speed steam engines, and all gearing and valve work is especially designed for high-speed running. Ordinarily these engines are designed for direct connecting to dynamos, although one engine was observed of 1,000 horsepower in course of erection, which is connected to a 32-groove fly wheel for rope attachment. The gearing in the Atlas Works comes for the most part from Germany. This recourse is general on the part of Danish plants. It would seem as if Danish works are reluctant to install machines for heavy gear cutting. Gear wheels on the Atlas engines are beveled, hollowed, and filled with lead to insure quiet running.

The castings of the Atlas engines are made up of Middleboro iron with a mixture of scrap and special pig irons. These castings are made in the company's own foundry. The forgings are for the most part obtained from Germany.

The principal output is steam engines of the superheated type for land service. The valve work on these engines is of a special Atlas design and is intended especially for steam engines working at high speed. This system is regarded as simple in construction, easy to adjust and maintain, and has the reputation of furnishing correct valve liftings with a quiet and noiseless working, even at high speed. A further advantage claimed is that the valve automatically resumes its seat when from some cause or other it happens to hang. Since June, 1907, the Atlas works have built and have under construction 21 steam engines fitted with this Atlas valve gear, representing a total of about 6,200 horsepower. In the same period a total of 60 engines of all types have been built. No attempt is made to enter the marine engine building field.

REFRIGERATING AND ICE-MAKING MACHINERY.

In addition to steam engines, the Atlas Works make a specialty of refrigerating and ice-making machinery. The latter machines are

designed to use either ammonia or carbonic acid. Under the head of refrigerating machinery the Atlas Works undertake to build machines for cooling water or brine, and machines for cooling air. The machines for cooling water or brine are built in weights varying from 40 to 640 hundredweight. For ice making this firm undertakes to build the plate, the can, and the cell systems. The weight of the ice-making machines of the can system varies from 50 to 1,100 hundredweight. The experience of the Atlas engineers is that steam engines should be worked under a highly superheated steam for use in connection with ice-making and refrigerating machinery. Under such conditions excellent results have been obtained in the amount of output of ice per ton of coal. All the ammonia machinery for ice-making purposes is tested to an air pressure of 30 atmospheres before leaving the works. The carbonic-acid machines have a working pressure of normally 70 atmospheres, and are naturally tested at higher pressure than the ammonia machines.

SOURCES OF TOOL SUPPLY.

The machine-tool installation of the Atlas Works comprises many American machine tools. German tools are also much in evidence. Most of the engine fittings are of German origin, and German packing is almost exclusively used. The German firm of Schaeffer & Budenburg furnishes most of the ordinary stock valves. Brass rods are obtained mostly from Danish sources. Steam lubricators are supplied by the Danish firm of Weilbach & Cohens.

The American machine tools in service are well liked. The only comment heard in criticism of American machines was with reference to the tool posts, but this is an old criticism, and one which American manufacturers have long ago recognized when dealing with a foreign market.

The twist drills in service have been supplied for the most part by the Cleveland Twist Drill Company, Cleveland, Ohio, and the Morse Twist Drill Company, of New Bedford, Mass.

Most of the files in use are of English or of Danish origin. There are a number of old German lathes in the shops, purchased many years ago, but Mr. Martens states that these tools are gradually being eliminated, and their places are being taken by new American types of tools. He also says that all of the old lathes have been strengthened so that high-speed steel can be used.

PRICES PAID FOR AMERICAN TOOLS.

Among the American machine tools in service are the following, purchase price and time of purchase being given when available:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Copenhagen.
G. W. Fifield, Lowell, Mass	Lathes—one 42″ x 18′ lathe	1899	$1,554
Do	Lathes—one 21″ x 12′ turret lathe	1899	482
J. E. Snyder & Co., Worcester, Mass	Vertical drills—one 20″ drill	1899	88
Flather & Co., Nashua, N. H	Lathes—one 14″ x 6′ turret lathe	1899	268
Do	Lathes—one 15″ x 8′ turret lathe	1899	322
Do	Shapers—one shaper	1899	241
Brown & Sharpe Manufacturing Co., Providence, R. I.	Grinder		
Pratt & Whitney Co., Hartford, Conn	Automatic bolt-making machine		
Betts Machine Co., Wilmington, Del	Heavy vertical boring mill	1899	3,270

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Copenhagen.
Landis Tool Co., Waynesboro, Pa.	Threader—one grinding machine	1899	$670
Warner & Swasey Co., Cleveland, Ohio	Turret lathes—one turret lathe	1899	509
Springfield Machine Tool Co., Springfield, Ohio.	One 18″ x 10′ lathe	1906	670
American Tool Co., Cincinnati, Ohio	Lathes—one 18″ x 10′ lathe	1906	670
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio.	Radial drill		
Dreses, Muller & Co., Cincinnati, Ohio	One 62″ drill	1899	402
Cincinnati Milling Co., Cincinnati, Ohio	One No. 3 Universal miller		
Davis & Egan Co., Cincinnati, Ohio	Lathes and drills—one 21″ drill	1899	107
Do	Lathes and drills—one 28″ drill	1899	268
Niles Tool Works, Hamilton, Ohio	Radial drill	1899	1,206

FOREIGN MACHINE-TOOL INSTALLATION.

The following-named makes of machine tools were noted among those in use, the year of purchase and price paid being given in most cases. Dimensions when not otherwise indicated are given in millimeters:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Copenhagen.
Nielsen & Winther, Copenhagen	Heavy 42″ swing lathe, engine lathe, turret lathe, milling machines, and planers—one 82″ x 22′ lathe.	1899	$2,814
Do	Horizontal boring machine	1899	1,179
Do	One 4,500 x 2,300 x 1,500 planer	1899	2,680
Do	One 14″ x 14′ lathe	1899	750
Do	One 14″ x 8′ lathe	1899	322
Do	One 20″ x 12′ lathe	1899	563
Do	One 16″ x 8′ lathe	1899	375
Do	One 18″ x 8′ lathe	1899	429
Do	Turret lathe	1899	965
Do	Universal milling machine	1900	831
Do	Planer milling machine	1900	482
Do	Turret lathe	1906	1,742
Billeter & Klunz, Aschersleben, Germany.	Side planer and vertical drill—one 1,600 x 850 x 750 planer.	1899	750
Franz Braun, Zerbst, Germany	Planers—one 3,000 x 1,200 x 1,000 planer.	1899	1,018
Do	One 20″ diameter lathe	1899	2,171
Do	One 10″ diameter lathe	1899	911
Do	Horizontal boring and turning mill	1899	456
Deutsche Werkzeugmachinenfabrik, Germany.	Electric-driven, horizontal boring and milling machine.	1908	3,752
Do	Vertical boring mill	1908	1,608
Ludwig Loewe, A. G., Berlin	Cutters		
Mayer & Schmidt, Offenbach, Germany	Tool grinders		
Naxos-Union, Frankfort	Double grinder		
Ernst Schiess, Dusseldorf, Germany	Slotters—one 200 x 400 slotting machine.	1899	643
Do	One 400 x 700 slotting machine	1899	1,045
Sondermann & Stier, Chemnitz	Vertical boring mill and horizontal milling and boring machine.		

A day's work at the Atlas establishment comprises 10 hours. The shop opens at 6 a. m. in the summer and at 6.30 a. m. in the winter, and closes at 5.30 p. m. in the summer and at 5 in the winter.

Nearly all wages are on a piecework basis, a good machinist earning on an average about 5.50 crowns ($1.47) per day. Practically all of the men in the shops are Danes, and it was stated that there is not much tendency on the part of the workmen to drift from shop to shop. At the time of the inspection about 350 men were employed, but when running at full capacity the force numbers approximately 450.

RUSSIA.

GERLACH & PULST.

The firm of Gerlach & Pulst, of Warsaw, Poland, is undertaking to build machine tools in series. The full name and address of this firm, as written in Polish, is Akcyjore Towatzystwo Fabryski Masryn Gerlach i Pulst.

The writer visited these shops on October 1, 1909, and was escorted over them by General Director Bronislaus Zalenski, who afforded him every opportunity to study the conditions existing. This is one of the most important plants visited in Poland, and there need be no hesitation in saying that it aims to turn out machine tools of high merit.

The original firm of Gerlach & Pulst came into existence in 1876, and in 1898 a limited company was formed, but within the past year a general reorganization has taken place.

MODERN METHODS AND MACHINE TOOLS EMPLOYED—VARIED OUTPUT.

Director Zalenski is a man with considerable experience in machine-tool construction and, to judge by the arrangements which were observed in the shops, he is apparently determined to follow the most modern methods and to utilize the best machine tools obtainable. It must not be forgotten that machine-tool houses have from time to time failed in Russia. Very few machine-tool building plants, it is stated, have succeeded, and the failure is attributed to the methods employed rather than to the lack of capital. Director Zalenski firmly believes that the success of the establishment at whose head he stands depends upon building in series and at the lowest possible cost. It is for this reason that he is more than willing to secure any machines that will enable him better to carry out series work and reduce the price of initial production.

Owing to the relatively high duty on machine tools entering Russia, there are most favorable opportunities awaiting domestic machine-tool plants. The Russian authorities are naturally anxious to encourage such industries, and the facilities existing in Russia to-day are recognized as being unequal to the country's demands.

Director Zalenski states that the duty on machine tools coming into Russia is 4.20 rubles ($2.16) per pood (36 pounds). There are extra costs, Director Zalenski says, which in reality increase the duty roundly to 5 rubles ($2.58) per pood.

Gerlach & Pulst are not yet able to confine their efforts to the building of only a few machines. The output of the shops at present comprises lathes, planers, vertical drills, milling machines, steam hammers after the Massey system, friction hammers, plate-bending machines, grinding machines, and bolt-cutting machines. Under the head of lathes are included turret lathes, and the firm is building the

Gisholt type of this machine. The lathes built embrace all classes, and probably more attention is being given to lathe production than to any one type of machine tool. They are built in series ranging from 10 to 50. Vertical drills are built in series of 10 for the large sizes and 25 for the small sizes. These vertical drills are referred to as being on the "American system." Chucks for lathe use are bought by the firm and are largely confined to Whiton chucks. Numerous collections of castings, especially for vertical drills, were observed, leaving no doubt that these orders were being got out in lots.

MACHINE TOOLS BUILT IN SERIES—AMERICAN GEAR CUTTERS PREFERRED.

Director Zalenski is of the opinion that his firm is the only one in Russia that is undertaking to-day to build machine tools in series. In this connection attention is called to the author's report on the Pneumatic Tool Works of St. Petersburg, which will show that at least one other firm visited is building after American methods.

The standard engine lathes built by Gerlach & Pulst follow the general designs of the John Lang & Sons' works, of Johnstone, Scotland. In this connection, it may be added that the Gerlach & Pulst shops are operated to-day in a manner similar to the Lang works, and are largely patterned after the latter. [A description of the Lang shops will be found in the publication issued by the Bureau of Manufactures, entitled "Machine Tool Trade in Germany, France, Switzerland, Italy, and the United Kingdom."] Gear cutting is done on Biernatzki tools, as well as on American tools. The only other foreign type of tool used for gear cutting is a cone-gear cutter furnished by the Oerlikon Works, of Zurich, Switzerland.

The attention of General Director Zalenski was called to the experience of Mr. Lang in gear cutting when employing Brown & Sharpe, Gould & Eberhardt, and Biernatzki tools, which experience largely favored the employment of American gear cutters, Mr. Lang going so far as to say that for all ordinary work the two German-made hobbing machines (Wanderer and Biernatzki) sufficed, but if he wanted to gear a wheel to sell he would do the work on a Brown & Sharpe or a Gould & Eberhardt tool. One Reinecker gear cutter was also observed in service, but for the most part the gear cutting is on American tools.

The castings for all of the machine tools built by this firm are made in its own foundry, which has a capacity for producing 150,000 poods per year.

No better indication of the modern character of the Gerlach & Pulst Works can be afforded than the installation of machine tools observed. The shops fairly bristle with high-grade American tools.

AMERICAN MACHINE TOOLS IN SERVICE.

The American Tool Works Co., of Cincinnati, Ohio, has supplied no less than seven planers of the medium size, and these tools are highly spoken of. The Niles-Bement-Pond Co., of New York, has supplied from the Pond Works one planer having a length of bed of 10 meters, a width of 2½ meters, and a height of 2,500 millimeters. The same company has supplied a planer from the Niles Works, of

Hamilton, Ohio. Bement, Miles & Co., of Philadelphia, have also supplied a planer, and here, as in many Austrian shops, it was found that Wm. Sellers & Co., of Philadelphia, had made sales direct. In this instance an engineer from Gerlach & Pulst, it is stated, personally visited the Sellers firm.

Pratt & Whitney, of Hartford, Conn., furnished as late as last year several lathes, and Mr. Zalenski states that he purchased these tools direct from the Hartford firm. Throughout the shop Brown & Sharpe gages are employed. Gerlach & Pulst undertake to manufacture many taps, and also buy taps and dies from Ludwig Loewe, of Berlin. One of the finest tools in the shops is from the Bement, Miles & Co. works, and has a length of bed of 14 meters.

In the power house there are two engines, one of 200 horsepower and one of 75 horsepower, built by Theodore Wiedes, of Chemnitz. The electrical fittings throughout have been supplied by Oerlikon, of Zurich, Switzerland. Electric power is utilized by Gerlach & Pulst for driving the machine shop and for lighting purposes. In the smithy German coke is largely used. It was stated that Russian coke contains too much sulphur to make it desirable.

The following American machine tools were in use in the shops:

Jones & Lamson Machine Co., Springfield, Vt	Turret lathe, Harkness patent.
Norton Grinding Co., Worcester, Mass	Grinder, 10″ x 72″.
Pratt & Whitney Co., Hartford, Conn	Lathes.
Niles-Bement-Pond Co., New York	Two lathes from the Pond Works, one planer from the Niles Tool Works, one heavy planer.
Gould & Eberhardt, Newark, N. J	Gear cutters.
Bement, Miles & Co., Philadelphia, Pa	One planer.
Wm. Sellers & Co., Philadelphia	Tool grinders.
American Tool Works Co., Cincinnati	Five engine lathes, seven medium-size planers.
Cincinnati Milling Machine Co., Cincinnati, Ohio	No. 1½ universal milling machine; tool grinders.
Davis & Egan Co., Cincinnati	Lathes.
Gisholt Machine Co., Madison, Wis	Grinder.

Director Zalenski stated that the Jones & Lamson turret lathe (Harkness patent) was bought in 1909 and cost $1,905, delivered in Warsaw. One of the Pratt & Whitney lathes cost, delivered, $618, and the price of the Norton grinder, delivered, was $2,163.

GERMAN TOOLS IN USE—ENGINE LATHES MANUFACTURED—WAGES PAID.

There are many German tools in use. Among them were sensitive hand drills and a small grinder from De Fries & Co., of Dusseldorf; two horizontal boring machines from Zimmermann, of Chemnitz; a backing-off lathe and gear cutter from J. E. Reinecker, of Chemnitz, and a slotter supplied by Selig, Sonnenthal & Co., of London. There are also many lathes which were manufactured by the firm itself.

A Reinecker grinder was in service, but the statement was made that it was necessary to make changes in this tool. The opinion was freely expressed that American grinders are better than Continental makes.

The various standard sizes of engine lathes made at this establishment are as follows:

Height of centers.	Distance between centers.	Price f. o. b. Warsaw.
Millimeters.	*Millimeters.*	
200	1,250	$283 to $1,287
250	1,500	438 to 1,699
300	2,000	554 to 2,060
350	2,500	695 to 2,575
400	3,000	1,287 to 3,090
500	3,000	.....
600	3,000	.....
800	5,000	.....
1,000	5,000	.....

At the time of the inspection about 400 men were employed. A day's work embraces nine hours, the works opening at 7 a. m. and closing at 5 p. m., with an intermission from 12.30 to 1.30 for dinner.

Director Zalenski states that all work is paid for on a piecework schedule, but that as a rule the men employed at the various tools are paid as follows per hour, a few cases occurring, however, in which a little more is paid:

Class of workmen.	Cents.	Class of workmen.	Cents.
Lathe men	20.6	Blacksmiths	15.5
Milling-machine men	17	Forge men	19.6
Turret-lathe men	15.5	Foremen	10.3
Drilling-machine hands	15.5	Laborers	6.7
Grinding-machine men	20.6		

The work on the lathes manufactured here appears to be strong and well finished. The spirit of the shops is so thoroughly progressive that there can be little question of the success of these works, provided the cost of production can be kept down. The Russian territory is an enormous one, and the machine-tool industry is decidedly in its infancy. With good management there is no reason why this firm should not develop and become a prominent factor in the Russian machine-tool trade. The present shops are adequate for the work in hand, but it is apparent that any increases in orders will demand additions. This fact should not be lost sight of by the American machine-tool interests, for there is little doubt of the readiness of the management of this plant to secure all new machine tools possessing more than ordinary merit.

K. RUDZKI & CO.

The establishment of K. Rudzki & Co., of Warsaw, Russia, is representative of that class of Polish works which engage in the manufacture of a general line of machinery. The full name and address of this plant is written in Polish as follows: K. Rudzki i Ska, Fabryka Machin i Odlewòw, w Warszawie. The firm was founded in 1858 and is a limited company. The present directors are: Edward Landie, banker; Casimir Jasinski, banker; Julian Eberhardt, engineer; and L. Schmidt and S. Wierzbicki, the latter two managing directors.

The Rudzki Works are divided between two sets of shops, one located within the city limits and the other at Nowominsk. An inspection was made October 2, 1909, of the Warsaw shops, Engineer Stanislaw Majewski acting as escort. The shops were fairly busy, there being considerable work on hand.

About 500 men were employed at the time of the visit; and at Nowominsk the total force was about 600. The latter shops are handling almost exclusively bridge work and shrapnel projectiles. About 200 men were then employed in the actual erecting of bridges. This force was from the personnel of the Warsaw plant. The main erecting shop is a building of modern construction and with modern framing for drive throughout.

LINES OF WORK—MACHINE-TOOL EQUIPMENT.

The general output of the Rudzki shops embraces bridges of all descriptions, pumps, railway frogs, complete waterworks for railways and towns, armatures for waterworks and lifts, complete arrangements for gas works, heavy sluice valves and covers for street hydrants. The sluice valves are made in sizes ranging from 1½ inches to 36 inches in diameter. The manufacture of railway frogs is an important element at the Rudzki Works, and I am informed that the rate of output of steel frogs for railways has reached 45,105 poods per annum (1 pood=36 pounds). The street-hydrant covers made by the firm are designed so as to permit of the passage of heavy traffic. The firm has a complete foundry and makes all castings required for its various outputs. There are a number of presses here which were made by this firm operating under 300 atmospheres pressure.

The general workmanship evinced was excellent, and it was apparent that there were many good machinists in this plant. It was disappointing, however, to find hardly an American machine tool in service. The only exception noted was a Morgan bolt machine from the Reliance Machine Tool Company, of Cleveland, Ohio. Speaking broadly, the machine-tool equipment of these shops is of German origin. There were observed a horizontal borer from the English firm of George Richards & Co., of Broadheath, England, and a universal miller supplied by Selig, Sonnenthal & Co., of London, "The Sundale." There was an old lathe from Fétu-Defize, of Liege, and a number of tools from Gerlach & Pulst, of Warsaw, but aside from this enumeration all of the foreign tools noticed were of German make and included the following: Maschinenfabrik, Weingarten, screw presses; Zimmermann, Chemnitz, engine lathes, slotters, planers; Otto Froriep, Rheydt, lathes, universal millers, vertical drills; Habersang & Zinzen, Dusseldorf, multiple drill; Werkzeugmaschinenfabrik Union, Chemnitz, lathes; E. Bergmann, Berlin, lathes; Vulkan Maschinenfabrik, Chemnitz, facing lathes; Billeter & Klunz, Aschersleben, open side planer; Ernst Schiess, Dusseldorf, planer; Droop & Rein, Bielefeld, slotters; Wagner & Co., Dortmund, large planer.

DIRECT AGENTS SECURE ORDERS.

Zimmermann, of Chemnitz, has probably placed more tools in these works than any one German firm. Inquiry was made as to how it has happened that Zimmermann has been drawn upon so largely,

and the information was given that this German house maintains a representative in Warsaw, and that experience had shown that tools could generally be delivered by Zimmermann within two to three weeks after the placing of the order. It is evident that a firm like Zimmermann considers it worth while to maintain a direct agency here; and to judge by the number of Zimmermann tools in evidence throughout the Warsaw shops, the conclusion is inevitable that selling arrangements are largely responsible for the presence of so many Chemnitz-made machines.

Mention has already been made of the fact that American machine tools have been bought in Europe largely on their known merits. There are many shops, however, where American machine tools are not known, and at the Rudzki plants, for instance, where the workmen are proficient, the writer could not refrain from contemplating the increased facility which could be secured in many instances were some of the best-known makes of American machine tools utilized.

The statement was made that this firm has had little or no experience with American machine tools. This is important and is a fact that should be considered by American machine-tool builders.

WELDING—WAGES—OUTPUT—RUSSIAN IMPORTS FROM GERMANY.

This firm is employing acetylene gas for welding work and is having recourse to acetylene gas burners as supplied by the French firm Générateur Antomatique d'Acetylène avec Évacuation des Résidus, Système Javal. The gasogen for use with gas machines is also of French make and is known as "Gasogènefavel" (Paris). Mr. Majewski says that they find this acetylene gas system very economical for small work but not economical on heavy work.

A good machinist at the Rudzki works earns on an average 3 rubles ($1.55) per day. A good foundryman, I was informed, earns between 3 and 4 rubles ($1.55 and $2.06) per day.

It is evident that these works aim to turn out high-class products, and in the writer's opinion it is well worth the while of American machine-tool interests to keep in touch with a plant of such established reputation.

It was stated that during the year 1908 the following quantities, given in poods, of the various articles were turned out: Water pipes, 89,408; miscellaneous castings, 54,116; steel castings, 45,105; bridges, 342,281; caissons, 20,481; roof girders, 26,062; railway turntables, 2,700; reservoirs, 12,164; bridge cranes, 14,616; shells for the army, 9,000 pieces; complete railway waterworks, 4 plants.

The turnover for the year 1908, I am informed, was 3,735,415 rubles ($1,923,739).

The German machine-tool exports to European Russia for 1908 amounted to a total of 3,141,800 kilos in weight (1 kilo=2.2 pounds. In 1907 Germany exported to Russia machine tools reaching a total weight of 2,219,000 kilos.

In 1908 the German exports of machine tools to Finland amounted to a total weight of 351,700 kilos and in 1907 to 194,400 kilos.

These figures are taken from the Imperial German statistics as published in 1909.

ROHN, ZIELINSKI & CO.

One of the most important among the pump-making plants of Russia is that of the Warsaw firm, Rohn, Zielinski & Co. This establishment was visited by the writer on October 2, 1909, under the personal guidance of Engineer Franciszek Zawodzki, who accorded him every facility for making a complete inspection.

Steam pumps of the Worthington type form the greater part of the output, but radiators are also built. Every effort is made to modernize as far as possible the methods employed. All pump parts are made in series, and these parts, as fast as completed, are stored and are available for assembling as orders are received. In this pump construction much recourse is had to jigs, and this is one of the few shops the writer has seen in Poland where jigs are an important element.

AMERICAN-MADE PUMPS COMPETE IN RUSSIA.

The cost of labor is naturally much less in Poland than in America, but notwithstanding this fact it was said that Messrs. Worthington, of New York, are establishing the prices to be paid in Russia, and that the American pump is, in fact, setting the pace for Russian manufacturers. This American firm is regarded as the strongest of the competitors the Russians have to meet. The Russian tariff on pumps, it would seem, does not bear so hard as on machine tools, and, according to Mr. Zawodzki, the duty on pumps coming into Russia is 3.20 rubles per pood (1 ruble=51.5 cents and 1 pood=36 pounds). Mr. Zawodzki, however, remarked that owing to the light weight of the Worthington pumps the duty collected is relatively small, and that Worthington has an advantage over Continental works that have to ship into Russia by rail. The opinion held by Mr. Zawodzki is that the sea freight paid on Worthington pumps is more favorable than the Continental rail rate.

