Iron and Steel

By Robert A. Whitman[1]

Contents

Records in shipments of steel mill products, in steel ingot production, and in output and shipments of pig iron were established in 1965. More than 92 million tons of steel mill products was shipped by the steel industry, or 70 percent of the 131 million tons of steel ingots produced.

Steel production in basic oxygen converters increased 48 percent, and shipments of merchant pig iron gained 6 percent over those of 1964. Consumption of over 81 million tons of pig iron in steelmaking furnaces constituted about 54 percent of the total metallics charged to steel furnaces.

The threat of a strike kept the steel industry producing at near capacity for the first 8 months of 1965. Excess inventory accumulated in anticipation of a strike, had been sufficiently reduced by December so that production was increasing. The annual production and shipment totals reflect a real increase in demand over that of 1964.

[1] Commodity specialist, Division of Minerals.

Table 1.—Salient iron and steel statistics

(Thousand short tons)

	1956–60 (average)	1961	1962	1963	1964	1965
United States:						
Pig iron:						
Production	67,460	64,853	65,638	71,840	85,458	88,207
Shipments	67,155	65,307	65,727	72,211	85,693	88,391
Imports for consumption	359	377	500	645	736	880
Exports	275	416	154	70	176	28
Steel:[1]						
Production of ingots and castings (all grades):						
Carbon	92,537	89,338	89,160	98,714	114,442	116,651
Stainless	1,067	1,137	1,085	1,204	1,443	1,493
All other alloy	7,579	7,539	8,083	9,343	11,191	13,318
Total	101,183	98,014	98,328	109,261	127,076	131,462
Index (1956–60) = 100	100.0	96.9	97.2	108.0	125.6	130.0
Total shipments of steel mill products	72,717	66,126	70,552	75,555	84,945	92,666
Exports of major iron and steel products	3,822	2,221	2,266	2,670	r 4,065	2,888
Imports of major iron and steel products[2]	2,556	3,308	4,297	5,637	r 6,630	10,691
World production:						
Pig iron[3]	240,907	282,596	292,525	310,363	351,034	370,065
Steel ingots and castings	330,310	387,560	397,000	426,570	482,570	507,540

r Revised.
[1] American Iron and Steel Institute.
[2] Data not comparable for all years.
[3] Includes ferroalloys.

The steel industry paid over $5.5 billion in wages and salaries in 1965. The net billing value of products shipped was over $17.7 billion compared with the $16.2 million in 1964.

Trends and Developments.—Steel companies reactivated obsolete equipment in order to keep up with the demand. This equipment was inefficient and costly to operate, with low productivity. After the successful labor negotiations the rapid decline in orders led to a corresponding cutback in production. Reactivated equipment was the first to be eliminated, then nonprofitable marginal equipment was the next to be closed.

The steel industry spent over $1.8 billion, both for modernization such as new basic oxygen converters, continuous casting, vacuum degassing, and related control equipment and for new plants. The industry announced plans for new plants in the Midwest and dedicated one at Burns Harbor, Ind.

Table 2.—Pig iron produced and shipped in the United States, by States

(Thousand short tons and thousand dollars)

State	Produced		Shipped from furnaces			
	1964	1965	1964		1965	
	Quantity		Quantity	Value	Quantity	Value
Alabama	4,321	4,296	4,353	$234,346	4,346	$234,944
Illinois	5,671	6,293	5,579	322,098	6,407	361,819
Indiana	11,511	11,081	11,483	658,162	11,071	621,604
Ohio	15,163	15,298	15,355	925,078	15,251	905,459
Pennsylvania	20,986	21,847	21,005	1,207,869	21,898	1,235,522
California, Colorado, Utah	4,726	4,886	4,739	276,743	4,886	285,115
Kentucky, Maryland, Texas, West Virginia	10,582	10,899	10,641	636,785	10,930	629,268
Michigan and Minnesota	7,387	7,537	7,405	409,657	7,511	416,248
New York	5,111	6,070	5,133	320,568	6,091	349,031
Total	85,458	88,207	85,693	4,991,306	88,391	5,039,010

PRODUCTION AND SHIPMENTS OF PIG IRON

There were 85 blast furnaces out of production at the end of 1965, reflecting the lack of orders during the fall months after the labor agreement. There were three fewer blast furnaces on January 1, 1966, and the average production per blast furnace day was 1,434 tons, according to the American Iron and Steel Institute (AISI). Production of pig iron was up 3 percent for a new record. Pennsylvania, Ohio, and Indiana produced 55 percent of the pig iron.

Metalliferous Materials Consumed in Blast Furnaces.—Nearly 1 million tons less domestic ore, 1.6 million tons more foreign ore, and over 3.6 million tons more agglomerates were used in 1965 to produce 2.75 million tons more pig iron than in 1964. The total of metalliferous materials decreased 22 pounds per ton of pig iron produced. The amount of fluxes used per ton of pig iron produced again increased, this year by 16 pounds.

The quantity of sinter and self-fluxing sinter declined to 40 million tons and 13.4 million tons respectively. There were 28.1 million tons of pellets, 1.8 million tons of unclassified agglomerates, 6.4 million tons of foreign agglomerates, and 38,000 tons of nodules used in blast furnaces.

Blast furnace consumption of oxygen increased 0.6 billion cubic feet to a total of 9.5 billion cubic feet. This was from a revised 1964 consumption figure of 8.9 billion cubic feet, according to AISI.

According to data collected by the Bureau of Mines, blast furnaces consumed 44.8 billion cubic feet of natural gas, an increase of 10 percent over that of 1964. There were 3.1 billion cubic feet of coke-oven gas used and 55.6 million gallons of oil, a 19-percent increase. In addition there were 20,369 tons of coal used in blast furnaces in 1965.

Table 3.—Foreign iron ore and manganiferous iron ore consumed in manufacturing pig iron in the United States, by source of ore

(Short tons)

Source	1964	1965 [1]
Brazil	188,745	450,487
Canada	4,658,880	5,821,137
Chile	1,169,654	1,474,125
Peru	354,326	648,896
Venezuela	5,779,531	5,382,452
Other countries	1,148,522	1,107,989
Total	13,299,658	14,885,086

[1] Excludes 25,271,802 tons used in making agglomerates.

Table 4.—Pig iron shipped from blast furnaces in the United States, by grades [1]
(Thousand short tons and thousand dollars)

Grade	1964 Quantity	1964 Value Total	1964 Value Average per ton	1965 Quantity	1965 Value Total	1965 Value Average per ton
Foundry	1,761	$95,984	$54.51	1,664	91,106	$54.75
Basic	78,003	4,546,819	58.29	79,979	4,554,584	56.95
Bessemer	2,789	165,308	59.27	2,703	153,798	56.90
Low-phosphorus	325	19,436	59.80	749	45,595	60.87
Malleable	2,523	146,810	58.19	2,940	173,425	58.99
All other (not ferroalloys)	292	16,949	58.04	356	20,502	57.59
Total	85,693	4,991,306	58.25	88,391	5,039,010	57.01

[1] Includes pig iron transferred directly to steel furnaces at same site.

Table 5.—Number of blast furnaces (including ferroalloy blast furnaces) in the United States, by States

State	January 1, 1965 In blast	January 1, 1965 Out of blast	January 1, 1965 Total	January 1, 1966 In blast	January 1, 1966 Out of blast	January 1, 1966 Total
Alabama	16	3	19	9	10	19
California	4	---	4	4	---	4
Colorado	3	1	4	4	---	4
Illinois	16	6	22	12	10	22
Indiana	21	2	23	21	2	23
Kentucky	2	1	3	2	1	3
Maryland	10	---	10	7	3	10
Michigan	9	---	9	9	---	9
Minnesota	2	---	2	1	1	2
New York	12	3	15	11	4	15
Ohio	36	13	49	26	23	49
Pennsylvania	50	13	63	37	23	60
Tennessee	---	3	3	---	3	3
Texas	2	---	2	2	---	2
Utah	3	2	5	2	3	5
Virginia	1	1	2	1	1	2
West Virginia	4	---	4	3	1	4
Total	191	48	239	151	85	236

Source: American Iron and Steel Institute.

PRODUCTION AND SHIPMENTS OF STEEL

The high rate of increase in oxygen steelmaking continued in 1965. Over 17 percent of a record 131.5 million-ton steel output was made in the converters. Open hearth production decreased to 72 percent and electric furnaces accounted for just over 10 percent. The Great Lakes steelmaking belt of Pennsylvania with 24 percent; Ohio, 17 percent; Indiana, 13 percent; Illinois, 9 percent; and Michigan, 7 percent again accounted for 70 percent of crude ingot production.

Steel shipments were over 92 million tons in 1965. There was very little change in market percentages.

Alloy Steel.[2]—There was a 19-percent increase in alloy steel production in 1965 to 13.3 million tons. Stainless steel production increased a little over 3 percent to 1.5 million tons. These figures include 67,000 tons of alloy steel and 1,500 tons of stain-

[2] The Bureau of Mines uses the American Iron and Steel Institute specifications for alloy steels, which include stainless and any other steel containing one or more of the following elements in the designated percentages: Manganese in excess of 1.65 percent, silicon in excess of 0.60 percent, and copper in excess of 0.60 percent. The specifications also include steel containing the following elements in any quantity specified or known to have been added to obtain a desired alloying effect: Aluminum, boron, chromium, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, and other alloying elements.

Stainless steel includes all grades of steel that contain 10 percent or more of chromium with or without other alloys or a minium combined content of 18 percent of chromium with other alloys. Valve or bearing steels, high-temperature alloys, or electrical grades with analyses meeting the definition for stainless steels are included. All tool-steel grades are excluded.

Heat-resisting steel includes all steel containing 4 percent or more but less than 10 percent of chromium (excluding tool-steel grades).

