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193

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CONTENTS

RECENT TRENDS IN BLAST FURNACE OPERATION IN RELATION TO FUEL ECONOMY

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The Author has exhaustively studied the recent developments in Iron Blast Furnace in various countries and is chiefly concerned with the incorporation of these techniques in iron and steel making processes. In this critical review, he has emphasized the necessity of adaptation of these methods for improving the economics of pig iron production.—Editor

INTRODUCTION

INDEX of industrial development of any country is judged on per capita consumption of steel. The manufacture of steel depends on two distinct stages, production of pig iron and its conversion into steel. The production facilities for iron, over 70% of which is converted into steel are, therefore, the most important criteria in the production of steel. Increase in steel output, therefore, demands production of pig iron, apart from reclamation and use of steel scrap itself steel making. The new oxygen converter steel making methods[1] need more pig iron per ton of steel than the conventional open hearth processes absorbing over 50% steel scrap. Due to the manifold increase of steel in consumer goods, the production of scrap will increase demanding additional pig iron even with the above iron/scrap ratio in steel making.

Pig iron is produced in blast furnace from iron ore, limestone and metallurgical coke, which supplied the requisite heat for smelting and also the reductants for the reduction of oxides of iron. As regards the transfer of sensible heat is concerned, a modern blast furnace is a highly efficient unit, but due to the thermodynamic equilibrium attained in the furnace due to the chemical reactions between the reducing gas and the iron oxides, the chemical heat from carbon cannot be fully utilized in the furnace. From this angle of view, the overall efficiency is debatiable. For this reason, the blast furnace process is indirectly responsible for the conversion of nearly half of the metallurgical coke employed for smelting to carbon monoxide, which is present in the top gas. About a third of the clean gas is employed for heating the blast supplied to the blast furnace for the combustion of carbon to carbon monoxide in the tuyere region, and thereby supplied sensible heat to the furnace, but the remaining two thirds has to be used elsewhere in an integrated iron and steel plant for fuel economy. For smelting in a blast furnace, carbonaceous fuel resistant to abrasion and load with a spongy structure and high chemical reactivity is essential. The blast furnace coke can only be produced in coke-ovens from a certain grade of coal. Besides high operating costs of conversion of coal to coke and the maintenance of coke-ovens plant, the progressive decrease in the metallurgical coal has focussed the attention to the coke economy in the blast furnace. Attempts to utilize non-coking coals for pig iron smelting, although promising, have met with limited commercial success[2]. For these reasons, all over the world, increasing attention is paid to reduce the coke rate.

The average coke rate in America in the past 20 years has dropped from 1970 lb. to less than 1700 lb. per ton of pig iron in 1958. In Domnenarfvet, Sweden, the coke consumption has dropped from 2100 lb. in 1934 to 1300 lb. in 1948, with further changes in design of the furnace and improvements in its operation particularly the introduction of sinter preparation and sizing of the burden etc. the coke consumption dwindled down to 1170 lb. per ton of pig iron. [3] During the period 1945, to 1956, the coke consumption decreased by 13% in the U. S. S. R. [4]

In certain countries, coking coal for making metallurgical coke is not available, the import of coking coal increases the cost of production. Even when coking coals are available, the cost of production of pig iron chiefly depends on the cost of producing coke. Consequently, the single factor which has received

THE UPS AND DOWNS IN THE INDIAN IRON & STEEL INDUSTRY

THE Bhilai Steel Works in India has been making tremendous progress in recent months, with its production of steel ingots even exceeding its rated capacity. Some of the items of machinery for the expansion of the Steel Works have already arrived from Russia. After mature consideration, the U. S. Government have agreed to finance a complete technical and economic Survey for the Bokaro Steel Plant with a view to possible financing of the project too. The Agency for International Development (AID) would pay for the study to be undertaken by the United States Steel Corporation. The steel mills in the private sector, viz., the Tatas and the Indian Iron have also been making good progress and achieved nearly 95% of their production capacities. The results of the smelting trials in the National Metallurgical Laboratory, Jamshedpur, of the magnetite discovered in Salem district in Madras State with the high-temperature carbonized coke obtained from the lignite found in Neyveli, have proved very successful and according to the Director of the Institute, Dr. B. R. Nijhawan, a steel plant could be set up in Madras State without any delay and he is also stated to have recommended the same to the Government.

But, this is only a part of the story and not the whole of it. The other side of the picture does make depressing reading, causing anxiety and concern in responsible quarters. For instance, production in the Rourkela Steel Works was much below its rated capacity, which was deplored only recently by the former Minister for Steel, Mines and Fuel, Mr. Sardar Swaran Singh, while addressing the first meeting of the re-constituted Iron and Steel Advisory Council. To quote the words of the Minister, " Rourkela, I am afraid, has not quite got over its ill-luck ". Even, in the case of Durgapur plant, its progress does not seem to be very satisfactory, though it is going on fairly well. Regarding the Rourkela Steel works, it has been well-recognised that from the start, one problem or another has been besetting it, and to top them all, the recent labour-management trouble. It is shocking to learn that serious lapses at the construction stage have been allowed to be perpetrated, like use of sub-standard cement for concreting purposes in the foundation and associated structures of the rolling Mills. God alone knows who were responsible for this—the German firms who were erecting the plant or the Indian Authorities supervising the work. From past experience, it is found that in the construction and erection of such a steel plant, the less the number of firms to be associated with the work, the better in the interest of speed and efficiency. Many other defects in the operation of the plant, like shortage of spares and tools which will affect the working of the blast furnaces, the grave shortage of rolling stock etc., have been listed in the report by the German experts.

In the case of Bhilai Steel Works, a different kind of problem has to be contended with. It is really deplorable that the different rolling mills had to be slowed down off and on in the recent past, as it was physically impossible to accommodate the stocks of finished products. All the rolling mills in this Steel Works, had achieved the highest rate of production, but work had to be slowed down for no fault of the plant or of supplies of raw materials but because sufficient number of wagons were not available for clearing the stocks of finished products. It is stated that about forty wagons were required to move out the daily output besides more wagons to clear the accumulated stocks which the Railways had not been able to provide. Such is the sorrowful state of affairs despite repeated assurances from responsible quarters, about ensuring adequate supply of wagons, more particularly for the steel works. Considering the speed with which the Russian Authorities have already started importing machinery for the expansion of the works, one is constrained to doubt whether the Hindustan Steel, who are responsible for the civil engineering work, can cope with the work.

According to a recent U. N. Survey's report, India would require 28 million tons of steel (present capacity 6 million tons) by 1972-75, if present plans for factories, power stations, railways, roads and other improvements were to be realised. Considering the much leeway we have yet to make in this field, we have to tackle effectively the problems that face the industry today on a permanent basis, on which depends the realisation of our targets. We trust and hope that the new Minister from Madras Hon'ble Sri C. Subramaniam who has taken up the portfolio, noted for his dynamic outlook and freshness of approach will prove equal to the task.

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significant attention for economic operation of blast furnace is the fuel consumption. The operational factors which influence the coke rate are :

(i) Reducibility of the iron ore and its improvement by preparation ;
(ii) Analyses of iron ore and flux and their preparation.
(iii) Ash content of coke, its analyses and quality ;
(iv) Blast temperature and its humidity ;
(v) Slag volume and its analyses ;
(vi) Iron analyses ;
(vii) Constancy of smelting operation and optimum rate of blowing ;
(viii) Use of high top pressure ;
(ix) Improved furnace design ; and
(x) Radiation and other sources of heat loss.

As the replacement of metallurgical coke by inexpensive solid fuels has not been practicable, attempts have been made to reduce the coke consumption in various ways such as preparation of the blast furnace burden, employment of higher blast temperature, addition of moisture to the blast, possible benefits resulting from oxygen enrichment of the blast, use of high top pressure and injection of gaseous, liquid and solid fuels at the tuyere level of a furnace. It is, the purpose of this brief article to present a critical review of the recent developments in blast furnace technique, and their effects on the fuel rate.

PREPARATION OF IRON ORES, AND OTHER RAW-MATERIALS

The world distribution of iron ore and metallurgical coke is shown in Fig. 1 and 2. Good grade iron ore suitable for charging directly in the blast furnace is becoming increasingly scarce all over the world. The metallurgical value of an iron ore depends not only on the iron contents, but also on the nature and amount of gangue material like silica and alumina contents, the inherent reducibility of the ore and its other physical characteristics. Lean ores with high gauge contents will lead to a large slag volume, which will increase in fuel consumption and decrease output. It is possible to reduce the gangue by suitable beneficiation techniques, depending on the nature of the ore. The methods like magnetic separation, magnetizing roasting, floatation, and washing are generally employed.

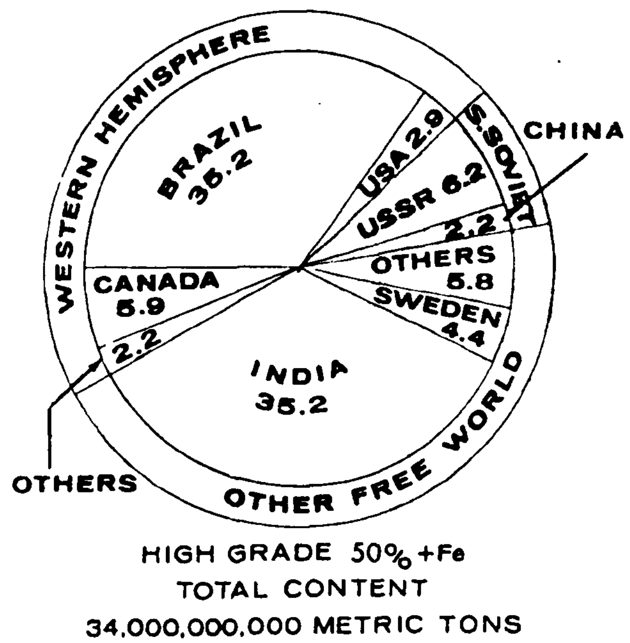


Fig. 1 : Distribution of High-grade iron ore

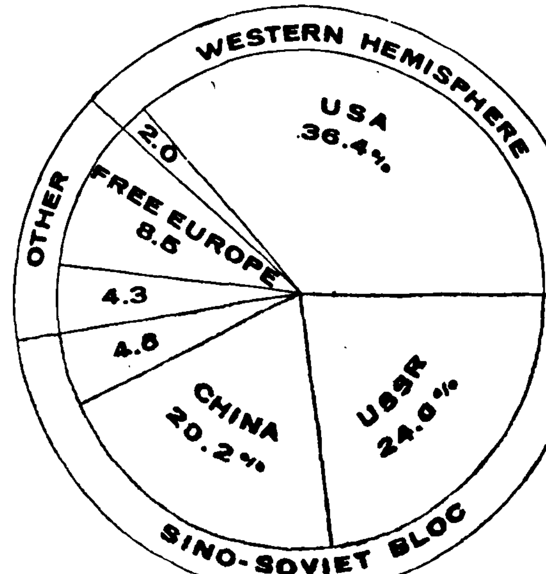


Fig. 2 : Distribution of Coking coal in the World

Danielsson[3] has given an interesting comparison where the degree of indirect reduction of 47, 44 and 50% and CO/CO_2 ratio of 1.42, 2.55 and 2.48 for a Domnarfvet blast furnace operating on self-fluxing sinter, an U. S. plant and an Indian Blast Furnace at Hirapur, showed carbon (in coke) consumption of 1015, 1404 and 1586 lb/ton of iron respectively. These differences can be explained on the basis of preparation of the burden. The higher coke consumption

at Hirapur, India, was also due to higher ash content of coke.

