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No. 62 THE PRIMARY IRON AND STEEL INDUSTRY IN CANADA

Contents

Introductory Note

During the decade 1940-1950 Canadian primary iron and steel producers carried out an expansion without parallel in the history of the industry. Capacity in Canada increased 75 per cent compared with 66 per cent in the United States. During the war years, and with government assistance, $125 million was spent on repair and maintenance, erection of blast, open-hearth and electric furnaces and the expansion of steel-fabricating facilities. Between 1945 and 1950, capital expenditures were devoted generally to modernization of existing mills and to diversification of rolling mill and other finishing facilities, but nearly $60 million was spent on new plants as well. Among other results of these outlays were a new cold-strip mill, an electrolytic-tinning line and a mill for large-diameter pipe to serve some of the growing needs of the Canadian oil and gas industries. Other additions to plant were coke ovens and improved raw materials handling facilities. Repair and maintenance expenditures totalling $85 million were also made in the post-war period.

With the steel shortage which developed following the outbreak of fighting in Korea, the question of further additions to Canadian primary iron and steel-making capacity arose. The upshot has been that all four major producers undertook substantial new expansions. The Dominion Foundries and Steel Company at Hamilton, Ontario, has completed the installation of a blast furnace to produce 300 thousand tons a year and of coke ovens and shipping facilities, at an

estimated cost of $18 million. The Steel Company of Canada, also at Hamilton, Ontario, is currently engaged in a programme which includes erection of a 450 thousand-ton blast furnace, to be completed by the end of 1952, and 650 thousand tons of open-hearth steel-furnace capacity, which will be in full production by 1953. This, together with the necessary dock, storage and coke-oven facilities, will involve a total outlay upward of $45 million. Algoma Steel Corporation Limited at Sault Ste. Marie, Ontario, also has embarked upon an expansion plan which will add a combination mill capable of turning out products such as steel bars, reinforcing rods and skelp for the manufacture of welded pipe and tubing. Dominion Steel and Coal Corporation at Sydney, Nova Scotia, is also carrying forward a programme designed to give higher production. It includes electrification of rolling mills and the construction of steel-furnace capacity. This equipment should be in operation by 1953. New investments by the Quebec Iron and Titanium Company at Sorel, P.Q., include facilities for making pig iron as a by-product of titanium oxide from ilmenite ore. Full scale production of new metal may be reached in 1953.

When the announced plans are completed, capacity for production of pig iron will have increased 45 per cent over 1950; of steel ingots by 30 per cent over 1950; and of rolled and drawn products by 30 per cent over 1950.

This paper sketches the broad outlines of the present picture. In order that current developments may be the better appreciated, a brief historical sketch is included, as well as a certain amount of information on the principal sources of domestic demand for the output of iron and steel products. A technical presentation has been deliberately avoided.

Definition

For purposes of this paper, the "primary iron and steel industry" includes:

1) production of iron from iron ore, limestone, and coke in blast furnaces

2) refining of iron into steel in open-hearth furnaces, electric furnaces and Bessemer converters

3) semi-finishing operations, where the hot steel ingots are rolled into blooms, slabs and billets.

Incidental mention is made of some of the finishing-mill operations, where the semi-finished forms (blooms, slabs, billets) are further rolled or drawn into such "shapes" as railroad rails, structurals, plates, sheets, strips, bars, rods, wires, pipes and tubes.

For the sake of simplicity, cast-iron and cast-steel products are handled together with rolling-mill products. Foundry operations in the industry are nevertheless of significant proportions. Of all iron produced in Canada, about 20 per cent takes the form of foundry or malleable pig iron, the remainder (80 per cent) is "basic" iron used for charging steel furnaces. Of all steel made, 8 per cent is used for steel castings, and the balance (92 per cent) for rolled and drawn products.

Reference should be made at this point to the industry-flow chart appended to this paper.

Background of the Industry

Historical Sketch of the Industry

The production of primary iron and steel has been carried on for many years in Canada and is now one of the country's key industries. Practically all the pig iron and more than 2/3 of the rolled and drawn products consumed are produced here. Some 37 thousand persons make their living in Canadian primary mills. Industries which use these products, taken together, employ another 282 thousand people.