Table 6.—Iron ore and other metallic materials, coke and fluxes consumed and pig iron produced in the United States, by States

(Short tons)

Year and State	Metalliferous materials consumed							Net coke	Fluxes	Pig iron produced	Metalliferous materials consumed per ton of pig iron made				Coke and fluxes consumed per ton of pig iron	
	Iron and manganiferous ores: Domestic	Iron and manganiferous ores: Foreign	Agglomerates	Net ores and agglomerates [1]	Net scrap [2]	Miscellaneous [3]	Net total				Net ores and agglomerates [1]	Net scrap [2]	Miscellaneous [3]	Total	Net coke	Fluxes
1964:																
Alabama	2,484,443	1,548,083	3,594,910	7,422,462	111,397	55,286	7,589,145	3,649,460	1,079,896	4,320,973	1.718	0.026	0.013	1.756	0.845	0.250
Illinois	4,236,471	(4)	5,220,224	9,022,912	345,039	514,480	9,882,431	3,983,486	1,258,201	5,671,009	1.591	.061	.091	1.743	.702	.222
Indiana	6,555,950	1,156,253	11,523,887	18,205,533	207,269	1,488,275	19,901,077	7,339,461	1,638,002	11,511,028	1.582	.018	.129	1.729	.638	.142
Ohio	6,159,946	1,753,649	14,673,231	21,713,499	1,320,517	1,704,666	24,738,682	9,977,842	3,654,148	15,163,176	1.432	.087	.112	1.632	.658	.241
Pennsylvania	7,857,245	4,048,268	19,781,888	30,825,959	1,059,531	2,423,251	34,308,741	13,455,012	3,585,231	20,986,345	1.469	.050	.115	1.635	.641	.171
California, Colorado, Utah	W	W	4,636,842	8,009,805	991,490	149,258	9,150,553	2,755,970	811,013	4,726,261	1.695	.210	.032	1.936	.583	.172
Kentucky, Maryland, Tennessee, Texas, West Virginia	1,962,501	3,897,716	11,184,176	16,413,990	278,158	1,019,137	17,711,285	6,796,548	1,511,766	10,581,928	1.551	.026	.096	1.674	.642	.143
Michigan and Minnesota	W	W	9,653,049	11,576,902	183,691	348,503	12,109,096	4,573,939	1,479,034	7,386,353	1.567	.025	.047	1.639	.619	.200
New York	1,464,287	645,529	5,897,949	7,767,468	133,326	464,018	8,364,812	3,250,092	1,334,387	5,111,326	1.520	.026	.091	1.636	.636	.261
Total	36,218,021	13,299,658	86,166,156	130,958,530	4,630,418	8,166,874	143,755,822	55,781,720	[4]16,351,678	85,458,399	1.532	.054	.096	1.682	.653	.191

1965:																
Alabama	2,115,483	1,791,493	3,461,985	7,153,044	137,954	46,346	7,337,344	3,664,482	1,122,968	4,296,226	1.665	0.032	0.011	1.708	0.853	0.261
Illinois	4,497,663	W	5,875,992	9,967,880	459,250	693,497	11,120,627	4,463,283	1,381,357	6,292,875	1.584	.073	.110	1.767	.709	.220
Indiana	5,711,891	1,666,213	11,199,282	17,860,400	150,206	1,089,546	19,100,152	6,763,985	1,500,324	11,081,335	1.612	.014	.098	1.724	.610	.135
Ohio	5,817,988	1,652,661	15,154,025	21,726,721	1,390,696	1,733,758	24,851,175	9,688,599	3,890,954	15,298,402	1.420	.091	.113	1.624	.633	.254
Pennsylvania	7,765,836	5,015,439	20,484,822	32,276,885	1,034,579	2,087,893	35,399,357	14,869,045	3,923,875	21,846,537	1.477	.047	.096	1.620	.681	.180
California, Colorado, Utah	W	------	4,843,540	8,353,969	928,568	179,383	9,461,920	2,925,131	896,812	4,885,494	1.710	.190	.037	1.937	.599	.183
Maryland, West Virginia, Kentucky, Texas	W	3,644,590	12,106,987	17,261,548	204,524	962,189	18,428,261	6,919,127	1,643,082	10,898,750	1.584	.019	.088	1.691	.635	.151
Michigan, Minnesota	W	W	10,341,189	11,482,138	174,351	178,815	11,835,304	4,523,336	1,520,731	7,536,531	1.523	.023	.024	1.570	.600	.202
New York	2,325,208	937,629	6,343,750	9,246,939	218,126	363,764	9,828,829	3,937,979	1,641,613	6,070,404	1.523	.036	.060	1.619	.649	.270
Total	35,273,683	14,885,086	89,811,572	135,329,524	4,698,254	7,335,191	147,362,969	57,754,967	[5]17,520,716	88,206,554	1.534	.054	.083	1.671	.655	.199

W Withheld to avoid disclosing individual company confidential data; included with "Total".

[1] Net ores and agglomerates equal ores plus agglomerates plus flue dust used minus flue dust recovered.

[2] Excludes home scrap produced at blast furnaces.

[3] Does not include recycled material.

[4] Fluxes consisted of 10,743,800 tons of limestone and 5,607,878 tons of dolomite, excluding 4,876,636 tons of limestone and 1,820,229 tons of dolomite used in agglomerate production at or near steel plants and an unknown quantity used in making agglomerates at mines.

[5] Fluxes consisted of 11,130,961 tons of limestone, 5,748,892 tons of dolomite, and 640,863 tons of other fluxes, excluding 4,593,166 tons of limestone, 2,189,606 tons of dolomite, and 261,689 tons of other fluxes used in agglomerate production at or near steel plants and an unknown quantity used in making agglomerates at mines.

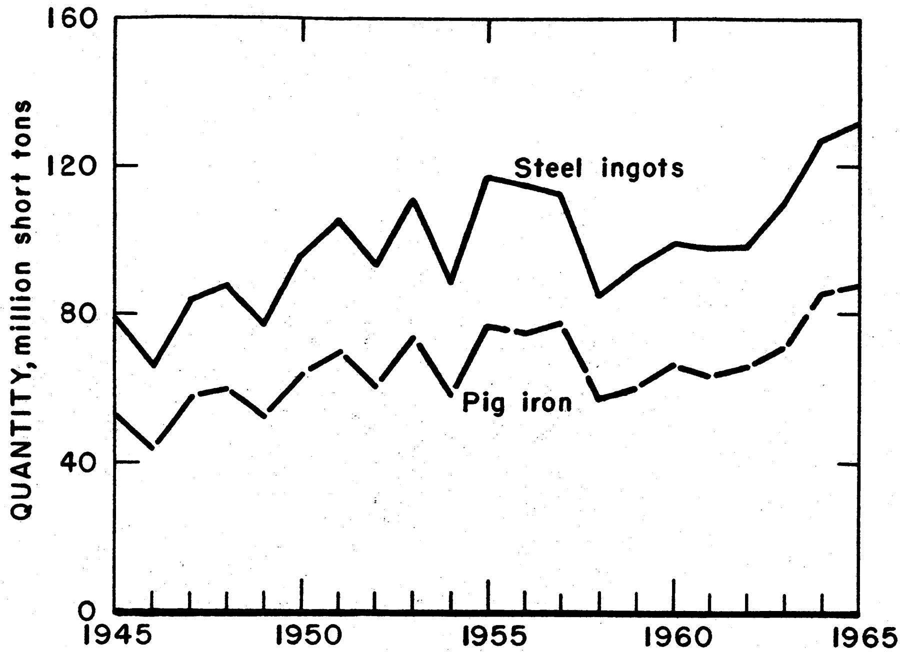

Figure 1.—Trends in production of pig iron and steel ingots in the United States.

less steel for castings. Alloy and stainless together comprise 11 percent of the total ingot production.

Series 400 stainless production increased 9 percent to 335,000 tons and topped the production of 1961. Production of Series 500 and all other high-chromium heat-resisting steels increased nearly 50 percent, but austenitic stainless (Series 200 and 300) steel production dropped slightly.

Basic oxygen converter steelmaking doubled its share of alloy and stainless steel production to 7.4 percent. Open hearth furnaces produced 56.2 percent and electric furnaces 36.4 percent.

Materials Used in Steelmaking.—Pig iron was a little over 54 percent of the 149.3 million tons of metallics charged into steelmaking furnaces in 1965. According to AISI, steelmaking furnaces consumed 345,304 tons of fluorspar, 5,181,467 tons of limestone, 2,912,633 tons of lime, and 619,698 tons of other fluxes. Oxygen converters used 41 percent of the 104.4 billion cubic feet of oxygen used in steelmaking furnaces. Open hearth furnaces used 56 percent and electric furnaces used nearly 3 percent.

Table 7.—Steel production in the United States, by type of furnace [1]

(Thousand short tons)

Year	Open hearth		Bessemer	Basic oxygen process	Electric	Total
	Basic	Acid				
1956–60 (average)	89,177	506	1,934	1,530	8,036	101,183
1961	84,108	394	881	3,967	8,664	98,014
1962	82,578	379	805	5,553	9,013	98,328
1963	88,437	397	963	8,544	10,920	109,261
1964	97,655	443	858	15,442	12,678	127,076
1965	93,866	327	586	22,879	13,804	131,462

[1] Includes only that steel for castings produced in foundries operated by companies manufacturing steel ingots. Omits about 2 percent of total steel production.

Source: American Iron and Steel Institute.

CONSUMPTION OF PIG IRON

Consumption of pig iron increased only 3 percent while domestic steel production increased nearly 3.5 percent. The South Atlantic was the only district in which consumption of pig iron decreased. Plants in the Middle Atlantic and East North Central districts consumed nearly 77 percent of the total production.

Table 8.—Metalliferous materials consumed in steel furnaces in the United States
(Thousand short tons)

Year	Iron ore		Agglomerates [1]	Pig iron	Ferro-alloys [2]	Iron and steel scrap
	Domestic	Foreign				
1956–60 (average)	2,317	5,313	1,321	60,259	1,410	52,600
1961	1,913	5,277	855	59,418	1,367	49,455
1962	1,875	4,768	644	60,561	1,408	49,606
1963	1,783	3,995	885	66,188	1,557	56,506
1964	2,114	4,816	1,379	78,925	1,819	64,348
1965	1,818	4,400	[3] 1,061	81,040	1,898	68,272

[1] Includes consumption of pig iron and scrap by ingot producers and iron and steel foundries.
[2] Includes ferromanganese, spiegeleisen, silicomanganese, manganese briquets, manganese metal, ferrosilicon, ferrochromium alloys, and ferromolybdenum.
[3] Includes 567,285 tons of sinter, 385,759 tons of pellets, 99,506 tons of nodules, and 8,199 tons of other agglomerates. (418,452 tons of foreign origin.)