The statement was made that Rohn, Zielinski & Co. regard Worthington of America, Gardner of England, and C. Schwabe, of Erfurt, Germany, as the three firms which are offering them competition. These three firms, it was said, are making the cheapest quotations for pumps in Russia, and their prices have necessarily to be met by the Warsaw establishment.

ESTABLISHMENT OF THE WORKS—SOURCES OF MATERIAL—SPECIALTIES.

Rohn, Zielinski & Co.'s works have been in existence about fourteen years. The plant was originally designed for bridge building, but was later transformed into a pump-making plant. At the time of this inspection about 300 men were employed. The pumps manufactured are mostly of the Worthington type and are designed for work at all pressures. Special pumps are manufactured, as boiler-feed pumps for high pressure. All material used in the building of these pumps comes from Russia; that is to say, all of the metal work and the pump cocks, but various special mechanical attachments are bought from German houses. Lubricators come from London. It was observed that brass casings are used to cover that portion of the pistons exposed between the cylinders of high-pres-

sure pumps, and it was stated that Rohn, Zielinski & Co. find it necessary to buy the brass piping in Germany.

In the power-installation plant Wolf engines, of the type superimposed on boilers, were installed. These engines come from Magdeburg, Germany. In this installation was noticed one engine made after the Wolf system by the firm of Orthwein, Karasinski & Co., of Warsaw. The coal used is of Russian origin, and costs about $5.25 per long ton.

There is considerable demand in these shops for double helical gears. In cutting these gears there is a general recourse to the firm commonly referred to as Wlochy, located near Warsaw. The Wlochy firm possesses a machine for cutting double helical gears, which, according to Mr. Zawodzki, was the design of a workman by the name of Polanowski. The Wlochy establishment developed this idea, and now undertakes to cut helical gears ordered by other Russian firms. These double helical gears are for pump work, and are regarded as much stronger and quieter than the ordinary gears.

AMERICAN MACHINE TOOLS REQUIRED.

The machine-tool installation comprises a number of American tools. The very fact that this firm is building pumps in series makes it advisable that recourse be had in certain instances to tools of American origin. German tools are in evidence, but not to the same extent noticed in other Polish shops. Wherever high-grade work is demanded, and especially series work, there is generally noted a demand for American tools.

There are many old tools in evidence in this establishment and also in others about Warsaw, which, while doing good work, might be replaced by machines more modern in type, and which would, no doubt, produce more economical results. Rohn, Zielinski & Co. recognize this full well, but they do not think it would pay to establish an American tool warehouse in Warsaw, declaring that they have no difficulty in obtaining American machine tools through agencies. The needs in this line of the Warsaw district suggest mutual advantages for both the American machine-tool builders and the firms themselves.

In the main machinery shops are the following American machine tools:

Prentice Bros. Co., Worcester, Mass_____Radial drill.
Bickford Drill and Tool Co., Cincinnati____Radial drill.
G. A. Gray Co., Cincinnati_____Planer.
Bement, Miles & Co., Philadelphia, Pa_____Horizontal boring machine No. 550.
Dreses, Muller & Co., Cincinnati_____Radial drill.
Davis & Egan Co., Cincinnati_____Radial drill.

FOREIGN TOOLS IN USE—WORKMEN'S WAGES.

Among the foreign machine tools are the following:

Ludwig Loewe, A. G., Berlin, vertical and horizontal millers, turret lathes; Sondermann & Stier, Chemnitz, shapers, lathes; Wilh. Scharmann, Rheydt, Germany, horizontal boring machine No. 1780; Deutsche-Niles Werke, horizontal borer; Hartmann, Chemnitz, lathes; M. Hasse & Co., Berlin, turret lathes; Kirchner & Co., Leipzig, wood-working planer; Schilling & Kramer, Suhl, Germany, horizontal boring machines with four spindles.

The wages paid per hour to skilled workmen are as follows, values being given in kopecks (100 kopecks=1 ruble=$0.515):

Class of workmen.	Kopecks.	Class of workmen.	Kopecks.
Lathe men	50	Assembling-department hands	45
Planer hands	45	Vise men, assembling department	45
Milling-machine men	40	Molders	50
Boring-mill hands	35	Carpenters	25
Grinding-machine men	45	Pattern makers	35
Foremen, assembling department	45	Forge men	40

AMERICAN MACHINE TOOLS HIGHLY APPRECIATED.

Mr. Zawodzki was asked to state if there was any fault to be found with American machine tools in service, having in mind European conditions and requirements, and to enumerate any criticisms. His reply was as follows: "No fault was found with the American machine tools in our service—no doubt that they are of best construction, built of best material, and are most exact in service."

The work carried on at the Rohn, Zielinski & Co. shops is of an especially high grade character. The writer frankly admits that he did not expect to find such excellent workmanship in the Warsaw district. There is good technical skill evinced here and a high degree of technical control. When one considers that this firm has to compete with experienced pump makers, like Worthington, it will be appreciated by machinery manufacturers that success depends wholly on being able to produce the manufactured parts at the lowest possible cost. In the writer's opinion this firm is essentially high class, and there is no denying that the equipment turned out from these shops is deserving of the highest consideration.

BORMANN, SZWEDE & CO.

The Bormann, Szwede & Co. works at Warsaw had at the opening of October, 1909, about 1,000 men employed. This is one of the leading machinery plants of Poland. The full name and address is written in Polish as follows: Towarzystwo Akcyjne Zakładów Mechanicznych Bormann, Szwede i S-ka, w Warszawie. Director Maurycy Bormann, was kind enough to show the writer over the plant. The location is within the city limits of Warsaw. The buildings are of brick construction throughout and cover about 355,000 square feet of ground.

The output of Bormann, Szwede & Co. embraces steam engines, boilers, engine fittings, valves, pumps, blowers for sugar works, and general equipment for sugar refineries and distilleries. The firm builds a standard type of steam engine for sugar works. In addition it undertakes to construct, more as specialties, complete installations for sugar refineries, distilleries, alcohol refineries, etc. All fittings and equipment necessary for boilers are manufactured by the firm, and without recourse to others.

The organization of the firm dates from 1875. The works were founded under the name of Guillaume Hoecke in 1818 as a copper-boiler establishment, and they were the most important in the

country. They engaged in making equipment for sugar works, distilleries, and breweries of that period. In 1864, after the death of the founder, the works were purchased by Teau Troetzer, and then undertook the building of steam engines and many machine tools. About 1875 the plant was taken over by two young engineers, Maurize Bormann and Alexander Szwede, and they secured at the same time considerable more ground. In 1900 this establishment became a limited company with a capital of $927,000, divided into 3,600 shares of $257.50 each. The company is under the actual control of three directors.

FIRST-CLASS WORK—AMERICAN TOOL EQUIPMENT.

The work in the Bormann, Szwede & Co. plant is first class throughout, and Mr. Bormann indicated his desire to acquire at all times the very best grade of machine tools. This readiness was evinced by the number of excellent American machine tools already in the shops. At the same time several German machine tools were recognized, and the impression was gained from Mr. Bormann that often these German tools were purchased because they were more readily available. He gave it as his opinion that there is sufficient business in the Warsaw district to warrant the maintenance of a well-stocked American machine-tool wareroom in the district. He referred to the large increase in mechanical work throughout Poland, and especially in the Warsaw and Lodz sections. The latter town, it should be borne in mind, is often referred to as the Birmingham of Poland. Mr. Bormann expressed the opinion that American machine tools were not sufficiently available for the wants of the district.

Among the American machine tools in evidence was a vertical turret lathe from the Baush Machine Tool Company, of Springfield, Mass., which was purchased about a year ago from Messrs. de Fries, of Dusseldorf. Shapers have been supplied by the John Steptoe Shaper Company, of Cincinnati, and are especially liked by Mr. Bormann, as is also a radial drill from the Bickford Drill and Tool Company, of Cincinnati. Mr. Bormann said, however, that the radial drill which he is at present using is too small and that it will be necessary for him to put in a larger-sized tool. The Bradford Machine Tool Company, of Cincinnati, and also the R. K. LeBlond Machine Tool Company, of Cincinnati, have furnished a number of lathes, but many of those in use are of German or Polish origin, and it is noteworthy that many of the German lathes were without manufacturers' names.

In the boiler shop the work is largely hand work and tools are not in evidence.

FOREIGN TOOLS—PRICES PAID FOR MACHINE TOOLS.

Among the foreign machine tools in service are the following:

Chemnitzer Maschinenfabrik, planer; De Fries & Co., Dusseldorf, lathes; Werkzeugmaschinenfabrik Union, Chemnitz, lathes, horizontal borer; Gerlach & Pulst, Warsaw, lathes, radial drill; Ludwig Loewe, A. G., Berlin, lathes; Zimmermann, Chemnitz, bolt-heading machine, engine and pit lathe, vertical miller, boiler plate punch machine, and boiler plate riveting machine; Augsburg, Nuremburg, planer; Fielding & Platt, Manchester, plate-bending machine; John Hetherington & Sons, Manchester, horizontal boring machine.

Transportable hydraulic riveters are in service, and there are at least three heavy rivet-making machines installed which are the design and build of the Russian firm.

In the Bormann, Szwede & Co. shops, in common with other Polish shops inspected heretofore, recourse is largely had to cutters from the Austrian firm of Gebrüder Böhler.

The prices paid for some of the machine tools in service delivered, duty paid, in Warsaw, are as follows, dimensions when not otherwise indicated being given in millimeters:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Warsaw.
AMERICAN.			
Baush Machine Tool Co., Springfield, Mass.	Vertical lathe 760	1908	$1,421
Walker Grinder Co., Worcester, Mass.	No. 1 machine	1908	345
Bickford Drill and Tool Co., Cincinnati	Radial drill W. B. 3	1907	1,091
Bradford Machine Tool Co., Cincinnati	Lathe, 200 x 1,420		693
John Steptoe Shaper Co., Cincinnati	Shaping machine 16″	1908	445
R. K. LeBlond Machine Tool Co., Cincinnati.	Lathe, 180 x 1,015	1908	543
Wilmarth Morman Co., Grand Rapids, Mich.	One tool	1908	128
FOREIGN.			
Henry Berry, Leeds, England	Double drill		2,117
J. Hetherington & Sons, Manchester	Flanging machine		1,854
	Triple drill		5,616
C. Word, Birmingham	Drill No. 21		420
Leed & Hunt, Nottingham, England	Circular saw		1,090
Le Progrès Industriel, Loth, Belgium	Lathe, 250 x 1,500		935
	Lathe, 250 x 2,000		958
De Fries & Co., Dusseldorf, Germany	Lathe, 180 x 1,500		628
Hartmann, Chemnitz	Lathe, 370 x 7,000		1,736
Ludwig Loewe, A. G., Berlin	Lathe, 200 x 1,420		670
Otto Froriep, Rheydt, Germany	Shaping machine, 450 x 1,750		953
Werkzeugmaschinenfabrik "Union," Chemnitz.	Lathe, 210 x 1,500		721
Zimmermann, Chemnitz	Planer, 1,200 x 1,200 x 3,000	1905	1,892
	Planer, 1,000 x 1,000 x 5,000		1,030
	Planer, 1,850 x 1,500 x 7,000		3,605
	Lathe, 350 x 2,500		1,030

WORK AND WAGES—OUTLOOK CONSIDERED EXCELLENT.

A day's work in the Bormann, Szwede & Co. shops comprises nine hours. The shops open at 7 a. m. and close at 5.30 p. m., with an interval from 1 to 2.30 p. m. All work is paid for on a piecework basis, and good tool men, Mr. Bormann states, earn from $1.55 to $1.80 per day. Ordinary workmen will earn only 77 cents to $1.29 per day. Laborers receive on an average 52 to 62 cents per day.

Director Bormann is a man of broad views and large experience. He is fairly optimistic regarding future conditions in his section, and realizes that all that is necessary to insure the success of Polish shops is good equipment and proper shop control. He recognizes that Russia possesses practically all of the elements necessary for machinery construction, and that works like his are favored by a strong protective tariff much like the United States tariff. He sees no reason why industrial plants should not thrive in Polish Russia, provided a fair modicum of that good judgment essential to all business success be exercised. His firm is endeavoring to do first-class and honest work, and American machine-tool interests will do well to keep in touch with an establishment so progressive as this one.

PNEUMATIC TOOL COMPANY.

The history of machine-tool works in Russia has, for the most part, been one of failure. Numerous instances can be cited of works established both with Russian and with foreign capital, and for the most part they either have not succeeded or have had indifferent success.

It would be presumption on the part of the writer to assume to explain offhand the cause of these failures, but from the best information he can obtain he is strongly inclined to believe that they have been largely due to the methods followed in manufacturing. This opinion has been reenforced by observations made in various machinery shops in Russia. The Russian workman is doubtless capable of as good work as men of any nation on the Continent of Europe. In several essentials he is better than the men of some countries, for the Russian will stick to a tool and become thoroughly expert in its handling. Wages are not high, and practically all material necessary for machine-tool building is obtainable within the country. The tariff accords a fair amount of protection to Russian machinery enterprises, and in the matter of orders one has only to consider that this is a country covering approximately one-fifth of the land surface of the globe, and containing a population of more than 150,000,000. In the St. Petersburg district alone it is estimated that there are fully 225,000 men engaged in mechanical lines. These figures were furnished by Mr. Ludwig Nobel of the Nobel Works, who is probably in as good a position to make estimates of this sort as any man in Russia.

And yet, with all of the elements existing for machine-tool enterprises, such establishments have not flourished. It would seem as if it has remained for American enterprise, American skill, and American direction to blaze the way, as it were, in this great Russian territory.

AN ESTABLISHMENT ON AMERICAN LINES.

The works of the Pneumatic Tool Company, of St. Petersburg, were visited by the writer October 4, 1909. At the head of this establishment is Mr. John K. Lencke, a native American and a former superintendent of the Q. & C. shops of Chicago, Ill. Everything that Mr. Lencke knows in the mechanical lines he learned in some of the best American shops, and the works which he has established in St. Petersburg are distinguished from a thriving up-to-date American plant only by the presence of Russian workmen and the fact that the shops stand on Russian soil. The full name and address of this company is the Pneumatic Tool Company, W. O. 17, Line No. 6, St. Petersburg, Russia.

The firm was originally established in consequence, the writer was informed, of representations made from Russian sources that a plant of this sort would be highly desirable; in other words, afford to government shops an opportunity to draw on tools made within Russian territory. Mr. Lencke says that his first knowledge of the Russian territory came from a visit on his part as a representative of the Q. & C. Company, of Chicago. He associated himself at the outset with Russian interests, but found it desirable later to assume sole control, which he has held since 1906.

One can not enter these works without being impressed at the outset with the strong individuality of the American at its head. With the exception of John K. Lencke and one English workman, there is not a native English-speaking man in the place; all the others are Russians. One entire afternoon was spent inspecting the works, and later a whole evening was passed in company with Mr. Lencke studying the workmanship of these Russian machinists. Many of these men do not know, perhaps, that they are working as close as would be demanded of our best American machine-tool hands, but Lencke is requiring no standard short of the superlative obtained in American shops. He is using Brown & Sharpe and Pratt & Whitney gages throughout.

MACHINE TOOLS PRODUCED AT LOW COST—METHODS.

It would probably surprise some American manufacturers to look over the cost sheets for various parts, as shown on Lencke's books. The writer does not feel at liberty to make any mention on this subject, but will say that pneumatic tools are being produced in Russia at figures far below prices in the United States. In the matter of orders this St. Petersburg plant is unable at present to turn out sufficient tools for the demand. During the past three years the business, according to the statements exhibited, has been most profitable. Mr. Lencke says that 25 per cent of the price received for a tool is sufficient to cover all selling expenses. The standard prices charged for tools of the Pneumatic Tool Company are, he states, the same as those charged by leading American houses.

Whatever has been the history of machine-tool building in Russia in the past, the Lencke shops in St. Petersburg are demonstrating that a plant run on strictly American lines, following up-to-date American methods, can command a splendid business to-day in Russia. It was no surprise upon entering these shops to find that practically all the tools in service are of American origin.

It is the practice in these shops to keep all of the tools for making any one part in a separate box. When a workman undertakes to make any particular machine part, he takes the box containing the necessary tools and turns in his name. This is only one feature, small in its way, which Lencke taught, and which he himself learned in American shops.

All of the tool castings made here are cleaned with sand blast, and these shops, it is said, were probably the first works in Russia to utilize sand for cleaning. The sand-blast machine employed is from C. Drucklieb, New York City. The drop forgings in use were supplied by J. H. Williams & Co., of Brooklyn, N. Y. Mr. Lencke pointed out one German tool which he had been induced to take from a German selling house in lieu of an American tool for which he had asked. It was stated, he said, that the American tool could not be delivered within reasonable time. Mr. Lencke avers that the representation was made to him that this German tool was the equal of the American. "At any rate I took the machine," he said, "only to discover that it was not up to standard."

Mr. Lencke states that pneumatic tools were first installed in Russia at the Newsky Works. This was in 1899. The Newsky plant is working about 4,000 men, and one branch of the business is shipbuilding.

ENGLISH AND GERMAN COMPETITION.

At the present time the shops of the Pneumatic Tool Company are engaged in the manufacture of pneumatic tools, but it is proposed to undertake shortly the manufacture of the Hendey type of lathe. Mr. Lencke authorized the statement that he estimates that the Hendey type of lathe with 16-inch swing and 8-foot bed can be manufactured in St. Petersburg for $230. It should be borne in mind that in giving information of this character Mr. Lencke is actuated by the desire to assist American machine-tool interests, and he declares that what he has accomplished in the machine-tool line can be effected by other machine-tool houses who care to enter the Russian field. There is only one English house that can be regarded as a possible competitor in Russia. This is Alfred Herbert (Limited), of Coventry. Herbert can be set down as a strong competitor in all countries outside of the United States, both by reason of the excellence of the output and the fact that Herbert tools are sold as a rule only by Herbert's men. It is the writer's observation that competition on the part of Herbert, while keen, may be regarded at all times as fair and aboveboard.

Aside from English competition, American machine tools in Russia have to encounter only German products. Those German houses which are worthy of consideration as competitors have been mentioned from time to time. For the most part, much of the German importation is in the nature of machines, especially in the medium sizes, inferior in both quality and working capacity to the best American tools.

THE AMERICAN TOOL EQUIPMENT.

The excellent equipment of these shops in the line of American machine tools will be observed from the following list of the tools in service:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in St. Petersburg.
American Tool and Machine Co., Boston, Mass.	No. 1 oil separator	1902	$111
Hulbert-Rogers Machine Co., South Sudbury.	3-inch accelerated cutting-off machine.	1905	477
J. E. Snyder & Co., Worcester	25-inch vertical drill	1899	360
Morse Twist Drill Co., New Bedford	Twist drills		
Prentice Bros. Co., Worcester	4-spindle vertical drill	1902	248
Washburn Shops, Worcester	Twist-drill grinder	1899	106
Browne & Sharpe Manufacturing Co., Providence, R. I.	No. 11 automatic grinding machine.	1899	734
	No. 2 universal milling machine	1899	875
	Gages		
Diamond Machine Co., Providence	Emery grinder	1902	45
	do	1905	49
Chas. Parker & Co., Meriden, Conn	26 different-sized parallel vises		
Dwight Slate Machine Co., Hartford	No. 2 full automatic gear cutter	1902	412
	3-spindle sensitive drill	1899	206
E. D. Quint, Hartford	8-spindle turret vertical drill	1905	314
Hendey Machine Co., Torrington	Lathe, 14″ x 6′	1900	463
	do	1901	479
	Lathe, 14″ x 5′	1901	463
	do	1901	463
	do	1903	525
Henry G. Thompson Co., New Haven	1 hack saw (Tool No. 125)	1909	56
Whitney Manufacturing Co., Hartford	Wet tool grinder	1899	77
Bundy Time Recorder Co., Binghamton, N. Y.	Time recorders		
C. Drucklieb, New York	Sand-blast machine		
Cataract Tool and Optical Co., Buffalo	Bench lathe	1901	533

Name of maker.	Type and dimensions.	When purchased.	Price delivered in St. Petersburg.
American Gas Furnace Co., Elizabeth, N. J..	Soldering-iron oven	1900	$13
	No. 2 gas forge	1899	103
	No. 16 oven furnace	1899	103
	No. 4 oven furnace	1899	191
	Cyanide furnace	1900	77
	High-pressure blower		
Landis Tool Co., Waynesboro, Pa.	No. 2 universal grinding machine	1899	772
	No. 3a universal grinding machine.	1904	1,287
William Sellers & Co., Philadelphia	No. 1 special tool grinder	1905	1,339
American Tool Works Co., Cincinnati, Ohio..	14″ sensitive drill	1900	104
	do	1901	72
	do	1901	72
	do	1903	72
	do	1904	72
	do	1904	72
	do	1905	83
	13″ sensitive drill	1903	67
Bradford Machine Tool Co., Cincinnati	Lathes		
	Lathe 18″ x 8′	1899	476
Cincinnati Milling Machine Co., Cincinnati.	Universal tool grinder	1902	309
	do	1909	345
Cleveland Automatic Machine Co., Cleveland.	2″ full automatic	1904	1,251
	$\frac{5}{8}$″ full automatic	1905	843
	$1\frac{1}{4}$″ full automatic	1905	1,053
	$2\frac{1}{4}$″ full automatic	1905	1,369
Oster Manufacturing Co., Cleveland	4″ gas-pipe cutter and threader	1907	165
R. K. LeBlond Machine Tool Co., Cincinnati.	Lathes		
	Lathe 16″ x 6′	1899	438
Springfield Machine Tool Co., Springfield..	15″ crank shapers	1899	330
Warner & Swasey Co., Cleveland	Hexagonal turret 2″	1902	1,493
	do	1904	1,370
	No. 2 turret	1902	384
	do	1903	598
	No. 5 turret	1899	713
	do	1903	868
	do	1904	824
	No. 1 turret	1906	368
	do	1906	368
Chicago Machine Tool Co., Chicago, Ill.	Speed lathe 10″ x 4′	1902	71
	do	1903	73
	do	1905	75
Q. & C. Co., Chicago	No. 4 shop saw	1899	60
Kempsmith Manufacturing Co., Milwaukee, Wis.	No. 12 plain milling machine	1904	710
	No. 2 plain milling machine	1905	890
Greenerd Manufacturing Co	No. $3\frac{1}{2}$ arbor press	1902	51

FOREIGN TOOLS EMPLOYED.

Among the foreign machine tools in use are the following, the prices paid, including delivery in St. Petersburg: Alfred Herbert, (Limited), Coventry, England, No. 3, hexagonal turret lathe, 3-inch, purchased in 1904 for $1,805; Mekaniska Verkstad, Koping, Sweden, plain milling machine, 1902, $160; Schuchardt & Schütte, Berlin, plain milling machine, 1904, $296; Churchill & Co., Manchester, No. 3 Smith slotting machine, 1906, $779.

Aside from the American tools employed in gear cutting it was noted that all gears were cut on tools bought from Churchill, and carrying only his name. The taps and dies used in these shops are made by Lencke.

The motive power employed is a 50-horsepower gas engine of the Körting type, for which a Körting gas producer is installed. Lencke is also using a Pintsch gas producer for service in connection with the gas furnace and for the blacksmiths' forges, but the main gas furnace in use is from the American Gas Furnace Company, Elizabeth, N. J.

All of the malleable-iron castings used by Lencke in the construction of tools come from the Sestrorezk Works. This plant, Mr. Lencke declares, is the only one is Russia that can supply the quality of malleable-iron castings which Americans would regard as suitable for machine tools. Mr. Lencke further states that the Sestrorezk malleable iron is, in his opinion, better even that the ordinary run of United States malleable iron.