Beneficiation of iron ore containing 53% Fe. 10% SiO_2, 1.5% Al_2O_3 to 55% Fe., 1.7% SiO_2, 0.4% Al_2O_3 decreased the coke rate by 160 lbs. and limestone consumption by 340 lb., per ton of pig iron, and increased the production by 9%.[5]

It has now been found that the improvement in the blast furnace operation necessitates the preparation of a sized iron ore burden and size of sinter, which reduces the specific coke consumption and increases the productivity. The increase of 1% iron in the concentrate has reduced the coke rate by 2 to 3% and increase the output by 2 to 4%.6

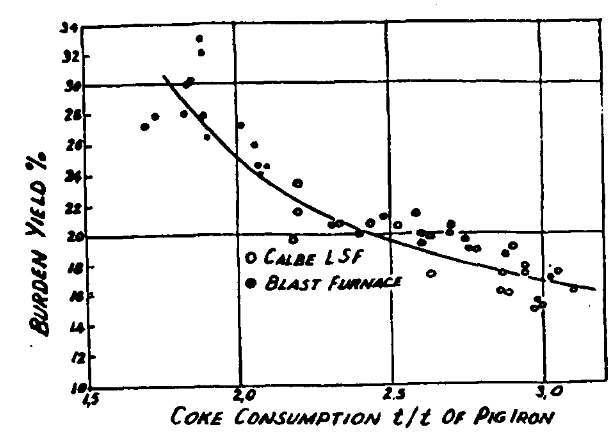


Fig. 3 : Relation between burden yield and coke consumption

The relation between slag volume and coke rate is shown in Fig. 3. An improvement of iron value of the ore with decrease in silica and alumina contents will reduce the amount of limestone necessary for fluxing with increase in burden-yield. The thermal requirement will decrease resulting in significant saving in coke and limestone, and will increase production. The effect of beneficiation of the ore [7] on decreasing the coke rate is shown in Fig. 4. Due to these benefits of ore beneficiation is now widely practised. In the U. S. S. R. the beneficiation of the ore has increased from 0.2% in 1913 to 52.8% in 1957. In Austria, the use of beneficiated iron ore has increased from 42% in 1942 to 92% in 1956. In Sweden even high grade iron ore containing 60% iron is upgraded by beneficiation.[6] In the United States, ore-dressing is extensively adopted. India has extensive deposits of good-grade iron ore. But as fines are inevitably produced during mining, the sintering process is being adapted in steel plants. As some of these ores are high in silica and alumina, their beneficiation is receiving attention. The reserves of coking coal is poor and it contains very high ash contents. Metallurgical coal is washed to reduce the ash contents.

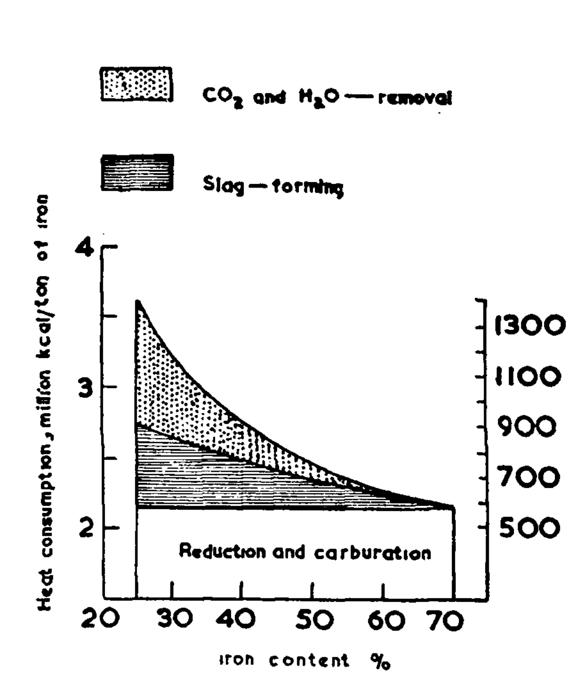


Fig 4 : Effect and beneficiation of ore and sintering on heat and coke consumption

The utilization of iron ore fines, substantial amounts of which are produced even during mining of hard ores, require agglomeration by sintering, pelletizing and briquetting. The sintering of carbonate or hydrates of iron removes carbon dioxide and water. The sintering operation reduces the sulphur contents and the smelting operation can be conducted with comparatively lower basicity degree of the slag which will reduce the flux rate and coke rate. The addition of pellets of iron ore (62.3 and 64.5% Fe. 4.12–9.01% SiO_2, 0.65 to 1.73% Al_2O_3) has decreased the slag volume with improvement in smelting characteristics.[8]

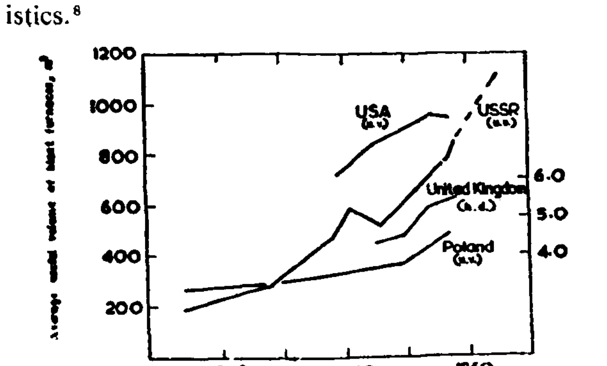


Fig. 5 : Increase in the size of blast furnace from 1920 to 1960.[6]

As the coke rate decreases with the increase in the useful volume, of the furnace, the average size of the blast furnace [6] has been increased as shown in Fig. 5. A larger furnace will require better grade of raw materials with greater crushing strength particularly coke and adequate preparation of the burden is equally necessary to derive full benefit of the increased furnace capacity. Fig. 6 shows increase in the output due to improvements in burden preparation and employment of larger furnaces.[6]

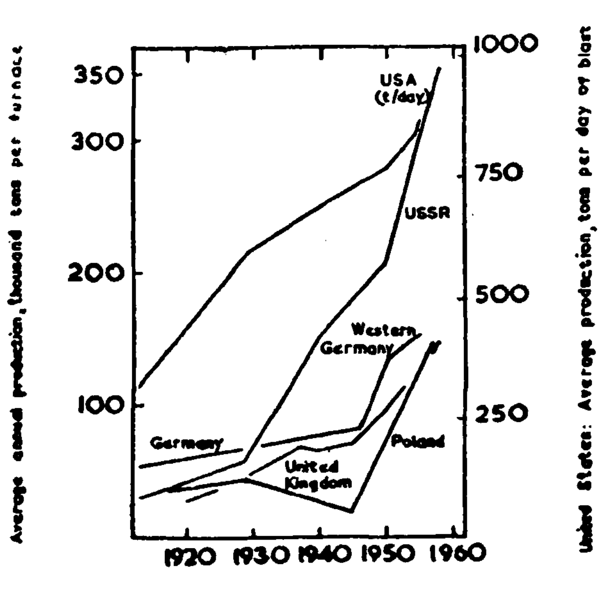


Fig. 6 : Increase in average output from blast furnaces from 1920 to 1960[8]

SINTERING OF IRON ORES

Sinter is a porous agglomerate of fine-grained iron ore obtained by binding the particles by heating when the bonding takes place due to formation of constituents like $FeO\text{-}SiO_2$, $CaO\text{-}Fe_2O_3$. In self-fluxing sinter, the requisite amount of limestone for fluxing is also added. The microporosity of sinter facilitates gaseous indirect reduction of iron oxides, and improves reducibility and thereby reduces the coke rate.

In smelting with lumpy raw materials, or with sinter burden, with the addition of limestone, heat is required for the endothermic decomposition of limestone which amounts 769/Btu/lb. of limestone. In the case of self-fluxing sinter, the requisite heat is supplied in the sintering strand either by the gas or by coke breeze and therefore the costly metallurgical coke is not consumed for the purpose inside the blast furnace. The decomposition of limestone releases CO_2 which reacts with solid carbon to form CO by what is known as the " solution loss ". The reaction is endothermic and 1595 Btu. is necessary for one pound of CO_2. The higher the concentration of CO of the ascending gases, the better is its ability to reduce oxides of iron by indirect reduction at the higher stock level of the furnace. The dilution of this gas with CO_2 liberated from limestone will lower the concentration of CO and will reduce the amount of indirect reduction. The introduction of limestone in the blast furnace, therefore, decreases the thermal efficiency of the latter.

The therm requirements[9] of a blast furnace with unfluxed sinter and limestone, and self-fluxed sinter burden are compared in Table I.

TABLE : I *Thermal requirement of fluxed and unfluxed sinter burdens.*[9]

Data	unfluxed sinter.	Fluxed sinter.
Amount of limestone charged. lb.	770 (for all purposes.)	135 (to flux coke ash only).
Decomposition of limestone Btu. per tonne of pig iron.	591,000	104,000
Carbon solution loss Btu./ton of pig iron.	256,000	45,000

From data in Table I, and assuming a CO/CO_2 ratio of 1.8, fluxed sinter will save 123 lb. of carbon per ton of pig iron. The gradual replacement of raw limestone in the burden by fluxed sinter at the Clyde Iron Works, Sctoland, progressively reduced the carbon rate and a relation was noticed between the carbon rate, slag volume and raw limestone.[9] It was noticed that replacement of 100 lb. of raw limestone by equivalent amount of lime in the self-fluxed sinter led to a reduction of 26 lb. carbon rate per ton of pig iron. The CO/CO_2 RATIO REMAINED unaltered despite the reduction in the limestone addition, which means that CO of the ascending gases was more fruitfully utilized in the reduction of iron oxides.