Table 9.—Consumption of pig iron in the United States, by type of furnace

Type of furnace or equipment	1964		1965	
	Thousand short tons	Percent of total	Thousand short tons	Percent of total
Open hearth	65,206	75.5	61,483	69.1
Bessemer	949	1.1	652	.7
Oxygen converter	12,446	14.4	18,518	20.8
Electric [1]	325	.4	387	.5
Cupola	3,704	4.3	3,757	4.2
Air	170	.2	173	.2
Direct castings	3,582	4.1	3,975	4.5
Total	86,382	100.0	88,945	100.0

[1] Includes a small quantity of pig iron consumed in crucible furnaces.

PRICES

In 1965, the weekly wholesale price index for finished steel products stayed at 102.9 for the first quarter. It was 103, through April, rising to 103.2 through May and remaining through June. In July it rose to 103.5 where it remained through August and September. In October it rose to 103.7 and in November to 104 remaining there through December. The base of 100 is the 1957-59 average price.[3] The average value of pig iron is recorded in table 11.

FOREIGN TRADE

The total value of major iron and steel products imported into the United States exceeded the value of those exported by 40 percent. The buildup of excess inventory as a hedge against a steel strike combined with a domestic business slowdown in the European Coal and Steel Community, the United Kingdom, and Japan were the principal factors in this major change in the foreign trade situation from 1964.

[3] U.S. Department of Labor, Bureau of Labor Statistics.

Table 10.—Consumption of pig iron in the United States, by districts and States
(Short tons)

District and State	1964	1965
New England:		
Connecticut	32,833	32,631
Maine and New Hampshire	1,999	2,550
Massachusetts	57,586	58,191
Rhode Island	42,408	41,034
Vermont	6,178	6,607
Total	141,004	141,013
Middle Atlantic:		
New Jersey	112,089	62,603
New York	4,606,010	5,453,068
Pennsylvania	21,373,302	22,074,877
Total	26,091,401	27,590,548
East North Central:		
Illinois	5,858,222	6,598,061
Indiana	11,367,746	10,994,983
Michigan	7,462,185	7,822,953
Ohio	15,092,990	14,936,271
Wisconsin	192,249	199,680
Total	39,973,392	40,551,948
West North Central:		
Iowa	88,128	77,016
Kansas and Nebraska	5,854	5,728
Minnesota	524,912	558,905
Missouri	39,687	41,823
Total	658,581	683,472
South Atlantic:		
Delaware and Maryland	5,691,698	5,428,115
Florida and Georgia	13,535	14,739
North Carolina	33,246	35,427
South Carolina	16,683	16,567
Virginia and West Virginia	2,375,911	2,354,691
Total	8,131,073	7,849,539
East South Central:		
Alabama	3,737,824	3,773,738
Kentucky, Mississippi, Tennessee	1,495,872	1,904,895
Total	5,233,696	5,678,633
West South Central:		
Arkansas, Louisiana, Oklahoma	12,144	12,487
Texas	1,332,816	1,386,743
Total	1,344,960	1,399,230
Rocky Mountain:		
Arizona and Nevada	---------	---------
Colorado, Idaho, Montana, Utah	2,510,068	2,657,102
Total	2,510,068	2,657,102
Pacific Coast:		
California and Hawaii	2,250,640	2,318,820
Oregon and Washington	46,884	74,427
Total	2,297,524	2,393,247
Grand total	86,381,699	88,944,732

WORLD REVIEW

The United States increased production of pig iron by 3 million tons to lead the world. The U.S.S.R. with a 7-percent increase in production became the second country to produce 100 million tons of ingot steel. The United States led in crude steel production with 131.5 million tons in 1965.

Table 11.—Average value of pig iron at blast furnaces in the United States, by States
(Per short ton)

State	1956–60 (average)	1961	1962	1963	1964	1965
Alabama	$54.33	$56.62	$57.46	$55.66	$53.83	$54.06
California, Colorado, Utah	57.01	50.50	51.59	50.31	58.40	58.35
Illinois	58.54	60.42	59.10	57.52	57.74	56.48
Indiana	57.49	58.96	57.34	56.15	57.32	56.15
New York	60.86	60.05	59.13	67.40	62.45	57.30
Ohio	56.72	60.78	59.89	57.78	60.24	59.37
Pennsylvania	58.73	59.48	58.93	59.34	57.50	56.42
Other States [1]	58.52	57.44	57.66	60.26	57.99	56.70
Average	57.98	58.51	58.15	58.47	58.25	57.01

[1] Comprises Kentucky, Maryland, Michigan, Minnesota, Tennessee, Texas, West Virginia, and Massachusetts (1956–60).

Table 12.—Free-on-board value of steel mill products in the United States, in 1964 [1]
(Cents per pound)

Product	Carbon	Alloy	Stainless	Average
Ingots	3.281	12.222	24.584	5.178
Semifinished shapes and forms	5.512	10.511	39.407	6.387
Plates	6.727	9.789	51.756	7.527
Sheets and strips	7.084	14.932	43.897	7.887
Tin mill products	9.136	------	------	9.136
Structural shapes and piling	6.507	(2)	------	6.507
Bars	7.357	13.198	62.378	8.869
Rails and railway-track material	8.288	------	------	8.288
Pipes and tubes	10.188	15.857	123.245	11.411
Wire and wire products	12.822	41.596	86.663	14.061
Other rolled and drawn products	(3)	22.869	57.818	26.316
Average total steel	7.654	13.234	52.826	8.506

[1] This table represents the weighted average value based on the quantity of each type of steel shipped; therefore, it reflects shifts in the distribution of the 3 classes of steel.
[2] Included with "plates."
[3] Included with rails and railway-track material.

Table 13.—U.S. exports of major iron and steel products

Products	1964		1965	
	Short tons	Value	Short tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	r 856,454	r $65,460,537	682,134	$52,505,152
Iron and steel bars and rods:				
Carbon-steel bars, hot-rolled, and iron bars	71,119	12,114,341	77,312	14,191,593
Concrete reinforcement bars	60,580	7,828,539	34,555	4,351,744
Other steel bars	42,831	17,221,341	58,247	22,476,144
Wire rods	33,939	5,717,371	19,191	3,144,749
Iron and steel plates, sheets, skelp, and strips:				
Plates, including boilerplate, not fabricated	176,613	35,199,150	161,653	38,342,997
Skelp iron and steel	29,574	3,283,888	44,134	8,024,865
Iron and steel sheets, galvanized	169,006	34,361,158	156,745	32,388,260
Steel sheets, black, ungalvanized	r 858,728	r 164,864,558	335,134	81,056,774
Strip, hoop, band, and scroll iron and steel:				
Cold-rolled	r 54,857	r 25,643,611	49,443	23,520,014
Hot-rolled	68,050	12,944,542	40,693	32,391,910
Tinplate and terneplate	351,642	52,709,046	262,485	37,391,073
Tinplate circles, cobbles, strip, and scroll shear butts	27,542	3,136,681	13,845	1,426,542
Total	r 2,800,935	r 440,484,763	1,935,571	351,211,817

See footnotes at end of table.

Table 13.—U.S. exports of major iron and steel products—Continued

Products	1964 Short tons	1964 Value	1965 Short tons	1965 Value
Manufactures-steel mill products:				
Structural iron and steel:				
Water, gas, and other storage tanks (unlined), complete and knockdown material	15,023	$7,527,697	12,986	$8,901,887
Structural shapes:				
Not fabricated	236,115	36,840,374	228,714	34,260,958
Fabricated	89,914	32,551,537	91,022	37,553,638
Plates and sheets, fabricated, punched, or shaped	11,815	3,727,697	13,653	5,825,901
Metal lath	1,016	407,126	---	---
Frames, sashes, and sheet piling	14,387	2,730,908	7,857	3,468,345
Railway-track material:				
Rails for railways	45,536	5,859,758	36,950	5,448,793
Rail joints, splice bars, fishplates, and tieplates	10,079	2,639,019	32,060	7,837,212
Switches, frogs, and crossings	1,578	1,057,159	9,884	14,729,821
Railroad spikes	756	191,720	896	221,158
Railroad bolts, nuts, washers, and nut locks	727	401,671	16,978	18,028,367
Tubular products:				
Boiler tubes	13,865	8,792,275	8,962	6,290,047
Casing and line pipe	125,486	34,766,192	121,183	41,412,462
Seamless black and galvanized pipe and tubes, except casing, line and boiler, and other pipes and tubes	358,708	129,353,673	39,876	11,080,572
Welded black pipe	13,800	3,745,308	12,190	3,906,913
Welded galvanized pipe	15,029	3,450,149	3,890	1,085,128
Malleable-iron screwed pipe fittings	1,471	1,384,949	1,245	1,166,989
Cast-iron pressure pipe and fittings	32,153	5,764,250	40,808	8,025,759
Cast-iron soil pipe and fittings	6,623	1,607,468	15,329	9,230,023
Iron and steel pipe, fittings, and tubing, n.e.c.	67,333	49,962,115	95,209	73,712,044
Wire and manufactures:				
Barbed wire	592	144,400	1,332	342,716
Galvanized wire	20,290	8,364,891	14,660	6,130,830
Iron and steel wire, uncoated	24,573	10,095,935	16,623	7,938,431
Spring wire	1,760	1,000,337	9,249	4,472,799
Wire rope and strand	10,549	6,306,286	12,796	9,432,300
Woven-wire screen cloth	1,701	[1] 2,629,557	2,746	[1] 4,460,781
All other	18,455	12,150,240	18,143	15,990,736
Nails and bolts, iron and steel, n.e.c.:				
Wire nails, tacks, staples, and spikes	r 5,218	r 5,001,342	7,179	5,697,373
Bolts, screws, nuts, rivets, and washers, n.e.c.	21,636	26,589,950	13,121	12,238,826
Castings, and forgings: Iron and steel including car wheels, tires, and axles	98,239	35,504,895	67,123	38,487,721
Total	1,264,427	440,548,878	952,664	397,378,530
Advanced manufactures:				
Building (prefabricated and knockdown)	---	7,668,546	---	6,658,982
Chains and parts	13,732	13,454,945	11,721	15,433,929
Construction material	12,461	7,288,026	10,970	4,207,307
Hardware and parts	---	27,354,061	---	21,849,037
House-heating boilers and radiators	---	7,259,766	---	18,311,665
Oil burners and parts	---	10,296,030	---	13,930,278
Plumbing fixtures and fittings	---	6,076,797	---	5,484,653
Tools	---	66,788,075	---	58,953,745
Utensils and parts (cooking, kitchen, and hospital)	---	2,989,943	---	7,413,708
Other	---	57,202,018	---	49,566,929
Total	---	206,378,207	---	201,810,233
Grand total	---	r 1,087,411,848	---	950,400,580

r Revised.
[1] Includes wire cloth as follows: 1964, $2,035,676 (3,707,046 square feet); 1965, $3,558,661 (14,353,618 square feet).