WAGES AND WORKMEN—AMERICAN OPPORTUNITY.

The number of men employed when working under maximum conditions is 156. The wages paid per hour are, in kopecks, as follows (100 kopecks=1 ruble=51.5 cents):

Class of workmen.	Kopecks.	Class of workmen.	Kopecks.
Lathe men	20 to 22	Foremen	35 to 40
Planer hands	20 to 22	Assembling-department hands	10 to 25
Milling-machine men	18 to 20	Vise men	10 to 12
Boring-mill hands	18 to 20	Carpenters	15 to 20
Grinding-machine men	15 to 22	Pattern makers	15 to 30

With reference to the value of the Russian workman as a machinist, Mr. Lencke states that with a little exertion plenty of men may be found who are both diligent and temperate. On the whole, he has found that the Russian is capable of learning mechanical work quicker than workmen of other nations with whom he had experience when in Chicago. He has found it possible to teach Russian workmen to work within limits which were difficult to obtain at home.

Mr. Lencke was asked to state his impressions regarding the opportunities for American machine-tool manufacturers to extend their business within Russian territory, and also if he finds it possible to obtain American machine tools with facility under present arrangements. Mr. Lencke declares it is his impression that if several American manufacturers would associate themselves and establish a selling agency at St. Petersburg or Moscow and furnish the selling agency with a large stock of different tools so that the same might be immediately delivered to the customer, a very large business could be done in Russia. As it is now, he says, Germany is much closer than America. Besides, the German shipping facilities are much better, with the result that when an order is given for a machine the German can always outclass the American on account of the long time required to bring the tool from the United States.

SINGER SEWING MACHINE WORKS.

The new Singer Sewing Machine Works at Podolsk, Russia, afford a striking object lesson of what can be accomplished in the manufacturing line in this great territory by following American methods. The works have been in existence for about eight years, and in October, 1909, were employing approximately 2,000 men. Although the rate of output is already astonishingly large, new buildings were going up so that within a few months the facilities for production will be greatly augmented.

The Russian plant of the Singer Sewing Machine Company is, in the writer's opinion, unexcelled in Europe in point of equipment and

shop efficiency. This statement is made advisedly and after having inspected several hundred of the best European shops.

UNDER AMERICAN MANAGEMENT.

Upon the occasion of a visit made at these works in October by the writer, Director W. F. Dixon acted as a personal escort and accorded every facility for an inspection. Mr. Dixon is an American citizen whose home is in Paterson, N. J. He acquired his technical mechanical knowledge in the Rogers Locomotive Works of that city, and in 1895 was sent to Russia by an American syndicate to build and equip locomotive works at Sormovo. These works are on the west bank of the Volga and are distant from Nizhni Novgorod five miles.

The American interest in these shops was subsequently sold to a Russian company. Mr. Dixon first prepared tentative designs, made at least two trips between Russia and the United States, and finally secured approval at St. Petersburg, and the shops were erected. Today the works at Sormovo are second only in importance to the Kolomna locomotive shops. Mr. Dixon stated that the entire machine-tool equipment for the Sormovo Works was dispatched to Russia in a specially chartered steamer. The point of unloading was St. Petersburg. He was in active charge of the locomotive building at the Sormovo plant when he was engaged to take charge of the new works in Russia for the Singer Sewing Machine Company.

Podolsk is a town due south of Moscow, distant about 27 miles. It lies on the through Moscow-Crimea Railway. Having been selected for the site of the new Singer plant, ground was broken in June, 1900.

The Podolsk plant is so essentially American throughout that one almost feels upon entering it that he is back in the United States. It would seem as if the Podolsk plant, as a highly efficient and complete American establishment, had been transferred bodily to the steppes of Russia. To describe the equipment of the Podolsk shops is merely to give a résumé of what the directors of all American works are accustomed to find at home. The machine tools are from the best American houses. Mr. Dixon is as much in touch with the American machine-tool trade as if the shops were located in Paterson, instead of in Podolsk.

THE BUILDINGS, WORKING FORCE, AND GENERAL EQUIPMENT.

The various buildings are constructed of steel, concrete, and brick throughout, having been erected with a view to long life, and are as nearly fireproof as possible. Iron doors are in use all over the place, and Otis freight elevators afford communication between all floors. Wooden floors exist in some of the shops, but Mr. Dixon explained that he hopes to substitute for these wooden floors a form of concrete. Fire plugs are indicated throughout the shops by red painted shingles, standing out at right angles to the walls with red lamps over them, so that they can be readily located day and night. Mr. Dixon explained that when a fire broke out some time ago, and the rooms filled with smoke, it was difficult to locate the fire plugs and hose racks. The red painted boards and red lamps are intended to meet any such contingency in the future.

The central power station comprises American-built engines of the tandem and cross-compound types, directly connected to electric

generators. The firing of the boilers is exclusively with crude oil, the cheapness of which in Russia is a strong argument in favor of the utilization of oil-motor engines. The Diesel type of engine is very much in evidence in parts of Russia, and it appears that Mr. Dixon is considering the advisability of installing internal-combustion engines in connection with further extension of the plant.

The present force of 2,000 men promises to be greatly increased within the next few years, and it need not be surprising if the number of men at Podolsk will before long be doubled. There are not at present more than seven English-speaking people at the Podolsk plant. Mr. Dixon's associates are either from England or from Scotland.

All work turned out is built to gage, and is interchangeable with the parts produced by the Singer Sewing Machine Company in the United States and the Singer plant near Glasgow. The mere statement of the fact that all parts are interchangeable between shops is sufficient to indicate that there is only one standard followed for the various Singer works. The Russian workmen at Podolsk are working to one one-thousandth part of an inch.

RUSSIAN WORKMEN UNDER AMERICAN MANAGEMENT.

It would seem as if the relations between the Singer management in Podolsk and the workmen have been exceptionally satisfactory, and Mr. Dixon has a good opinion of the Russian machinist. He declares that after learning the workings of a machine the Russian will stick to the tool and become an expert, evincing no particular desire to pass from one machine to another, as is the case with workmen of certain Continental countries. When the Russian machinist has learned his tool he becomes a most valuable man, and Mr. Dixon stated that the Russian machinist not only can, but in the case of the Podolsk shops does, work to exactly the same gage standard as in the United States. The men taken on at Podolsk have been, for the most part, young fellows. They are accorded the best of treatment and an absolute certainty of pay. The advent of the Singer shops in this district has afforded not only a livelihood for many families, but has been a source of general contentment.

Only one policeman is in evidence at the yards, and little or no occasion exists for his services. Asked if he had any trouble with strikes, Mr. Dixon said that on the occasion of the troubles throughout Russia in 1905 there was a tendency to act in sympathy, as it were, with outside movements, but the men soon returned to work and there has never been any recurrence of the sort. It is difficult for Americans who have not been in Russia to appreciate the tact and skill demanded in this territory. It would seem, however, as if a man of the type of Director Dixon is just what is needed to bring out the best in the Russian workman. Mr. Dixon is optimistic regarding Russian conditions; he believes in the Russian workman, and knows his value.

Russian law, Mr. Dixon declared, insures ample protection, and the relation of the works with various administrative officials is all that can be desired.

Having in mind the excellent work being accomplished in St. Petersburg by the Pneumatic Tool Company, an American institution, Mr. Dixon was asked if he considered the Russian territory offered opportunities to American machine-tool manufacturers to establish plants there. He pointed out the fact that practically every such establishment that had been started in recent years in Russia had either failed or engaged in some other line. Among these may be mentioned works at Kharhof, Moscow, and on the Black Sea. From what can be learned it seems that these shops did not undertake to specialize, and did not understand the term "shop efficiency," as known in America.

Facts of this sort have previously come to the attention of the writer, who had strongly suspected that much of the difficulty was due to the manufacturing methods employed. In consequence of the investigations made at the Pneumatic Tool Works in St. Petersburg, and the Singer plant in Podolsk, the writer's views have, in effect, been more or less confirmed that the trouble has not been through any lack of business, but rather with the methods employed in manufacturing. It would seem as if the constant trade in Russia is with private plants. The Pneumatic Tool Company and the Singer Sewing Machine Company appeal directly to the Russian people. The former company also has to do with government works, but in the main its business is with private works.

There is one American plant near Moscow which was erected largely through assurance of government railway orders. The recent war made it impracticable for this business to go forward, and in consequence the American company found it advisable to take on a new line of output in the shape of engines for installation plants, and it is stated that the business in this line is very satisfactory.

ESTABLISHING MACHINE-TOOL WORKS IN RUSSIA.

Mr. Dixon was asked if, in his opinion, it would be safe to indicate to American manufacturers that the establishing of works in Russia is well worth consideration. He replied, in effect, that he believes such a course fully warranted, provided judgment is exercised with reference to the type of tools manufactured for the Russian market. In Mr. Dixon's opinion there is a good market in Russia for American machine tools, and a plant erected to build some of the good solid tools, other than exact machines of the universal miller type, should do good business here. He seemed to think especially that machines of the type of the Snyder drills, or the former Woodward & Powell planers, would find an excellent outlet in Russia.

The organization of the Singer works stands as a Russian company and as such is entitled to the same treatment as other companies of the Russian Empire.

With reference to the selling of American machine tools in Russia, Mr. Dixon seems to think that American firms are making a mistake in handing the business over to foreign agents, and especially to agents who are not Russians. He also referred to the tendency of American manufacturers to take care of the foreign trade only when times are bad in America, and declared that bad treatment often drives the European to take machines of Continental make.

THE MACHINE-TOOL EQUIPMENT.

There are a number of machine tools installed here which are of the special make of the Singer Sewing Machine Company. These tools include machines for making special types of dies and for running out special work in one operation. In this list of special machines are a number of grinders of the make of the Singer company.

Among other American machine tools in service in the Podolsk works tools from the following firms were noticed: Stockbridge Machine Tool Company, Worcester, Mass.; Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass.; Woodward & Powell Planer Company, Worcester, Mass.; Brown & Sharpe Manufacturing Company, Providence, R. I.; Farrell Foundry Company, Providence, R. I.; Bullard Machine Tool Company, Bridgeport, Conn.; Pratt & Whitney Machine Tool Company, Hartford, Conn.; E. W. Bliss Company, Brooklyn.

With few exceptions all material entering into the construction of the Singer sewing machines is secured in Russia. The firm makes its own taps and dies, but with this exception buys practically all its equipment in the United States. Both the Singer works and the Pneumatic Tool Company plant are employing American methods to clean small casting. While the latter firm has recourse to sand-blast machines, the Singer works are using tumblers.

In discussing the general Russian field with Mr. Dixon, more especially as regards the market for American machine tools, he said that it should be borne in mind that the tendency in Russia is to centralize manufacturing into large works, and he cited especially plants like the Poutiloff Works, of St. Petersburg, employing 8,000 men; Kolomna Works, near Moscow, employing 8,000 men; the Nefsky Works, of St. Petersburg, employing 4,000 men, and the Sormovo locomotive shops, as built by Mr. Dixon, employing 6,000 men.

The principal manufacturing sections of Russia where machine tools would find a market are in and around St. Petersburg, Moscow, Warsaw, Odessa, the Ural country, and the Donetz mining district in the south.

J. A. SEMENOFF.

The works of J. A. Semenoff, which are located at Pesotschnaje No. 6, St. Petersburg, contain many high-grade American machine tools of medium sizes. I visited the plant on October 6, 1909, and was personally shown over the works by Mr. Semenoff and Engineer Stephen S. Gulanitzky. The latter has had experience in the United States and is quite familiar with a number of the best American shops. Mr. Semenoff visited the United States at the time of the St. Louis Exposition, and in consequence of that trip purchased many American machine tools. In the majority of cases where foreign directors have come in actual contact with American machine tools the result has been advantageous to American manufacturers.

The Semenoff shops have been in existence for about twelve years, and are wholly owned by Mr. J. A. Semenoff, who commenced business, it is stated, in a comparatively small way. About 300 men are employed at present. To judge from the busy appearance of the

shops, it was unnecessary to ask if business was good. I was assured that there was a large number of orders in hand.

PRINCIPAL OUTPUT—MODERN METHODS EMPLOYED.

The Semenoff shops are engaged largely in the manufacture of cigarette and cigarette tube making machinery. A large number of highly machined parts is demanded for such machines, and these parts the Semenoff concern is manufacturing in series. All parts are absolutely interchangeable. In addition to the foregoing, the firm undertakes to build several special machine tools, and in the list are two types of cam machines, one for working off surfaces and one for disk cams. At present the Semenoff shops turn out a special machine for boring long bearings in frames, starting both ends at once, and are also building automatic weight machines under Popoff's patent. The Semenoff plant will undertake shortly to build the Prentice type of lathe. The frames of the cam-making tools are patterned largely on Brown & Sharpe lines, but both milling and copying arrangements are claimed to be original in design.

The cigarette-making machines are built both for the Russian trade and for export, and the principal countries drawing on these machines are Austria-Hungary and Germany. Single machines have been shipped to the Azores, to South America, and to the United States.

The workmen are supplied with complete drawings for all parts, and the methods throughout the shops are patterned largely after those in vogue in the best American plants. Mr. Gulanitzki, chief of the drafting department, has introduced a principle of separate drawings for each piece, standard drawing sizes, and standard parts in machinery designed, with a classification of drawings based on the Dewey decimal classification.

In the manufacture of the cigarette-making machines the Semenoff shops use soft steel, purchased from the Crucible Steel Company of the United States. This steel, which is declared to be better than German steel, is employed for all parts under 1½ inches in size. Jigs are employed to a considerable extent, and Mr. Semenoff knows to a fractional part the cost of producing all parts of his machines.

Up to January, 1909, the Semenoff shops had turned out 1,491 cigarette and cigarette tube making machines. As a side issue they are now building a carriage for a Russian dirigible balloon. The latter is government work.

The cam-making tools have pleasing lines, possess undoubted merit, and are strong in construction. Only one size is made, and at first glance the tool might be taken for one of Brown & Sharpe's make. Mr. Semenoff states that he designed this tool because of the absence on the general market of any special machine for making guide surfaces or guide grooves on cams. Such work, he pointed out, is, as a rule, approximately made by milling machines and finished by hand. The difficulty, according to Mr. Semenoff's idea, has been to secure an equal-wearing working surface with an absence of shock, and the latter can be secured only when the roller is bearing uninterruptedly throughout its length. Notwithstanding that extensive means have been employed up to this time in cam-making work, Mr. Semenoff feels that the desired results have not been secured. In the

working of the new cam machine, the milling cutter moves in similar manner as the roller will later actuate on the cam surface. In this machine the copying arrangement on the table is combined with a special movement of the table itself, and it is found that when a new cam is completed on this tool it immediately satisfies all demands without recourse to hand finish.

Practically all taps and dies are purchased from America, although some purchases are made from Germany. The great majority of the files, however, come from England, with a few from French sources.

CHARACTER AND SOURCE OF TOOLS IN SERVICE.

There are no less than 16 lathes in service from the Prentice Brothers Company, of Worcester, Mass. It is this type of lathe which the Semenoff shops will undertake to build. Brown & Sharpe tools are very much in evidence, and there are also a number of Pratt & Whitney tools. Mr. Semenoff stated that he generally buys Brown & Sharpe and Pratt & Whitney tools direct from the manufacturers.

During the course of my inspection I observed that a German machine of recent make had been dismounted and was undergoing a general overhauling. The machine was a special lathe for cutting threads and had been purchased from a well-known German selling house. The machine had been sold to a Russian customer, by whom the tool had been turned over to the Semenoff shops in order to make the same good.

Practically all the gears cut in these works are handled on Brown & Sharpe and Gould & Eberhardt tools. However, one machine built by the Semenoff plant was turning off elliptical gears. All castings come from Russian sources.

One spindle lathe from an American firm, which had only recently entered the shops, had not yet been mounted. Another late arrival was a No. 1 universal milling machine from Brown & Sharpe. Four Gray planers are in service, and it was stated that the Semenoff shops would like to secure another planer of this make. In addition, there is one new Prentice lathe that has just come in. It is apparent that Mr. Semenoff is purchasing machine tools right along. The Semenoff shops are employing many cutters of their own make, and these are made from steel supplied by the Crucible Steel Company. Brown & Sharpe cutters are also used.

The motor power for drive in the shops is supplied by a Diesel motor engine of 75 horsepower, built by the Nobel Works, of St. Petersburg. Many of these Diesel motors are in use in northern Europe, and especially in Scandinavia.

The Semenoff shops are housed in a handsome, modern structure, fitted with more conveniences than one is accustomed to find in European establishments. The elevators were supplied by the Lemerick Works, of St. Petersburg, and are of a type familiar in many American machinery works.

PRICES PAID FOR AMERICAN AND FOREIGN TOOLS.

In the following table is given a list of the American tools in service in the Semenoff shops. The type and dimensions of the tools,

the date of purchase, and the price paid for each delivered in St. Petersburg are given in cases where such data were available.

Name of maker.	Type and dimensions.	When purchased.	Price.
Millers Falls Co., Millers Falls, Mass.	Cold-saw machine		
Fitchburg Machine Tool Co., Fitchburg	Spindle lathe		
Prentice Bros. Co., Worcester	11 lathes, 6 x 30″	1894–1906	$305
Do	Lathe 7½ x 38″	1900	650
Do	11 lathes 6 x 48″	1895–1906	450
Morse Twist Drill and Machine Co., New Bedford.	Twist drills		
Faneuil Watch Tool Co., Boston	Grinder for interior work	1905	575
Brown & Sharpe Manufacturing Co., Providence, R. I.	No. 00 milling machine	1904	250
Do	9 No. 0 milling machines	1902–1907	450
Do	2 No. 2 milling machines	1904	800
Do	No. 2a universal milling machine	1904	1,100
Do	No. 2b milling machine	1903	750
Do	No. 3 milling machine	1904	900
Do	Gear-cutting machine	1904	1,000
Do	2 No. 11 grinders	1901, 1902	625
Do	No. 3 tool grinders	1904	263
Whitney Manufacturing Co., Hartford, Conn.	2 No. 6 keyway slotting machines	1902, 1907	263
Pratt & Whitney Co., Hartford	2 No. 2 turret lathes	1901, 1902	550
Do	No. 1 turret lathe	1904	725
Do	Centering machine	1904	175
Do	Cutting-off machine	1904	500
Do	5 punch lathes		
Do	4 turret lathes		
Hendey Machine Co., Torrington	Lathe 7 x 38″	1899	487
Do	Lathe 20 x 40″	1900	850
Do	3 16-inch shapers	1894–1903	400
Seneca Falls Manufacturing Co., Seneca Falls, N. Y.	Machine, 5 x 35″	1900	300
Gould & Eberhardt, Newark, N. J	Gear cutter	1900	685
Landis Tool Co., Waynesboro, Pa	No. 1 grinder	1907	1,000
Cincinnati Milling Machine Co., Cincinnati, Ohio.	3 No. 1a machines	1900	950
Do	No. 1 machine	1900	665
Do	Tool grinder	1900	350
Do	No. 1 universal miller		
G. A. Gray Co., Cincinnati	2 planers, 8′	1901, 1904	1,150
Do	2 planers, 5′	1907	900
Lodge & Davis Machine Tool Co., Cincinnati.	Lathe, 7 x 42″	1896	275
Lodge & Shipley Machine Tool Co., Cincinnati.	Lathe, 8 x 50″	1906	600
Do	Lathe, 16″		
Sebastian Lathe Co., Cincinnati	Lathe, 7 x 36″	1896	275
Warner & Swasey Co., Cleveland	4 No. 2 machines	1906	485
Do	3 No. 1 machines	1906	317
Cleveland Twist Drill Co., Cleveland	Twist drills		
Stoever Novelty Works, Freeport, Ill	2 machines, 30″	1895	50
Gisholt Machine Co., Madison, Wis	Special tool grinder		
Hisey Machine Tool Co	Machine	1906	65
Bement Machine Co	Slotting machine	1899	725

A list of some of the foreign tools in use at the plant is given in the following table, along with the type and dimensions of the tools, the date of purchase, and the price paid for each delivered in St. Petersburg:

Name of maker.	Type and dimensions.	When purchased.	Price.
Robert Getz, Russia	Seven lathes, 7″ x 26″ and 11″ x 38″	1890–1892	$125
Do	Three lathes, 9″ x 25″	1893	200
Goldberg, St. Petersburg	Lathe	1893	188
Skavronski, St. Petersburg	do	1907	88
Tsesavrevieh Nicholas School of Trade	Three lathes	1891, 1907	113
Unknown	German lathe	1890	188
Frister & Rossman, Germany	One 6″ x 35″ lathe	1894	475
Do	Two lathes	1894	225
Do	Two 2′ lathes	1894	475
Do	Two grinders	1894	50
Do	One 8″ drill press	1895	123

Name of maker.	Type and dimensions.	When purchased.	Price.
Frister & Rossman, Germany	Two German grinders	1906	$75
Do	Four German grinders	1894–1905	38
Do	Two German milling machines	1894	650
Leipziger Werkzeugmaschinenfabrik	Lathe	1905	375
Fittler, Leipzig	do	1896	413
H. W. Ward Co., Birmingham, England	do	1906	365
Naxos-Union, Germany	Grinder	1899	60
Ludwig Loewe, Germany	Russian polishing machine	1906	75
Do	German 11″ shaping planer	1903	335
Do	German 4′ shaping planer	1907	650
Do	English 4.5′ planer	1907	700
Bernghard Fischer, Germany	One 20″ drill press	1894	288
Siemens & Halske, Germany	Drill press	1907	75
Do	German 4-spindle 27″ drill press	1899	250
Do	German 20″ drill press	1895	288
Do	German 2-spindle 30″ drill press	1904	150
Do	German radial 10″ drill press	1906	190
Do	Three Russian 3′ planers	1891–1893	250

The Semenoff Works have also built several machines for their own use, the cost of which was as follows: One milling machine for making cams, $750; two milling machines for making cams, $375 each; three grinders, $50 each.

SHOP EFFICIENCY—WAGES—OPINION OF AMERICAN TOOLS.

The Semenoff shops are keeping well up with modern practice in shopwork. I called the attention of Mr. Semenoff to the general practice in America of obtaining figures bearing on shop efficiency, and on the usual basis of calculating this he estimates their shop efficiency at about 2,000 rubles ($1,000) per man per year.

The wages paid in the Semenoff shops are as follows, per day:

Class of workmen.	Wages.	Class of workmen.	Wages.
Lathe men and planer hands	$1.75 to $2.25	Carpenters	$0.75 to $1.00
Milling-machine men	.75 to 1.13	Pattern makers	1.13 to 1.75
Grinding-machine men	.75 to 1.25	Forge men	1.00 to .....
Foremen	2.00 to 2.75		
Assembling-department and boring-mill hands, and assembling-department vise men	.75 to 2.25		

In view of the wide experience of Mr. Semenoff with regard to machine tools, and especially with regard to European conditions, I requested him to state his views as to the relative merits of American and Continental-built machines, particularly with reference to medium-sized machines for series work. He replied, in effect, as follows:

> The appearance of American machine tools on the European market has been of high importance and influence. The distinctive character is a perfect adaptability to all practical needs, both for quick manipulation and rapid and precise work. Year by year American machines are expelling German ones. A slight defect noticeable in American machines, speaking generally, is that single pieces are not often heavy and strong enough for Russian workmen, who are not always as intelligent and handy as American workmen.

Mr. Semenoff gives his personal attention to the control of the shops and spends much of his time in designing. He is essentially an engineer who believes in conducting his work after the most approved modern methods. The constant growth of his shops attests strongly to the wisdom of the policy pursued.

NETHERLANDS.

WILTON ENGINEERING AND SLIPWAY COMPANY.

The Wilton shipyards at Rotterdam were employing in November, 1909, about 1,800 men. Both night and day work were then in progress. The full name of this establishment is Wilton's Engineering and Slipway Company. This plant is one of the best known in Holland for marine repair work, but ship and engine building work is also undertaken.