In view of these benefits, the employment of sinter in blast furnace burden shows an upward trend [9] in many countries as shown in Fig. 7. A large number of examples can be cited to illustrate the conspicuous decrease in coke rate on increasing the sinter in the burden (Fig. 8). The increase in output with sinter burden [9] is shown in Fig. 9. These clearly demonstrate the advantages obtained by employing sintered burden, and it is felt that in future its use will further increase.

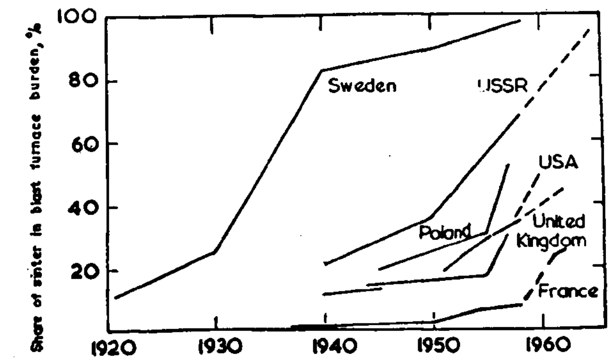


Fig. 7 : Increase in the use of sinter in blast furnace production

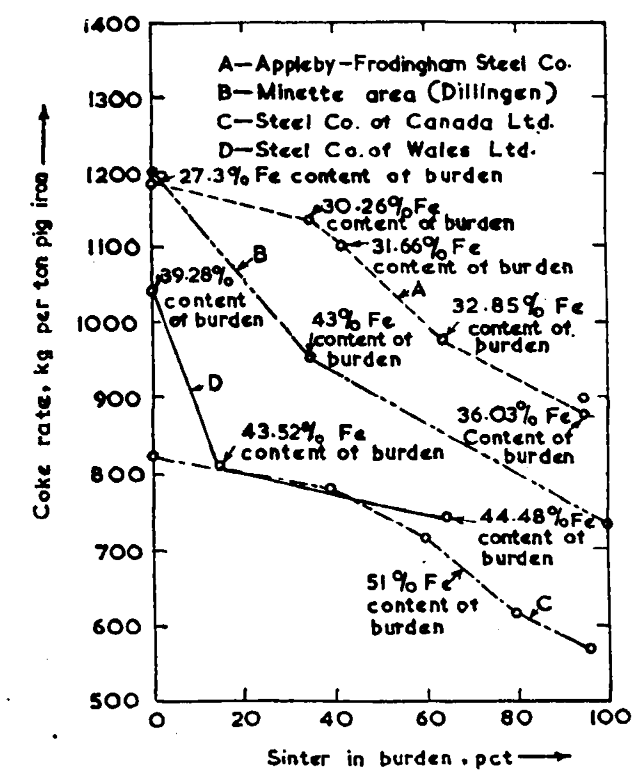


Fig. 8 : The Effect of Sinter in the Burden on decreasing the coke-rate

As 45% of coking coal is imported by Japan, the reduction of coke rate has received attention. A reduction of 300 lbs./ton of iron has been effected by the utilization of self-fluxed sinter, and high blast temperature [13, 16]. The operational data with prepared and unprepared burdens consisting of 100% self-fluxing sinter (A), 50% sinter and raw iron ore (B) and 100% raw iron ore (C) are recorded in Table II, and decrease in coke rate[16] is shown in Fig. 11. The total heat required for smelting a ton of pig iron was 4.82, 5.83 and 6.1 million Btu. for conditions A. B. and C respectively.

MATERIALS

Burden, Lb. per Net Ton.	A	B	C
Self-fluxing Sinter	3,282	—	—
Ordinary sinter		1,618	
Pellet		156	146
Raw iron ore		1,338	2,782
O. H. Slag	199	280	238
Limestone		476	464
Manganese ore	25	48	24
Millscale		22	76
Scrap		74	60

(Table II)

OPERATION

Data		A	B	C
Coke rate, lb. per ton		1,096	1,352	1,438
Wind volume, cu. ft. per ton		49,000	61,200	66,000
Blast temperature deg. F		1537	1470	1292
Flue dust (dry) lb. per net ton		36	84	123
Blast pressure, p.s.i.		8.68	11.85	10.30
Gas volume (calc.) cu.ft. per net ton		63.838	81.15	88.172
Gas temperature Deg. F		450	454	581
Gas analysis, pct :				
CO		22.8	25.6	26.7
CO_2		17.2	15.1	13.8
CO/CO_2		1.33	1.69	1.94
Average daily out-put net tons		612	647	500
Average iron analysis, pct ;				
C	—	4.38	4.56	4.27
Si	—	0.67	0.68	0.78
S	0.033	0.033	0.036	0.039
P	—	0.175	0.250	0.202
Mn	—	1.17	1.14	1.11
Slag volume lb. per net ton		878	1,056	882

Data		A	B	C
Average slag analysis, pct :				
SiO_2	—	34.9	33.2	31.2
Al_2O_3	—	14.1	16.5	20.6
CaO	—	40.8	42.4	39.8
MgO	3.8	3.8	4.2	4.1
S	—	1.1	1.3	1.3
Ratio bases to silica		1.28	1.40	1.41

In the U.S.S.R. the use of sintered burden is steadily increasing from 20% in 1949 to 54% in 1955 and it might have attained 73 million tonnes in 1955 in 1960 resulting in about 80% of the ore burden.[10] The aim is to use a two component burden consisting of sinter and coke. The charging of hot self-fluxing sinter with a basicity of 1.25 has increased the production by 12% and saved coke by 11%.

In Soviet practice, constancy of smelting operation has received great interest, and development of automatic instrumentation has eliminated many operational disturbances due to human factors. It has also reduced the man power necessary for the production of a certain amount of pig iron.

The use of a burden consisting of self-fluxed sinter, sized limestone and good metallurgical coke of low ash contents is very effective in increasing the production with decrease in cost of production.

EMPLOYMENT OF HIGH BLAST TEMPERATURES

In blast furnace operation, pre-heated air at 700–800 deg. C. introduced through the tuyeres and the gases leave the furnace at 200—250 deg. C. The amount of hot blast required for making a ton of pig iron amounts approximately to 80,000 cu. ft.; with a temperature of 800 deg. C. the sensible heat input is about 2.2 million Btu./ton of pig iron, which is equivalent to 300–340 lbs. of coke/ton of pig iron, or 15–20% of the total heat input from the hot blast and that obtained by the combustion of coke in the furnace. It is, therefore, obvious that an increase in the hot blast temperature will reduce the coke rate. By thermal calculation, it can be shown that an increase of 100 deg. C in the blast temperature can reduce the coke rate by about 47 lbs./ton of pig iron. In the U. S. S. R. the average increase in hot blast temperature is 412 deg. C. for the period 1945 to 1959, where extensive investigations were conducted to assess the affectiveness of increased in the hot blast temperature.[11] The increase in hot blast temperature from 900 deg. C to 1000 deg. C. did not effect the regularity of the burden movement; but the pressure of the ascending gases dropped by 0.02 Kg. Cm² 0.28 lb./sq.in. and the top-gas temperature was reduced. It was previously considered that high hot blast temperature promotes the fuel consuming direct reduction which stood in the way of employing very high blast temperatures.[12]. This observation was not corroborated as the degree of direct reduction was not altered substantially on increasing the blast temperature. It was noticed that the average saving in coke was 2.3% on increasing the temperature from 900 to 1000 deg. C and 4.4% on 100 deg. C. increase in the temperature range of 600—800 deg. C. In other words, at 900 deg. C. saving was 17 kg.tonne/100 deg. C., while at 700 deg. C. it was 57 kg./tonne/100 deg, C. No difficulties were found on heating the blast to 980°C.[3] The effect of blast temperature on coke consumption is illustrated in Fig. 10. It is clear that greater saving of coke can result in increasing the blast temperature at lower levels than by an identical rise at high temperature. A higher combustion temperature is attained by an increase in blast temperature and the intensity of combustion is accelerated, which increases the productivity; the combustion zone, however, is reduced. There are some economic and practical

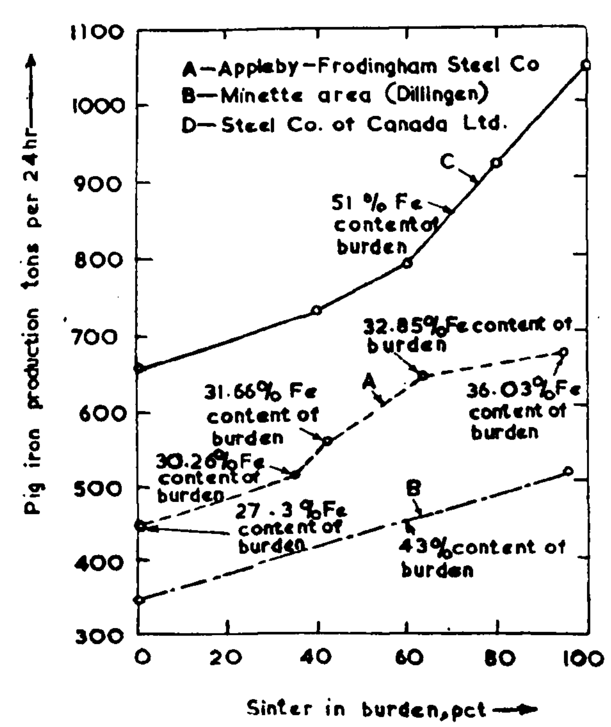


Fig. 9 : The Increased output due to the use of Sinter.

limitations to the employment of very high blast temperature, the chief of which is the ability of the refractories of the stoves to stand higher temperature on heating, and the blow pipes can bear. About 870 deg. C. stainless steel blow pipes are required and above 950 deg. C. ceramic lining is necessary. The other problems are connected with ability of valves and other mechanical components to stand the higher temperatures.[14]

The development of a smaller combustion zone, with higher blast temperature, may adversely affect the smooth descent of the burden column. The problem, however, becomes different with simultaneous increase in moisture content of the blast or injection of natural gas, or other hydrocarbon fuel oil through the tuyeres or through auxiliary tuyeres, when the additional heat input due to higher blast temperature is balanced by endothermic dissociation reactions of the injected material.

With modifications, the smelting with higher blast temperature can be possible with uniform distribution of ascending gases through a permeable burden and a regular descent of the burden. There should be facilities for heating the blast to the desired temperature and the stove refractories should enable efficient heat transfer. The employment of hot blast temperature of 835 deg. C. did not involve any operational difficulties in an 18′—4½″ hearth diameter furnace operating with 100 per cent sinter burden, but caused hanging and slipping with 50% sinter or 100% raw iron ore burden due to the lack of adequate porosity of the burden.[15]

HUMIDIFIED BLAST AND CONTROL OF MOISTURE

The amount of moisture in the air blast varied depending on the season and the daily weather conditions. A higher fuel rate in rainy season is well known. In order to keep the moisture at the same level through out the year, and for the advantages described later, humidification of the blast is practised. The humidification of the blast to 2.5% by volume is practised in the U. S. S. R. and over 90% of pig iron is produced in furnaces blown with the controlled humidity of the blast. The fixedness of the moisture content facilitate even operation of the furnace in different season. The constant moisture content[16] of 2.5% (9 grains/cu. ft.) helps to increase the production by 7% and decrease the coke rate by 2%. The belief that higher moisture contents of the blast may increase the hydrogen content of pig iron has not been substantiated. It does not affect the size of the combustion zone around the tuyeres.