Table 14.—U.S. imports for consumption of pig iron, by countries

(Short tons)

Country	1956–60 (average)	1961	1962	1963	1964	1965
North America: Canada	285,021	349,403	386,296	387,449	395,202	485,089
South America: Brazil	3,924	---	---	---	67,895	73,537
Europe:						
Belgium-Luxembourg	882	---	---	---	---	221
Finland	2,051	---	681	12,123	73,004	66,422
Germany:						
East	---	---	---	---	57,182	82,289
West	17,232	719	56,341	87,435	51,412	64,220
Italy	---	---	---	---	---	68
Netherlands	1,448	---	---	---	---	---
Norway	168	---	3,584	3,319	101	666
Portugal	879	---	---	---	1,051	---
Spain	21,583	19,113	42,416	45,161	11,683	42,085
Sweden	1,824	1,201	1,416	10,146	9,969	11,203
U.S.S.R.	569	396	---	---	---	34,188
United Kingdom	10	---	94	8	---	6,595
Total	46,646	21,429	104,532	158,192	204,402	307,957
Africa:						
Zambia, Southern Rhodesia and Malawi	1,051	---	---	---	---	---
South Africa, Republic of	15,638	4,096	5,030	76,696	68,620	12,867
Total	16,689	4,096	5,030	76,696	68,620	12,867
Asia:						
India	1,427	---	---	---	---	---
Japan	2,135	---	---	---	---	---
Total	3,562	---	---	---	---	---
Oceania: Australia	2,612	2,252	4,216	22,997	352	801
Grand total:						
Short tons	358,454	377,180	500,074	645,334	736,471	880,251
Value	$19,448,155	$20,511,391	$24,684,220	$28,936,920	$31,591,381	$38,022,760

NORTH AMERICA

Canada.—Dominion Foundries and Steel Ltd. (DOFASCO), who started the first basic oxygen steelmaking in North America in 1954, completed its 10 millionth ton 11 years later.

Algoma Steel Corp. Ltd., ordered two continuous casting machines. One machine is a 4-strand unit producing blooms ranging from 9 to 15 inches wide by 10½ inches thick. The second machine is a 2-strand unit capable of casting beam blanks, as well as slabs up to 6 by 30 inches.

The Steel Co. of Canada Ltd. (Stelco), started up a new 148-inch plate mill. Also, during 1965 Stelco put into operation its new hydrochloric acid pickle line, which is 700 feet long and 74 inches wide.

DOSCO Steel Ltd., a subsidiary of Dominion Steel and Coal Corp. Ltd., planned to construct two steel rolling mills at Contrecoeur, Quebec.

Manitoba Rolling Mills, a division of Dominion Bridge Co. Ltd., ordered two twin-strand, curved mold, continuous casting units. These units will take steel from two 14-foot-diameter electric furnaces.

Atlas Steels Co. Ltd. installed a continuous casting machine at its Tracy, Quebec, plant capable of casting approximately 60 tons of steel in 40 minutes. The machine was being used for stainless steel.

The integrated steel complex to be built at Becancour, Quebec, will be engineered and constructed by two firms of Montreal consulting engineers, together with two other engineering firms, one from France, and one from Canada. The steel firm will be known as Siderurgien d'Quebec (SIDBEC).

Mexico.—Out of 360 industries which were deemed necessary for Mexico's development, open for private or foreign capital investment and eligible for tax exemptions or reductions, there were 18 in the iron and steel sector.

Table 15.—U.S. imports for consumption of major iron and steel products

Products	1964 Short tons	1964 Value	1965 Short tons	1965 Value
Iron products:				
Bar iron, iron slabs, bloom, or other forms	248	$71,221	262	$81,202
Pipes and fittings:				
Cast-iron pipe and fittings	34,655	3,859,069	28,749	3,079,210
Malleable cast-iron pipe fittings	2,884	1,124,632	3,846	1,539,515
Castings and forgings	8,268	6,187,207	12,181	10,312,652
Total	46,055	11,242,129	45,038	15,012,579
Steel products:				
Steel bars:				
Concrete reinforcement bars	411,997	32,132,687	567,545	43,985,640
Solid and hollow, n.e.s	367,869	40,485,012	554,859	61,933,143
Hollow and hollow drill steel	4,757	1,988,406	5,803	2,298,514
Wire rods, nail rods, and flat rods up to 6 inches in width	952,767	88,455,563	1,283,636	123,525,772
Steel ingots, blooms, and slabs; billets, solid and hollow	344,760	36,526,720	282,621	35,267,115
Circular saw plates	(1)	819,951	(1)	876,704
Sheets and plates and steel, n.s.p.f.	1,596,137	r 181,620,109	4,257,282	450,989,793
Tinplate, terneplate, and taggers' tin	80,693	13,754,201	121,941	20,807,444
Structural iron and steel	1,062,864	101,000,875	1,484,537	144,850,891
Rails for railways	10,843	1,044,333	19,851	1,888,706
Rail braces, bars, fishplates, or splice bars and tieplates	828	85,717	967	119,812
Steel pipes and tubes	787,111	114,464,632	950,891	139,371,184
Wire:				
Barbed	72,433	9,191,390	74,855	10,119,393
Round wire, n.e.s.	r 379,997	r 65,981,165	488,485	87,951,341
Telegraph, telephone, etc., except copper, covered with cotton jute, etc	r 937	r 618,700	603	301,761
Flat wire and iron and steel strips	14,238	5,962,758	15,910	7,169,117
Rope and strand	r 51,557	r 14,870,822	64,607	18,059,576
Galvanized fencing wire and wire fencing	42,790	6,003,340	41,129	6,114,766
Iron and steel used in card clothing	(2)	160,559	(2)	171,019
Hoop and band iron and steel, for baling	30,479	4,019,129	32,906	4,408,620
Hoop, band and strips, or scroll iron or steel, n.s.p.f.	44,119	16,257,407	52,707	18,132,351
Nails	310,437	44,643,750	329,174	51,176,620
Steel castings and forgings	16,038	4,075,042	15,568	3,383,102
Total	r 6,583,651	r 784,166,268	10,645,877	1,232,902,384
Advanced manufactures:				
Bolts, nuts, and rivets	74,624	22,744,338	106,106	34,451,073
Chains and parts	12,408	8,179,704	16,101	10,099,806
Hinges and hinge blanks	---	2,353,359	---	2,836,009
Screws (wholly or chiefly of iron or steel)	---	9,306,665	---	13,310,953
Tools	---	r 28,714,759	---	20,425,112
Other	---	r 1,150,150	---	1,478,374
Total	---	r 72,448,975	---	82,601,327
Grand total	---	r 867,857,372	---	1,330,516,290

r Revised.
1 Saws, reported in number; 1964, 190,840; 1965, 162,869.
2 Weight not recorded.

Fabricacion de Maquinas-SA (FAMA) switched from a cupola melting system to two induction electric furnaces, one a 7-ton furnace and a 100-kilowatt power source for two 500-pound furnaces. Tubos de Acero de Mexico (TAMSA) obtained authorization to establish a 500-ton sponge iron plant at Vera Cruz.

SOUTH AMERICA

Argentina.—Dalmine Siderca was authorized to increase the production capacity of its plant for special steels to 300,000 tons a year. Output of seamless steel tubes was expected to increase to 190,000 tons a year.

A new plant of Lametal Unión, a sheet steel producer, was formally opened in the Federal capital in April.

The Argentine Government formally approved by Executive Decree 1106 on February 1965, the 1.5-million-ton integrated steel mill project of Propulsora Siderúrgica. The plant is to be erected in Ensenada, near Buenos Aires. Financing for the project has not yet been obtained.