Manufacture of primary metal in Canada is not a recent development. Over 200 years ago ore was first smelted to make pig iron near Three Rivers in the Province of Quebec, and it is reported to have been the most important manufacturing industry during the Napoleonic Wars. In those days charcoal furnaces were used in Canada as elsewhere. Economic production could be carried on wherever there were deposits of iron ore and forests reasonably close together and reasonably near to local markets. Throughout the 19th Century similar operations were undertaken in other parts of Canada. Some were in Nova Scotia. Several were located in Eastern Ontario. It is interesting to note that large deposits of medium grade ore in this latter area are again attracting attention.

Although pig iron was being produced in volume in Canada during the last century, the manufacture of steel lagged behind that of other countries. The result was that imports of ingots, billets, slabs and bars began to rise soon after processes for making steel on a large scale were discovered and developed in the United Kingdom and Europe in the 1850's. There were several attempts to make primary metal in Canada, but for many years steel production was confined to the remelting of scrap. During the latter half of the 19th Century, the tendency was to erect finishing facilities to process shapes imported from abroad. A number of rolling and drawing mills were set up in order to make nails, nuts, bolts, rod and light bars for industries such as the construction and farm implements industries. Production of wire fencing and re-rolling of railway rails also became important in the 80's and 90's, when Canada's transcontinental railways were being built.

It was only at the turn of the century that modern-type blast furnaces and steel-making plants came into operation in Canada. The period from then until 1913 witnessed the establishment of all four present-day major producers. Steel output rose rapidly to meet the needs of a swiftly growing economy, particularly to meet the demand for rails and for light plate and structurals to be used in building railway rolling stock. In the Maritime Provinces export trade also became an important outlet for the industry. Primary operations began to be concentrated in a few large industrial centres and ownership of finishing plants scattered across the country gradually passed into the hands of the larger mills.

During World War I demand for heavy gun forgings and castings as well as for rolling-mill products required in the manufacture of munitions kept Canadian producers operating at capacity. New installations resulted in an output of 1.9 million tons of steel ingots and castings in 1918, compared

with only 26 thousand tons in 1900, and 822 thousand tons as late as 1910. This high level of 1.9 million tons in 1918 was only exceeded after the outbreak of hostilities in 1939.

During the inter-war period the pattern for consumption of iron and steel products changed notably. The rapid rise of the motor-vehicle industry and development of the nation's hydro-electric power resources provided new uses for Canadian metal. Sales to mines and to farm and industrial-machinery producers also increased. Numerous multi-purpose steel alloys were developed. However, in the early 1930's, the decline in general business conditions seriously affected operations of the industry. Output fell rapidly after 1929, and for four consecutive years steel furnaces, taken as a whole, operated far below capacity.

After the outbreak of the Second World War the level of activity in the industry rapidly rose and it again began to expand. By 1942 domestic output had reached a record rate of 2.9 million ingot tons annually. Between 1942 and 1950 expansion was highly selective. Open-hearth and electric furnace capacity each increased by about 200 thousand tons. During these years more and more emphasis was placed upon modernization and on adding rolling mill and other fabricating facilities to permit greater integration and more effective operation of existing plants.

As a result of these outlays, Canada is now self-sufficient in tin plate. Production of cold-rolled strip, large-diameter oil and gas-line pipe, specialty alloys and stainless-steel sheet is also being carried out in this country on a large scale. Other items such as rail, bar, rod and wire products, as well as hot-rolled plate and sheet in certain widths are important products of Canadian mills.

Imports tend to be confined to products which are not made in quantity here. These include large items beyond the capacity of Canadian mills; Bessemer skelp for the production of pipe, special steel sheet material for large transmission towers, and certain wire products, forgings and castings. The tightness in steel since mid-1950 has occurred mainly in these products, including hundreds of shapes, many of which require expensive processing equipment for their manufacture. Such items are usually made to meet customers' specifications, and very large sums of money would have to be invested in new plant and equipment if Canadian mills were to attempt to produce <u>all</u> of the many varieties of steel which are now brought into the country.