As the reaction between steam and red hot coke is endothermic, the additional heat is provided by higher temperature of the blast.

The use of steam in the hot blast was practised in order to control the hearth temperature which is related to burden coke ratio of the charge. Some experiments were conducted at the Indiana Harbour Works of Island Steel Company[17] in 1957. In comparing operating results of with or without moisture, it was noticed that production was 5.2% higher, coke rate was 1.9% higher ; slag volume was 2.3% less and wind rate was 2.2% higher.

In Russian Blast Furnace practice, it has been found that with blast containing 8.75 to 11 grains per cu. ft. of moisture, increase the furnace productivity by 3.7 to 7% and reduces the coke rate by 1.5 to 2% per cent, provided the additional heat required fot decomposing the steam is compensated by increase of blast temperature.[18]

The operation of blast furnace using moisture in blast has also been tried in U. S. A.[19]. The moisture addition increases the size of the combustion zone. An enlargement of the combustion zone facilitates the upward movement of the reducing gases resulting in regular operation of the furnace. The moisture in the blast aids in regular descent of the burden.

In furnace operation with moisture addition in the blast, it is essential to know the heat effects produced by the presence of moisture in the air as the reaction between carbon and water is endothermic.[20]

Taking the wind volume of the furnace 75,000 cfm. of dry air at the temperature of 1000 deg. F. the heat input to the furnace :

$$7500 \times 1000 \times \frac{.0188}{\text{cft °F}} = 1410{,}000 \text{ B. T.U.}$$

If 5 grains of moisture/cu.ft. is added to the blast, and assuming that bosh gas volume constant, the conditions become :

Volume of the air = 74003 cu. fm.

Lb. of moisture added/ min. = 53.57

Sensible heat in dry air =

$$74003 \times 1000 \times \frac{.0188}{\text{cft.°F}} = 1391.256 \text{ B.T.U.}$$

Heat in moisture:

$$\frac{53.57\ \text{lb. water}}{\text{min.}} \times 1000 \times \frac{.49}{\text{Lb.} \times {}^\circ\text{F}} = 26.249\ \text{B.T.U.}$$

Total sensible heat in Blast — 1417505 B. T. U.

But there is an additional loss of heat due to dissociation of water present in the air blast due to reaction :—

$C + H_2O — CO + H_2$ which absorbs 3096 BTU/lb. of carbon.

$$53.57 \times 3096 = 165{,}853\ \text{BTU}.$$

Therefore, sensible heat in the hot blast less heat loss of steam reaction is 1417505 -- 165853 = 1,251,652 B.T.U.

Thus difference is 1410000–1251652 = 158358 BTU. between dry air and equivalent dry air and moisture.

To compensate the loss due to heat of dissociation of steam, the temperature of the blast is raised.

$$\frac{158348}{141750} \times 100^\circ F = 112^\circ F.$$

The blast temperature equivalent per grain of moisture is

$$112 \div\ = 22.4^\circ F.$$

The Table II shows the increase in temperature of blast for various additions of moisture.

Table II *Moisture Additions and Blast Temperatures.*

Amount of Moisture grain/cu.ft.	Blast Temperature. °F.	Difference. °F.
0	1000	—
5	1112	+112
10	1224	+224
15	1336	+336
20	1448	+448
25	1560	+560
30	1672	+672

In the reaction of steam of red hot coke, an atom of carbon generates $CO + H_2$ which is a strong reducer, but on reaction with air CO becomes associated with inert nitrogen. The addition of steam to the hot blast enriches the blast with oxygen because steam contains 88.9% oxygen by weight while dry air contains only 23.3%. The moisture increases the hydrogen content and reduces the nitrogen ballast of the tuyere gas. The hydrogen increases the reducing capacity of the bosh gas, speeds up the rate of reaction of iron oxides, and improves the furnace efficiency. The steam in excess of the desired value, however, enhances the thermal load on the furnace. A variation of the blast moisture can be helpful for controlling the hearth temperature. For example, if temperature begins to rise, an increase in humidity will bring it down and conversely if the hearth temperature begins to fall a decrease in blast moisture will restore it.

On humidification of hot blast following results have been noticed.[21]

(i) To maintain constant production, the blast temperature should be enhanced by about 22°F as per grain of moisture added.

(ii) At constant blast temperature, production decreases by about 0.5%, per grain of moisture.

(iii) At 15 grains cu. ft. of moisture, the coke rate decreases by about 0.4 lb/ton of pig iron for each 1°F. increase in blast temperature.

(iv) At constant blast temperature, (1555°F) the coke rate decreases about 7.5 lb. for a decrease of 1 grain of moisture/cu.ft.

(v) For constant coke rate, the blast temperature should be increased 22°F for each additional grain of moisture.

It may be mentioned that[18] due to the presence of moisture:

(i) One lb. of carbon burnt at tuyeres generates 2.5% more reducing gas but 3.2% less gas volume.

(ii) A cu.ft. of steam in the blast requires 4% more carbon for burning and produces 7% less heat/cu.ft.

(iii) The flame temperature is lowered by 65°C due to endothermic reaction of steam. $H_2O + C = H_2 + CO$.

(iv) The decrease of hearth temperature by smaller amount of heat generated per lb. of carbon at a lower temperature must be compensated by increase in blast temperature, as has been discussed.

In the United States of America, the oxygen enrichment of the blast necessitated the addition of moisture and with a blast temperature of 585–621 deg. C the following practice was followed:[5]

Oxygen enrichment%		Moisture Grain/cu. ft.
1.0	—	5
1.5	—	6
2.0	—	7
2.5	—	8
3.0	—	10
4.0	—	14

The effects of addition of moisture and oxygen enrichment of the blast changes in the composition of bosh gas and on driving rate are shown in Tables III and IV.

Table: III *Composition of Bosh Gas.*[5]

Blast conditions	CO%	N_2%	H_2%	$CO+H_2$	Relative volume
Dry air	34.7	65.3	—	34.7	1. 0
10Gr/ft³+22.5%O_2	37.4	60.2	2.4	39.8	1.03
20Gr/ft³+24% O_2	39.0	55.5	4.7	44.5	1.06
30Gr/ft³+25.5%O_2	41.8	51.4	6.8	48.6	1.09

Table: IV *Composition of the Blast and driving rate.*[5]

Blast conditions.	Composition of blast-vol.%			lb. C burned by			Driving rate.
	O_2	N_2	H_2O	O_2	H_2O	Total	
Dry air	21	79	—	1330	—	1330	1. 0
10Gr/ft³/ 22.5%O_2	21.825	75.175	3.0	1385	95	1480	1.11
20Gr/ft³/24% O_2	22.56	71. 44	6.0	1425	190	1615	1.21
30Gr/ft³/25.5% O_2	23.205	67.795	9.0	1470	285	1755	1.32

The presence of moisture in the blast with its enrichment with oxygen increases the amount of $CO+H_2$ and decreases inert nitrogen in bosh gas. With 4% oxygen enrichment and 24 grains moisture/cu.ft. in the blast having a temperature of 852°C. the production increased substantially with significant decrease in coke rate.

Nijhawan[22] has discussed the recent developments in Russian Blast Furnace practice such as humidification, of the blast, oxygen injection of the hearth level.

HIGH TOP-PRESSURE

In a normal blast furnace operation not provided with the mechanism to develop high top pressure, the wind is introduced at a pressure of 15–20 lbs./sq. in. in through the tuyeres and the furnaces fases leaves at 1 lb./sq. in. For operation under high top pressure, the air enters the furnace at 30 lb./sq.in. and leaves the top at 16 lb./sq.in. The increase of pressure intensifies the combustion, of coke and increases the production. It does not involve any smelting difficulties, but the blowers should be capable of delivering air at higher pressure and the large bell seating should be gas-tight.

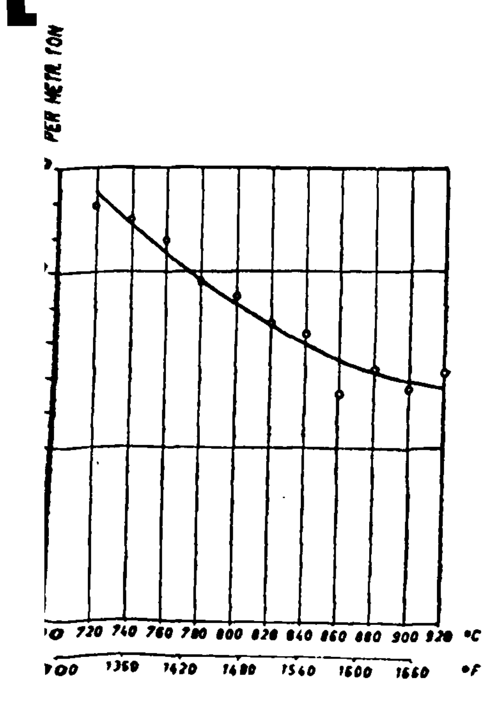
The operation of the blast furnace under high top pressure was investigated at Clyde Iron Works of Colvilles Limited,[23] in 1951. Under high top pressure, the furnace operation was very smooth and regular, flue dust loss was low and reasonable production was obtained at economic coke rate. It was observed that increase in production of about 1% for each pound of top pressure above normal resulted.

The amount of air blown in is a limiting factor in a furnace operation. The practical use is made of the idea that if reducing gases are compressed in rising through the blast furnace, their velocity will be reduced; which will result in increased and prolonged gas-solid contact inside the furnace. The time of reduction of iron oxide by CO or H_2 can be shortened by increasing the pressure of the gas. For a regular

-ration, the amount of air blown should be -e that gases formed can afford maximum reduction of iron oxides, during their -he higher velocity of the gases will cause -scent of burden in the stock of furnace, -causing high dust loss. The increase in -e enables control of burden ratio, coke -O_2 ratio, top gas temperature and signifi- -es the amount of flue dust produced. As -ainly contains small particles of coke, a flue dust will reduce the coke-rate. At -oke saving amounted to 130–255 lb./ton decreased from 215–270 to 145–170 t./ton

-tion of the flue dust is a function of the -ng. The use of elevated top pressure with -l volume reduced the flue dust substan- operation became smoother.[25]

-ced that with the increase of top pressure -sq. in. to 10 lbs./sq. in. the velocity of -ses in the stock and at the top was -nearly 32.5%. With high top pressure, -of air blown could be increased without



Effect of blast temperature on coke consumption.