The Wilton works are the exclusive property of five Wilton brothers. The eldest is Mr. Bartel Wilton. The present plant is a development from a small blacksmith shop started in 1854, in one of the side streets adjacent to the docks of Rotterdam by the late B. Wilton, father of the present owners.

GROWTH OF ESTABLISHMENT.

This shop enjoyed from the first a reputation for excellent work, and, as a natural sequence, it became necessary to enlarge the plant. Mr. Wilton added to his first business boiler making, and in the course of time entered the realm of shipbuilding. In 1875 Mr. Wilton secured a piece of land close to the river Maas and here developed a landing for steamers for general repair. At the Maas plant there were installed a boiler-fitting shop, brass foundry, pattern shop, joiner's shop, and a shipbuilding yard. From the first it was the policy of Wilton's yard to do work well and quickly, and it is said that Mr. Wilton could always be found at 6 o'clock each morning among the workmen. Two of the sons were trained in English shipyards, and Mr. Bartel Wilton has seen service at sea in the engineering department.

The present works were established about five years ago, and three weeks after the stone had been laid for the first new building Mr. B. Wilton died. The control of the plant thenceforth devolved upon his sons, and the present active head is Mr. Bartel Wilton.

This establishment appears to be especially well adapted to undertake repair work. It is provided with a marine railway capable of hauling out vessels of 5,000 tons and a dry dock capable of lifting vessels of 8,000 tons. The boiler shops permit of handling boilers of 17 feet 3 inches diameter, designed for 200 pounds steam pressure. The works are fitted up with electric traveling cranes of 40 tons' power. Hydraulic equipment is utilized for riveting, bending, and flanging plates.

Lately a forge department has been fitted up, equipped for handling general steamer repair work. Shafts 16 inches in diameter have been turned out from these works. Electric welding is resorted to

and has been found to be very economical. The system in use was developed by the Wilton brothers. So far as was learned, there are no better facilities in Rotterdam for general repairing than at Wilton's. The spirit at these works is progressive, and directors are seldom met who are more keenly alive to modern requirements than the Wilton brothers.

APPRECIATION OF AMERICAN MACHINE TOOLS.

On the subject of machine tools, Mr. Bartel Wilton declared that it is his opinion that American machine tools are, broadly speaking, preeminently in the lead. The question of price, he said, was largely a controlling element with him. In the inspection which was made of the shops, only two American machine tools were found in use, an engine lathe from the R. K. LeBlond Machine Tool Company, of Cincinnati, Ohio, and a small grinder from the Walker Grinder Company, of Worcester, Mass. Naturally, at a shop such as Wilton's one does not expect to find many of the medium-sized machine tools, such as are required for very exacting work, as, for example, in automobile construction. At the same time Wilton's are undertaking to turn out high-class engines, and for some of this engine building they require modern tools of undoubted merit. It is in such material that the directors of Wilton's are naturally interested. There is no question that the workmanship of this plant is first-rate, and the speed is excellent. Many of the machine tools in use are of English origin. There are also some German tools in evidence. The imports of machine tools into Netherlands from Germany in 1908 amounted to 1,169,800 kilos (kilo=2.2 pounds), as compared with 1,175,000 kilos in 1907. The imports from Germany into the Dutch East Indies amounted to 1,198,000 kilos in 1907 and only 158,700 kilos in 1908.

SOURCES OF FOREIGN MACHINE-TOOL EQUIPMENT.

Fielding & Platt, of Manchester, England, have supplied flanging machines. Wm. Muir & Company, of Glasgow, Scotland, are in evidence with cutting tools. De Fries of Dusseldorf, Germany, has installed probably more tools than any other one firm. The Walker grinder was bought from De Fries. In use near it is a tool grinder of De Fries's make. Among the machines supplied by De Fries are heavy lathes, motor-driven and with chained belts for short connections; tool grinder, planers, horizontal boring machines, radial drills, and millers. It is said that these De Fries tools are manufactured at the Dusseldorf shops. The De Fries radial drills are cutting steel of English manufacture.

Ernst Schiess, of Dusseldorf, has supplied punches and shearing machines, and Fielding & Platt hydraulic riveters. D. New, of London, and Thomas Shanks, of Johnstone, Scotland, supplied plate-edge planing machines, and Droop & Rein, of Bielefeld, Germany, have supplied slotters. Additional slotters have been secured from Eastbrook & Allgarde, of Sheffield, England. In addition to the above equipment there are a number of English lathes in service.

Other tools in use are cold saw machines from Noble & Lund (Limited), of Newcastle; lathes from F. &. J. Butterfield & Co.

(Limited), Keighley, near Leeds, England; and wood-working machines from A. H. Schütte, of Cologne. Transportable electric drills are in service for boiler and ship work. Pneumatic tools are used in the docks and slipways and in the shops.

RAW MATERIAL IMPORTED—PRICES PAID FOR MACHINE TOOLS.

Most of the steel that is worked up into equipment here is of Siemens-Martin quality, and is obtained for the most part from Germany. It is the practice at the Wilton yards to buy blooms direct from Germany. In working up forgings, however, about 80 per cent of scrap iron is utilized for shafts, etc. In common with other Dutch plants, the Wiltons find it necessary to import all raw material, and this material is secured partly in Germany and partly in England, but the greater part comes from Germany, inasmuch as it is cheaper. The German material is delivered at the yard by canal boats.

The coal used comes from the Westphalian mines and from the English east coast, and costs about $3 per ton. It is declared, however, that much of the German coal is found to be more economical than British east coast coal.

The following-named prices were paid in recent years by the Wiltons for the machine tools mentioned:

Name of makers.	Type of tools.	When purchased.	Price delivered in Rotterdam.
De Fries & Co., Dusseldorf	5′ planing machine	1909	$3,618
Do	Double-bed shafting lathe	1909	8,040
Do	Radial drilling machine	1908	2,010
Do	12″ center spindle lathe	1909	884
Walker Grinder Company, Worcester, Mass.	Grinding machine	1909	1,005
LeBlond Machine Tool Co., Cincinnati, Ohio.	.....do	1909	302
Noble & Lund, Newcastle, England	Band-sawing machine	1905	1,005
Thomas Shanks, Johnstone, Scotland	18′ plate edge planing machine	1909	2,110
James Bennie	Mast plate bending machine	1909	2,010
Rushworth Co., Sowerby-Bridge, England	Beam-bending, horizontal punching, angle-cutting machine.	1909	965

SHOP EFFICIENCY—WAGES PAID.

The Wilton works are keeping up with the most modern practice in shop works. In view of this fact the attention of Messrs. Wilton was called to the general practice in America of obtaining figures bearing on shop efficiency. On this basis Messrs. Wilton estimate their shop efficiency at $844.20 per man per year.

Lathe men and planer hands receive 10 cents per hour; foremen, 32 cents; and molders, 9 cents.

One is impressed at the Wilton shops with the great amount of personal attention that is given to the control of the shops. Mr. Bartel Wilton actually lives within the works, having recently built a home for himself within the confines of the yards. All of the brothers have been educated with a direct view to participation in the business. Two of them are essentially engineers; a third is charged

with traveling for the firm, and two others undertake the supervision of the commercial branch.

The constant growth of the Wilton yards attests strongly the excellence of their work, and this development is in itself the firm's strongest recommendation.

SMULDERS SHIPBUILDING AND ENGINEERING WORKS.

The Smulders yards at Schiedam, just outside of Rotterdam, were working at the time of my visit (November, 1909) about 800 men. The full name and address of this plant is Werf Gusto, Firma A. F. Smulders, Schiedam-Rotterdam, Holland. Mr. F. Smulders, one of the partners, accorded the writer every facility for inspecting the shops.

The Smulders plant was located at Schiedam about five years ago, but the firm has a history extending over a period of nearly fifty years, starting originally as a small works in Bois-le-Duc, under the direction of the late A. F. Smulders. The firm originally undertook the repair of steam engines and the construction of small mechanical equipment. After eight years' existence in Bois-le-Duc the establishment, owing to its increase in importance, was transferred to Utrecht, where it was known for years under the name of the Utrecht Iron Foundry and Engine Works.

Shortly after locating in Utrecht, the Smulders undertook to manufacture dredging apparatus for shore work, and later constructed dredges for harbor and river work. It was realized that the firm labored under a disadvantage in not having a shipbuilding plant in connection with the Utrecht work, and in consequence of the increase in the dredging business, the firm bought out the yard known as the Industry, situated in Slikkerveer. A short time previous the boiler works of Rensan & Co., at Grace-Berleur, near Liege, had been purchased by Messrs. Smulders.

ESTABLISHMENT AND EXTENT OF NEW PLANT—MODERN EQUIPMENT.

It will be seen that the firm possessed boiler shops, shipyards, and engine works, all in separate localities. A natural disadvantage arose owing to the separation of the different departments, and in consequence it was decided to center all at one point. With this object in view the Smulders secured ground on the river Maas, at Schiedam, and in 1903 commenced the erection of the present works.

The area covered by the Smulders plant at Schiedam embraces 60,000 square meters (1 square meter = 1.196 square yards). The yards are in the form of an irregular quadrangle, and are bordered by the river Nieuwe Maas and the Eastern Harbor. The shipbuilding slips have been built along the western side of the yard and are all constructed on piles. The outermost of these slips has a breadth of 15 meters (1 meter = 1.09 yards), and can be enlarged to a length of 180 meters; the other slips have breadths of 10 meters. All slips are situated in such a manner that vessels can be launched directly into the river Maas, with 9 meters depth of water available at the launching point.

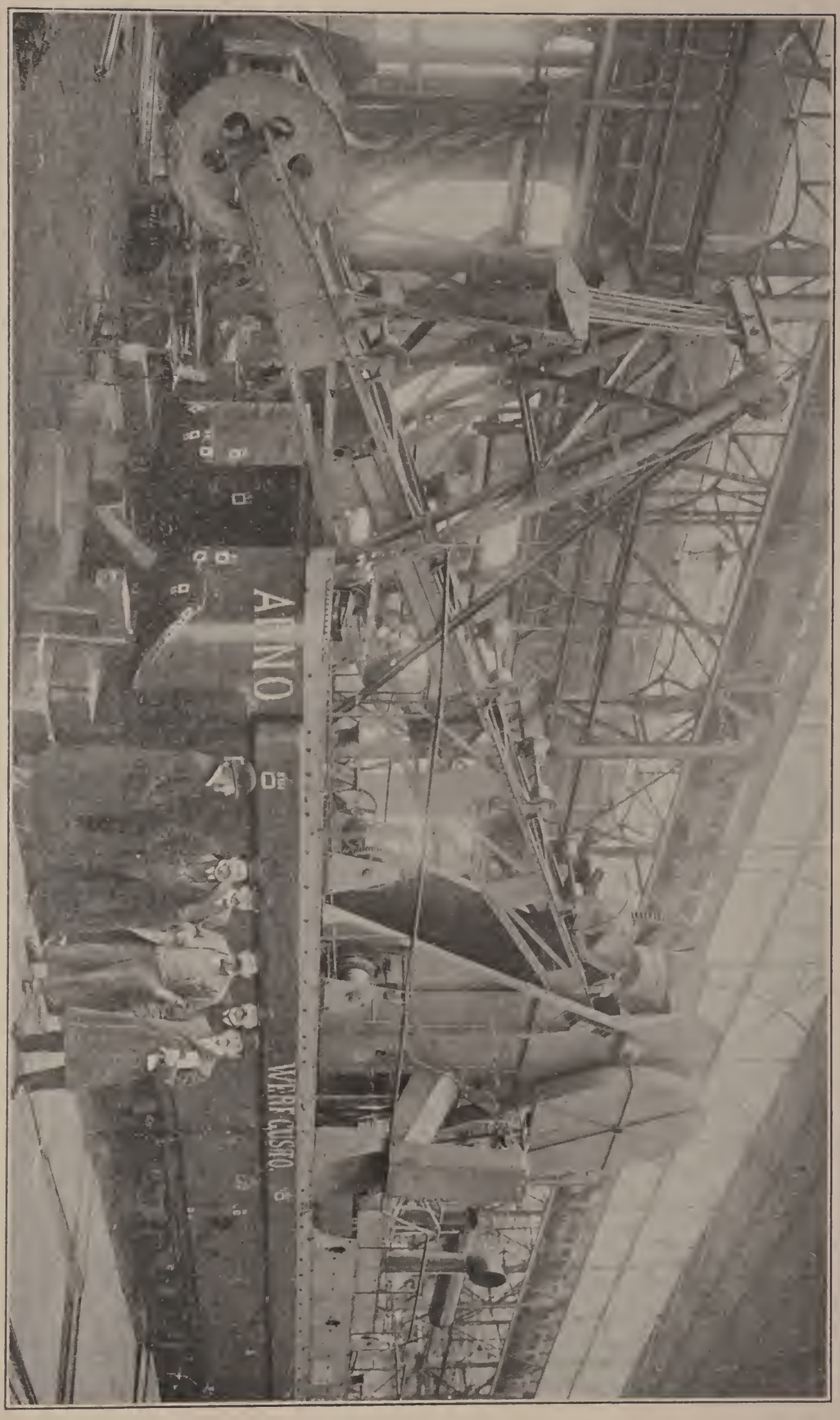

FIG. 24.—Interior view of shipbuilding hall, Smulders Works.

Seldom has the writer found works built with more regard to pleasing effect and to the comfort of the workmen than the new Smulders shops. The buildings are not only substantial in construction, but in many particulars may be described as ornate. The most modern appliances have been utilized to insure the comfort of the men and good sanitation. The blast system for the furnaces and the heating throughout is after the system of the Buffalo Forge Campany, of Buffalo, N. Y.

There are two main buildings at the Smulders yards devoted to machine work, and the machine-tool installation is necessarily found in these structures. Each of these main buildings is 140 meters long and 52 meters wide. The main office building is 30 meters long. Each of the main buildings is divided into three sections; in other words, a center building with two bays. The central hall has a breadth of 25 meters, and the width of each bay is 13½ meters. These buildings are all fitted with electric traveling cranes and connected with railways.

ELECTRIC POWER AND LIGHTING—APPRECIATION OF AMERICAN TOOLS.

The power plant is equipped with two direct-connected engines, each having an output of 168 kilowatts, and also 250-kilowatt dynamos. Vertical compound engines, two of 350 and one of 250 indicated horsepower, drive these dynamos. Foundations have been built for new engines, which it is expected will be required later. The current supplied from this station is 440 volts, and for lighting purposes this is divided into 2 by 220 volts.

In the eastern building there are five driving shafts each fitted separately and driven by its own motor. These shafts supply the power to the various machine tools. There are five electric traveling cranes in service in the east building, two of 15 tons and three of 5 tons lifting capacity.

The machine-tool installation comprises many American tools of high grade. There is the usual proportion of less recent English and Belgian tools and a small number of German tools, but Mr. Smulders, in speaking with the writer on the subject of American and foreign machines, said that the only objection he had to American machine tools was the price.

Mr. Smulders was asked to make some statement based on his experience with American and Continental tools, especially in reference to any defects apparent to him in American types, and having in view Continental needs. He has kindly made the following memorandum regarding his general view of American machine tools:

> I consider American machine tools very suitable, generally. They are well designed, and in the hands of a skillful machinist and with proper tools they turn out a good deal of work, especially when quantities of the same pattern are to be produced. As a rule, however, they are not worked to their utmost capacity, the speed being kept too low.
>
> An inconvenience is caused by the long and somewhat uncertain term of delivery, so that, as a rule, we are compelled to take a machine which happens to be in stock at one of the agencies. Another difficulty is experienced in obtaining spare parts; these are seldom to be found in stock at this end and consequently we have to pay very high, and, in some cases, prohibitive prices.

CHARACTER OF OUTPUT—COALING VESSELS A SPECIALTY.

The work carried on in the Smulders yards is confined largely to the building of steam, seagoing dredges; tugboats; gravel and bog dredges; coal-mining dredges; hopper and suction dredges; elevators, either fixed or floating, with single or double bucket chain; electrically driven elevators; coal elevators; steam hoppers; universal barges; excavators for canal and railway cutting; excavators for removing mounds; tugboats combined with suction and force pump; steamers of different degrees of horsepower; floating docks of the self-docking type, with independent pont tool, or of other systems; cranes, fixed and floating; patented coaling vessels; and steam pile-driving installations.

There are hardly any important government undertakings to which the Smulders plant has not contributed in recent years excavating equipment, including the Panama Canal. This firm has exported material to Russia, Belgium, Italy, Denmark, Portugal, Brazil, Chile, Uruguay, Tunis, Argentina, Siam, and China. It is doubtful if there are other firms in existence in Europe with a more extensive and varied knowledge regarding dredging and excavating work than the Smulders concern.

The Smulders firm is making a specialty of building coaling vessels. These vessels are self-propelling and have a hold which is divided into compartments by means of transverse bulkheads. One of these harbor coaling vessels has a capacity of 1,000 tons. By means of sliding doors the coal compartments empty themselves successively into buckets of the conveyor, which runs in a tunnel over the vessel's keel. The end of this conveyor, or bucket chain, is driven up by one of the two engines, which also propel the twin screws. Before reaching the upward bend, to pass on to the latter, elevator fashion, they run over an automatic weighing machine, and the coal is automatically weighed throughout the operation. The coal is hoisted, elevator fashion, and is delivered to the bunkers through a telescopic chute. As it is possible to make the chute as long as required, bunkering can be effected from a rather great distance. It is even possible to bunker the offside bunker ports or a steamer in a floating dock. It is stated that there is an output from these coaling vessels of over 250 tons of coal per hour. One great advantage secured is that the coal is not exposed to the air while passing from the lighter to the bunkers, and there is thus obviated the usual accompaniment of dust and dirt.

One of these coaling vessels was at work at the time of my visit, on the opposite side of the harbor. Mr. Smulders had just returned from an inspection, and was apparently very much pleased with the service.

CHARACTER AND PRICES OF AMERICAN MACHINE TOOLS.

In the eastern building the principal machine tools in service comprise 54 turning lathes, of which 8 are turning and boring lathes, 25 planing and mortising lathes, 3 heavy cylinder-boring lathes, 6 milling machines, and 15 boring machines.

The following-named American machine tools were observed in service, the prices wherever indicated being those which Messrs. Smulders stated to the writer were paid for the respective tools:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Rotterdam.
Jones & Lamson Machine Co., Springfield, Vt.	3 turret lathes		
	2″ turret lathe	1902	$1,387
	do	1903	1,093
Browne & Sharpe Manufacturing Co., Providence, R. I.	No. 24 miller		
Bullard Machine Tool Co., Bridgeport, Conn.	Horizontal turning and boring mill.		
Do	Turret lathe	1906	1,246
Niles-Bement-Pond Co., New York, N. Y.	5′ radial drill	1905	663
Buffalo Forge Co., Buffalo	Blower fans and exhausters		
Landis Tool Co., Waynesboro, Pa	Plain grinder, No. 28	1905	2,734
Do	Universal grinder, No. 4	1905	1,075
Cleveland Automatic Co , Cleveland, Ohio	1¾″ automatic lathe	1906	1,126
Cincinnati Tool Works, Cincinnati	1 lathe	1906	583
Dreses, Muller & Co., Cincinnati	4′ radial drill	1905	941
Dreses Machine Tool Co., Cincinnati	2 radial drills		
Lodge & Shipley Machine Tool Co., Cincinnati.	6 lathes, 14″ swing	1906	400
American Tool Works Co., Cincinnati	Lathe		
Niles Tool Works, Hamilton	Horizontal turning and boring mill.		
Chicago Pneumatic Tool Co., Chicago, Ill.	Boyer drills		
W. F. & J. Barnes Co., Rockford	4 vertical drills		

Men at the Jones & Lamson machine tools are earning, it was said, about $5.34 per week.

The Brown & Sharpe tool was spoken of very highly. The Dreses radial drill is well liked, and was referred to as a very handy tool. Ingersoll-Sergeant engines are employed. There are many shapers in use in these shops without any names showing. The tools appear to be of Belgian origin.

Much of the steel worked up here, in connection especially with dredge hoppers, is of fluid steel.

FOREIGN TOOLS—SHOP HOURS AND WAGES.

Among the foreign tools in use the following were observed:

Billeter & Klunz A. G., of Aschersleben, Germany, power hammers controlled by foot; De Bergue Company, Manchester, multiple punch; J. Whitworth & Co., Manchester, punch; J. Bennie & Sons, Glasgow, punches; G. Muir & Co., Glasgow, lathes; Fetu-Defize, Liege, slotters; G. & A. Harvey, Glasgow, horizontal borers; Zimmermann, Chemnitz, horizontal borers; J. Deneffe, Liege, vertical millers; J. E. Reinecker, Chemnitz, hob machines.

English boring and lathe tools are in service and the Deutsche-Niles Werke have supplied several boring machines. The Smulders cut all teeth on hob machines from Reinecker, of Chemnitz.

A week's work at the Smulders plant comprises approximately 62 hours. The shop opens at 6 in the morning; there is an interval from 8 until 8.30, and an interval from 12 to 1; at 4 o'clock there is a third interval for 30 minutes, and the shops close at 7, except on Saturday, when work stops at 4 p. m.

The weekly wages paid in the Smulders Works are as follows (florin=40.2 cents):

Class of workmen.	Florins.	Class of workmen.	Florins.
Lathe men	14 to 18	Assembling-department hands	16 to 20
Planer hands	14 to 16	Vise men, assembling department	16 to 18
Milling-machine men	14 to 17	Molders	14 to 16
Boring-mill hands	12 to 16	Carpenters	14 to 18
Grinding-machine men	12 to 16	Pattern makers	14 to 18
Foremen	[a] 25 to 30	Forge men	15 to 20

[a] Plus extras.

FIJENOORD SHIP AND ENGINE BUILDING WORKS.

The Fijenoord shipyards of Rotterdam had 1,500 men at work in November, 1909, when the writer was granted by Mr. P. J. Biesta, of the administration department, the privilege of an inspection. All departments of this establishment were busy, but no occasion existed for night work. This is one of the best establishments of its kind in Netherlands. The machine-tool installation comprises many American tools of standard types; the character of the output is high, and there is a progressive spirit dominating all parts of the works. The full name and address is: Maatschappij voor Scheeps en Werktuigbouw Fijenoord, Feyenoorddyk 80, Rotterdam.

The firm is doing practically all the work required for shipbuilding. This includes not only hull work, but engines and boilers, propellers, shafting, and numerous small parts, outside of special articles. Broadly speaking, these works engage in the building and repairing of ships and in the making of engines for power installations. Several vessels, including torpedo boats, have been built at this yard for the Dutch navy. Boilers are also built, and there were at the time of the visit a number of orders on hand for heavy Scotch boilers, and for sugar machinery. No pneumatic tools were observed in service in connection with boiler work.

THE EQUIPMENT, BUILDINGS, AND GROWTH OF FIRM.

In the power station attention was attracted by three beautiful high-speed engines recently received from Belliss & Morcom, of Birmingham, England. These engines are self-lubricating and with direct connection. The Fijenoord firm is able, with its excellent foundry equipment, to cast practically all parts required for ship work.

The main erecting shop in this plant is a fine building measuring 230 by 130 feet. It is iron framed throughout and well lighted. There is a main bay, with two large side bays, and with still a fourth bay running at right angles to the building proper. This last bay is equipped in the manner of the main erecting shop. Overhead traveling cranes serve all parts of the building. It is noteworthy that in the erecting shops plenty of room is afforded. The flooring is of brick placed on edge. There appeared to be, however, some unevenness in spots, but it is assumed that these bricks can be as readily removed as in the case of block flooring.

The Fijenoord company has been in existence for eighty-six years. It is a limited company, and was founded under the auspices of King

William I, in 1823, principally as a steamship company to introduce steam navigation into Netherlands. In the course of years the various steamship lines were abandoned and the company is now concerned exclusively with shipbuilding and engineering.