Table 16.—World production of pig iron (including ferroalloys) by countries [1]

(Thousand short tons)

Country [1]	1961	1962	1963	1964	1965 [p] [2]
North America:					
Canada	5,064	[r] 5,415	6,059	6,707	7,246
Mexico (sponge iron)	864	912	947	1,068	1,090
United States	66,717	67,636	73,853	87,922	91,016
Total	72,645	[r] 73,963	80,859	95,697	99,352
South America:					
Argentina	437	438	467	[r] 634	730
Brazil	2,050	2,337	[r] 2,772	[r] 2,938	2,756
Chile	314	[3] 440	[3] 480	482	340
Colombia	208	164	224	243	254
Peru	56	43	36	30	33
Venezuela	6	136	333	357	352
Total	[r] 3,071	[r] 3,558	[r] 4,312	[r] 4,684	4,465
Europe:					
Austria	2,500	2,339	2,326	2,434	2,429
Belgium	7,104	7,439	7,622	9,327	9,307
Bulgaria	227	246	292	1,026	762
Czechoslovakia	5,529	5,767	5,847	6,361	6,743
Denmark	73	76	76	77	79
Finland	168	[r] 365	413	[r] 704	1,085
France	16,372	15,716	16,010	[r] 17,699	17,653
Germany:					
East	2,239	2,287	2,370	2,491	2,557
West	28,033	26,732	25,253	29,963	29,751
Hungary	1,455	1,543	1,544	[r] 1,653	1,746
Italy	3,528	4,054	4,264	3,996	6,304
Luxembourg	4,226	3,965	3,954	4,620	4,569
Netherlands	1,606	1,732	1,884	2,147	2,606
Norway	834	798	[r] 826	976	1,190
Poland	5,258	5,854	5,947	6,220	6,349
Portugal	134	[r] 243	265	[r] 295	303
Rumania	1,211	1,666	1,881	2,121	2,226
Spain	2,340	2,374	2,187	[r] 2,172	2,678
Sweden	2,094	2,164	[r] 2,232	[r] 2,563	2,713
Switzerland	[e] 60	[e] 60	49	35	30
U.S.S.R. [4]	56,100	60,919	64,697	[r] 68,759	73,017
United Kingdom	16,517	15,335	16,342	19,347	19,555
Yugoslavia	1,161	1,216	1,168	[r] 1,184	1,295
Total [4]	158,769	[r] 162,890	[r] 167,449	[r] 186,170	194,947
Africa:					
Rhodesia, Southern	243	266	[r] 260	[r] 351	276
South Africa, Republic of	2,566	2,663	[r] 2,676	[r] 3,182	3,972
United Arab Republic (Egypt)	192	[r] 194	[r] 226	[r] 212	[e] 190
Total	3,001	[r] 3,123	[r] 3,162	[r] 3,745	4,438
Asia:					
China, mainland [e]	16,500	16,500	18,700	19,800	20,900
India	5,621	6,522	7,431	7,432	7,868
Japan	18,059	20,325	22,525	[r] 26,951	31,041
Korea:					
North	1,047	1,365	1,305	1,510	[e] 1,800
South	10	2	6	[r] 7	20
Taiwan	58	69	60	68	79
Thailand	6	6	7	6	6
Turkey [5]	260	323	434	[e] 440	419
Total [4]	41,561	45,112	50,468	[r] 56,214	62,133
Oceania: Australia	3,549	3,879	4,113	[r] 4,524	4,730
World total [e]	[r] 282,596	[r] 292,525	[r] 310,363	[r] 351,034	370,065

[e] Estimate. [p] Preliminary. [r] Revised.

[1] Pig iron is also produced in Republic of the Congo, but quantity produced is believed insufficient to affect estimate of world total.

[2] Compiled mostly from data available July 1966.

[3] Including ferroalloys.

[4] U.S.S.R. in Asia included with U.S.S.R. in Europe.

[5] Includes foundry iron.

232-748 O-67—34

Table 17.—World production of steel ingots and castings by countries

(Thousand short tons)

Country	1961	1962	1963	1964	1965 [p] [1]
North America:					
Canada	6,488	7,173	8,190	9,131	10,029
Mexico	1,882	1,896	[r] 2,247	[r] 2,593	2,743
United States [2]	98,014	98,328	109,261	127,076	131,462
Total	106,384	107,397	[r] 119,698	[r] 138,800	144,234
South America:					
Argentina	486	725	1,006	1,394	1,486
Brazil	2,756	2,875	[r] 3,145	[r] 3,392	[e] 3,340
Chile	[r] 431	[r] 582	[r] 574	[r] 644	515
Colombia	212	173	245	[r] 254	266
Peru	83	[r] 78	[r] 84	[r] 90	103
Uruguay	10	10	8	15	14
Venezuela	83	248	401	485	1,196
Total	[r] 4,061	[r] 4,691	[r] 5,463	[r] 6,274	6,920
Europe:					
Austria	3,418	3,274	3,249	3,521	3,553
Belgium	7,728	8,115	8,298	9,624	10,106
Bulgaria	375	466	508	522	648
Czechoslovakia	7,764	8,421	8,375	9,234	9,789
Denmark	356	405	396	[r] 437	402
Finland	305	[r] 335	[r] 340	391	371
France	19,211	18,857	19,214	[r] 21,501	21,610
Germany:					
East	[r] 4,303	[r] 4,508	[r] 4,511	[r] 4,841	4,883
West	36,881	35,895	34,830	41,159	40,588
Greece	[e] 150	[e] 170	230	[r] 231	231
Hungary	2,263	2,572	2,617	2,606	2,778
Ireland	31	21	22	22	22
Italy	10,283	10,755	11,196	10,795	13,978
Luxembourg	4,534	4,420	4,445	5,025	5,054
Netherlands	2,173	2,301	2,582	2,924	3,468
Norway	550	538	599	678	756
Poland	7,974	8,470	8,823	9,449	10,018
Portugal	101	184	235	265	292
Rumania	2,344	2,702	2,981	3,350	3,775
Spain	2,579	2,547	2,747	[r] 3,472	4,134
Sweden	3,926	[r] 3,980	[r] 4,300	[r] 4,899	5,208
Switzerland	327	351	[r] 355	380	380
U.S.S.R. [3]	77,994	84,113	88,403	[r] 93,738	100,310
United Kingdom	24,737	22,950	25,222	28,918	30,246
Yugoslavia	1,689	1,758	1,750	1,849	1,950
Total [3]	[r] 221,996	[r] 228,108	[r] 236,228	[r] 259,831	274,550
Africa:					
Rhodesia, Southern	101	[r] 97	[r] 93	[r] 141	[e] 120
South Africa, Republic of	2,738	2,903	3,124	3,414	3,743
United Arab Republic (Egypt)	174	209	217	[r] 202	[e] 180
Total	3,013	[r] 3,209	[r] 3,434	[r] 3,757	4,043
Asia:					
Burma [e]	12	14	17	17	17
China, mainland	10,500	11,000	13,200	[e] 15,400	[e] 16,500
India	4,502	[r] 5,611	[r] 6,581	[r] 6,649	6,962
Israel	68	88	[r] 91	[e] [r] 90	[e] 95
Japan	31,160	30,364	34,724	43,871	45,372
Korea:					
North	855	1,157	1,127	[r] 1,248	[e] 1,355
South	73	163	176	[r] 142	171
Taiwan	218	201	303	331	485
Thailand	9	8	[r] 3	[r] 4	8
Turkey	356	323	400	[r] 536	734
Total [3]	[r] 47,753	[r] 48,929	[r] 56,622	[r] 68,288	71,699
Oceania: Australia	4,351	4,667	[r] 5,124	[r] 5,620	6,092
World total [e]	[r] 387,560	[r] 397,000	[r] 426,570	[r] 482,570	507,540

[e] Estimate. [p] Preliminary. [r] Revised.
[1] Compiled mostly from data available July 1966.
[2] Data from American Iron and Steel Institute. Excludes production of castings by companies that do not produce steel ingots.
[3] U.S.S.R. in Asia included with U.S.S.R. in Europe.

Brazil.—The Inter-American Development Bank has granted Brazil a $200,000 loan for the partial financing of a survey toward the possible establishment of a steel mill at the Bay of Aaratü, in northeastern Brazil, by Usina Siderúrgica da Bahia, S.A. (USIBA) would set up a blast furnace to process iron ore, using natural gas as a fuel, and manufacture tinplate as well as hot- and cold-rolled thin steel plate. Total construction costs are budgeted at $52 million.

Aços Villares, S.A., a specialty steel producer, obtained assistance from the International Finance Corporation to finance an expansion program on its plant near São Paulo which will increase its ingot steel capacity 16 percent. The company's largest customer is the Brazilian automobile industry.

The Intendente Camara Steel plant with an initial output of 500,000 tons of steel was being built at Ipatinga in the State of Minas Gerais, Brazil.

Colombia.—Acerías Paz del Río, the Government-owned steel mill, supplied 80 percent of domestic steel consumption in 1964. Colombia produced about 400,000 tons of steel in 1965.

Ecuador.—A plant for rolling steel bars will be financed by $400,000 allocated by the Atlantic Community Development Group for Latin America (Adela).

Venezuela.—Siderúrgica del Orinoco accounted for about 49 percent of the 1.2 million tons of steel produced in the country in 1965. The company had reached a record production of 55,000 tons in January.

EUROPE

Austria.—Austria, the cradle of the LD basic oxygen furnace, used this method to produce about 60 percent of the 3.5 million tons of crude steel produced in 1965.

Three Austrian steel producing companies sold an $11 million order of finished steel to Stahl und Metall Handelsgesellschaft of East Germany.

VOEST Steel Manufacturing Company signed an agreement with Communist China to deliver a 700,000-ton Linz-Donawitz oxygen steel plant to China.

Bulgaria.—Bulgaria added a 100-ton electric arc furnace to the facilities of the Kremíkovtsi Iron and Steel Works near Sofia.

Czechoslovakia.—Czechoslovakia, which produced 9.75 million tons of steel in 1965, was rolling some of that steel from continuous casting machines. The first machine of 120,000-ton-annual-capacity was built about 5 years ago. Another one has been ordered by the United Steel Works in Kladno from Motala Verkstad in Sweden. It will probably be an Olsson low curved-mold continuous casting machine.

Czechoslovakia intended to control the entire production of its largest steel works, at Ostrava-Kuncice, by two English Electric computers, a LEO 360 and a KDF 7.

A foundry company near Opava ordered a complete Hallsworth automatic foundry plant. The heart of the system is a four-station rotary mold-making machine upon which the high productivity rate depends. With only one operator this machine can produce up to 240 complete mold boxes, ready for pouring, per hour.

European Coal and Steel Community (ECSC).—A merger of great significance to the world steel industry was that of the ECSC High Authority, the EEC, and Euratom. Thus control of the Community Steel industry passes to a European commission with broad authority, responsibility, and outlook.

Steel production in the common market totaled about 95 million ingot tons, or an increase over the 1964 output of about 4 percent. Output in Italy rose nearly 30 percent, while production in both France and West Germany declined about 1 percent each. Because of overproduction in the Common Market, new investment probably declined about $200 million for 1965.