-as velocity and if such increase is not -y coke consumption, the productivity -an be increased.

In Russia, most of the blast furnaces are operated with high top pressure and over 60% of pig iron is produced in such furnaces. The top pressure has been increased to 13 to 15 lb./sq. in. which results with increase of production by 6.7%, and coke consumption decreased by nearly 4%. Now most of the furnaces are operated with high top pressure. It has increased the productivity by 10% without change in coke rate. The use of high top pressure has out-standing advantages even with imprepared burden as it reduces flue dust losses and increases the output of the furnace. The employment of high top pressure is not adapted in all countries.

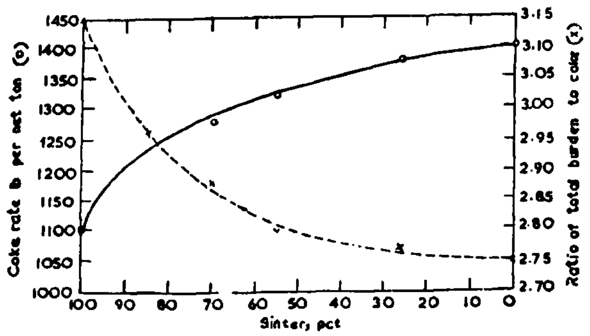


Fig. 11. Dependance of coke rate and ratio of total burden to coke in relation to self-fluxing sinter.

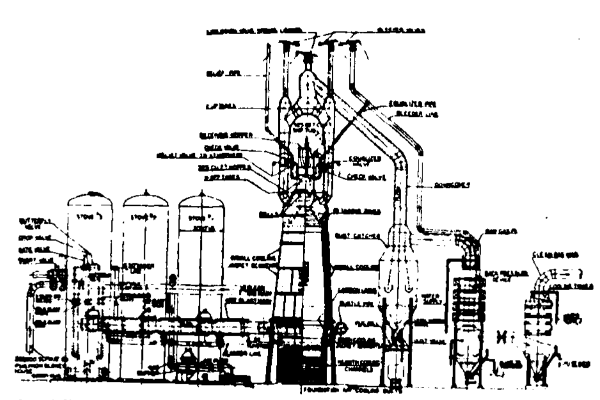


Fig. 12. New Furnace design offer high top pressure operation.

It has been announced by Koppers Engineering and Construction Division that a blast furnace with a ultra-high top pressure of 40 lbs./sq. in. (which is four times the present high top pressure) is under development.[39] The output of about 2000 tons/day in a normal 28 ft. hearth diameter furnace of normal top gas pressure of about 2 lbs./sq. in. will be boosted upto 4000 tons/day working at 40 lbs./sq. in. top pressure; with

beneficiated burden. The furnace height is proposed to be reduced to 72 ft. from tuyere to the stock line to avoid condensation of moisture from top gas. The blast, will be heated to 982°C–1093°C. The blowing rate is 194,000 cfm. will be supplied by a Turbo-blower capable of delivering 2000,000 standard cfm. of air at 60 lb./sq. pressure. Fig. 12 shows the various features of the proposed new design.

Injection of Fuel Oil, Natural Gas, Coke Oven Gas, solid Fuels into the Hearth of a Blast Furnace

In order to replace a part of the metallurgical coke required for smelting, hydro-carbon fuels both liquid and gaseous, and solid fuels have been injected directly into the smelting zone of the blast furnace through special arrangement in the normal tuyeres or through a set of auxiliary tuyeres. The injection of gaseous or liquid fuels does not introduce any slag forming material and therefore the net heat obtained is very considerable, and 20–30% of the coke can be saved.[28] The reductants such as natural gas, coke-oven gas, and fuel oil absorb heat for their dissociation from the high temperature zone around the tuyeres and additional heat is necessary to compensate it, as in the addition of moisture to the blast. Partial combustion of natural gas by a mol of O_2 generates 140,000 Btu. less than the reaction of the same amount of oxygen with coke and 1% gas injection requires 55°C rise in blast temperature. The dissociation of water vapour leads to $CO+H_2$ and it takes away carbon. The fuel gas or oil dissociates to furnish carbon and takes away oxygen.[29] The fuel injection will contribute carbon and therefore will decrease coke rate more effectively than steam additions. There are no difficulties in gaseous injection, but the liquid fuel needs atomization. Both moisture addition and fuel injection increase hydrogen in the ascending gases and a portion of hydrogen reduces iron oxides in furnace stock column. This reduces carbon requirements. The injection of fuel oil improved the indirect reduction of iron oxide, reduced the solution loss reaction[30] and reduced the coke rate[31]. The injection of coke oven gas at 4% of the volume of blast in a 22 ft. hearth diameter blast furnace decreased the coke rate from 1817 to 1506 lb.— a saving of 12.4% at a blast temperature of 1500°F. A combination of natural gas injection with high blast temperatures has reduced the coke rate by 15% and increased the production by more than 10%.[32] In Lone Star Steel Co., U. S. A., injection of natural gas amounting to 3% of the blast volume, raised the output considerably with substantial decrease in coke rate when the temperature of hot blast was increased by 25% and these modifications lowered the operational costs by 15%.[33]

The injection of pulverised coal directly into the smelting zone of a blast furnace can replace a part of coke[34]. In an experimental blast furnace, injection of authracite fines reduced the coke consumption by 24% but the blast temperature had to be increased to compensate for the chilling effect of the cold fuel injection. For fuel injection, it has been mentioned that the requisite temperature of the combustion zone and the thermal gradient should not be disturbed; the volume of the ascending gases should allow optimum indirect reduction; the blast temperature should be high; and the formation of carbon black should not occur.[35] At Fairless Works, U. S. A., full scale test of natural gas injection increased the daily output by 14% with 20% reduction in coke rate. Amongst the fuels injected, 1.11 lb. of coal or 0.775 lb. of fuel oil, or 15.4 cu. ft. of CH_4, 20.8 cu. ft. of rest gas, 37.7 cu. ft. of coke oven gas or 77 cu. ft. of H_2 can replace 1 lb. of coke.[35] The fuel injection gives a top gas of higher calorific value.

In many blast furnaces in U. S. A., natural gas and fuel oil are used and investigations are conducted on the injection of solid fuels like coke breeze.[36] Alongwith the injection of hydro-carbon fuels, the enrichment of the blast with oxygen has been adopted at several places.

By the injection of 20–25 gallon fuel oil/ton iron produced, 2 cwt. of coke can be replaced, without increasing the blast temperature on increasing it by 150–200°C. further replacement of 1 cwt./ton was possible.[40]

The enrichment of the air blast with oxygen is receiving attention as it increases the output substantially. The increase of oxygen in the blast by 4% has increased the production by 19% at the Weirton Steel Co., U. S. A. In Soviet practice, 1% additional oxygen increased output[6,37] by 2.5–3.0%. The oxygen enrichment which is still in the experimental stage, will require steam additions to the blast or injection of hydro-carbons, in the smelting zone. The increase in cost due to oxygen enrichment should balance the benefits obtained.

In Russian practice, it has been observed that the coke consumption became minimum at a definite smelting rate. A slower or faster rate of blowing than the optimum adversely affected the coke rate.[37]

From an analyses of statistical data,[38] it has been mentioned that :—

(i) An increase of 1 cwt./ton in total burden results in an increase of 0.15 cwt./ton in carbon rate ;

(ii) An increase of 0.1 unit in lime basicity ratio of the slag CaO/SiO_2 leads to an increase of 0.35 cwt./ton in carbon rate;

(iii) An increase of 100°C. of blast temperature reduces the carbon consumption by 0.4 cwt./ton ;

(iv) An increase in hard ore at the expense of soft ore reflects on higher carbon rate ; and

(v) An increase of 10% sinter reduces the carbon rate by 0.7 cwt./ton.

In conclusion, it may be mentioned that till the time direct reduction of iron ore to steel becomes commercially practicable the means to achieve fuel economy in blast furnace operations would continue to receive considerable attention. The various factors affecting the fuel rate should be thoroughly explored for optimum operational efficiency, and the fuel consumption should be decreased for improving the economics of production. The capital investments for incorporating these modifications is expected to pay rich dividend.

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Machining of High Alloy Steels on a Chrome, Chrome-Nickel and Chrome-Nickel-Manganese Base

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(Continued from previous issue November 1961 — Vol. 2 No. 1)

BROACHING

BROACHING offers outstanding advantages in volume production. Since the economics of this method of machining are mainly a question of appropriate tool design, it is advisable during the planning stage to obtain the advice of suitable tool manufacturers.

An exceptionally important factor with broaches is that there should be no vibration in the guidance arrangements; for this reason at least three teeth should be in action at all times. The configuration of the broach must ensure uniform chip removal by each tooth so as to obviate localized work hardening through the tooth sliding. Recommended depths of cut per tooth range from 0.0008 to 0.001 in. Suitable values of front rake for broaching soft steels are 12 to 18°, the upper limit being intended for austenitic and ferritic steels. For the harder martensitic steels the preferred range of front rake angles is 8 to 12°. Furthermore, it is essential that the tooth spaces should be of adequate depth, properly radiused and polished. Tooth pitch t is given by the expression $t = 0.35\sqrt{\text{length of cut}}$, whilst tooth depth $Z = 0.5\ t$. Long broaches should be provided with staggered chip-breaker grooves.

Cutting speeds may range between 6.5 and 26 ft./min.

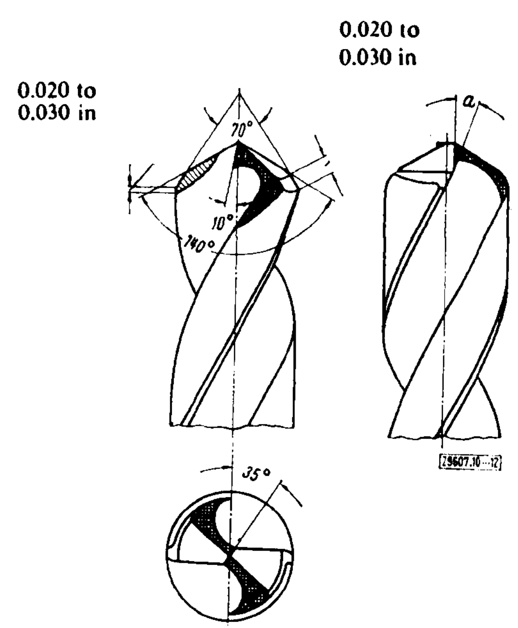
The materials mentioned are readily machinable up to a hardness of 35 Rockwell "C". Where the hardness exceeds this figure, the work should be soft-annealed prior to broaching, otherwise rapid dulling of the expensive broaching tools will result. Heat tinting resulting from the subsequent hardening operation can be removed with special broaches.