At the time of the inspection the firm was engaged in building a large steamer for the Dutch East India service. The principal dimensions of this ship are, in feet: Length, 323; breadth, 44½; depth, 25. Still other work in hand in November, 1909, comprised two passenger steamers for Java, a steamer for hydrographic service, a light-ship, and various engines for other shipbuilders and for sugar

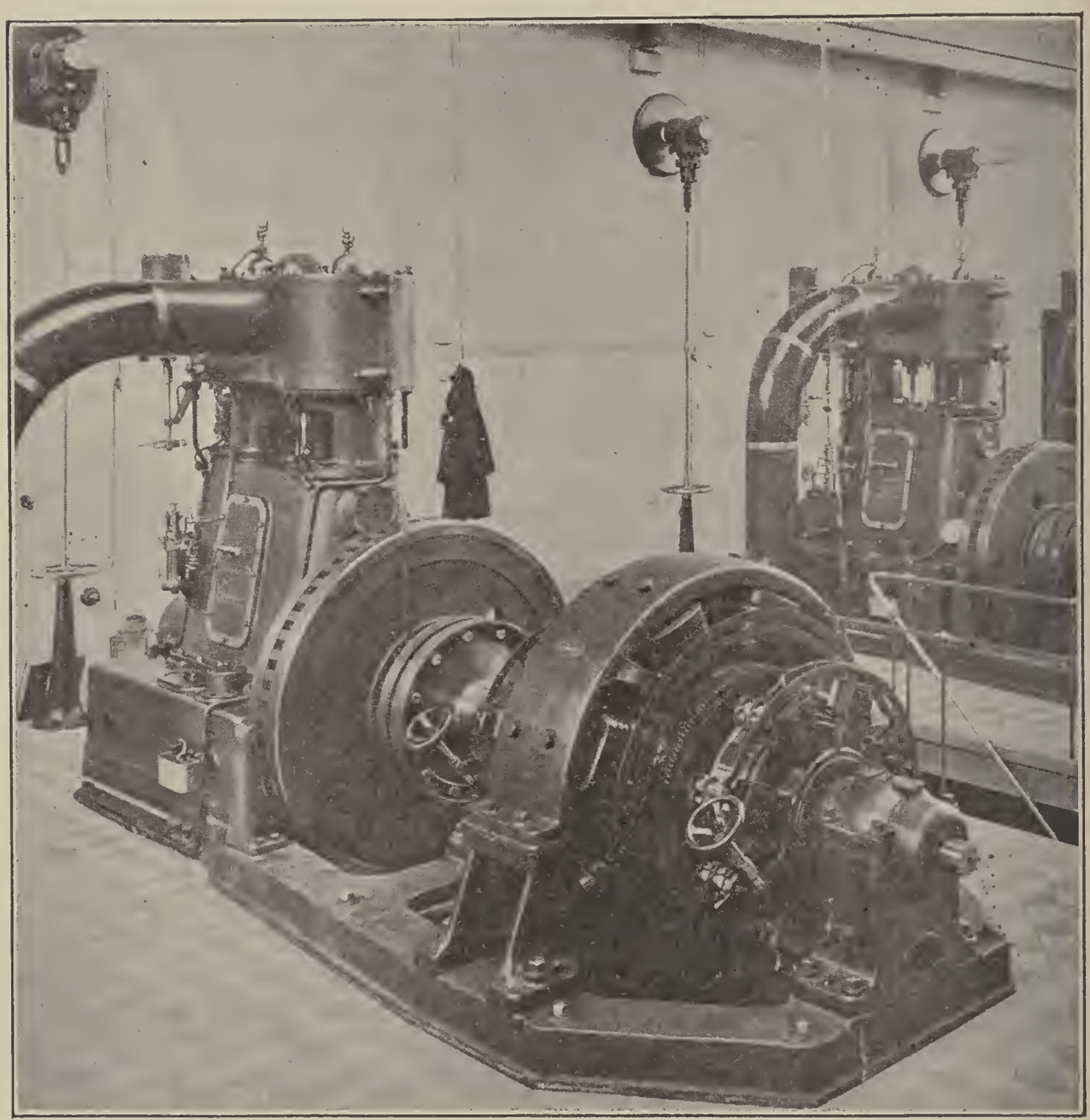

FIG. 25.—Belliss & Morcom engines in Fijenoord power plant, Rotterdam.

machinery, etc. Most of the raw material required is drawn from Germany. It was stated that coal from Germany was being offered at the time of the visit at $2.82 per ton, delivered in lighters at the yards.

AMERICAN MACHINE TOOLS IN EVIDENCE.

The machine-tool installation of this plant is, on the whole, fully in keeping with an establishment of high character. There are a number of English tools, but there is a far larger proportion of American tools in use than had been previously observed in Dutch

shops. Among the American tools are several Jones & Lamson turret lathes. One of these machines has been in service for thirteen years, and the statement was made that it works to-day with the same exactitude as when first purchased. A new and larger Jones & Lamson machine was purchased last year on the strength of the showing made by the original tool.

De Fries, of Dusseldorf, has furnished several tools, and this firm is catering largely to the trade in Netherlands. The tools supplied by De Fries are mostly lathes. Fetu-Defize, of Liege, has also furnished a number of lathes.

The American machine tools in service include the following:

Jones & Lamson Machine Co., Springfield, Vt.—Turret lathes.
P. Blaisdell & Co., Worcester, Mass.—Lathes.
Bath Grinder Co., Fitchburg.—Grinder.
F. E. Reed Co., Worcester.—Large lathes.
Fosdick Machine Tool Co., Cincinnati, Ohio.—Radial drills.
Lodge & Shipley Machine Tool Co., Cincinnati.—Lathes.
John Steptoe Shaper Co., Cincinnati.—Shapers.
Smith & Mills, Cincinnati.—Shapers.
Rahn-Mayer-Carpenter Co., Cincinnati.—Lathes.
Cincinnati Planer Co., Cincinnati.—Planers.
Dreses, Muller & Co., Cincinnati.—Radial drills.
Gisholt Machine Co., Madison, Wis.—Grinder.

FOREIGN-MADE TOOLS—AMERICAN AND FOREIGN TOOLS COMPARED.

Among the foreign machine tools in evidence are the following:

Fetu-Defize, Liege, long-bedded heavy lathe and lathes; Thomas Shanks & Co., Johnstone, Scotland, heavy turning lathe, long-bedded lathe, and heavy slotter; De Fries & Co., Dusseldorf, engine lathes, pit lathes, and long-bedded heavy lathe; Deutsche-Niles Werke, Oberschoneweide, lathes; Kendall & Gent, Manchester, cylinder borers, 2 threading machines, 3 small lathes, and radial drill No. 3293; Breuer, Schumacher & Co., Kalk, planer; G. & A. Harvey, Glasgow, horizontal borer; Wagner & Co., Dortmund, cylinder borer No. 3674, heavy planer No. 3675, and 2 small lathes; Goddard & Massey, riveters; Hulse & Co., Manchester, heavy slotter; Maclea & March, Leeds, crank shaper.

In view of the wide experience of the Fijenoord firm in regard to machine tools, and especially with reference to European conditions, a statement was requested as to the relative merits of American and Continental machine tools, especially with regard to the medium-sized machines. The reply was as follows: "In general we find American tools best for light work on account of their good design and handiness. We have had no experience with the heavier American tools and have hitherto bought machines of this sort in Germany, Great Britain, and Belgium."

WORKMEN'S WAGES.

The wages paid at the Fijenoord yards are as follows per hour:

Class of workmen.	Cents.	Class of workmen.	Cents.
Lathe men	5 to 11	Assembling-department hands	10 to 11
Planer hands	10 to 10½	Vise men, assembling department	11
Milling-machine men	11	Molders	8 to 10
Boring-mill hands	9	Carpenters	10
Grinding-machine men	9	Pattern makers	8 to 11
Foremen	16	Forge men	6 to 11

The Fijenoord plant is a credit not only to the city of Rotterdam but to the country of Netherlands, and the work turned out reflects the greatest credit on the engineers and directors in charge.

NEDERLANDSCHE WORKS.

There is no more important engineering plant in Netherlands than the Nederlandsche Fabriek van Werktuigen en Spoorwegmaterieel. The establishment is located in the environs of Amsterdam. A visit was made to these works in November, 1909, when General Director J. Muysken accorded every facility for an inspection of the shops and personally escorted the writer over the plant.

There need be no hesitancy in saying that the Nederlandsche Works rank among the very best of the engineering plants on the Continent of Europe. The character of the output is extremely high, and every attention and care is bestowed on the work. At the time of the visit the number of men employed approximated 2,000.

NATURE OF OUTPUT—LOCOMOTIVE BUILDING IMPORTANT.

The output consists for the most part of steam engines, Diesel engines, machinery for cane and beet-sugar factories, steam boilers, locomotives, and rolling stock for railways and tramways.

The construction of locomotives has become in recent years also an important feature of the establishment. Until within a comparatively few years the Dutch railways had drawn largely on English plants for locomotives and tenders. Beyer, Peacock & Co., of Manchester, have furnished for many years locomotives for Netherlands. Years ago, however, German locomotive builders also began exporting to Netherlands. It was with the object of furnishing the Dutch railways with homemade locomotives that locomotive work was inaugurated at the Amsterdam plant. Director Muysken states that to-day his works are quite able to underbid the English locomotive builders, but that their strongest competition is with the Germans, who, to use the actual language of the Dutch manager, "often export under cost price."

The locomotive building here is mostly on the plate-frame form, and the types of locomotives built embrace the following: Express locomotives with two coupled axles; freight engines with three coupled axles; and shunting engines. Of late years many of the locomotives built here use superheated steam (Schmidt's superheaters). The manager states that locomotives with inside cylinders are as a rule preferred by the companies. The finishing on the engines is generally of a very high standard, and is in accordance with the rules laid down by the railway companies.

At the time of the visit the work in progress was largely confined to steam engines and Diesel motors in addition to locomotives. The shop makes Diesel engines up to 1,000 horsepower, but the majority of the engines turned out are between 50 and 600 horsepower. The firm has built a Diesel engine for marine purposes, which, it is stated, is installed on a schooner plying between Scandinavian and ports of Netherlands.

A shipyard with which this company is connected adjoins the engineering yards proper, and ships have been turned out from here, which are now operating in the Dutch East Indies, with engines up to 5,000 horsepower.

EXTENSIVE AMERICAN MACHINE-TOOL OUTFIT.

The machine-tool installation in this establishment is one of the best the writer has seen in Netherlands. Among the American machine tools at work are some of the very best types produced in the United States. The following-named firms and machines are included:

Mark Flather Planer Co., Nashua, N. H.—Lathes and shapers.
Jones & Lamson Machine Co., Springfield, Vt.—Turret lathes.
Baush Machine Tool Co., Springfield, Mass.—Radial drill.
Becker Milling Machine Co., Hyde Park, Mass.—Vertical drill.
F. E. Reed Company, Worcester—Lathes.
William Powell Planer Co., Worcester—Planers.
Bullard Machine Tool Co., Bridgeport, Conn.—Vertical turret lathes, boring mill.
Pratt & Whitney Co., Hartford—Turret lathes.
Gould & Eberhardt, Newark, N. J.—Gear cutters.
Pond Machine Tool Co., Plainfield—Boring mill.
Landis Tool Co., Waynesboro, Pa.—Grinders.
Pedrick & Ayer Co., Philadelphia—Millers.
William Sellers & Co., Philadelphia—Lathes, planers, and grinders.
American Tool Works Co., Cincinnati, Ohio.—Lathes and planers.
Baker Bros., Toledo—Drills.
Bickford Drill and Tool Co., Cincinnati—Radial drills.
Cincinnati Shaper Co., Cincinnati—Shapers.
Davis & Egan Co., Cincinnati—Lathes.
G. A. Gray Co., Cincinnati—Planers.
Lodge & Shipley Machine Tool Co., Cincinnati.—Lathes.
R. K. LeBlond Machine Tool Co., Cincinnati.—Lathes.
Schumacher & Boye, Cincinnati—Lathe.
Springfield Machine Tool Co., Springfield.—Lathe.
Smith & Mills, Cincinnati—Shapers.
Ingersoll Milling Machine Co., Rockford, Ill.—Slab miller.
Kearney & Trecker, Milwaukee, Wis.—Miller.

APPRECIATION OF AMERICAN TOOLS.

The Kearney & Trecker miller is referred to as being a most satisfactory machine. The writer has repeatedly referred to the Kearney & Trecker millers as eliciting marked approval on the part of manufacturers in Europe who have had an opportunity either to study or to see this machine. He is forced to the conclusion, from the voluntary expressions of opinion offered on the part of many directors, that the Kearney & Trecker machines greatly appeal to European dealers. This firm might with advantage pay special attention to European territory. A Landis grinder was observed grinding down pistons for Diesel engines. These Landis machines appear to be very well liked.

One of the oldest American tools in the shops is a planer from Wm. Sellers & Co., which was installed as long ago as 1867. When working, the frame moves, and not the bed. Still another machine, a lathe, was also obtained in 1867 from the Sellers firm. These tools, it is declared, are still doing fine work, and it was stated that the old Sellers lathe will cut screws up to 6-inch pitch, something which it was found difficult to do with other machines in the shop.

One of the Lodge & Shipley lathes in service is probably the largest size made by the firm. The miller from the Ingersoll Milling Machine Company, was working at the time at milling locomotive engine

connecting rods. Director Muysken said that he was very much satisfied with the Ingersoll machine and would, in fact, some day buy a second one.

The machinery department is equipped throughout with traveling cranes.

PRICES PAID FOR AMERICAN TOOLS.

The directors of the shops state that the prices paid for American machine tools during the last few years have been as follows:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Amsterdam.
Mark Flather Planer Co	Shaping machine, 14″	1907	$287
Do	Shaping machine, 16″	1908	458
Jones & Lamson Machine Co	Harkness turret lathe, 2¼″ x 24″	1907	1,491
Do	Harkness turret lathe, 80/200″	1908	1,849
Bullard Machine Tool Co	Standard boring and turning mill, 60″.	1908	2,549
Pratt & Whitney Co	Lathe, 1″ x 10″	1908	786
Do	Turret lathe, 1½″ x 18″	1909	1,166
Smith & Mills	Shaping machine, 20″	1907	350
Lodge & Shipley	Lathe, 22″ x 12″	1908	1,126
R. K. LeBlond Machine Tool Co	Lathe, 14″	1908	426
Do	Shaping machine, 20″ x 22″	1908	373
Do	Lathe, 16″	1908	539
Do	Lathe	1908	896
Do	Lathe, 20½″	1909	748
Do	Lathe, 17¼″	1909	1,081
Springfield Machine Tool Co	Springfield lathe, 16″	1908	563
Cincinnati Shaper Co	Cincinnati shaping machine, 26″	1908	579
Kearney & Trecker	Milwaukee milling machine, N-3 BP.	1908	1,487

FOREIGN TOOLS AND THEIR APPRECIATION.

Among the foreign tools in service are the following:

Alfred Herbert, Coventry, England, turret lathes; Pollock & Macnab, Manchester, turret lathe; Joh. Moll, Augsburg, Germany, tool for turning down crank shafts; Hartmann, Chemnitz, Germany, heavy planer; Deutsche-Niles Werke, Oberschoneweide, heavy planer, boring mill, horizontal borer; Fetu-Defize, Liege, lathe; Ludwig Loewe, Berlin, millers, lathes, shapers, vertical miller; Kendall & Gent, Manchester, milling machines; Geo. Richards & Co., Broadheath, side planers, keyway cutter; Dean, Smith & Grace, Keighley, England, lathes; Ernst Schiess, Dusseldorf, several special machines; J. Whitworth & Co., Manchester, lathe; William Asquith, Halifax, a large number of radial drills; John Lang & Sons, Johnstone, Scotland, lathes; Wagner & Co., Dortmund, Germany, lathe; H. W. Ward & Co., Birmingham, turret lathe; Gebr. Heinemann, horizontal turret lathe; Zimmermann, Chemnitz, lathe; Otto Froriep, Rheydt, multiple drills.

There are a number of Ludwig Loewe lathes from Berlin. Director Muysken says that he likes these lathes, but finds them more expensive than the general run of American lathes. The firm has just installed two new Loewe shapers. The advantage claimed for these is that the machines will make a short cut at very high speed. The Pollock & Macnab turret lathes are referred to as good tools in design and not expensive. The Dean, Smith & Grace lathes are declared the best for heavy cuts on rough work, but Director Muysken states that they are rather too heavy, and therefore too expensive for finer work.

Acetylene gas is used in cutting large engine frames. All the plate frames are milled, and for this work recourse is largely had to the heavy tools supplied by Collett & Engelhard, of Offenbach. This firm has already been referred to as having furnished the majority of heavy milling tools employed in Continental locomotive works.

ORIGIN OF RAW MATERIAL—WAGES AND HOURS.

The material used in these shops for engine and locomotive building comes, for the most part, from Germany, although some material has been obtained from England. The Witkowitz Works, of Austria, it is said, have offered of late steel shafts rough turned for 26 marks ($6.19) per ton. This is regarded as extraordinarily cheap, and the opinion seems to prevail that the price is less than the cost of production.

The coal used at these works is largely drawn from Germany, and can be delivered by canal. It has previously been noted that the prices quoted in Rotterdam during November, 1909, were approximately $2.68 per ton. In some of the Netherlands works the Westphalian coal is regarded as superior to the English east coast coal, although costing a little more, as it is said it yields more economical results.

Lathe men, planer hands, and milling-machine men in these shops are paid 9.2 to 12 cents per hour. Boring-mill hands receive from 8 to 11 cents and grinding-machine men 10.4 cents. Twelve cents an hour is the maximum wage paid the assembling-department hands and molders. Carpenters get 10.4 cents, and pattern makers and forge men 12 cents an hour.

The hours of work are from 7 a. m. to 12 noon and from 1.30 p. m. to 6 p. m., except Saturdays, when work stops at 12.30 p. m.

SCHELDE SHIPBUILDING AND ENGINEERING WORKS.

Of the various shipbuilding establishments in Netherlands there is no better than the Schelde Works, located in Flushing. A visit was made to this establishment on November 26, 1909, upon which occasion every facility was accorded for an inspection of the shops. Acknowledgments are especially due to Engineer-Manager W. H. Martin, and to his assistant, Engineer W. B. Fulton, who personally escorted the writer over the yard. At the time of the visit the number of men employed was approximately 1,600.

MERCHANT AND WAR VESSEL CONSTRUCTION.

A fine steamer, recently launched and designed for service between Netherlands and the East Indies, was lying alongside the docks. This vessel is of 5,000 dead-weight tonnage and 5,000 horsepower. She is designed for both cargo and passenger service, and is the fifteenth ship built at this yard for the company to which she belongs.

On the building slips were two torpedo destroyers in process of construction, each designed for 30 knots speed, to be fitted with engines of 8,000 horsepower. These torpedo destroyers are designed for service in the Dutch East Indies, and are probably the last vessels of the type in the Dutch service to be fitted with reciprocating en-

gines. It is understood that in all probability the Dutch authorities will utilize turbines in future ships of war.

On still another slip was observed a vessel of 5,000 dead-weight tonnage under construction. This vessel is being built on the Isherwood system of longitudinal stiffening. Mr. Martin seemed to think that there would be a saving of about 300 tons in material by reason of this longitudinal design. The frames of the boat are spaced about 12 feet apart, and are necessarily deep. The only possible disadvantage, so far as space is concerned, would appear to be a reduction in athwartship room for lumber cargo, as, owing to the deep frames, it is not possible to store lumber close out to the sides.

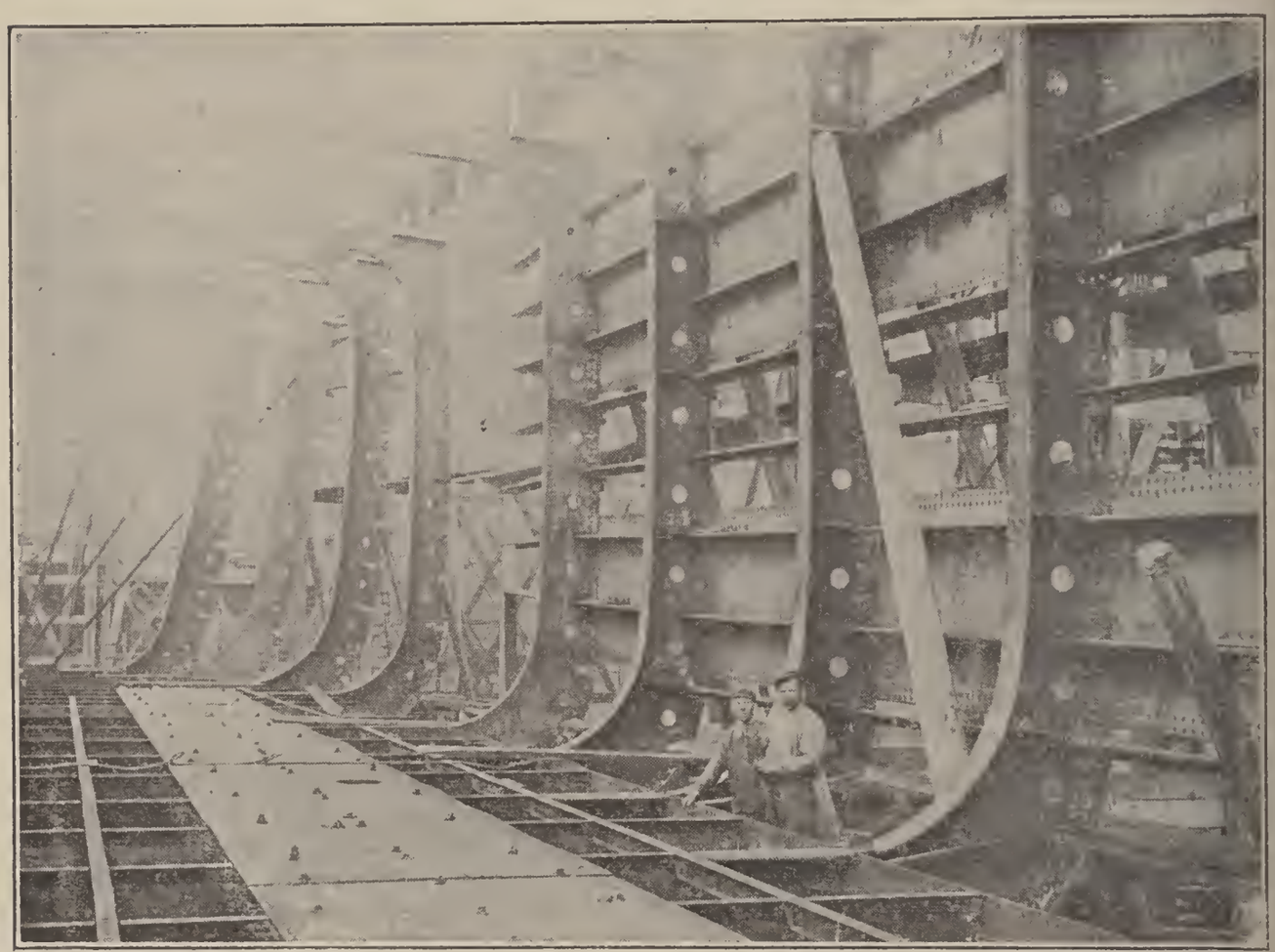

FIG. 26.—Vessel of 5,000 tons being built on the Isherwood system at the Schelde Works.

Still other navy work in progress was the building of a submarine, and the installing of Diesel engines. The engines are built at Augsburg-Nuremburg. They have eight cylinders and are chiefly of gun-metal construction.

Prominent features of the shipyard are four electric cranes of great height and radius of arm. They are placed between two slips and can cover two vessels of 500 feet length. The horizontal arm carries a trolley with lifting hook and can make a complete circle; the length of arm is 100 feet and the height of the hook in top position is also 100 feet, the center crane being 12 feet more so as to clear the others. These cranes can lift 3 tons at the extreme radius and 6 tons at 50 feet. A fourth crane of similar dimensions travels parallel to the ship's keel. Little in the line of repair work is undertaken here.