Two steel companies merged when Bochumer Verein für Gussstahlfabrikation A.G. was absorbed by Fried. Krupp Huettenwerke. The largest steel manufacturer in Luxembourg, Aciéries Réunies de Burbach-Eich-Dudelange (ARBED) took steps to absorb the smaller Luxembourg concern, Hadir.

French and German interests plan to construct a 1-million-ton-per-year oxygen steel plant at Dilling in the Saar. ECSC loaned the French company Société Brentonne de Fonderies et de Mécanique $3.5 million to help set up a big iron and steel plant at Lorient-Hennebont, France. ECSC had $41 million to be loaned to steel and coal firms in Germany, Belgium, and Italy.

The High Authority decided late in the year to extend the application of the specific duty on foundry pig of $7 per ton and also the application of a 9 percent "ad valorem" custom duty on imports of steel products into the Community from nonmember countries through 1966.

Delivery of 100 tons of hot metal over a distance of 190 miles to the Chertal plant of S.A. Métallurgique d'Espérance-Longdoz was accomplished with a temperature drop of only 125° C over a 12-hour period. This follows the successful transporting of hot metal to the Chertal plant from a blast furnace only 14 miles away.

The year was one of uncertainties for the steel industry in Belgium as in all of the Common Market countries. While some Belgium steel companies cut the price of rolled steel strip by up to 6 percent at the end of the year a large producer announced that the decline in steel selling prices appeared to have been checked. Espérance-Longdoz announced a cutback in production while another large steel producer was increasing its output. Overall the steel production for 1965 was only about 400,000 tons above that of 1964.

French steel production was essentially the same in 1965 as in 1964. To stimulate growth the fifth economic plan for France announced a program of modernization and rationalization of the steel industry, which would need a substantial capital investment. The Société des Aciéries de Lorraine (SACILOR) was guaranteed State loans of about $53 million for the establishment of an oxygen steel plant and rolling mill at Gandrange, Moselle, in eastern France. Société des Aciéries de Pompey received nearly $7,300,000 in State-guaranteed loans for improvements and extensions to its plant.

Four West German firms were allowed by the ECSC High Authority to rationalize their output of merchant bars and sections through joint steel rolling programs. All orders will be booked together and the production runs will be distributed amongst the four firms allowing longer runs of any certain type for each company.

Two 60-ton Kaldo furnaces were being built in Essen, Germany, for the new steel works under construction by Sanyo Special Steel Co. Ltd., of Japan. During refining the vessels are to be rotated at rates up to 40 rpm. Their combined annual capacity is 330,000 tons.

Bessemer steelmaking was losing out in West Germany as well as in the United States. A basic Bessemer plant at the Hörde Works was closed down by Dortmund-Hörder-Hüttenunion, AG. The Bessemer plant produced over 30 million tons in its 85 years of operation. Several West German firms cut back operations toward the end of the year.

The newest steelmaking plant in the ECSC was the all-new oxygen plant dedicated in the spring of 1965 at Taranto. Designed for an eventual output of 7 million tons of ingots per year it had two 330-ton oxygen converters in 1965. A new electric furnace melt shop near Milan, Italy, was designed around two 30 Mva 140-ton arc furnaces. This plant was run entirely on scrap. There was a new steel tube production plant at Brescia, Italy. Its two vertical 1,600-ton extrusion presses were furnished by a German firm at Düsseldorf. Italsider established new LD steel works in Bagnoli, a suburb of Naples. The three LD converters had an annual capacity of 2 million tons of crude steel ingots.

A new plant at Follonica was designed to burn 700,000 tons of pyrites for sulfur used in the contact process of manufacturing sulfuric acid. The pyrites cinders are then reduced to an iron oxide of high purity by means of heavy naphtha on a fluidized bed followed by magnetic separation. From 2,200 tons of pyrites per day the plant produces 2,200 tons of sulfuric acid, and 1,000 tons of iron oxide pellets. (66 percent Fe).

The Netherlands increased steel production about 500,000 tons in 1965, and Koninklijke Nederlandsche Hoogovens en Staalfabrieken N.V., the principal producer, was embarking on a $280 million expansion project, which will include a 2.5-million-ton-per-year oxygen steel plant.

N.V. Nederlandsche Kabelfabrieken at Delft put in an electric furnace to considerably increase its steel capacity. It was planned to raise the company's finished products capacity to 500,000 tons a year.

Finland.—A 200-ton-per-day oxygen plant. was ordered from Air Products Ltd., in England, by Rautaruukki Oy, at Raahe. The plant will furnish oxygen for two 50-ton LD converters to be installed. The hot metal comes from a blast furnace commissioned in October 1964 which produces about 550,000 tons of pig iron per year.

Greece.—Several agreements for export of pig iron have been signed. A total of about $4 million worth of pig iron will be exported from the blast furnace at Eleusis. This will materially increase Greece's foreign exchange earnings.

Contracts were let for the establishment of a steel rolling mill at Thessalonika. Also plans were announced to establish a cold-rolling plant at Salonica.

Hungary.—A cold-rolling mill was commissioned in July for the Danube Steel Works at Danaújváros. This was the major investment so far in the integrated steel plant and was designed to eventually roll 256,000 tons a year.

Poland.—Poland announced plans to reconstruct its steel industry and to triple production by 1980. Its industry then was expected to produce 46 percent of output by open hearth, 41 percent by oxygen blown converters, and 13 percent in electric furnaces. This is similar to the production pattern envisioned for 1980 in the United States steel industry.

Sweden.—The Stora Kopparbergs Bergslags, AB installed two new 90-ton Kaldo oxygen converters to refine the output from a new Dored rotating ore-reduction system. Nyby Bruks Aktiebolag invested $3 million with Amsted Industries in pressure pouring equipment for stainless steel. The Oxelösund plant of Grängesberg Co. installed a new Martin furnace.

SKF Hellefors Jernverk steelworks has installed vacuum degassing with induction stirring of steel in the ladle. Sandvikens Jernverks AB has developed a stainless steel thread of .007 mm. diameter for the manufacture of fabrics.

Switzerland.—Concast AG. announced signing of contracts to deliver a four-strand continuous casting machine to the BHP Newcastle works and another four-strand machine to Vereeniging, Republic of South Africa. Both machines will cast about 300,000 tons of steel annually.

United Kingdom.—The Wolsingham Steel Company Ltd., commissioned a new 25-ton 7,500 Kva electric arc furnace. The Stocksbridge works of Samuel Fox & Co. Ltd., awarded $7.7 million in contracts as a start in a modernization project which will replace 5 open-hearth furnaces with two 135-ton electric arc furnaces. Tube Investments, Ltd., announced a 100,000-ton-per-year seamless tube-making mill. It will be the largest tube-mill in England with a complete range of tubes between 1 and 5 inches in diameter up to 300 feet long. It will have the first multi-stand 3-roll stretch reducing facility in England.

Air pollution became a more serious problem. Steel, Peech & Tozer spent over $2 million on electrostatic precipitators for the Spear project and The Steel Company of Wales Ltd., was installing several more of the gas cleaners at its Abbey works.

British Railways was using unit trains to deliver steel directly from the various producing areas to consumers in Birmingham and the West Midlands.

A combustible mixture of gasoline, diesel oil, and air was the power source for a high-energy-rate-forming process developed by the Department of Mechanical Engineering, University of Birmingham.

The first Ruhrstahl Heraeus steel degassing plant in England was installed at the Bilston Works of Stewarts and Lloyds Ltd. The $560,000 plant will treat 100 to 120 tons of both carbon and low-alloy steels per batch.

U.S.S.R.—As a result of the Seven-Year Plan ending in 1965, 18 new blast furnaces have been installed in the U.S.S.R., with a capacity of over 20 million tons of pig iron or hot metal. Nearly 80 percent of the 72 million tons of iron produced was smelted with natural gas although only 67 percent of the blast furnaces use natural gas. Forty-three percent of the blast furnaces use oxygen. During the Seven-Year Plan 51 new open-hearth furnaces with capacity of over 21 million tons were built. Some open-hearths were reported in the 500- to 600-ton capacity, and six were of 900-ton capacity.

During this period six basic oxygen converters, rated at 100 tons per heat, were blown in. These could account for all the 4.8 million tons of oxygen-produced steel reported in 1965. The U.S.S.R. produced much less steel by the oxygen converter process than did Japan or the United States.

Steel plants in the U.S.S.R. reported 1.32 million tons of "workblanks" from continuous casting machines. Most of these were vertical machines. This is more than the reported capacity of commercial installations in the United States.

AFRICA

South Africa, Republic of.—South African Iron & Steel Industrial Corp. Ltd. (ISCOR), put on stream a 120-ton-per-hour tandem hearth furnace at the Vanderbijlpark works. ISCOR also built an additional blast furnace here with a 28-foot-diameter-hearth.

ASIA

Japan.—Yawata Iron and Steel Co., Ltd. (Yawata) planned to use a computer to simulate steel processing and capital equipment planning. Yawata has produced 100 million metric tons of steel ingots since 1901. Yawata with 28 percent of total steel output over the 64-year period, was Japan's largest producer. Yawata kindled a blast furnace at the Sakai works capable of producing 3,800 tons of pig iron daily. Furnace diameter is 32 feet and the height nearly 100 feet. Two 185-ton oxygen converters were blown in to complete the integration of the Sakai works.

The Kobe Steel Works Ltd., and the Amagasaki Iron and Steel Manufacturing Co. Ltd., merged under the Kobe name to become the fourth largest steel company in Japan.

The first unit of a new fully integrated steel mill on the Inland Sea, an 80-inch temper mill, was put into operation after tests runs by Nippon Kokan K.K. The Fukuyama Iron works is built entirely on a land fill, giving it an integral deep water port.

Fuji Iron & Steel Co. Ltd., blew in two 60-ton LD converters at the Kamaishi Works, giving it crude steel capacity in LD furnaces four times that in open-hearth.

A 600,000-ton billet mill was the first production unit at the Mizushima Works of the Kawasaki Steel Corp. This was the company's second integrated works and had a planned annual capacity of 13 million tons.