Very careful consideration should be paid to ensuring proper lubrication of broaches; extreme pressure oil mixed with paraffin oil has proved satisfactory for this purpose.

REAMING

The reaming of parallel holes presents no difficulty provided that suitable tools are used. Tapered holes, on the other hand, are better bored out.

Reamers should have left-hand spiral fluting with a least 7° angle of spiral. The most satisfactory results in the softer steels are given by reamers having a lead angle of 15°, and in the harder steels by reamers with a 20° lead. In contrast with the usual type of reamer,



Figs. 10 to 12. Specially ground twist drill for drilling tough CrNi and Mn steels.

Offset of cutting edges 0.004 to 0.006 in.

a Rake angle (ground to suit the material) = 0.020 to 0.030 in.

the rake angle must be made 3 to 5°. This makes for better chip flow and gives improved cutting performance. *Table 5* gives data on cutting speed and feeds for high speed steel reamers. The cutting conditions detailed allow a good deal of latitude to enable all requirements in regard to surface quality to be met; low cutting speeds give smoother surfaces. It is important that an adequate reaming allowance should be left so that the reamer does not slide (work hardening). Lands should be kept narrow when regrinding. Reamers sometimes have to cut over the full length of their cutting edges and often develop a considerable amount of heat in the process. In addition, very fine cuttings are produced which are best flushed away by feeding the extreme pressure oil into the hole under pressure. Effective oil filters must be provided to

Table 5. Cutting Conditions for Reamers from 7/32 to 1 in. dia.

Recommended grades DMo 5 for $\frac{7}{32}$ to 1 in. dia.
BMo 9 for < 3/8 in. dia.
EMo 5 V 3 for < 3/8 in. dia.

Material	Cutting speed ft./min.	Feed/rev. in.
Ferritic heat-treatable and hardenable martensitic steels	23 to 66	0.003 to 0.008
Stable austenitic steels	23 to 66	0.003 to 0.008
Unstable austenitic steels	33 to 66	0.003 to 0.008
Austenitic Mn steels	16 to 33	0.003 to 0.008

make sure that these fine cuttings are intercepted before the oil re-circulates.

DRILLING

Drilling is one of the most difficult cutting operations, particular in austenitic steels.

Even the act of centre-punching can lead to work hardening. A punch ground to a pyramid shape should therefore be used and struck only lightly.

Very unfavourable cutting conditions prevail in the centre of the hole, and for this reason the included point angle is increased to 130°, and for drilling thin work (such as sheet, etc.) to 140°. To keep the chisel edge short, the cutting edge is often chamferred. Chamfer width range from 0.01 to 0.06 in. according to drill diameter. Point thinning *Figs. 10 to 12*, is adopted for austenitic steels to minimize the zone under the drill point which is particularly susceptible to work hardening. The lip relief angle should be between 7 and 15°. If the dimensions of the drill permit, chip-breaker grooves should be ground, *Fig. 13*, to facilitate chip flow. When drilling fairly deep holes, this feature gives improved drill life. For drilling austenitic steels, it is found helpful to slope back the highly stressed cutting edges by grinding the outside of the tip to a smaller point angle, *Fig. 10*.

Work hardening in the bottom of the hole is difficult to eliminate. It may be found that even carbide-tipped drills fail to bite and that the hole can only be completed by burning it out.

Short drills with a small helix angle are stiffer, feed accurately, and clear the cuttings more readily than conventional drills. They are particularly well suited to drilling holes of small diameter.

For drilling deep holes, drills of the type employed for making oilways in crankshafts are used. These drills have a thicker web, a quicker flute spiral and usually a chip-curling groove of the kind shown in *Fig. 11*. When carbide-tipped, such drills are also suitable for drilling Mn steels, provided that the chisel edge is shortened by point thinning or by cross grinding.

Holes under 3/16 in. diameter are best drilled with manual feed. Satisfactory values for feed and cutting are given in *Fig. 14*.

When using small drills it is better to have the speed too fast rather than too slow, because the risk of breakage increases as the cutting speed falls.

When drilling deep holes, the cuttings readily bind in the flutes. The drill must therefore be withdrawn and cleaned if necessary after it has reached a depth equal to four or five times the hole diameter (and thereafter at further depth increments equal to three-quarters of the hole diameter). It is vitally important that the drill should bite immediately, that the feed should be kept uniform, and that the drill should be changed promptly as soon as its performance declines. For cooling and lubricating purposes, soluble oils are satisfactory, but they must have greater tenacity than for drilling structural steels.

TAPPING

In tapping, it is the lead length of the tap which does the whole of the cutting work, and since

Fig. 13. Point-thinned twist drill with chip-curling groove

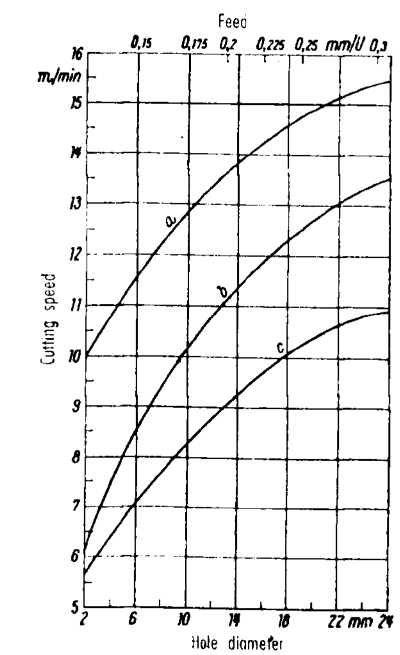


Fig. 14. Cutting speeds and feeds for drilling high alloy steels

a Ferritic-martensitic chrome-steels
b Austenitic chrome-nickel steels
c Austenitic manganese steels

austenitic steels tolerate an undue amount of compressing (nip effect), the taps used and the techniques employed must be modified accordingly. For all types of high alloy CrNi and Mn steels, the taps used should be spiral-pointed, and should have a hook angle of 10 to 15°, *Fig. 15*. The spiral point must include the first full thread. Polishing of the point surfaces and of the flutes enables cuttings to flow away more easily. For cutting long internal threads, taps having narrow lands are desirable in order to minimize the " nip effect ", *Fig. 16*. For the same reason, a type of tap frequently used for tapping long holes has alternate teeth missing, *Fig. 17*. Taps are provided with two flutes up to about 1/8 in. in diameter, normally with three flutes up to the M 12 size, and with 4 flutes above this size. For threads of the M 24 size and larger, built-up taps, possibly carbide-tipped, are used.

To lighten the duty on the tap, the hole to be tapped should be broached or reamed accurately to size, the size being made adequate for the purpose to offset the nip effect.

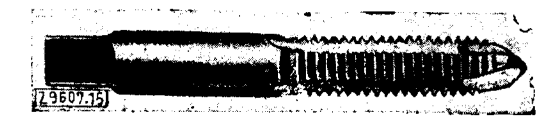


Fig. 15. Tap with spiral point

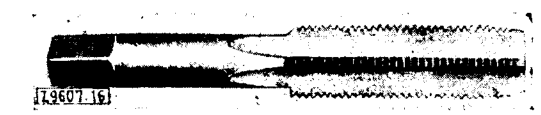


Fig. 16. Narrow land tap

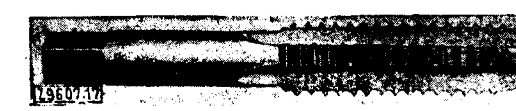


Fig. 17. Tap with half the normal number of cutting threads

The strength of a screw fastening with a fully cut thread is only 5% higher than for a thread cut to 75% of the thread height, but the power required to cut it is 50% higher; considerable trouble can be saved by bearing this in mind. Short threads up to half the thread diameter in length, however, must be cut full. Threads having a length equal to twice the diameter need only be cut to 75% of the full height, since this will give sufficient load-carrying capacity. Still longer threads need only be cut to 50% of full height (l).

To calculate the tapping hole size, the following expression can be used

$$D_K = D - 1{,}29\ A_G\ h \ldots\ldots \quad (1)$$

In this expression D_K is the diameter of the hole to be tapped, D is the nominal size, A_G the height of the thread cut as a percentage, and h the lead.

An expression relating height of thread to tapping hole size is obtained by re-arranging expression (l), as follows

$$AG = \frac{D - D_K}{1{,}29\ h} \ldots\ldots\ldots \quad (2)$$

If tapping in a blind hole cannot be avoided, the tap used should have a shortened lead.

Machines used for tapping should offer maximum resistance to deflection and should have an accurately mounted spindle; the tap itself should be guided by a leader. If the class of accuracy required permits, a cut tap is often good enough for roughing purposes if a ground tap is used for finishing.

High speed steel taps are usually preferred. Taps in nitrided steel or in hard-chromed tool steel are also suitable. These latter types, however, often need re-treatment after being reground.

Permissible cutting speeds are given in *Table 6*. Owing to the friction brought about by the nip effect a tenacious lubricant is essential. Mixtures of white lead and extreme pressure oil prepared to the consistency of a thick paste have proved satisfactory. Another paste lubricant very easily made up and giving excellent results is a mixture of equal parts of white lead and tallow.

Taps, which should be kept sharp at all times, should be reground only by reference to gauges.

Table 6. Recommended Values of Cutting Speeds for Tapping

Recommended quality: DMO 5

Material	Cutting speed ft./min.
Ferritic and ferritic-austenitic Cr steels	10 to 23
Heat-treatable Cr steels	10 to 20
Martensitic Cr steels (annealed)	7 to 16
Austenitic CrNi steels with stable austenitic structure	10 to 20
CrNi steels with non-stable austenitic structure	16 to 33
Austenitic Mn and CrNiMn steels	7 to 16

EXTERNAL THREAD CUTTING

The cutting of external threads causes less trouble than tapping. Hand cutting by dies, however, is not a very suitable method for the steels considered here. Hand-cut threads lack accuracy and die life is very short. Machine die heads, on the other hand, are provided with interchangeable dies which can be ground individually to a very high standard of accuracy. Die heads of this kind with tangentially mounted dies are excellent for heavy-duty cutting conditions and long threads. The die lead angle should be 20° for normal pitch threads and 15° for fine pitch threads.

Die heads with radially arranged dies are suitable for cutting fine threads. The lead angle for this purpose should be about 20°.