<u>Structure of the Industry</u>

The Canadian steel industry is currently operating the following plants: 412 coke ovens, with an annual rated capacity of 2.6 million tons; 15 blast furnaces with an annual rated capacity of 3.0 million tons; 76 electric steel furnaces with a rated capacity of 690 thousand tons; five blooming mills; five billet mills; numerous bar mills and galvanizing units and many subsidiary plants producing tacks, nails, screws, rivets, bolts, wire, wire products, forgings, pipes and a wide range of associated steel products.

The structure of the industry is largely determined by the degree of integration from raw materials to rolling and drawing mills. In all, there are 13 primary manufacturers in

Canada. The "big four" include the Dominion Steel and Coal Corporation, Sydney, N.S.; the Steel Co. of Canada and the Dominion Foundries and Steel Co., both in Hamilton; and Algoma Steel Corporation at Sault Ste. Marie, Ontario. They account for nearly all of the nation's ingot output. These mills collectively combine all processing stages from pig-iron production to the manufacture of flat-rolled and wire products. Canadian Furnace Ltd., wholly owned by Algoma Steel Corporation, at Port Colborne, Ontario, produces pig iron only. Another six smaller companies make steel for rolling from scrap, as they have no blast-furnace facilities. These are located at Montreal and Sherbrooke in Quebec; Welland and Hamilton in Ontario; Selkirk, Manitoba; and Vancouver, British Columbia. Two other companies located in Hamilton, Ontario, operate only cold-rolling mills.

Canadian iron-ore and coal reserves are very large. However, the major coal deposits lie far to the east and west of the principal industrial centres. Iron-ore mines now operating on the Canadian side of the Great Lakes have only been opened up in recent years and supplies from Quebec-Labrador will probably not be available before 1954 or 1955. Availability of these resources has, as yet, had little influence on the structure of the industry. American iron and coal resources have been more centrally located and southern Ontario firms are still drawing most of their raw materials from mines which they own in the United States. Dominion Steel and Coal Corporation at Sydney is an exception. It obtains iron ore from its Wabana mines in Newfoundland and coal from collieries close to its steel plant on Cape Breton Island.

The mills in southern Ontario are able to use cheap water transportation for their raw materials. They have the advantage of ready access to industrial markets in central Quebec and Ontario and a large local supply of scrap metal. The mills at Sault Ste. Marie and Dominion Steel and Coal Corporation are at a disadvantage in this respect. Since they were organized primarily to serve the market for rails during the period of railway construction, they encountered difficulties when this demand largely disappeared. Local raw materials have involved many mining and metallurgical problems. When the Sydney plant was built it was the intention it would also enter the overseas export markets.

Canadian Steel Consumption

Canadian consumption of primary steel as such has been rising for many years. In 1900, it was less than 15 lbs. per person (ingot equivalent). By 1920, it had risen to 350 lbs. and, in 1939, it was 335 lbs. Per capita consumption in 1950 was approximately 675 lbs.

These figures are well below those reported in the United States and are in the same order as those for Great Britain. In 1950 per capita usage in the U.S. was 1,200 lbs. and in the U.K. it was 630 lbs. The apparently low rate of consumption in Canada relative to the U.S. is partly explained by the fact that considerable tonnages of steel are imported in the form of production parts and finished goods such as vehicles and machinery and equipment. When allowances are made for this, per capita consumption in Canada is found to be in the order of 950 lbs. a year.

The following table compares the distribution of primary shapes between major steel using industries in Canada, the U.S. and the U.K. for 1949. It illustrates the dependence of the Canadian primary iron and steel industry on the railways and the construction industry. Motor vehicles and machinery are less important due to the importation of finished parts. Mining concerns also obtain a large percentage of their supplies from foreign sources.

TABLE I

Year 1949

Per Cent

Industry	Canada	U.S.A.	U.K.
Construction	28	17	13
Railway Rolling Stock & operating	20	8	8
Other Machinery and Equipment	11	12	23
Mining (including gas & oil)	8	10	8
Containers	8	9	7
Motor Vehicles	6	22	10
Electrical Machinery & Equipment	5	9	6
Shipbuilding	2	1	9
All Other	12	12	16
TOTAL	100	100	100

Over the last 50 years, the long-term rate of growth in Canadian demand for primary iron and steel has been in the order of 4 per cent per annum. Therefore, if it is assumed that this trend will continue over the next 10 years, domestic requirements in 1960 will be around 4.5 million tons of rolling-mill products or 1.3 million tons greater than they were in 1950. When new demands arising out of defence and resource-development programmes, and greater participation in the consumer-durables field, are also taken into account, these estimates of future requirements appear to be on the conservative side.