DEVELOPMENT OF FIRM—RAW MATERIAL PURCHASED ABROAD.

The Schelde Shipbuilding Works have been in existence for more than thirty-three years, and have always been recognized as one of the representative plants of Netherlands. Mr. Martin is of Scotch birth, and has been identified with the plant since its establishment. The visitor early gains the impression that the methods in vogue here are strictly in keeping with the most modern practice along the Clyde. The entire spirit of the works is essentially progressive, and the writer was impressed with the readiness of the management here to avail itself of the most up-to-date and latest appliances, regardless of origin.

The Schelde shipbuilding establishment is a limited company, and the capital is practically all Dutch, and including debentures is ap-

FIG. 27.—Shipyard cranes in the Schelde Works.

proximately $973,300. It was stated that the yards have enjoyed plenty of work during the past few years, notwithstanding the general depression in other sections of Europe.

The raw material used here comes from Germany and England; most of it, however, from Germany. This is in consequence of the lower prices of German steel plants. The shafting and forged-steel parts, for example, are generally received in the rough and are finished up at the Schelde plant.

The crank shafts required, it was said, are practically all bought in Germany. Haniel & Lueg, of Dusseldorf, and the Oberbilk Works supply most of these crank shafts. All of the propellers going on the new ships are of the built-up type and are made of Stone-Martin bronze. Mr. Martin, of this combination, is the en-

gineering manager of the Schelde yards. It struck one as novel to see large bronze blades cast hollow from the root to about halfway up the blade, to prevent the gradual breaking action which often takes place.

IMPORTANT BOILER CONSTRUCTION—MACHINE TOOLS.

It is seldom that better boiler work is to be seen. Particular attention was attracted to several boilers under construction which weighed more than 40 tons each. The Schelde yards have recently turned out 80-ton boilers. These generators were, of course, double ended. The boilers were fitted with Howden's draft system, which is employed in at least one-half of the boilers turned out here.

The Schelde yards make a specialty of building Yarrow tubular boilers, and it is claimed that these can be built cheaper at Flushing than at Yarrow's own yards on the Clyde. The Yarrow boiler built in the Schelde shops is more properly described as a modified Yarrow,

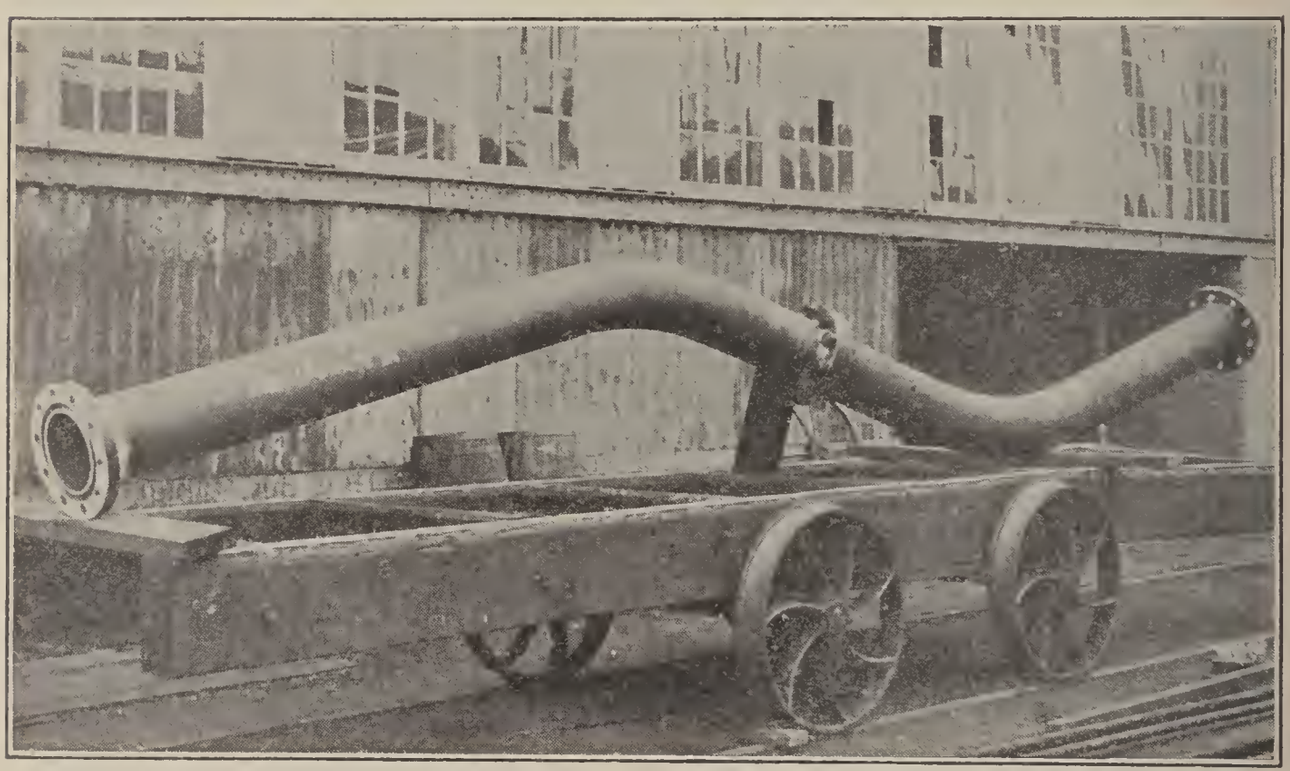

FIG. 28.—Steam pipe made from solid forging, bored with trepanning tool, Schelde Works.

inasmuch as some new features have been incorporated. These modified Yarrows are also fitted with Howden's draft system.

For steam work, generally, the Schelde establishment believes in utilizing only steel pipes. All the smaller pipe ends are expanded into the flanges. For the larger steam pipes solid shafts with flanges forged on are bored out. These larger pipes are made of Siemens-Martin steel and are tested to 1,500 pounds pressure. Attention was called to the great strength of the flanges combined with the gradual increasing thickness of pipe for some distance behind the flange. It was noticed that all high-pressure flanges are spigoted, packing being introduced in the spigot only and the flanges standing open beyond that.

For boiler work there are two 150-ton flanging machines, one from Fielding & Platt, of Manchester, the other from Breuer, Schumacher & Co., Kalk, near Cologne.

The 40-ton boilers under construction are built of 1½-inch plate. It was observed that the Schelde yards are rolling very broad and

long plates, weighing over 12 tons each. This gives the additional advantage that the joints are all above the water line and obviates to a great extent corrosion or leaking at the joints. The Schelde yards turn out as a rule about 50 heavy Scotch boilers per year. The average weight is about 40 tons each.

Attention was attracted to the fact that the yards are using seamless rolled water domes for Yarrow boilers. These domes are rolled out of single ingots and are obtained from Press & Walzwerk, Dusseldorf. The especial advantage in using rolled water domes is the saving in weight, a valuable feature for torpedo-boat construction.

In the boiler shops much welding is done with oxygen and acetylene gas, and it was stated that this process is found to be very economical. The managers find that acetylene gas is cheaper and better to use than hand welding. All flange ends of boiler plates are milled.

The corrugated furnaces used with the Scotch boilers are obtained from German sources. It was stated that the German prices on corrugated furnaces were, as a rule, 25 per cent less than the English figures. These corrugated furnaces generally come from Schultz Knaudt, of Essen, and other German firms. The Hoerde Works supply most of the plates used for boiler construction.

It was observed that furnace ports and manholes were being cut out with two machines, one by G. & A. Harvey, Glasgow, the other by Hulse, of Manchester. This latter firm has also supplied a heavy multiple drill for boiler work. There are several heavy tools by Campbell & Hunter, of Leeds, besides a four-column boiler-shell drill by Buckton. In the boiler shops 50-ton traveling cranes are in service.

POWERFUL HYDRAULIC MACHINES AND AIR COMPRESSORS.

Felding & Platt, in addition to their riveting machines, have supplied a 150-ton hydraulic flanging plant. The practice in the Schelde yards is to use up to 150 tons hydraulic pressure on the boiler-shell rivets, and 60 to 80 tons hydraulic for inside work.

Ingersoll & Sergeant (American) air compressors are in use. There are five 60-horsepower compound compressors from this firm in service. In the machine shop Buckton & Co., of Leeds, are in evidence with lathes, planers, boring mill, and vertical planers. One of the latter planes to a length of 26 feet and to a height of 16 feet.

In the plate department J. Bennie & Sons, of Glasgow, have provided both punch machines and shearing machines, and most of the hydraulic tools in this shop are from Hugh Smith, of Glasgow. A keel-plate bender for 30-foot plates has also come from the same firm, and Smith Brothers & Co., of Glasgow, have supplied plate rolls. The Schelde shops make practically everything required in ship work with the exception of crank work and especially patented articles.

In the forge department attention was attracted to a Breuer, Schumacher & Co. compound steam and hydraulic press. The steam gives the blow, and the hydraulic furnishes the squeeze at the end. This is a 400-ton press. B. & S. Massey steam hammers (English) are much in evidence. It is the practice of the Schelde shops to use superheated steam for all of these steam hammers.

Solid, as well as open, valve motion links are ground to a correct curve on a De Fries vertical grinder fitted with traveling table.

The American grinders in use have been supplied by Gisholt and also by Landis. Wilmarth & Morman, of Grand Rapids, Mich., have furnished one tool grinder. Working along with the Grand Rapids tool are some grinders from Mayer & Schmidt, of Offenbach. There are two heavy Landis tool grinders in service, and these machines, it was stated, are liked very much. As a rule, heavy piston rods are ground on these tools; that is to say, up to 12 feet 6 inches long.

In the power station Howden high-speed direct-connected engines are in service, along with one Bellin and one of Schelde's own make.

NOVEL METHOD OF HEATING—AMERICAN MACHINE TOOLS.

On passing through the shops it was remarked how even was the temperature, and how comfortable the shops were for working, considering the low temperature outside. It was explained that in the fitting shop steam was passed through all of the cast-iron columns of the building; in other words, the columns were also utilized for radiators. No apprehension was expressed of undue corrosion likely to result, inasmuch as there was no opportunity, it was pointed out, for water to lodge.

The class of work carried on in the machinery department is of high order, and it would seem that these Dutch machinists are working to very close measurements. The machine-tool installation here is an extraordinarily good one. There are many English tools in service and a few good grades of American tools. At the same time one could not help but notice that there was room for additional American machine tools of some of the latest types.

Among the American machine tools and equipment in use in the Schelde shops are the following:

Jones & Lamson Machine Co., Springfield, Vt	Turret lathes.
Mark Flather Planer Co., Nashua, N. H	Shaper.
Becker-Brainard Milling Machine Co., Hyde Park, Mass	No. 1½ miller.
Prentice Brothers Co., Worcester	Vertical drills, lathes.
Hendey Machine Co., Torrington, Conn	Lathes.
Brown & Sharpe Manufacturing Co., Providence, R. I	No. 2 miller, No. 4a miller.
Gleason Tool Co., Rochester, N. Y	Bevel gear cutter.
Ingersoll-Sergeant Co., New York	Five air compressors.
Manning, Maxwell & Moore, New York	Lathes.
Gould & Eberhardt, Newark, N. J	Shapers.
Landis Tool Co., Waynesboro, Pa	Grinder.
Davis & Egan Co., Cincinnati, Ohio	Lathes, vertical drill.
Lodge & Shipley Machine Tool Co., Cincinnati	Lathes.
G. A. Gray Co., Cincinnati	Planer.

AMERICAN MACHINE TOOLS COMPARED WITH EUROPEAN.

In view of the wide experience of Mr. Martin with reference to machine tools, and especially with regard to European conditions, he was requested to state his views as to the relative merits of American and Continental built machines, particularly such as might be advantageously used in shipbuilding plants. In response to this he has prepared the following memorandum:

American lathes are not so well liked by our men as the modern British. The reason for this may probably be in the greater complication, for although the quick changes of feed and speed are very convenient, they have their drawbacks in requiring more attention and causing delay when out of order.

Another point is the greater number of small parts made of malleable cast iron. They get broken in a very short time and have to be replaced by forged

steel. This is particularly the case with the slide rests, which are all too short and have too small a bore. This defect shows up particularly when turning a steep taper of considerable length or when boring a deep hole with a tool having great overhang.

Otherwise the American lathes which we have are equal in every respect to British, besides having a superior general finish. The lathes which give the best all-round satisfaction in our shipyard are those of the type of John Lang, of Johnstone, or Dean, Smith & Grace, of Keighly.

Brown & Sharpe and Cincinnati millers I consider superior to any, and I think the same can be said of Landis grinders. For shipyard tools I find that Scotch are superior to either English or German, especially in the heavier type. Of American heavy shipyard tools I have no experience, as it is seldom that one meets with them here.

MACHINE TOOLS OF EUROPEAN MAKE.

Among the principal foreign machine-tools in use in the Schelde yards are the following:

Fielding & Platt, Manchester, 150-ton flange machine, 150-ton hydraulic riveter; John Lang & Sons, Johnstone, Scotland, lathes; Hulse & Co., Manchester, multiple drills for boiler heads, vertical lathes and planers; G. & A. Harvey, Glasgow, boiler plate tools, lathes, radial drill; Kendall & Gent, Manchester, lathes, milling machines, vertical and horizontal; Buckton & Co., Leeds, horizontal boring tool for boiler, vertical side planer, planers, lathes, slotters; Dean, Smith & Grace, Keighly, lathes; Demoor & Co., Brussels, lathe, shaping machines, drills, and testing machines; Alfred Herbert, Coventry, turret lathes; Smith & Coventry, Manchester, turret lathes; Craven Brothers, Manchester, radial drill; Mayer & Schmidt, Offenbach, grinder, tool grinders; Taylor & Taylor, Leicester, engraving machine; Ludwig Loewe, Berlin, miller; Panhard & Levassor, Paris, band saw sharpening tool; Breuer, Schumacher & Co., Kalk, 150-ton hydraulic riveter and compound steam and hydraulic press; B. & S. Massey, Manchester, steam hammers; Smith Brothers, Glasgow, plate roll, 26 feet; J. Bennie & Sons, Glasgow, punching and shearing, and sharpening machines; Hugh Smith, Glasgow, hydraulic tools for working up plates; Smith Brothers & Co., Glasgow, vertical plate rolls.

There are many Buckton tools in use in these shops. One of the heavy Buckton planers is using a spring return system, and this machine is liked very much because of its high return speed of 200 feet per minute.

SHOP EFFICIENCY—THE WAGE SCALE.

The attention of Mr. Martin was called to the general practice in America of obtaining figures bearing on shop efficiency. On the basis usually employed in the United States the Schelde plant estimates the shop efficiency at $1,045 to $1,186 per man per year.

The wages paid throughout the Schelde shops are partly on a piecework schedule; in the fitting and turning shop Rowan's wage-scale system is in use. Fifty hours per week constitute the working time. The wages per hour are as follows (1 florin=40.2 cents):

Class of workmen.	Florins.	Class of workmen.	Florins.
Lathe man	0.20 to 0.25	Vise men, assembling department	0.16 to 0.21
Planer hands	.20 to .25	Molders	.16 to .24
Milling-machine men	.16 to .20	Carpenters	.16 to .24
Boring-mill hands	.18 to .21	Pattern makers	.16 to .26
Grinding-machine men	.22 to .24	Forge men	.20 to .25
Foremen	.30 to .60		

Mr. Martin gives close and personal attention to the control of this fine Schelde concern. He is essentially an engineer who believes in conducting work after the most approved modern methods. The high state of efficiency apparent at this plant attests strongly to the wisdom of the policy followed under his direction.

ITALY.

TURIN AUTOMOBILE WORKS.

The Italian automobile works, known as Societa Itala, located in Turin, in May, 1909, employed about 800 men. At the subsidiary shops in Caluso, where the forging, stamping, and pressing work is done, there are more than 200 men employed. The number of machine tools in service is 480. The great majority of these tools are of American origin. The shops cover an area of 30,000 square meters (322,936 square feet) and are modern in character. The attention to detail in the construction department and the accuracy with which material is worked up are perhaps unexcelled in any automobile establishment in Italy. During the past year I found that the wages paid in Italy to good machinists are on the average of 50 centimes (9.7 cents) per hour. In the Itala shops payments are made on both a fixed and a piecework schedule and on a premium basis. A working-day comprises 10 hours.

MANNER OF WORKING AND CLASS OF MACHINES TURNED OUT.

The shops are turning out all their brake hubs on Gisholt turret lathes. One man is finishing up a brake hub complete every $2\frac{1}{2}$ hours. The differential pinion work is being turned out on Potter & Johnston machines, and the gears are being cut on Bilgrams in about $1\frac{1}{2}$ hours.

The initial piston work in the Itala shops is handled entirely on lathes. The second part of the work, consisting in lining up, is finished with Landis grinders. This is in marked contrast to the methods in vogue in the Darracq Works at Suresnes, France, and in the Dietrich Works at Argenteuil, also near Paris. Both of these French works turn down the pistons on the face and flats, center same, and cut the necessary oil grooves, doing the entire work on Potter & Johnston machines. At the Panhard & Levassor works at Paris the practice followed is the same as in the Itala works, viz, to have recourse to lathes for the piston jobs.

The proportion of foreign tools (tools other than American) in the Itala works is not large. There are a number of Ludwig Loewe machines and a few English machines of various makes. Ernault, of Paris, is represented, and there are a few Italian machines. I did not, however, observe any Belgian or Swiss machines. Itala is employing at least 3 Dubosc gear cutters.

BUSINESS CONDITIONS AND PRODUCTION.

Business conditions with the Itala shops are reported as fairly good, and I understand that the firm's output this year is nearly double that of last year. This output, which is being worked up under normal conditions, is reported to be practically disposed of.

The machines turned out comprise the following horsepower: 16 to 20; 20 to 30; 35 to 45; 50 to 65; 60 to 75. In addition, touring chassis are also turned out, as well as chassis for drays and omnibuses of 800, 1,500, and 3,500 kilos (1,763, 3,306, and 7,716 pounds) working load. Cutter and aviation engines are also a product of the Itala firm.

The automobile motor is placed forward and comprises 4 vertical cylinders for the 3 types, of which the horsepower is 20 to 30, 35 to 45, and 50 to 65, respectively, and 6 cylinders for the 60 and 75 horsepower. In the Itala engines the transmission is by cardan shaft, with special compensating joints, which system, I understand, it has used from the first for touring cars, even of high power. The clutch is composed of metal disks, which is another feature which Itala has used on all cars since 1905. The ignition succeeds by a special system of Itala design at low tension.

AMERICAN MACHINE TOOLS IN USE.

I found the following American machine tools in service on the Itala floors, and the prices paid therefor, as given by the administration of the works:

Name of maker.	Type and dimensions.	Price.
Fellows Gear Shaper Co., Springfield, Vt	Gear cutters	$1,351
Jones & Lamson Machine Co., Springfield, Vt	Turret lathes, 2-inch	1,718
Becker-Brainard Milling Machine Co., Hyde Park, Mass	Vertical millers, No. 5	915
Prentice Bros. Co., Worcester, Mass	Lathes, 14 inches by 6 feet	275
Do	Vertical drills, 16 inches by 7 feet.	447
F. E. Reed Co., Worcester, Mass	Lathes, 16 inches by 8 feet	372
Brown & Sharpe Manufacturing Co., Providence, R. I	Plain millers, No. 4	1,081
Do	Grinders, No. 13	1,062
Do	Gear cutters, 26-inch	917
Do	Vertical millers, No. 2	898
Potter & Johnston Machine Co., Pawtucket, R. I	Automatic turret turning and chucking machine.	2,017
Pratt & Whitney Co., Hartford, Conn	Turret lathes, 3-inch	2,412
Hendey Machine Co., Torrington, Conn	Lathes and shapers	.....
Whitney Manufacturing Co., Hartford, Conn	Horizontal millers	.....
Landis Tool Co., Waynesboro, Pa	Grinders, No. 3	994
Newton Machine Tool Works, Philadelphia, Pa	Keyseat miller, No. 1	.....
Niles-Bement-Pond Co., Philadelphia, Pa	Slotters	.....
Cincinnati Milling Machine Co., Cincinnati, Ohio	Universal millers, 1½-inch	762
Cincinnati Milling Tool Co., Cincinnati, Ohio	Vertical drills	185
American Tool Works Co., Cincinnati, Ohio	Planer drill	146
Warner & Swasey Co., Cleveland, Ohio	Hexagonal turret lathes, 2-inch.	899
Hamilton Machine Tool Co., Hamilton, Ohio	Lathes, 16 inches by 8 feet	405
Springfield Machine Tool Co., Springfield, Ohio	Lathes, 20 inches by 6 feet	444
Bakers Bros., Toledo, Ohio	Keyseaters	666
Bickford Drill and Tool Co., Cincinnati, Ohio	Radial drill	.....
Fosdick Machine Tool Co., Cincinnati, Ohio	do	.....
Cincinnati Planer Co., Cincinnati, Ohio	Planer	.....
Cincinnati Shaper Co., Cincinnati, Ohio	Shapers	.....
Chicago Machine Tool Co., Chicago, Ill	Horizontal millers, No. 3	395
W. F. & J. Barnes Co., Rockford, Ill	Vertical drills	.....
Gisholt Machine Co., Madison, Wis	Turret lathes, Model H	2,065
Do	Vertical turret lathes, 30-inch.	1,139

In the above list of American tools, the Hendey lathes are in the majority among all the lathes employed.

The Brown & Sharpe tools comprise 2 No. 2 plain milling machines, 2 No. 4 of the same type, 3 No. 2 vertical plain milling machines, 1 No. 2 universal grinding machine, 1 No. 13 grinding machine, 3 gear cutters of the size 26, and 1 No. 2 surface grinding machine.

The Landis grinders comprise 2 No. 1, 1 No. 1½, 4 No. 3, and 2 No. 23.

The Becker-Brainards consist of 4 No. 5 vertical milling machines and 2 No. 7 horizontal milling machines.

The Cincinnati Milling Machine Company tools comprise 5 No. 3 plain millers, 3 No. 2 universal millers, and 1 No. 1½ universal miller.

The Baker Brothers machines consist of 3 No. 1 tools, and 1 cylinder boring machine.

The Whitney Manufacturing Company is represented by No. 6 type of machine.

The Cincinnati Shaper Company is represented by 2 shapers, 1 a 16-inch, the other a 20-inch.

I found furnaces in service from the American Gas Furnace Company, Elizabeth, N. J.

FOREIGN TOOLS IN USE.

Among the foreign machine-tool makers represented in the Itala shops are the following: From Germany: J. E. Reinecker, lathes, gear cutters, and horizontal millers; Ludwig Loewe, vertical and horizontal millers; Deutsche-Niles Werke, large vertical millers; Mayer & Schmidt, cylinder grinder; Biernatzki & Co., gear hob machine; De Fries & Co., tool grinder; and Lorch Schmidt, small precision lathes. From England: Alfred Herbert, small hexagonal turret lathes; Luke & Spencer, tool grinder; and Acme Lathe and Products Company, 4 spindle automatic machines. From Italy: Dubosc, gear cutters; and Itala, metal-sawing machines, power press, universal grinder for ball bearings, 4 spindle cylinder-boring machines. From France: H. Ernault, horizontal borers.

ROME ARSENAL.

The Italian Government arsenal, known as Laboratorio di Precisione, in May, 1909, was working about 150 men. This plant is located in the city of Rome, and is under the control of the Italian War Ministry. The actual direction of the shops is assigned to the artillery branch of the army. The director of the Laboratorio di Precisione is Col. Luciano Bennati, the vice-director is Maj. Luigi Longo, both distinguished officers of artillery, who afforded me every facility for the inspection of the shops.