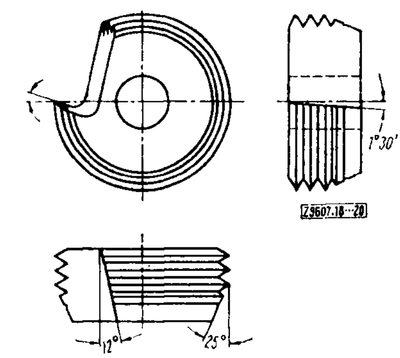
A tool very widely used for external thread cutting is the circular type chaser, *Figs. 18 to 20*. It should have a lead extending over the first 1½ to 3 threads and must be chamfered to produce a curling cut when threading austenitic steels.

Table 7 gives details of proven cutting speeds for external threads; very fine threads should be cut at speeds 5 to 10 ft./min. slower. As a lubricant, a mixture consisting of one part extreme pressure oil and five parts paraffin oil has given good results. The oil in circulation must be very carefully filtered, since fine cuttings impair tool life.

Table 7. Recommended Values of Cutting Speeds for External Threading with Die Heads

Recommended quality: DMo 5

Material	Cutting speed ft./min. Normal pitch thread	Fine pitch thread
Ferritic and martensitic Cr steels (annealed) and ferritic austenitic steels	10 to 20	6.5 to 10
Unstable austenitic steels	10 to 20	6.5 to 10
Stable austenitic steels	13 to 26	6.5 to 10
Heat-treatable Cr steels	13 to 26	6.5 to 10
Austenitic Mn steels	6,5 to 17	5 to 8



Figs. 18 to 20 Circular type chasers

SAWING

Sawing can be carried out by circular saws, power hacksaws and bandsaws, provided that the cutting point is amply cooled. The coolant prolongs saw tooth life and flushes away the cuttings so that a clean-surfaced cut is produced. For these reasons, the coolant should not be unduly thick although a high viscosity is needed. In the case of circular saws, it is of the utmost importance that there should be no bearing play. Saws must be sufficiently powerful to maintain the necessary feed rate through these very tough and substantially stronger steels, since inadequate feed could lead to work hardening of the material.

Circular saws should be equipped with rigid saw blades of tool steel with insertable teeth or tooth segments of high speed steel; alternatively, high speed steel saw blades can be used. Tooth rake should be 10 to 15° and the clearance angle 6 to 10°. For the harder grades of steel, saws with roughing and finishing teeth are advisable. When re-grinding, care must be taken to ensure that the shape of the tooth spaces is preserved. The cuttings must break off so that they do not pile up, and so that the coolant can carry them away. Very good results have been obtained with chip removers which mesh into the saw teeth and remove cuttings which have become lodged.

For all chrome steels, the best results with circular sawing are obtained at peripheral speeds from *33* to *52* ft./min. and with feeds up to *2* in./min.

For the austenitic steels the cutting speed should be between *23* and *33* ft./min. In this case, the feed rate should not exceed 1 in./min. These values should be reduced still further for the highly heat-resistant austenitic steels and for manganese steels.

Power hacksaws are also suitable provided that they have very stiff frames. The weighting of the frame must be made sufficiently heavy and the saw blades themselves must be ground in such a manner that they cut clear, and that all the teeth can cut. On the return stroke the blade must be lifted to prevent work hardening of the steel at the cut surface.

For light cutting conditions, blades having 24 teeth to the inch are suitable, but for heavier cutting the tooth pitch must be made correspondingly larger.

When bandsaws are used it is very important that the blade guidance should allow no play. Details of cutting conditions for sawing high alloy sheet and plate with bandsaws are given in *Table 8*. Efficient cooling is important, particularly with the austenitic steels.

Table 8. Recommended Values of Cutting Speeds for Bandsawing High Alloy Sheet and Plate

Material	Number of teeth/"	Cutting speed in ft./min. for sheet or plate thickness of $^1/_{16}$ to $^9/_{32}$ in.	$^9/_{32}$ to ⅝ in.	⅝ to 1 in.	above 1 in.
Ferritic Cr steels	14 up to 18	98 to 131	82 to 98	66 to 82	49 to 82
Heat-treatable Cr steels, hardenable martensitic Cr steels	12 up to 14	98 to 115	72 to 98	66 to 72	49 to 66
Austenitic CrNi steels with stable austenitic structure	12 up to 14	72 to 98	56 to 72	43 to 56	39 to 43
Austenitic CrNi steels with unstable austenitic structure and ferritic-austenitic steels	10 up to 12	66 to 75	49 to 66	39 to 49	26 to 72
Austenitic Mn steels	10 up to 12	59 to 69	43 to 59	36 to 46	20 to 36

Fig. 21. Circular saw with roughing and finishing teeth in high speed steel

The Grinding of Cutting Tools

The proven procedure for high speed steel tools is to grind on a coarse wheel (e. g. 60 grit) and to hone also on a wheel (120 grit). To secure better chip flow, all rubbing points on tools should be lapped or polished. Grinding should always be done by gauge.

Dry grinding can easily lead to loss of hardness and to grinding cracks on the surface of the tool. Wet grinding is therefore preferable, an ample supply of cooling water being necessary. More extensive grinding operations, such as forming the cutting edge, are best carried out prior to hardening.

Carbide tools likewise are best rough-ground, preferably with a wheel of 46 grit and Grade I hardness. For finish-grinding, a wheel of 150 grit and Grade H to L hardness is suitable. After the grinding stage the tools must be lapped or polished on diamond wheels. Carbides are not so sensitive to overheating and can therefore be readily ground dry.

Cleaning and Passivating

Stainless steels without exception are only corrosion-resistant if their surface is clean, and, more particularly, if there are no surface deposits which prevent the formation of a passive layer. For this reason, it is advisable after machining to ensure thorough removal of all traces of lubricants and coolants.

If equipment for chemical cleaning by perchloroethylene or trichlorethylene vapour is available, the parts can be eleaned by this method. Where these facilities are not available, good results are given by hot solutions of trisodium phosphate (5% P III at 95°C), sodium silicate, sodium aluminate or sodium borate, etc. plus a small addition of free alkali (to assist the cleaning action). The passivating treatment should follow immediately on the cleaning operation. The best passivating agent is nitric acid. For steels having 13 or 17% chromium and a carbon content above 0.25%, and for steels which must not suffer any damage to their polish, a passivating bath consisting of 18 to 22 parts by weight of nitric acid and 1.5 to 2.5 parts by weight of sodium bichromate in water at a temperature of 50 to 60°C can be recommended.

After the parts have remained in this bath for 15 to 30 minutes, they are rinsed in clean water and dried, for example by dry sawdust or superheated steam. Stainless steels having 17% and upwards of chromium tolerate 20 to 40% nitric acid at a temperature of 60 to 70°C. This mixture has a mild pickling action and is not suitable for polished parts.

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The Krupp-built Dive Sphere

By A Special Correspondent

COURAGE, inventive flair, and engineering know-how have forced the gates to the last unexplored regions of our globe, the nethermost depths of the ocean. On 23 January 1960, the Swiss scientist, Jacques Piccard, accompanied by the US-Navy Lieutenant, Don Walsh, dived 11,000 m beneath the surface of the Pacific to the bottom of the Marianas Trench, the deepest known spot in the world's deepest ocean. This record dive was made in a steel sphere of 2,18 m diameter and a wall thickness of 12 cm, forged by Krupps of Essen from Cr-Ni-Mb steel. The sphere itself was made in three sections, the contact surfaces being merely cemented together with a special steel-bonding adhesive, the precision finish making welding unnecessary. This unique engineering feat has aroused no less admiration than the record dive itself, in which the Krupp sphere was subjected to an outside pressure of 172,000 tons.

At the Indian Industries Fair, New Delhi, the public obtained information on every point connected with this pioneering achievement. Krupps exhibited on their stand a full-scale replica of the now-famous " Sputnik of the Deep ".

PROBLEMS ENCOUNTERED IN BUILDING THE KRUPP SPHERE

To enable the sphere to withstand the fantastic water pressure, a host of engineering problems had to be solved.

Krupp engineers decided upon building the sphere from three forged sections, namely a central member and top and bottom. The steel selected was a chrome-nickel-molybdenum grade made in an electric-arc furnace and cast by the vacuum process.

Careful control of the forging temperature and degree of reduction ensured highest quality of the work. Facilities specially developed for the purpose made it possible to achieve the best direction of the flow lines and an extremely uniform consolidation of the metal. In the subsequent machining of the three parts, the outer surfaces were contour-turned on a copying lathe by means of spherical finishing attachments. The three forgings were subjected to several heat treatments for stress relieving and for imparting uniform properties.

FREEDOM FROM DEFECTS

Subsequent tests showed the following average values for tensile strength and notch-impact strength :

	Yield point kg./sq. mm.	Tensile strength kg./sq. mm.	Elongation %	DVM notch-impact value mkg./sq. cm.
Specified	80	90—110	10	4
Obtained	92	104	15.4	9.8

Non-destructive testing by the supersonic and magnetic-particle methods was frequently resorted to in the course of manufacture. The result : All three parts were entirely free from defects.

OPTIMUM PRECISION

The contact surfaces of the sphere required precision-finishing so that metal-to-metal contact alone provided a satisfactory seal.

In order to guarantee complete cohesion of the three sections forming the 12-ton sphere and as an additional insurance against leaks, their contact surfaces were cemented together. The cementing process was performed in two stages, the adhesive in each case being cured in a heat-treating furnace.

COMMUNICATING WITH OUTSIDE

Access to the interior of the sphere is obtained through a man-hole closed by a heavy steel hatch. For communicating with the outside world, 12 holes were bored round the window in the lower section of the sphere, 8 for electric cables, two for additional ventilation when the sphere is surfaced, and two for connecting pressure gauges.

The sphere has two observation windows, 180 mm. thick, pointing downwards at a steep angle. These windows are at opposite sides of the sphere and give a 70 per cent field of vision.

COMPLETED IN 5 MONTHS

The sphere, complete with interior fittings, took 5 months to build and was delivered to Piccard in March 1959.

On 23 January 1960, a red-letter day in the history of science and engineering, Jacques Piccard and his companion, U.S. Navy Lieutenant Walsh, penetrated to the bed of the ocean at its deepest point—the Marianas Trench, near Guam

ATTACHED TO FLOTATION TANK

The Krupp sphere was not, as many suppose, let down by cable to the depths, but was attached to the bottom of a flotation tank, filled for buoyancy with 100,000 litres of petrol. The bottom being open, the tank—in contrast with the Krupp sphere—was not exposed to pressure differential.

This tank, built of steel sheeting only 5 mm. thick, held the sphere attached to it as a balloon holds the gondola. For the descent, the Bathyscaph was ballasted with 11 tons of steel shot, subsequently dumped on the ocean bed for surfacing.