The following table outlines the relative importance of domestic production, imports and exports of primary iron and steel since 1939:(1)

Note: (1) It includes value of all primary products including iron, steel castings and steel rolling mill products.

TABLE II

Value in $ Millions

Year	Domestic Production (2)	Imports	Exports	Domestic Supply
1939	76	39	9	106
1942 (war peak)	213	108	7	314
1946	134	72	14	192
1947	176	105	18	263
1948	231	124	31	324
1949	253	150	29	374
1950	274	149	34	389
1951	325	253	20	558

In recent years, expansion of Canadian plant has improved the relations between capacities at various stages in primary iron and steel manufacture. However, certain significant imbalances remain. For example, steel ingot capacity of several producers exceeds that of their rolling mills.

The completion in 1952 of four new open-hearth furnaces capable of producing 650 thousand tons of steel ingot a year and the erection of new rolling facilities in 1952 and 1953 will bring primary and secondary capacity into much better balance.

Effective blast-furnace capacity may also be considered insufficient in relation to steel output. However, deficiencies in pig iron output have been made up by the extensive use of scrap for re-melting. This difficulty will largely be overcome when the new capacity now under installation is completed.

Current Situation

Pig Iron

The following table outlines Canadian production, imports, and exports of pig iron since 1939:

TABLE III

Thousands of Tons*

Year	Production	Imports	Exports	Domestic Supply
1939	846	1	12	835
1942 (war peak)	1,975	1	--	1,976
1946	1,406	12	1	1,417
1947	1,963	9	1	1,971
1948	2,126	7	1	2,132
1949	2,154	21	13	2,162
1950	2,310	30	195	2,145
1951	2,553	15	224	2,344

* Short tons are used throughout this paper

The total supply of pig iron reached a peak in 1949, when twelve Canadian blast furnaces turned out nearly 2.2 million tons of new metal. Since then, domestic output has risen further. Imports, which are relatively small, have also increased. Exports rose sharply in the period between April and December 1950 when government controls were not in effect. As a result, the domestic supply of pig iron for the year as a whole was slightly lower than in 1949.

In 1951, domestic production of pig iron reached a new high, due to fuller utilization of existing capacity and due to the introduction of a new 300-thousand-ton-a-year blast furnace at Hamilton. Another 450-thousand-ton-a-year blast furnace to be built at the Steel Company of Canada will not be producing iron until late in 1952. Pig iron is also a by-product of the smelting of titanium ores. It is expected that production from the new plant at Sorel, Quebec, will reach 175 thousand tons annually in a few years time. However, little will be available from this source in the immediate future. Exports in 1952 are likely to be at about the same level as last year. In spite of the improvement in supply the requirements of the defence, defence-supporting, and resource development programmes will cause an increase in the current pressure on scrap.

As was mentioned earlier, in recent years approximately 80 per cent of the pig iron consumed in Canada has been charged to steel furnaces. The remaining 20 per cent has been divided almost equally between foundry and malleable pig iron used in the manufacture of castings. Only a relatively small proportion of the basic pig iron made by the primary steel industry is sold to other steel-using industries. On the other hand, very little of the foundry and malleable pig iron is used directly by the primary producers themselves.

Demand for basic pig iron, which remained virtually unchanged from 1947 up until the middle of 1950, has since shown a moderate increase. In 1951, an additional 300 thousand tons were needed to support a higher level of domestic steel production.

Canadian consumption of foundry and malleable pig iron has varied much more widely over the past few years. In the years from 1946 to 1948, manufacturers of farm implements, industrial machinery and railway rolling stock were increasing their output. Therefore their consumption of pig iron rose steadily throughout this period. In 1949 and the first half of 1950, demand from these industries declined. However, with the exception of farm machinery, this trend has again been reversed. Throughout the post-war period, consumption in plants making sanitary ware and cooking and heating equipment has continued steadily upward. In 1951, increased demands were encountered in most of these industries.