The work turned out is of unusually high order. The workmen represent the best element among Italian mechanics, and I have no hesitancy in expressing the opinion that the best class of Italian machinists have no superiors in Europe. The men in the Laboratorio di Precisione are for the most part high-grade men, for there is very little room in such an establishment for other than skilled employees.

The material turned out is almost exclusively artillery equipment, and comprises range finders, position finders, gun directors, artillery ranging glasses, sights, gun-controlling gear, calipers, gages, and almost the entire gamut of highly precise material required for artillery direction. Workmen receive sums varying from 7 to 12 cents per hour, 10 hours constituting a day's work. The shops open at 7 a. m. and close at 5 p. m., with an interval of 30 minutes at noon.

SMALL SHOWING OF AMERICAN TOOLS.

Almost the first impression I received on entering the establishment was the very small showing of American tools. This is a plant which preeminently demands just those types of machines in which many American makers excel. It is not surprising to find in European locomotive works, for example, many heavy tools of the rougher sort originating from the Continent, but in shops where great accuracy is demanded there are few foreign tools of the medium size which can meet requirements so readily as the best grades of American tools. One naturally questions why more machines from the United States are not in use in the Rome shops. The officials at the head of such a plant as Laboratorio di Precisione are naturally desirous of learning of new and meritorious tools. They are largely dependent on the manufacturer. If the latter has not made his products known, then there can be no reason for surprise at his machines not being in service. I understand that the present officials at this arsenal have never received a visit from a director of an American plant. Representatives of American firms have called, but in nearly every case they were foreigners.

My reception at the Laboratorio di Precisione was cordial in the extreme, and I enjoyed a full and comprehensive talk with both Colonel Bennati and Major Longo. The two officers spoke in very high terms of the splendid merits of those American machines which they are using. Major Longo, who is giving special attention to the machine-tool equipment, expressed the opinion that the arsenal is being called upon to pay too much for American machines.

This question of prices charged abroad is one calling for personal attention on the part of principals of American firms. If agents are quoting correct figures, both manufacturer and buyer should know it. General-Director de Jong, of the Minerva Works at Antwerp, stated that by buying machine tools direct in the United States he could often save from 20 to 25 per cent. These figures, I was given to understand, included all items of outlay down to the actual placing of the machine tools on the Minerva floors. On the occasion of my visit to the Charleroi Electrical Works the statement was made that the normal prices (meaning standard prices) asked for American machine tools were reasonable, and that if those prices were adhered to it would be to the interest of the American industry.

I have heard this question of prices raised so frequently that it can not be ignored. If the foreign houses handling American machine tools are unjustly charged, they should be set aright. The American manufacturers are alone in position to judge.

AMERICAN AND EUROPEAN TOOLS IN SERVICE.

The following American tools are in service in the Laboratorio di Precisione:

F. E. Reed Co., Worcester, Mass.....Lathes.
Prentice Bros. Co., Worcester, Mass.....3-spindle drill.
Millers Falls Co., Millers Falls, Mass.....Metal saw machine.
Pratt & Whitney Co., Hartford, Conn.....Drill.
Hendey Machine Co., Torrington, Conn.....2 lathes.
D. E. Whiton Co., New London, Conn.....Chucks.
Landis Tool Co., Waynesboro, Pa.....Grinder.
Hugo Bilgram, Philadelphia, Pa.....Gear planer.
Cincinnati Machine Tool Co., Cincinnati, Ohio.....Drill.
Cincinnati Milling Machine Co., Cincinnati.....One universal miller, No. 1½.

One of the 2 Henley lathes is of the turret type. In the above list, the Bilgram tool, I understand, was bought direct from the United States, yet there is the name of an Italian firm on a face plate on this tool. I observed a 3-spindle drill and a 2-foot power lathe, both apparently of American origin, but with names of makers not showing.

The foreign tools in service are of French, English, Italian, and German origin, but German machines predominate. Greenwood & Batley, of Leeds, England, have supplied several universal spiral gear cutters. This firm, I understand, did considerable business with the Italian Government works in previous years, at a time when the Leeds house was regarded as one of the first in the building of arsenal tools. The Greenwood & Batley tools present are not of recent make. From Italian sources, Zust, of Laggo Maggiore, has supplied several lathes and millers, and there are a couple of planers from Ansaldo, of Turin, while Dubosc & Co., also of Turin, have supplied a few tools. In the German representation there are milling machines from both Ludwig Loewe, Berlin, and the Wanderer Works, of Chemnitz. Kirchner, of Leipzig, has supplied practically all the wood-working machinery. I observed a Ludwig Loewe miller, which had recently arrived, so that it was evident that Loewe is being looked to just now for millers. In the forge shop there are pneumatic hammers from P. Pilkington, of Bamber Bridge, and Greenwood & Batley, of Leeds, England. Zuller & Zost have supplied a steam forge hammer.

The engineers of the laboratory have designed and built several special tools of exceptional merit. One of these machines is for indexing dials. There are several vertical tracers in service, the design and build of the arsenal.

As might be expected, the general conditions with relation to sanitation, light, and air are what one would expect to find in a modern and efficient government arsenal. The shops have metal overhead framing for all pulleys and belting, and the drive is electrical throughout. There is no attempt at speed or high output capacity, the shops being run solely to meet the army artillery demands and with every regard to accuracy.

TERNI ARSENAL.

The most important arsenal in Italy for the manufacture of military small arms is located in Terni. This is a government plant. The correct name of the works is Precisione d'Artiglieria della Fabbrica d' Armi di Terni.

I visited the Terni small-arms establishment and was received by Maj. Guglielmo Lucci, the vice-director in charge. Every facility was afforded me to inspect the shops, and I avail of this opportunity to make acknowledgments both to this officer and to Cav. Santo Galbardi, technical chief, who personally escorted me over the works.

The general lay out of the plant is excellent. Modern type building, good light, plenty of air, solid construction, electric drive throughout, no makeshifts or flimsy scantling; all these features are at once apparent, and the impression becomes fixed that the Terni works demand the best equipment obtainable, and yet, in the entire lot of 1,400 machine tools in service, there are only 10 American. In vain I looked for some of those American machines which for arsenal work are unexcelled. Turning to the technical chief, I asked

if any American manufacturers had ever called. He replied that since 1882 he had known but one American machine-tool man to visit the works.

THE MACHINE TOOLS IN USE.

The English firm of Greenwood & Batley, of Leeds, have supplied nearly 900 machine tools to Terni. This was in the early eighties. For the Terni installation the Leeds firm received, I understand, about $386,000. Much of the Greenwood & Batley equipment is now old, and it is this material which must, in the general order of things, give way gradually to more modern and superior tools. When one considers that the Terni works are to Italy what the Springfield arsenal is to the United States, it will be appreciated that the importance of the former establishment is too great to admit of any but the best tools being employed. The rifling machines in service at Terni are mostly of the Jaspar type. In the Pieper Works, of Herstal, Belgium, Jaspar machines are being replaced by Pratt & Whitney riflers, and the latter machines are being operated by women.

The only encouraging sign at Terni, so far as American machine tools are concerned, was the presence of a recently purchased Garvin milling machine. The technical chief spoke highly of this tool. In addition to the Garvin there are 2 lathes from the Bradford Machine Tool Company, of Cincinnati, 1 No. 1 Becker vertical miller, 4 Becker-Brainard No. 2 vertical millers, and 2 turret lathes, also from the Bradford Company. The Garvin miller was supplied by Baldini & Co., of Pontedera, Italy. For the No. 2 Becker-Brainard millers, I understand that Terni paid 3,000 lira ($579) each, and for the No. 1 Becker vertical miller 5,500 lira ($1,062).

The writer has visited several hundred manufacturing works in Europe, but has seldom seen a plant so apparently neglected by American manufacturers as the Terni small-arms works. The officers in charge here are keen to learn regarding the existence of all new and especially meritorious machines. My position would not permit any suggestions or recommendations, but I have no hesitancy in saying that there are many types of American machine tools which could be introduced to advantage in the Terni shops. The situation is one calling for personal attention on the part of principals of American firms.

All the screw machines in service at Terni are of the Greenwood & Batley type. Alfred Herbert (Limited), of Coventry, England, is represented by lathes, but aside from this firm and Greenwood & Batley, the tools in use are mostly German.

ELECTRIC POWER—EMPLOYEES.

The electric power utilized is obtained from hydraulic turbines. About 1,000 horsepower is required for driving purposes. This power is obtained from 8 water turbines. The number of men employed at the Terni works in May, 1909, was about 500. In case of need, this number can be increased to 2,000. A day's work comprises 9 hours. The shops open at 7 a. m. and close at 5 p. m. The material turned out here is of the highest grade, and the requirements on all sides are of an exacting character. The workmen are a credit to their officers and their country.

FRANCE.

ANDRÉ CITRÖEN & CO.

The cutting of double helical gears has been carried to an advanced stage by the Citröen shops of Paris. When in St. Petersburg recently it was learned that shops of that city were sending to Paris to have double helical gears cut. In the Warsaw district double helical gears were being cut by a machine controlled by the Wlochy Works near Warsaw. The writer visited the Citröen shops on November 20, 1909, and was personally received by Mr. André Citröen and his associates, Messrs. Victor Heftler and A. Boas. In company with these three gentlemen he was shown over the works.

Until recently it was necessary to round out by hand the curve at the bottom of the V in the helical gear. Now, however, this work is performed automatically, and wheels which formerly required 200 hours to cut are disposed of in 60 hours' time. Not more than 5 hours of hand work is required, it is declared, on a wheel.

WELL SUPPLIED WITH WORK.

The Citröen shops are working 40 men, and have in service 14 gear-cutting machines. These machines run from No. 1 to No. 6 in size. Two additional machines are now being built and will be ready for service in December.

To judge from appearances the Citröen shops have more work on hand than they can at present handle, and Mr. Citröen says that he is able to turn out double the amount of work of the past year with one-half the force. This is due to the development of his machines, whereby the rounding out of the base of the V is effected automatically.

It was observed that the Citröen shops were engaged on some important orders for the Transvaal. The firm is also turning out gears for marine work for the French navy.

Up to the present time Mr. Citröen has consented to only one machine being sold. This tool is installed in Brussels, Belgium. He prefers to confine his work to the cutting of gears rather than to the manufacture of machines for sale, but states that he is willing to enter into negotiations for the use of his machines in the United States, in which event he would send over a competent engineer to insure the proper working of the tools.

ADVANTAGES OF HELICAL GEARING.

On the subject of spur and bevel gears with double helical teeth, the Citröen shops lay stress on the fact that the great advantage of helical gearing is shown for particularly heavy powers. It is pointed

out that gears with straight teeth can not run without back lash, causing wear and vibration and undue noise at high speeds. In order to eliminate this back lash, single helical gearing was invented, and though this does away with noise, there is a disadvantage arising from side thrust, and consequent great loss of efficiency. It was in order to obviate side thrust that the double helical gearing was adopted many years ago. The principle of the gearing is to have two helical parts standing in opposite directions, the side thrust originating through one part being counteracted by the thrust from the other. The advantages claimed for the double helical gearing are absence of noise at high speeds and the obviating of back-lash shocks or vibration; also the reducing of friction and a consequent maximum of efficiency. The absence of friction tends to longevity. A still further advantage is that the helical gears are recognized as being stronger, inasmuch as the surface of the teeth is greater. Heretofore double helical gears were obtained in rough castings which, even when trimmed by hand, have not a true helical form, and consist, in fact, of only a tooth made up of two inclined straight parts. Under such circumstances the accuracy obtained was only approximate. The angle at which these inclined parts were cast was a very wide one, and there generally was more wear on one tooth than on some other. The old double helical gears also made it impossible to get the tops of the teeth in the same circle, and this caused a considerable side movement and wore the shaftings, bearings, and machinery generally.

One way of obtaining double helical gears was to take two single helical gears and to bolt them together. Gears so constructed did not permit of high power, inasmuch as there was soon caused a certain play between the two halves.

THE CITRÖEN DOUBLE HELICAL GEARS.

Under the Citröen system the double helical gears are cut in one operation in the solid. It is claimed for this machine that the tool is perfectly accurate, as regards both the cutting and the dividing teeth, whether the gear be spur or bevel. The teeth have a true helical shape, the two helical parts standing in opposite directions. The teeth are cut at an angle of 45° to obtain the longest possible tooth surface and a maximum height. This affords an efficiency, it is claimed, of 98 per cent, and even more is guaranteed for both spur and bevel wheels.

The Citröen gears are guaranteed noiseless up to the following speeds per minute: For gun metal, 3,400 feet; cast iron, 3,000 feet; steel, 1,800 feet.

The company at present cuts double helical spur and bevel gears in any metal to any size up to 15 feet in diameter and 3 feet in width. In the Citröen shops may be seen pinions of which the teeth are shrouded either to the pitch line or completely. This, it is declared, has not been possible heretofore in cut gears. The Citröen tool cuts any pitch, even fractional, the advantage being that the exact pitch can be calculated according to the center distance in a given number of teeth.

All gears are tested without load at the specified speed. The test is made without load, since the noise in gearing is more apparent when they are allowed to run light.

It is claimed that double helical gearing does away with the use of soft material, such as rawhide, paper, fiber or wooden cogs, which materials are often adopted to avoid noise in the gearing.

By cutting the teeth at an angle of 45° the tooth is made stronger at the root than at the pitch circle. It is pointed out that in straight-tooth pinions of less than 30 teeth the reverse is the case.

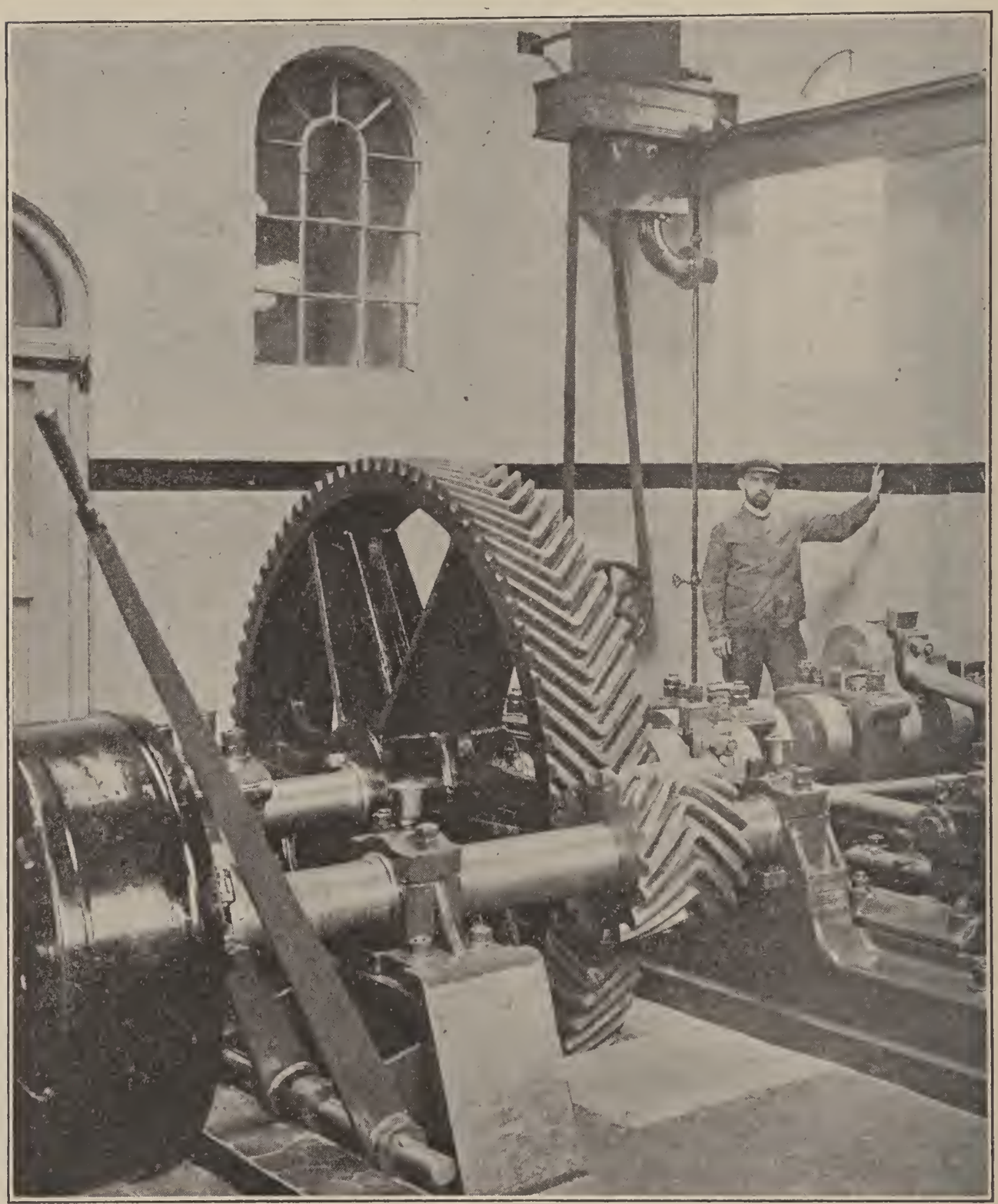

FIG. 29.—Citröen double helical gear in service.

CHIEF USES OF DOUBLE HELICAL GEARS.

The principal applications of the double helical gears are for high-speed transmissions, for shafting in factories, reduction gear, and turbines; for heavy-power transmissions in rolling mills, hydraulic presses, pumps, grinding and stamping machines; for transmissions

in which great regularity is a necessity, as in the case of steam engines, gas engines, textile and printing machines, steering and winding gear.

Under the Citröen system bevel gears with cut double helical teeth can not throw each other out of mesh and will, it is declared, draw each other into mesh. It is asserted that this system of double helical gear-cutting counteracts shaft expansion. In passing, the fact should be mentioned that Citröen is able to cut 5-tooth pinions. The cutting of gears of such a small number of teeth is in itself noteworthy.

An Armstrong turning and boring lathe for heavy ordnance work, weighing 220 tons, has been installed in the Le Creusot shops, the double helical gears on which were cut by the Citröen shops.

SALES METHODS.

The best methods of exploiting the market for machine tools in Europe have been pointed out by men active in the field, among whom are Mr. Hugh Reid Griffin, a member of the board of directors of the American Chamber of Commerce of Paris and general director for Europe of the Johnston Harvester Company, of Batavia, N. Y.; Laurence V. Benét, president of the American Chamber of Commerce of Paris and general director of the Hotchkiss Ordnance Company, of St. Denis, near Paris, and Mr. J. Ryan, agent in France for the Potter & Johnston Machine Company, of Pawtucket, R. I.

Mr. Griffin's experience abroad covers more than 25 years, and consists of a personal knowledge of nearly all the countries on the Continent. He believes that the sale of American machinery and machine tools abroad can best be accomplished through the control of Americans on the spot. He strongly advocates the utilization of the best local talent, but declared that Americans should be at the head of affairs. In the case of his own company, the policy followed in France is to reach as far as possible the small dealers. In no instance, however, does his firm undertake to do a retail business.

JOHNSTON HARVESTER COMPANY'S PLAN.

Under the plan at present followed in France, it is the practice of the Johnston Harvester Company to plat small districts, and in these limited areas to avail of local merchants; in other words, the practice is very similar to what is followed in America. Mr. Griffin points out that the general tendency of Americans in doing business abroad is to give too large a territory to one agent. This, he believes, is a very great mistake, and, speaking for his own company, the general experience is that the best results are obtained from parceling out a territory after the manner at present followed, that is to say, when a company has its organization thoroughly established in a country. Mr. Griffin's views should be taken as appertaining more especially to France.

Mr. Griffin concedes that there is a distinction to be observed in the sale of agricultural implements and machine tools, but he firmly believes that this distinction tends all the more to personal representation on the part of Americans. He finds in the case of agricultural implements that it is necessary to employ expert machinists, who are charged with traveling from point to point and inspecting machines as mounted by the local dealers. He cites cases where his machines were criticised and where the trouble lay entirely with faulty mounting. Under his direction salesmen and expert machinists are kept constantly traveling, and he knows exactly at all times the whereabouts of these representatives.

In a very few cases only does his company undertake to consign machines to dealers. The rule is followed of shipping direct from

the United States to Marseilles, Bordeaux, and Havre. From these seaports the goods are forwarded to the interior to the best advantage. Mr. Griffin declares that the cost of transport from New York to a French port, and thence by rail, provided a careful system is worked out, is even far less than the expense which a local maker must meet when distributing from a factory in the center of France, say, to an extreme point in France. Harvesting machinery is delivered free to all stations in France.

SUCCESSFUL BUSINESS—THE OUTLOOK.

Mr. Griffin says that business in general in European Russia has been exceptionally good during 1909, and his reports from Russia indicate that the business in agricultural implements has been phenomenally good during the same period; in fact, it would seem as if 1909 will be counted a record year in Russia for American agricultural implements.

Mr. Griffin is very hopeful for the future, and he believes that with the adjustment of the new tariff laws between the United States and France a bright era will open up for American export trade. The experience of his firm in selling agricultural implements should be, he thinks, of value, from a comparative standpoint, for American machine-tool manufacturers. He is convinced that in order to effect the maximum of sales it is necessary personally to visit the works, and that results can best be accomplished where American expert machinists undertake to demonstrate the working possibilities of machine tools.

Mr. Griffin declares that the policy of dealing with smaller agents after ground has been broken is the result of competition, or the fact that larger agents try for too large profits. Where a trade is worked, as in France, the factory has to hold stock at various points to meet orders as they come. This, Mr. Griffin says, is expensive and involves a special organization. Harvesting machinery, he points out, has been sold in Europe since 1858, and machine tools have had a much shorter record of activity. Quick deliveries, he thinks, can only be made if stock is held at a convenient point. Wholesale agents who buy quantities order early and hold stock, but Mr. Griffin says that finding out what is wanted, or demonstrating that the article which one has is better than those in general use, is the real pioneer work, and that Americans in pushing agricultural machinery have been most successful and they should be successful in many other lines.

PIONEER WORK SELLING AGRICULTURAL MACHINES.

Mr. Griffin says that when he first came to Europe he visited parts of the Continent where neither mower nor reaper had been heard of, and at such points arranged for demonstrations, and always with success. In Poland a reaper was attacked by a mob as bewitched, but this superstition was easily overcome, and 25 machines were sold as a result, while the sale of hundreds followed. Mr. Griffin added:

> We have, of course, made changes to suit local wants, and trade has been collected by the parceling of districts, and securing agents who sell to farmers and who are workers. The machine-tool business suffers now from competition, and foreign houses handle American tools and copies, the latter sometimes

nearly as good, and with slight changes to suit special work or custom. The American manufacturer who through live Americans follows his trade closely will secure the best chance. Tariffs, in my judgment, will adjust themselves.

Mr. Griffin seems to think that there is no time so opportune as the present for developing the foreign market, and he emphasizes the fact that the United States is now producing more than the home market buys, and that the cultivation of the foreign market is a national duty.

VIEWS OF PRESIDENT OF CHAMBER OF COMMERCE.

Few men are better posted on the subject of the sale of American machine tools abroad than President Laurence V. Benét, of the American Chamber of Commerce in Paris.

Mr. Benét was asked to indicate what steps, in his opinion, should be taken by American machine-tool interests to insure their full share in the European market. Speaking with reference more especially to France, Mr. Benét declared that American manufacturers, or American selling agencies, must send their own men into the foreign territory. These representatives should be expert machinists. The business, Mr. Benét declared, must be sought out, and he declared it as his conviction that the general run of European manufacturers do not know their own needs. Expert tool men, understanding the full capacity of the products they represented, are required to bring the facts home to the foreign shop officials. He cited that in his own case he had had occasion very recently to make inquiries for gear cutters. He could not find in all Paris anyone to demonstrate to him the value of certain American gear planers. He had been using Reinecker (German) machines, and was not satisfied with the equipment. He was under the necessity of going to England, and found an American gear planer in the hands of an English agency. This agency could tell him practically nothing about the tool; nevertheless he purchased the machine and installed it in the shops at St. Denis. "It will now be necessary," he remarked, "to worry along with this tool as best we can and hope that we may eventually discover its capacity."