OCEANIA

Australia.—The Broken Hill Pty. Co. Ltd. (BHP), commissioned a 500,000-ton steel mill using two 100-ton oxygen converters. BHP also blew in a new blast furnace at Whyalla. The 26-foot-hearth furnace was rated to produce 1,700 tons of iron per day.

Australia was reported to have a per capita consumption of 830 pounds of steel, third highest in the world. Some Parliament members advocated establishment of a State-owned company to compete with BHP, which pours most of the steel in Australia.

TECHNOLOGY

The steel industry operated very nearly at capacity during the first half of 1965. It might have been possible to turn out 150 to 170 million tons of ingot steel by utilizing all equipment available, ancient and inefficient as well as modern and efficient. However, in terms of usable steel for today's market, there was not enough processing equipment for that tonnage.

Over $1,800 million was spent on capital improvements in 1965 by the steel industry.

Half of the papers at a 1965 sectional meeting of the National Open Hearth and Basic Oxygen Steel Committee dealt with new technology while the rest treated problems of the open hearth such as that of reducing costs or increasing productivity. Steel producers in areas with large natural

Table 18.—Comparison of operating data prior to and after using end-burner oxygen enrichment in open-hearth furnace

	Without oxygen enrichment (1957–58)	With oxygen enrichment (1963–64)	Improvement
Ingot steel, short tons per heat	229.60	225.10	------
Ingot steel, short tons per hour	21.90	28.50	6.60
Average time, tap to hot metal	4 hr. 3 min.	2 hr. 59 min.	1 hr. 4 min.
Average time, hot metal to tap	6 hr. 15 min.	4 hr. 54 min.	1 hr. 21 min.
Average time, tap to tap	10 hr. 18 min.	7 hr. 53 min.	2 hr. 25 min.
Hot metal, percent[1]	62.00	56.80	------
Million Btu per ingot ton	2.78	2.73	0.05
Cubic feet of oxygen per ton	------	675.60	------

[1] Averages based on AISI reports of all metallics.

Table 19.—Physical characteristics of an incremental degassing unit[1]

Vessel dimensions:
- Inside diameter: 9 feet, 3 inches.
- Inside height: 12 feet.
- Inside nozzle diameter: 2 feet, 6 inches.
- Inside nozzle height: 6 feet.

Vacuum system:
- 4-stage steam ejector.
- Lowest possible pressure: 75 micron.
- Capacity: 1,000 pounds of air per hour at 1 millimeter mercury.

Vessel movement speeds:
- Full speed: 34 feet per minute.
- ⅔ speed: 22 feet per minute.
- ⅓ speed: 11 feet per minute.

Alloying system:
- Three main bins of 105-cubic-foot capacity with 25-cubic-foot trimming bins equipped with vibratory feeders.
- Two main bins of 40-cubic-foot capacity with 10-cubic-foot trimming bins equipped with vibratory feeders.
- One 40-cubic-foot carbon bin equipped with a paddle-wheel feeder.

[1] Dortmund Hörder unit, Pittsburgh Works, Jones & Laughlin Steel Corp.

gas reserves were converting their open-hearths to use more natural gas. Others were using oxygen, either by roof-lancing, or in end-burners. Improvement gained by using oxygen in end-burners is found in table 18.[4]

The Steel Co. of Canada Ltd. (Stelco), has experimented with using oxygen both in a single hearth furnace and with a dual hearth arrangement. Jones & Laughlin Steel Corp. installed a Dortmund Hörder (DH) incremental degassing unit in their No. 4 open-hearth shop. The unit was designed to treat a 400-ton heat in 25 minutes. (see table 19.) In this installation the vacuum chamber is raised and lowered over the ladle by its own mobile gantry. The company has made significant improvements in the quality of both fine-grained and semikilled steels with this process.[5]

Basic Oxygen Converters.—The steel industry produced 22.9 million tons of ingot steel in basic oxygen converters. This was nearly 90 percent of a capacity which was rated at only 25.9 million tons at the end of 1965. The United States and Japan together produced about 50 percent of the steel made by the basic oxygen process.

The two 150-ton converters of the Pittsburgh Steel Co. have made as much as 132,000 tons of steel in a month. The company obtained an average of 195 tons of steel from each vessel per heat.

Republic Steel Corp. began operation of the first of 3 new basic oxygen furnaces (BOF) at Warren, Ohio. These 150-ton furnaces are 22 feet in diameter and a little over 32 feet high. All gas emission from the furnace will pass through electrostatic precipitators. A digital computer calculates weight of charge materials before the heat and also calculates during the heat the amount of additives needed as determined by chemical analyses. Republic also has installed two 150-ton basic oxygen converters at Gadsden, Ala., which are monitored by a computer.

The Colorado Fuel and Iron Corp. has completed the replacement of one of its original converters with a 100-ton-per-heat vessel. These new converters have separate trunnion rings instead of integral trunnion rings which the original furnaces had.

The amount of steel made throughout the world now by the oxygen process, having increased from nothing in a little over 10 years, makes it clear that this method will dominate steelmaking within a few years. In the United States most of the installations were of the LD type, a nonrotating vessel fed oxygen through a water-cooled lance. One company, Sharon Steel Corp., uses a Kaldo or rotating oxygen-lanced vessel. In Western Europe, however, there were five methods in use, LD, LD-AC, Kaldo, Rotor, and the Ajax process. For a company with plenty of low-phosphorous hot metal, such as most of U.S. companies have, the LD type process would seem to be adequate; however, a need to use a

[4] Thompson, M. A. Results of Oxygen Enriched Firing in Open Hearths. J. Metals., v. 17, No. 6, June 1965, pp. 649–651.
[5] Parke, A. J., R. F. Kowal, and F. O. Altimore. DH Unit Operations in a Basic Open Hearth Shop. J. Metals, v. 17, No. 8, August 1965, pp. 897–901.

larger proportion of scrap would indicate the Ajax process or Kaldo converters. These two furnaces have longer charge to tap periods and need less automation for good control. However, the Kaldo, because of its rotation and contained heat, uses more refractories. If use can be found for waste heat the LD is the better converter. To make the best use of the refining speed of the LD converter, however, some system of dynamic control is needed with a computer which uses feed-back information throughout the heat.

The Bureau of Mines studied the use of an oxygen converter rotating on its vertical axis. Six or more oxygen jets, aimed at an angle wide of the vertical, may be used.

The principal problems connected with basic oxygen steelmaking fall into two categories, how to cope with the extreme heat generated by the oxygen and how to take advantage of the increased production that the speed of the steelmaking cycle makes possible. The higher heat of this new method has already required a different type of refractory lining brick to withstand the increased heat of the basic oxygen converter. The extremely high heat affects not only the basic oxygen vessel itself but also the trunnion ring by which the vessel is tilted for charging and for casting. A research program in which temperatures were continuously recorded in order to set up a typical thermal pattern of a furnace shell showed that the highest continuous temperatures occurred at the top, due to the proximity to hot gases and the reflected heat from the hood, and at the middle where the trunnion ring prevented the radiation of heat directly to the atmosphere. These are the areas most subject to distortion and to refractory wear. Ordinarily, temperatures at the bottom of the vessel are from 200° to 300° C below these other points and refractory wear is correspondingly less.[6]

The effects of lime properties in basic oxygen steelmaking were studied at August Thyssen-Hütte A.G. where it was determined that a soft burned lime was much superior to a hard lime and in fact lessened the consumption of fluorspar, caused much less frequent slopping, and generally had a good effect on the metallurgy of the heat.[7]

Consett Iron Co. Ltd., England's most northerly integrated steelworks, solved the problem of which equipment to install for oxygen steelmaking by installing two 120-ton Kaldos and two 120-ton LD vessels along with two 1,000-ton mixers. This dual system also required two different approaches to waste heat recovery. Waste heat boilers are provided for the BOF units and cooling hoods with no provision for waste heat recovery are used on the two Kaldo units.

Both the Ukrainian Institute of Metals and the Moscow Institute of Steel and Alloys report using exothermic ferroalloy briquets to eliminate the heat losses occurring when solid ferroalloys are used. There need no longer be a furnace for melting ferroalloys in the converter shop, and the ferromanganese consumption on the average was 17 percent lower than with liquid ferromanganese.

During the Annual Meeting of the American Society for Testing and Materials (ASTM) in June 1965, revisions to nine specifications were approved to allow the use of basic oxygen steel in boiler and pressure vessel plates.[8]

A self-propelled car for carrying a ladle full of molten iron to oxygen furnaces and for pouring the iron into such furnaces was designed and built by the Pennsylvania Engineering Corp., New Castle, Pa. Dominion Foundries and Steel Ltd., of Hamilton, Ontario, has ordered a unit as a major step toward complete automation of their steelmaking furnaces.

Rapidity of operation is foremost in all of basic oxygen steelmaking. Not only do the original methods of charging scrap and hot metal have to be speeded up but, with refining time measured in minutes, corrections to the heat in the form of additions of lime, fluorspar, or scrap must be made rapidly. One flux-charging system under

[6] Chamberlin, R. S., and P. R. Johnson. Thermal Considerations in Basic Oxygen Furnace Design. Iron and Steel Eng., v. 42, No. 6, June 1965, pp. 111–120.
Journal of Metals. Shell Replacement and/or Major Repairs to Basic Oxygen Furnaces—A Panel Discussion. V. 17, No. 8, August 1965, pp. 902–909.

[7] Behrens, K. F., J. Koenitzer, and T. Kootz. The Effects of Lime Properties on Basic Oxygen Steelmaking. J. Metals, v. 17, No. 7, July 1965, pp. 776–784.

[8] American Society for Testing and Materials. Comparison of the Properties of Basic Oxygen and Open Hearth Steels. ASTM Data Series, DS 30 (formerly STP 364), August 1965.

analog and digital computer control can calculate, prepare, and add a corrective flux charge in approximately 3 minutes.[9]

The Bureau of Mines was investigating the mechanics of fuming in oxygen steelmaking and the feasibility of preheating the oxygen to suppress fuming.