Overall demand for pig iron of all types in 1952 is likely to be several hundred thousand tons greater than in 1951. These increased needs are being met by additional production in this country.

Steel Castings

Canadian firms make the bulk of the rough steel castings used here. In 1942, they produced 151 thousand tons, mostly in electric furnaces. Post-war output reached a peak of 113 thousand tons in 1948. Thereafter it declined, due largely to reduced operations in the railway rolling stock industry. Production in 1950 was only 71 thousand tons; in 1951, 121 thousand tons.

Rolling Mill Products

The following table outlines Canadian production, imports and exports of rolling mill products in recent years:(1)

Thousands of Product Tons

Year	Canadian Production (2)	Imports	Exports	Domestic Supply
1939	1,080	463	179	1,364
1942 (war peak)	2,145	1,452	87	3,510
1946	1,633	722	194	2,161
1947	2,070	907	188	2,789
1948	2,246	949	277	2,918
1949	2,240	1,169	231	3,178
1950	2,391	1,067	238	3,220
1951	2,498	1,613	84	4,027

(1) These figures do not include steel castings

Expressed in ingot tons equivalent the preceding table would read:

Thousands of Ingot Tons*

Year	Canadian Production	Imports	Exports	Domestic Supply
1939	1,490	638	247	1,881
1942 (war peak)	2,959	2,002	120	4,841
1946	2,252	995	268	2,979
1947	2,855	1,251	259	3,847
1948	3,099	1,309	382	4,026
1949	3,089	1,612	319	4,382
1950	3,298	1,472	327	4,443
1951	3,446	2,225	116	5,555

* About 27.5% of ingot weight becomes process scrap before the finished product leaves the plant. i.e., of every 100 ingot tons 72.5 finished product tons emerge.

A decided improvement in the supply of rolling-mill products occurred in 1951. Canadian production increased by nearly 160 thousand tons over the previous year due to the adoption of improved smelting and fabricating techniques and the re-opening of marginal plant. Exports were reduced substantially. As of January 1951, exports of semi-finished steel for further processing were prohibited except in special circumstances. Increased imports also helped substantially to improve the Canadian supply position last year.

Canadian demand for rolling-mill products has been growing steadily in recent years. In 1949 and 1950 the supply was not increasing at a comparable rate. This is the principal reason why inventories were drawn down during the latter half of 1950.

The pattern of consumption of steel by end-use industries has also been changing significantly in recent years. Between 1949 and 1950, consumption of rolling-mill products declined in the farm machinery, railway rolling stock and shipbuilding industries. At the same time, demand from firms making motor vehicles, electrical apparatus and consumer durables increased. Larger tonnages were also required for the construction of oil pipelines and refineries, and for petroleum and natural gas exploration and development. Usage of steel also increased in mines and smelters, in railway operations, in electric-power development and in the construction of industrial and commercial buildings, and for public works.

In 1951 different trends were established. The principal increases in consumption took place in defence, defence-supporting and resource-development industries. Manufacturers of railway rolling-stock, motor vehicles and electrical and other machinery and equipment, as well as shipbuilding yards, took tonnages substantially above those consumed the preceding year. Increased investment in construction of new manufacturing plants (including oil refineries and smelters), electric power projects and railways have raised total Canadian steel requirements. In the petroleum and natural gas industries completion of the major pipeline projects has more than offset increased demands for oilwell pipe casing arising out of the accelerated development programme. Declines in consumption of steel were confined to housing and the construction of commercial buildings.