REPRESENTATIVE SHOULD BE AN EXPERT.

Mr. Benét said:

There is an enormous field in France to-day for American machine tools, but the machines can not be sold through commercial agencies on any such basis as one would sell groceries. The Potter & Johnston Company, of Pawtucket, R. I., has sold probably more machine tools in France than any one American firm, agency, or combination. That company has kept in the field here one man, and one man only, but this representative makes a practice of personally covering the manufacturing plants of the country. He is familiar with every detail of his line, and knows better than the manufacturer what the manufacturer wants. He sells only one machine. All his interests are centered in that one tool. He is constantly on the lookout for trade for his particular machine. He is an expert in its manipulation. No commercial agent can possibly excel him in the representation of the possibilities of the tool. No stock is kept on hand, and in consequence the selling expenses are reduced to a minimum.

The method followed by Potter & Johnston commends itself to every manufacturer of good machine tools in America. It is not necessary to open in France expensive warerooms. Machine tools are not household commodities. The situation is one requiring the presence on the ground of an expert man for each type

of tool, whose duty should be to personally visit the works and keep traveling. Such a man will be welcome wherever he goes, and what Potter & Johnston have done others can do.

It is a great mistake to turn machine-tool representation over to agents, who are handling a varied line of machines. My own experience is that the majority of these agents do not understand the machines they are selling, and in the case of those agents who are also manufacturing on their own account there is always a tendency to push articles of their particular manufacture.

FOREIGN LANGUAGE GREAT AID, BUT NOT A NECESSITY.

On the subject of foreign languages, Mr. Benét says that a knowledge of the language of the country in which it is attempted to exploit machinery or other goods is certainly a very great aid, and while not desiring to be understood as in any way failing to appreciate the value of such knowledge, he wishes to make it clear that without a knowledge of the language an American is able to do business which a foreign agent of American goods will not perhaps be able to accomplish in spite of doing business in his own language. Mr. Benét said that Mr. Hotchkiss, the founder of the Hotchkiss Ordnance Company in France, hardly knew a word of French, and yet he was constantly brought in contact with leading officials of the French Government.

Mr. Benét states that he would also call attention to the German practice of exploiting German products abroad through Germans, and he pointed out that no one who has traveled extensively and has observed the wonderful development of German commerce, has not been struck by the fact that German experts, travelers, and agents are to be found in all parts of the world, speaking the language of the country, adapting themselves to the customs of the country, and sending home such information as will enable their principals to cater to local requirements. Mr. Benét believes that American machine-tool interests should not hold good men back from going abroad because they do not speak French. A knowledge of that language or of any other language, he pointed out, can be acquired, and it should always be remembered that a good tool demonstration largely talks for itself.

President Benét is emphatic in stating that the sale of American machine tools should be wholly in American hands—at least the control or direction of the selling arrangements. He took occasion to refer to the success of Mr. J. Ryan, of the Potter & Johnston Machine Company, Pawtucket, R. I.

VIEWS OF MR. J. RYAN.

The writer had the pleasure of an extended conversation with Mr. Ryan, who has been selling Potter & Johnston tools in France for the past five years. The machines handled by him are automatic turret turning and chucking machines.

In the year 1907 Mr. Ryan sold in France $400.000 worth of machine tools, and in that period has turned in orders exclusively from France for more than 400 Potter & Johnston automatic machines, representing a total business of more than $1,000.000. Asked what methods he had employed in securing this large volume of trade, Mr. Ryan replied that he personally visited the French manufacturing

works and sought out the directors. He maintains no warehouse or stock room. His offices are located on the Avénue de la Grande Armée, near the Porte Maillot, and his office force consists of two people besides himself.

Before taking over the Potter & Johnston representation in France, Mr. Ryan was chief engineer of the Bayard A. Clément Automobile Works, located at Levallois, near Paris. He had bought several of the Potter & Johnston machines for use in the Clément shops and became enthusiastic over the results obtained. He left the Clément Works to take up the sale of Potter & Johnston machines. He spoke appreciatively of Mr. Clément's kindness in affording him permission to show prospective buyers the workings of the Potter & Johnston tools in the Clément establishment, and says that he was greatly aided by the help and good will of Mr. A. Clément. "There was a distinct advantage," Mr. Ryan says, "in being able to point out the various features of the Potter & Johnston tools at work in comparison with other equipment which was considered modern."

PERSONAL DEMONSTRATIONS MAKE SALES.

Mr. Ryan does not believe in a stock-room exhibit; in other words, running a tool in some showroom. He has very little sympathy with the idea that machine tools can be sold as commodities. He has found from actual experience that his best sales have been secured in consequence of personal visits to the works and by indicating at first hand what the machines are capable of doing. The writer can confirm the accuracy of these views from many voluntary expressions which he has heard on the part of French directors regarding Mr. Ryan's forcefulness. More than one director is recalled who, during the past year, stated that he had absolutely no idea of buying automatic machines until the subject was brought to his attention by that gentleman and his interest aroused.

In every case Mr. Ryan has given guaranties of the working possibilities of the machines, and he has seldom been satisfied until he has induced a prospective buyer to accompany him to some installation point where, in person, he has worked a machine to its full efficiency. Herein lies one of the chief points of advantage—an expert mechanical knowledge coupled with the essentials of a good sales agent. Mr. Ryan says that he has never been content to sell less than three machines, claiming that if an automatic turret turning and chucking lathe was desirable, then there should be at least three of these machines in service in order to develop the series work to its full capacity.

The testimony of French manufacturers has been that a man like Mr. Ryan is something more than a mere salesman. He has shown them how to develop the capacity of their plants.

OUTLOOK GOOD IN FRANCE AND ENGLAND.

When asked what, in his opinion, was the outlook for the sale of American machine tools in Europe, Mr. Ryan replied that, so far as France was concerned, he felt that there was a greater field for the sale of American machine tools than in the past; he believed, however, that the sale of these machines could not be accomplished as easily as in former days, owing to cheap foreign competition, but, assuming

always that the tools offered by American manufacturers possess merit, he is convinced that it is possible to greatly enhance the sale of tools in this country. American machine tools, he declared, are in high favor, and it is only necessary for Americans to get personally out among the works in order to sell the tools. The business, he declared, will not come to one, and for this reason he believes in discouraging any attempt at warehousing of material. He does not recommend that machine tools be assigned to firms handling tools of their own manufacture, for he thinks it but natural for such firms to push their own products.

Mr. Ryan, who was born in Brooklyn, N. Y., and is an American citizen, speaks French fluently, but at the same time he declares that because a man does not speak French is not sufficient reason why he should not be sent abroad.

Mr. Ryan has recently undertaken to extend his operations into England, and he declared that he believes there is an enormous field in the United Kingdom for the sale of American machine tools. He did not appreciate this fact until he had personally commenced to exploit that territory.

In general, Mr. Ryan is exceedingly optimistic regarding the future for machine tools in Europe. He does not believe that Americans should undertake to manufacture in this territory, at least not for the present, and believes that good American machine tools can always be sold on the Continent in competition with cheaper foreign makes.

In conclusion, it may be added that, prior to Mr. Ryan's taking charge of Potter & Johnston's business, the French agency was in the hands of a local man who had sold in two years' time one machine.

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SUPPLEMENTARY REPORT

ON

MACHINE-TOOL TRADE IN RUSSIA.

BY

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MACHINE-TOOL TRADE IN RUSSIA.

KOLOMNA MACHINE COMPANY.

EARLY HISTORY OF LOCOMOTIVE-BUILDING ESTABLISHMENT.

The plant of the Kolomna Machine Works Company is one of the most important locomotive-building concerns of the kind in the Russian Empire. The works are located near the station and monastery, Golutvin, on the Moscow-Kasan Railway, about 109 versts (72 miles) east-southeast of Moscow. Near Golutvin is the more important town of Kolomna, and it is from the latter that the works take their name. Through the courtesy of the president of the company, Mr. B. Lessing, an inspection of the plant was made under the personal escort of General Director Alexandre Belonoschkin.

The founder of the establishment was Mr. Armand Struve, a talented military engineer, whose services had been especially employed in bridge building. In 1862 Mr. Struve undertook to build an iron bridge across the Oka River for the Moscow-Kasan Railway. For the purpose of constructing different parts of the bridge, he established an iron foundry and a blacksmith shop near the confluence of the rivers Moskva and Oka. The Kolomna works date their origin from the establishment of this shop. Two years later Mr. Struve associated with himself his brother Gustav Struve, and the business was conducted under the firm name of Struve Brothers. A little later a partnership was formed with Mr. Lessing, who brought to the firm a valuable commercial experience.

From 1862 to 1869 Messrs. Struve were largely engaged in the building of bridges and freight cars. At that period locomotive works did not exist in Russia, and all locomotives were necessarily bought abroad; but in 1869 the Struve shops constructed a freight locomotive, which was one of the first built in Russia. The venture was successful and orders for more followed. In 1872 the firm was reorganized under the title of The Kolomna Machine Works Company, and as such continues until the present day. In 1873 the company acquired a metallurgic works at Koulebaki. The products from the Koulebaki works are transported to the Oka River by a narrow-gage railway, and from there to the Kolomna works, by water in summer and by railway in winter.

CAPITALIZATION—SIZE OF PLANTS—EMPLOYEES—PRODUCTS.

The company is capitalized at 10,000,000 rubles ($5,150,000) and the reserve capital amounts to 2,600,000 rubles ($1,339,000). The annual output of the plant at Kolomna, which embraces an area of 150 acres, 21 of which are covered by the shops, is valued at approximately 12,500,000 rubles ($6,437,500). The metallurgic works at

Koulebaki cover an area of 5,300 acres and employ about 3,000 men. The value of the annual output is estimated at 3,500,000 rubles ($1,802,500). At both plants the management of the company has erected many buildings for the workmen, including schools for workmen's children, hospitals, dining rooms, vapor baths, playhouses, clubs, libraries, and many lodgings.

The Kolomna works were employing in October, 1909, about 6,800 men and the output of locomotives is about 20 per month, all for Russian orders and mostly for the state railways. The output has been as high as one per day, and this rate, it is claimed, is greater than that of any other locomotive establishment in Russia.

The various products of the Kolomna works embrace locomotives of various types, cars for passenger and freight service, street railway cars, and oil tank cars. The output of freight and oil cars averages 1,800 per year, and of passenger cars about 180. Still other products are iron bridges, river steamboats, steam dredgers, barges and ice boats, locomobiles, peat presses, steam engines and boilers, and Diesel oil engines. Machine tools for special work are also made, but the shops necessarily draw on outside sources for the great bulk of the machine tools required.

Most of the departments at the Kolomna works are run on a 24-hour day schedule, but the number of hours required of any one workman is ten. The total number of buildings comprised in the works is 39. At the present time about 4,300 horsepower is utilized in running the plant. The fuel consumption per week is approximately 225 tons of oil and 228 tons of coal.

All parts of locomotives and steam engines, except boiler tubes and special patented appliances, are made from raw materials received at the works. In constructing locomotives, plate frames are generally used.

TYPES OF LOCOMOTIVES MANUFACTURED.

The principal types of locomotives built by the Kolomna works comprise the following: Ten-wheel freight tandem compound; eight-wheel freight; eight-wheel passenger tandem compound; ten-wheel passenger with Schmidt superheater; eight-wheel passenger compound; six-coupled tank engine; eight-coupled tank engine; ten-wheel passenger compound, Mallet system.

The gage to which all locomotives for Russian service are built is 1,524 millimeters, or 5 feet. The locomotives are designed to burn wood, coal, or oil, the fuel used being determined largely by the territory in which the locomotive operates. As a rule the Kolomna locomotives are operated at 14 atmospheres pressure. Schmidt's superheaters are largely used, most of the engines fitted with them being employed on the Moscow-Kasan line. The Mallet type of locomotives is also being handled.

The principal dimensions of the ten-wheel freight tandem compound, and the ten-wheel passenger with Schmidt superheater, are as follows:

Locomotive and tender.	Freight.	Passenger.
LOCOMOTIVE.		
Gage.....feet..	5	5
Weight in working order.....pounds..	132,740	144,730
Weight on drivers.....do....	114,900	94,290
Wheel base driving (rigid).....inches..	168	162
Wheel base, total.....do....	257.9	308.6
Height (center of boiler above rails).....do....	94.4	98.4
Diameter of cylinders:		
High pressure.....do....	15.75	20.47
Low pressure.....do....	23.62	.....
Stroke of piston.....do....	23.62	23.62
Drivers.....number..	8	6
Diameter:		
Drivers.....inches..	50	66.93
Truck wheels.....do....	29.53	40.55
Boiler inside at smallest ring.....do....	59.05	57.87
Working steam pressure.....pounds..	170	170
Tubes:		
Number.....	235	176
Outside diameter.....inches..	1.96	2
Length over tube sheets.....do....	169.3	179
Heating surface:		
Fire box.....square feet..	122	137.5
Tubes.....do....	1,714	1,385.5
Total.....do....	1,836	1,523
Grate area.....do....	27.4	25.26
TENDER.		
Wheels:		
Diameter.....inches..	45.28	39.76
Base.....do....	137.8	131
Water capacity.....cubic feet..	530	494
Weight:		
Empty.....pounds..	36,465	40,785
Loaded.....do....	85,100	84,440
Total wheel base of engine and tender.....inches..	551.7	548.5

The Allan system of valve gears is used on the freight locomotives and the Walshaert system on the passenger. Friedman injectors and generally Westinghouse brakes are used on both, although engines for the Moscow-Kasan line and some others have the New York brake.

AMERICAN MACHINE TOOLS IN SERVICE.

The number of machine tools installed at the Kolomna works is approximately 1,020. The American tools in use include the following:

Mark Flather Planer Co., Nashua, N. H.....2 planers.
Prentice Bros. Co., Worcester, Mass.....3 vertical drills, lathes, vertical miller.
H. Fisher, Worcester.....Lathe.
Norton Grinding Co., Worcester.....2 grinders, slotter.
L. Robbing, Worcester.....Lathe.
F. E. Reed Co., Worcester.....4 lathes.
Brown & Sharpe Manufacturing Co., Providence, R. I.....Vertical miller.
Bullard Machine Tool Co., Bridgeport, Conn.....Vertical miller.
Pratt & Whitney, Hartford.....2 turret lathes.
New Haven Manufacturing Co., New Haven.....4 lathes.
Hendey Machine Co., Torrington.....Lathe.
Niles-Bement-Pond, New York.....Vertical drill, vertical miller, slotter.
Landis Tool Co., Waynesboro, Pa.....Grinder.
American Tool Works Co., Cincinnati, Ohio.....Radial drill.
Cincinnati Milling Machine Co., Cincinnati.....Miller.
Davis & Egan, Cincinnati.....5 turret lathes, 2 bolt cutters.
Dreses, Muller & Co., Cincinnati.....Radial drill.
Bickford Drill and Tool Co., Cincinnati.....Universal drill, drill.
G. A. Gray Company, Cincinnati.....5 planers.
Warner & Swasey Co., Cleveland.....2 turret lathes.
Gisholt Machine Co., Madison, Wis.....Turret lathe.

FOREIGN TOOLS IN USE.

Among the foreign tools in evidence are the following:

Billeter & Klunz, Germany, open-side planer; Atlas Works, Stockholm, radial drill; F. Schultz, Mulhausen, horizontal borer; Phoenix Works, St. Petersburg, radial drill, heavy lathe; Pitler, Leipzig, spiral gear cutter; Giernacky, Chemnitz, hob machine; Alfred Herbert (Limited), Coventry, England, turret lathe, No. 8 vertical miller; Wagner & Co., Dortmund, horizontal borer; Friedrich Schmaltz, Offenbach, interior surface grinder; B. & S. Massey, Manchester, hammer; Pokorny & Wiettkind, Frankfort, compressors; Kendall & Gent, Manchester, slab millers; Ernst Schiess, Dusseldorf, various tools; Felser, Riga, heavy tools; Smith & Coventry, Manchester, vertical millers; Droop & Rein, Bielefeld, double shaper; Chemnitz Works, Chemnitz, planers; Pneumatic Tool Co., St. Petersburg, compressors; Fétu-Defize, Liege, vertical miller; Reinecker, Chemnitz, millers; Fairbairn, Naylor & Co., England, slotters.

Felser, of Riga, has supplied a large planer with a bed 10 meters long and 4 meters wide, which cost 45,000 rubles ($23,175), and one heavy lathe having a length of 12 meters and a diameter of head 1.3 meters, which cost 23,000 rubles ($11,845). There is one horizontal boring machine in service supplied by Sondermann & Stier, which cost 18,415 rubles ($9,483). The stroke of the borer of this machine is 6 feet 6 inches and the lift of the spindle 4 feet 3 inches. A radial drill supplied by the same firm cost 5,500 rubles ($2,832). A radial drill supplied by Schuchardt & Schutte, having a length of arm of 7 feet, cost 8,000 rubles ($4,120).

The prices paid for some of the important tools of foreign origin purchased by the Kolomna works within the last six years were as follows:

Name of maker.	Type and dimensions.	When purchased.	Price delivered in Golutvin.
Droop & Rein, Bielefeld	Lathe, height of center 40″	1906	$1,738
Do	Radial drill, spindle, 1¼″, lift 8″	1906	590
Do	Radial drill		1,687
Hartmann, Chemnitz	Lathes for axles (2), height of centers 18″, length 9′ 10″.	1906	2,626
Deutsch Niles Werke, Berlin	Lathes (2), height of center 18″, length 9′	1905	2,271
Reinecker, Chemnitz	Grinder, length 10¾″, height 12″	1905	1,493
Do	Lathes (7), height of center 9″, length 64″	1906	963
Leipzgier Werkzeugmaschinenfabrik.	Turret lathes (2), height of center 10″, length 48″.	1906	904
Weichelt, Mosnon	Lathe, height of center 7½″, length 38″	1906	404
Loreur, Oetlinger, Baden	Lathe, height of center 10″, length 84″	1906	1,336
Ludwig Loewe, Berlin	Lathe, height of center 15″, length 70″	1906	1,792
Do	Millers (2), height of center 7″, length 40″	1906	1,390
Do	Vertical borers (2), lift 5′ 6″	1907	6,154
Do	Turret lathe, height of center 10½″ length 4′	1906	1,519
Sondermann & Stier	Miller (and drill), stroke 6′ 6″, lift of spindle 4′ 3″.	1906	9,984
Ernst Schiess, Dusseldorf	Radial drill, spindle 4″, lift 18″	1903	1,988
Do	Lathe foreranks, height of center 48″	1903	2,522
Do	Lathe for crank shafts, height of center 24″, length 32′.	1902	6,476
Do	Lathe, height of center 26″, length 14′ 6″	1903	3,798
Do	Planer, stroke 8′ 4″	1906	5,768
Wm. Muir & Co., Manchester	Planer, stroke 14′ 6″	1906	3,801
Do	Slotter, lift 8″	1906	1,133

In the central power station there are three Curtiss turbine engines of 2,200 kilowatts, built by the Allgemeine Elektricitaetsgesellschaft, of Berlin, three engines made by the Willans & Robinson, of Rugby, England, and three steam engines made by Gebruder Sulzer, of Winterthur, Switzerland.

OPPORTUNITY FOR EXTENDING AMERICAN TRADE.

The writer was very strongly impressed with the fact that the value of American machine tools, in general, had not been brought home, or at any rate not successfully, at this great plant. Director Belonoschkin has in comparatively recent times become active manager of the plant. He is a man of high technical attainment, progressive, and laudably ambitious to make the Kolomna works second to none in point of efficiency and in economy of production. Such a manager will, in my opinion, warmly welcome any representation regarding machine tools that possess merit and afford economy in work. Director Belonoschkin speaks French fluently and possesses, in addition, engineers who are well versed in English. Under such circumstances there is no valid reason why the best American tools should not be made familiar at the Kolomna plant, provided American machine-tool houses see that this establishment is provided with the necessary literature. Before coming to the Kolomna works, Director Belonoschkin was on the staff of the great Putiloff works at St. Petersburg.

Recently there has been built a superb machine-erecting building. The material is steel and cement throughout, with all the modern features for light, sanitation, and heating. This new building will necessarily require new tools, although for the present Director Belonoschkin is under the necessity of installing many old machines from other portions of the works. That the plant has installed as many as 10 planers of the Gray type is sufficient proof that tools of merit are demanded, for from the information I have generally received the Gray machines are regarded as the most expensive American planers offered in Europe.

The Pneumatic Tool Company, of St. Petersburg, which is operated by an American, has succeeded in installing some compressors here, and pneumatic tools will also be ordered. Some of the best grades of American boring machines, radial drills, and vertical millers could with advantage be brought to the attention of the Kolomna management.

SHIPBUILDING DEPARTMENT.

The building of river steamers, barges, and dredges is an important feature of the Kolomna works, and not the less interesting because this shipbuilding is carried on in almost the center of European Russia. At this time of year (October, 1909) the Oka River is quite low. The writer expressed some astonishment at finding vessel hulls at considerable distance from the river banks and within apparently landlocked basins. The general director explained that by the time the vessels under construction were ready for launching, namely, in the spring of 1910, the Oka River would have a depth of fully 33 feet, and not only would the banks of the river reach the yard's limits, but the vessels would be lifted out of the basins by the rising of the stream. The spring freshets in central Russia generally greatly increase the depth of the streams.

Most of the vessels building at the Kolomna works are constructed for service on the Volga River and the Caspian Sea. The barges are especially designed for use in the transportation of crude oil and have two Diesel engines of 600 horsepower each. The writer observed one fine steel-hulled barge in course of construction, having a length

of 380 feet, an extreme beam of 46 feet, an extreme depth of hold of 25 feet, and with a carrying capacity of 4,000 tons of oil. The workmanship on this barge is of as high a character as will be found in the best American lake shipbuilding establishments.

In company with General Director Belonoschkin, the writer boarded one of the newly built river steamers lying in the Oka directly off the works. This vessel was constructed for towing purposes. It is a side-wheel steamer, and the writer understands that the price obtained was 265,000 rubles ($136,475). The principal dimensions of this vessel are: Length, 178 feet; width, 32 feet; depth of hold, 8 feet 6 inches; maximum draft of water with all stores on board, 3½ feet. There are two engines of the Diesel motor type of 800 horsepower. This vessel is designed to tow 2 barges, having a total capacity in the tow of 1,000,000 poods (pood = 36.112 pounds). The bar pull on the towing bitts is estimated to be 15½ tons. Director Belononschkin declared that the Diesel engines, using oil, are an ideal type for this kind of craft. The cost of operating these engines in service, when towing, is 0.4 kopek per horsepower per hour (ruble = 100 kopeks = 51½ cents).

The writer observed a second towing steamer, which had been prepared for transport down the Oka River, under the assistance of pontoons. The entire hull of the vessel was inclosed in balks in order to lighten the draft. This is necessary in order to take the craft over the shoals which exist in the river at this time of the year. Pneumatic tools were employed in the construction of this river barge, but no American pneumatic tools are in use.

CONSTRUCTION OF MOTORS—WAGE SCALE.

The building of Diesel motors is another important adjunct to this great plant, and I was particularly interested in some new features connected with the utilization of these Diesel engines in the central power station.

The average daily wages paid by the Kolomna works for various classes of mechanics are as follows:

Class of workmen.	Wages.	Class of workmen.	Wages.
	Rubles.		*Rubles.*
Lathe men	2.02	Radial-drill men	1.63
Milling-machine men	1.60	Grinding-machine men	1.20
Vise men	1.49	Planer hands	2.16
Turret-lathe men	2.02	Boring-mill men	1.89
Molders	1.31	Laborers	.70
Assembling men	2.26	Blacksmiths	2.00

NOTE.—The foregoing report was delayed in transmission and was received too late to be included in the monograph, "Machine-tool Trade in Austria-Hungary, Denmark, Russia, and Netherlands."

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