The high fuming rate of basic oxygen steelmaking necessitates use of air pollution control systems. The two most widely used in the United States are electrostatic precipitators and wet scrubber systems. However, a much less expensive cloth filter gas cleaning system has been developed in France. The key to this system is a method to cool the gases to allow treatment in a fabric filter. Some of the advantages claimed for this system are low cost of utilities, low and predictable maintenance costs, "clear stack operation" irrespective of weather conditions, and dry dust collection, which it is claimed, is more easy to handle than dust from spray-cooled systems.[10]

A fume hood system cooled with high-pressure water or steam functions as a heat recovery system and can save annually millions of dollars in the new oxygen steelmaking plants. United States Steel Corp. has installed such a hood at its Duquesne works.[11]

Automation.—Computers were slowly being adapted to iron and steelmaking. There were computer-controlled blast furnaces in the U.S.S.R., France, Japan, and the Netherlands. Engineers at Hoogovens in the Netherlands estimated that instrumentation costs of $100,000 were recovered in the first year of operation. In France the number of casts with the desired chemistry increased 50 percent after automation of the blast furnace. In the United States, however, sequencing and scheduling were the areas of greatest technologic progress.

There was more automation in oxygen steelmaking in Western Europe than in the United States. The Austrian steel industry developed the LD converter and Great Britain and the Common Market countries rapidly adopted oxygen steelmaking. Work has been done on automation on both LD furnaces and LD-AC furnaces. Probably the most advanced control was that of an oxygen-lime process (OLP) basic oxygen furnace operated on an experimental basis by IRSID at the Denain plant of USINOR. Through closed circuit operation the computer actually programs the operations for both phases of refining. When the operator has determined that the converter is ready for the first refining phase, he signals the computer to start. The calculations and decisions made by the computer are as follows: (1) initial positioning of the lance, (2) opening of the oxygen valve, (3) continuous calculation of the carbon content of the bath, (4) continuous calculation of the rate of decarburization, (5) regulation of the height of the lance above the bath as a function of the rate of decarburization, (6) charging of additives calculated on the basis of data from the preceding charge, (7) cessation of blowing (lifting of the lance and closing of the oxygen valve) when the calculated carbon content has reached a predetermined level.

There are several points of control on the various oxygen furnaces. Temperature and/or radiation intensity of the LD flame may be monitored by pyrometers. The ratio of oxygen, carbon dioxide, and carbon monoxide in the waste gas may be continually monitored. The formation of a foaming slag in the converter vessel may be detected by acoustical measurements. Thermocouples have been manufactured in the United States for almost instantaneous determination of the bath temperature. All of these measurements and their effect on the rate of refining must be put into the computer program so that proper control can result.

Control is further complicated by two inherent problems; variations in the rate and direction of the reactions of the vessel during the heat and from one heat to another, and the relative inaccessibility of the interior of the converter vessel during the oxygen blow. During the refining the first element to oxidize usually is silicon followed by manganese, then carbon. After the carbon removal any further oxygen reacts with the iron, reducing the yield and giving a high-iron slag. These reac-

[9] Weiss, Carl J., and Henry L. Te Selle. Flux Addition Control in Oxygen Steelmaking. Iron and Steel Eng., v. 42, No. 5, May 1965, pp 101–112.

[10] Finney, I. A., Jr., and Jean De Coster. A Cloth Filtered Gas Cleaning System for Oxygen Converters. Iron and Steel Eng., v. 42, No. 3 March 1965, pp. 133–140.

[11] Sefcik, A. J., D. E. Lyons, and W. O Williams. Development, Design, and Operation of a Controlled-Circulation Fume Hood for Basic Oxygen Furnaces. Iron and Steel Eng., v. 42 No. 7, July 1965, pp. 87–93.

tions are affected by oxygen pressure, lance position, jet area, bath level, and various other factors. To prepare to take a sample from or check the temperature of an open-hearth is a matter of opening the door. In contrast, for the BOF, first the oxygen must be stopped, the dust collecting hood raised, and the vessel titled to the charging platform. All of which takes valuable time when refining time is measured in minutes rather than hours.

Vacuum Degassing.—Vacuum degassing units have been modified and many different systems developed. Although the three principal types are still ladle, stream, and incremental, the various components have been so modified and intermixed, each with its alphabetical designation, that it is almost impossible to keep up with the new developments. In incremental degassing such as the D-H or R-H systems small amounts of molten steel are forced into the vacuum chamber to be degassed and then returned to the ladle. Ladle degassing is distinguished from this in that the entire ladle is enclosed within the vacuum system and the contained molten metal is stirred by electrical induction currents. This induction stirring keeps renewing or changing the surface exposed to the vacuum to promote degassing.

Sweden's SKF Hellefors Jernverk uses induction-stirred ladle degassing. At Republic Steel Corp. it is called "Induction Stirred Ladle Vacuum Degassed" or ISLVD. The advantages claimed for this system are that it reduces total gas content to about one-half that of regular double-slag electric furnace steels. It produces significant improvements in micro-cleanliness as measured by oxide inclusion counts and it provides steels of improved mechanical properties, fatigue characteristics, and service life. Republic has deoxidized over 500,000 tons using the ISLVD system.

British Iron and Steel Research Association (BISRA) has a continuous vacuum degassing system of industrial size. The degassing vessel, 6 feet high and 6 feet in diameter, has an inlet and outlet pipe, both with tundishes raised and lowered by hydraulic rams. After the degassing vessel is evacuated to a pressure usually from 1.5 to 8 torr, and the intake tundish is filled, the seal is broken on the inlet pipe through which the molten steel is moved into the chamber, which it enters in an unrestricted spray. This metal collects and flows across a slanted floor. When enough metal has collected to preserve a vacuum on the outlet side, that tundish is lowered and about 1 ton of steel per minute flows through the degassing chamber in a continuous stream.[12]

Continuous Casting.—The average heat size of 8 continuous casting machines listed as working in 1965 was 30 tons, while the average heat size of 10 machines listed as under construction at the end of 1965 was 180 tons. The machines were listed as casting from one to eight strands with dimensions from 2 to 6 inches by 2 to 50 inches, and are either vertical, vertical with bender, or curved mold installations. The curved mold keeps the total height lower and should save on capital construction cost in building.

Continuous casting machines now installed have a total operating capacity of over 1 million tons. Four other plants were using development units for casting slabs. Installation of 12 more machines averaging 180 tons per heat, or six times the size of those now operating, will greatly increase the continuous casting capacity of this country in the next 2 years. Companies were beginning to increase the size of castings and to build molds to turn out oblong and round shapes. A British firm was rolling H-beams from "dog-bone" shaped blanks cast in Canada. Tube blanks were being continuously cast without an internal mandrel.

Another system of continuous casting which was introduced consisted of a revolving drum which, by turning through a bath of molten steel covered with a bath of molten fused salt, would first pick up a layer of fused salt then a layer of molten steel which would gradually solidify. Then as the layers emerged from the ladle the drum picks up another layer of fused salt. This method would seem to be more feasible for strip and slab steel.

Nearly half of the continuous casting machines operating at the end of 1965 were listed as developmental and they were about evenly divided between vertical and curved mold machines.

In addition to the oscillating mold casting machines, the Hazelett Belt Casting

[12] Steel Times (London). BISRA's Continuous Vacuum Degassing Process for Steel Now Operating Industrially. V. 190, No. 5055, June 4, 1965, pp. 801–803.

machine was being evaluated for the continuous casting of steel. This machine uses endless parallel metal belts moving under tension and cooled by a high-velocity stream of water.

Pressure pouring, which was originated to cast steel wheels for railroad cars, was slowly finding wider use as companies became aware of the savings. Savings result from improved percentage of cast metal from molten metal, lower grinding losses in surface dressing, and the elimination of heating and blooming operations. Companies could make up to 5,000 castings in graphite molds made with new, improved techniques. Larger molds were being constructed. One graphite block made to mold one side of a slab measured 2 by 6 by 26 feet. Individual castings of over 15,000 pounds became possible. Many different types of steel have been cast, and research increased the possibilities. Some companies planned to combine vacuum degassing and vacuum deoxidation with pressure casting.

National Steel Corp. purchased two controlled-circulation boilers which will be installed on their basic oxygen converters at the Weirton Steel Division. These boilers not only burn the waste combustible gases coming from the reaction in the converter but also use the contained heat of the gas by cooling it from about 1,300° F to around 900° F at which temperature it can be handled by gas-cleaning equipment.

Electric Furnaces.—Lukens Steel Co., installed a 150-ton electric furnace to supplement two 100-ton furnaces already in operation.

The Timken Roller Bearing Co. installed a top-charge 110-ton electric furnace equipped with induction stirring and a fume collector.

Continental Steel Corp. announced plans for two 140-ton electric furnaces.

BLH Standard Steel, a division of Baldwin-Lima-Hamilton Corp., fired a 45-ton electric furnace.

The sixth electric arc furnace in the worlds largest electric arc melting shop was commissioned by Steel, Peech and Tozer, bringing their steelmaking capacity to 1.35 million ingot tons per year.

A tapered shell and an internally water-cooled roof are innovations being tried on electric furnaces. Solid state components were used for electrode control. A replaceable shoe-type holder which reduced repair cost as well as power and electrode consumption was introduced.

Ultrahigh power, in the 80-Mva range, was tried by Northwestern Steel & Wire Co. to increase production from its 150-ton electric furnace to 2,000 tons per day.[13]

The Bureau of Mines published the results of two investigations on the use of substituted metals in stainless steel. Research on the effects of adding gadolinium was carried out in cooperation with the Atomic Energy Commission.[14] Another paper describes the corrosion rates determined when substituting cobalt for nickel in stainless steel.[15]

---

[13] Robinson, C. G., and W. E. Schwabe. Ultrahigh Power Electric Steel Furnace Operation. J. Metals, v. 17, No. 1, January 1965, pp. 75–80.

[14] Copeland, M., W. Barstow, C. Armantrout, and H. Kato. Stainless Steel-Gadolinium Alloys. BuMines Rept. of Inv. 6636, 1965, 29 pp.

[15] Tilman, M. M. Effects of Substituting Cobalt for Nickel on the Corrosion Resistance of Two Types of Stainless Steel. BuMines Rept. of Inv. 6591, 1965, 17 pp.