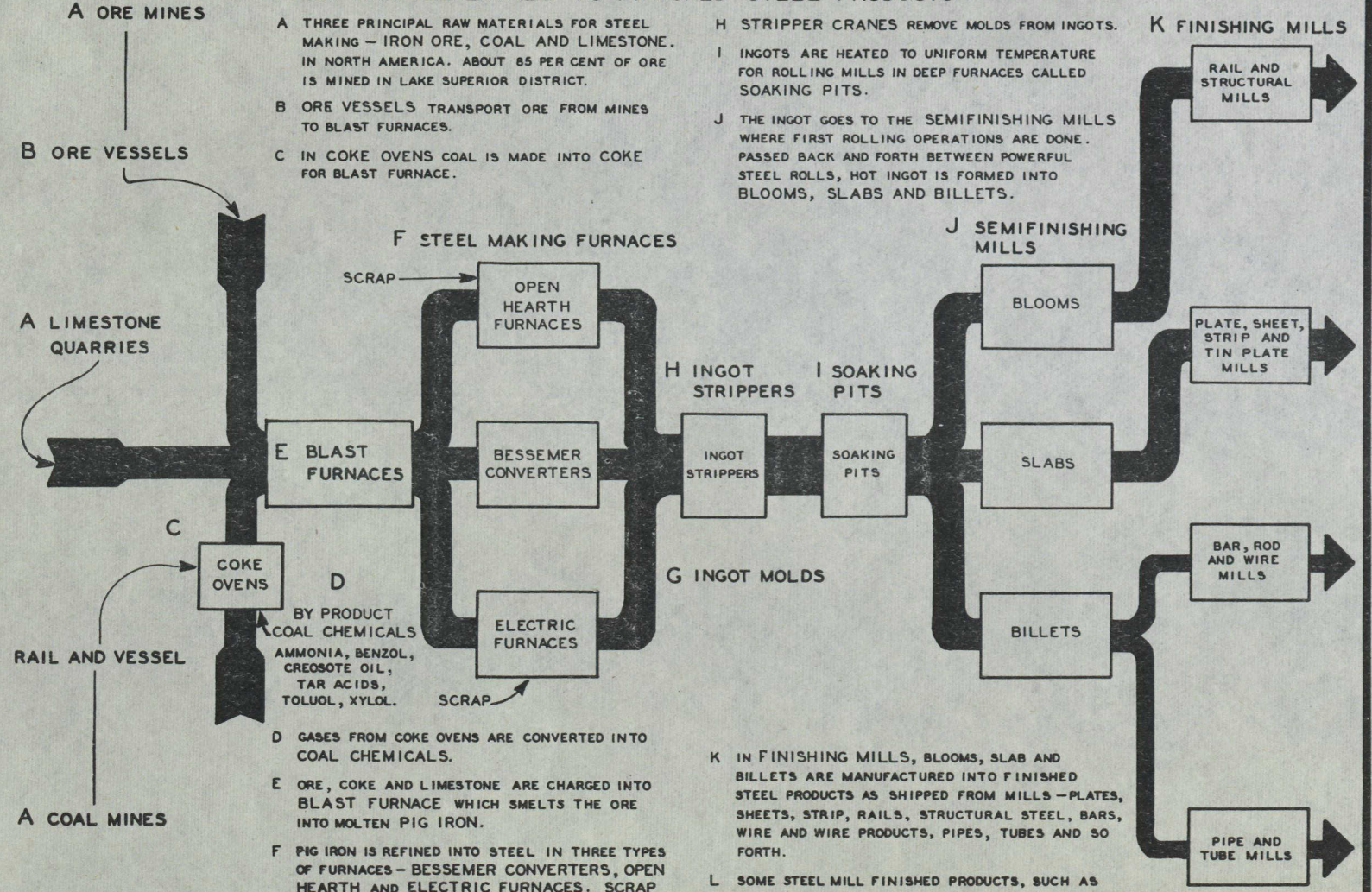
While total figures for the current year indicate a decided improvement in the steel-supply situation, this is not true of all types of steel. Requirements of structural steel, re-inforcing bar and plate has so far been running ahead of supply. In the case of large structural-steel sections and heavy plate, Canada's dependence on imports has presented particular difficulty in procurement. The demand for re-inforcing bars produced largely by Canadian mills is also greater than supply due to the heavy dependence of the defence and defence-supporting programmes on re-enforced concrete for construction purposes.

RP/A

June, 1952.

STEEL MAKING

FROM RAW MATERIALS TO FINISHED STEEL PRODUCTS



A THREE PRINCIPAL RAW MATERIALS FOR STEEL MAKING — IRON ORE, COAL AND LIMESTONE. IN NORTH AMERICA. ABOUT 85 PER CENT OF ORE IS MINED IN LAKE SUPERIOR DISTRICT.

B ORE VESSELS TRANSPORT ORE FROM MINES TO BLAST FURNACES.

C IN COKE OVENS COAL IS MADE INTO COKE FOR BLAST FURNACE.

D GASES FROM COKE OVENS ARE CONVERTED INTO COAL CHEMICALS.

E ORE, COKE AND LIMESTONE ARE CHARGED INTO BLAST FURNACE WHICH SMELTS THE ORE INTO MOLTEN PIG IRON.

F PIG IRON IS REFINED INTO STEEL IN THREE TYPES OF FURNACES — BESSEMER CONVERTERS, OPEN HEARTH AND ELECTRIC FURNACES. SCRAP IS USED IN LAST TWO.

G MOLTEN STEEL FROM THE FURNACES IS TEEMED INTO INGOT MOLDS, WHERE STEEL SOLIDIFIES INTO INGOTS.

H STRIPPER CRANES REMOVE MOLDS FROM INGOTS.

I INGOTS ARE HEATED TO UNIFORM TEMPERATURE FOR ROLLING MILLS IN DEEP FURNACES CALLED SOAKING PITS.

J THE INGOT GOES TO THE SEMIFINISHING MILLS WHERE FIRST ROLLING OPERATIONS ARE DONE. PASSED BACK AND FORTH BETWEEN POWERFUL STEEL ROLLS, HOT INGOT IS FORMED INTO BLOOMS, SLABS AND BILLETS.

K IN FINISHING MILLS, BLOOMS, SLAB AND BILLETS ARE MANUFACTURED INTO FINISHED STEEL PRODUCTS AS SHIPPED FROM MILLS — PLATES, SHEETS, STRIP, RAILS, STRUCTURAL STEEL, BARS, WIRE AND WIRE PRODUCTS, PIPES, TUBES AND SO FORTH.

L SOME STEEL MILL FINISHED PRODUCTS, SUCH AS RAILS, RAILROAD WHEELS AND AXLES, NAILS AND WIRE FENCE ARE READY FOR USE. BUT MOST PRODUCTS SHIPPED FROM STEEL MILLS ARE MANUFACTURED BY OTHER INDUSTRIES INTO THOUSANDS OF PRODUCTS.

L

SOME MANUFACTURED STEEL PRODUCTS

RAILS AND STRUCTURAL STEEL

RAILS, BRIDGES, BUILDING, SHIPS AND MACHINERY, ELECTRICAL TRANSMISSION TOWERS, RAILROAD CARS AND LOCOMOTIVES

PLATE, SHEET, STRIP AND TIN PLATE

AUTOMOBILES, SHIPS, OIL REFINERY TANKS, REFRIGERATORS, WASHING MACHINES, STOVES, DRUG, CHEMICAL AND PAPER MANUFACTURING EQUIPMENT, AIRCRAFT, FURNITURE, TOYS, LICENSE PLATES, TOASTERS, FARM MACHINERY AND IMPLEMENTS, SURGICAL, MEDICAL, DENTAL EQUIPMENT, TIN CANS, GALVANIZED PAILS, DRUMS, ROOFING, RURAL MAIL BOXES, TERNE PLATE ROOFING, AUTO FUEL TANKS

BAR, ROD AND WIRE

(BARS)

AUTOMOBILES, MACHINERY, HARDWARE, TOOLS, FARM MACHINERY, REINFORCED CONCRETE, TIRE RIMS

(WIRE)

WIRE, SPRINGS, FENCE, NAILS, NUTS AND BOLTS, SCREENS, ROPE AND CABLE, COAT HANGERS, PAPER CLIPS, PINS AND NEEDLES, STRINGS FOR PIANOS AND OTHER MUSICAL INSTRUMENTS

PIPES AND TUBES

AUTOMOBILES, AIRCRAFT, OIL WELL EQUIPMENT, OIL REFINERIES, OIL, GAS AND WATER LINES, REFRIGERATION PLANTS, BOILERS IN SHIPS AND LOCOMOTIVES, FURNITURE, SHIP MASTS, BICYCLES, BEARING RACES, FLAG, TELEPHONE AND TELEGRAPH POLES

ECONOMIC RESEARCH DIVISION, DEPT. OF TRADE AND COMMERCE.