TELEGRAM OF THANKS

On 24 January, the day after his record dive, Jacques Piccard sent Krupps the following telegram: "Thanks to your excellent work, dived in perfect safety 11,000 metres—kindest regards—Jacques Piccard".

ECONOMIC, PERSONAL, AND CULTURAL RELATIONS BETWEEN KRUPP AND INDIA

Deliveries made by Krupp to India in recent years include: 90 locomotives, 3 cement factories, 5 weirs, a large 12-kilometer conveyor system, one of the longest of its kind in the world, for an open-cut lignite mine, as well as a low-shaft furnace, a number of cranes, oil mills, cable-making and stranding machines, can-making machines, steel structures of various kinds, and rolled steel products.

At present, Krupp is supplying 52 large wharf cranes for the extension of harbour facilities at Calcutta and Madras. Certain of the structural steel assemblies for this order are being made for Krupp in India. Krupp will also deliver, in the first part of 1962, 15 large tyre-curing presses to a tyre factory in India.

Krupp deliveries to India from 1957 to the present time alone amounted to a value of 225 million DM. A considerable part of this sum went for supplies and equipment for the Rourkela iron and steelworks, in the design and construction of which Krupp had a leading share, and which is considered to be the most modern plant of its kind in Asia. Near this plant a residential city for 100,000 persons, built to plans supplied by Krupp, has grown up out of the jungle.

The following facts show the value Krupp places on its economic, personal, and cultural ties with India:

Krupp is planning to establish in India its own steel fabrication and mechanical engineering shop, as well as its own production plant for sintered carbide.

Krupp is continually training young Indians for their future jobs—a modest contribution towards the solution of the problem of ensuring a steady supply of skilled labour in coming generations.

On January 23, 1960, Jacques Piccard and his companion Don Walsh, in a steel sphere constructed by Krupp and provided with glass windows, dived about 11,000 m (approx. 36,000 feet) to the bottom of the Pacific and were thus the first men to reach the greatest depth ever recorded.
The Krupp sphere is the first in the world capable of withstanding the enormous pressure at 36,000 ft. of 8.0 tons per square inch. The leading dimensions of the Krupp sphere are as follows: Outer diameter 7,15 ft. Wall thickness 4,7 inches. Weight 13,4 short tons.

Alfried Krupp has made numerous good will trips to India—as has Berthold Beitz, Chairman of the Krupp Executive Board—where he met with Prime Minister Nehru and other leading personalities.

In order to further strengthen the traditional ties of friendship between India and Germany, Krupp organized in 1959 at Villa Hugel in Essen the exhibition, "5000 Years—Art from India". The 900 exhibits from 31 Indian museums attracted 140,000 visitors. This exhibition was shown afterwards in a number of European capitals.

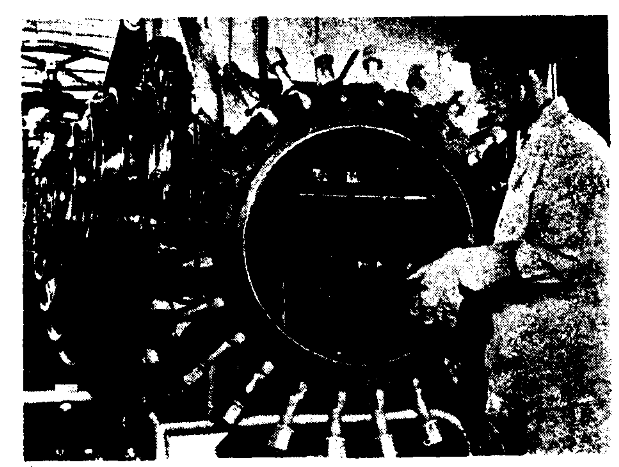
GEC Furnace at BISRA Laboratories, Sheffield

By An Engineering Correspondent

A vacuum induction melting furnace is now in operation at the Sheffield Laboratories of the British Iron and Steel Research Association. It was supplied by G. E. C. (Engineering) Ltd. in association with Vacuum Industrial Applications Ltd. and is being used for research into vacuum melting and casting of ferrous metals, with particular emphasis on the determination of optimum temperatures and pressures necessary for the removal of impurities such as tin, copper and hydrogen. It is also suitable for studying the effect of reduced and elevated pressure on various steel-making reactions having been designed for operation at pressures up to 200 lb/sq. in. The furnace is capable of working at a maximum temperature of 1700°C, and has a melting capacity of 10 lb.

DESCRIPTION OF FURNACE

In order to permit easy cleaning of inner surface, the 24 in. diameter furnace chamber has been arranged horizontally. A handle penetrates the side of the chamber enabling the charge to be poured into a mould by tilting the crucible. Six tipping buckets for adding alloying metals to the molten charge have been provided.



An operator removing a mould from the G.E.C.-V.I.A. vacuum induction melting furnace installed at the B.I.S.R.A. Laboratories, Sheffield.

(Photo: GEC)

A two-stage pumping system comprising a 10 in. oil booster-diffusion pump backed by a gas-ballasted rotary pump is used to evacuate the chamber. Water-cooled baffle plates protect the pumping ports from radiant heat from the charge. With these pumping arrangements provided it is possible to reach the minimum working pressure of one micron in about five-minutes, and the pumping speed is high enough to maintain this pressure under conditions of severe outgassing.

There are two control consoles, arranged one on either side of the furnace. One of the consoles contains the vacuum equipment while the other houses the high frequency plant supplied by Radyne. Power for the furnace is supplied by a 27 kW 10 kc/s generator.

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(Sd.) T. S. Sundar Rao
Signature of Publisher

Fagersta Bruks AB's contribution to Iron & Steel Industry

By A Correspondent

FAGERSTA BRUKS AB is a group of five steel works. They are :

Fagersta Works	at	Fagersta
Dannemora Works		Osterbybruk
Kloster Works		Langshyttan
Horndal Works		Horndal
Forsbacka Works		Forsbacka

The Group was formed in 1927 by an amalgamation of the first four of the above-named works. Forsbacka Works joined the Group in 1929. Also the Arbit Works at Arboga where cemented carbides—brand SECO—are produced is now included in the Fagersta Group.

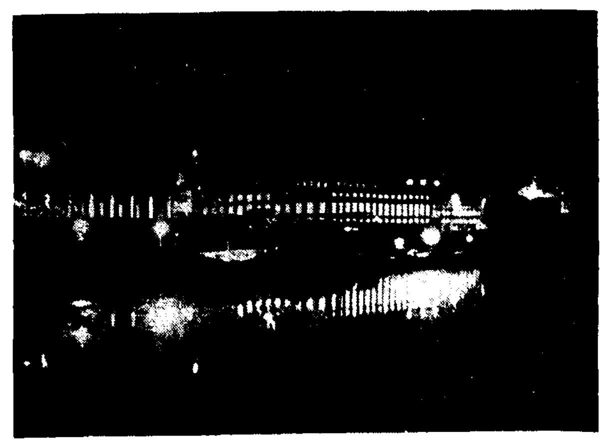
All the five steel works have very old traditions and have their origin in the steel making which began in the landarea "Bergslagen" during the 1300 and 1400's.

Cold drawing of wire (Fagersta Works)

The total number of employees in the Group amounts to about 6.000, of which approximately one sixth are white-collar workers.

FAGERSTA WORKS

The Fagersta Works are the biggest of the works in the Group. Here are common departments for selling planning, economy etc. and manufacturing, e.g. iron-works (Blast furnace plant), steel works (open-hearth, bessemer and electric furnaces), rolling mills (for billets, structural shapes, bars, plates, sheets, strips, wire, etc.), forge shop, wire drawing mill, rope mill,



The metallurgical plant at the Fagersta Works

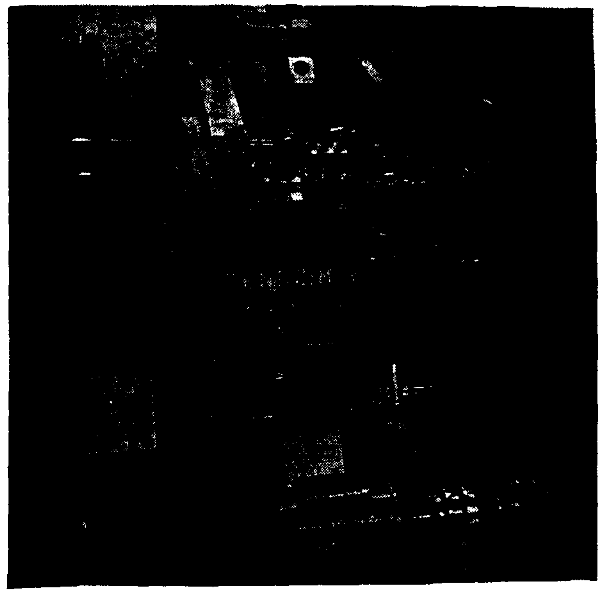
tube mill, saw blade mill, SECO rock drill works and SECO hard metal works (tips and tools). At Fagersta there are also departments for mining in the Group, and for forests, saw mills and agriculture.

Dannemora Works: Steel works (electric furnaces), rolling mills, forge shops (rough and weak forging),

From the laboratories in the Fagersta Works
Examination of the steel structure

steel-casting foundry and knife plant (machine knives).

The manufacture in the Dannemora Works is concentrated on all kinds of tool and high speed steels. One of the specialities of the steel-casting foundry is cast magnets, brand FAMA, TICONAL.



Sendzimir Rolling mill for cold rolled strips of stainless steel (Kloster Works)

Kloster Works : Steel works (open-hearth and electric furnaces) and rolling mills. The manufacture is concentrated principally on hot and cold rolled strips of high quality.

Horndal Works : Steel works (open-hearth furnace) and rolling mills. The manufacture is foremost concentrated on reinforcement bars of all types and qualities, and other constructional steels.

Forsbacka Works : Steel works (open-hearth furnaces), rolling mills and forge shop. The principal products are unalloyed and low-alloyed constructional steels, and various products such as rock and forging tools, milling balls, etc.

Arbit Works, Arboga : Manufacturer of "SECO" cemented carbide tools, "VIVAX" drawing dies, pressing tools, "PANSAR" sandblast nozzles, etc. The cemented carbides are manufactured in the powder metallurgy departments at Fagersta, SECO standard and special tools also in the Arbit Works.

SOME GENERAL DATA

Share capital	100,000,000 Sw. Crs.
Sales (1960)	271,500,000 Sw. Crs.
Export	30%
Quantity delivered to customers	215,000 tons

EXAMPLES OF THE PRODUCTS

Pig iron
All kinds of steels, e.g. constructional, tool, stainless and heat resistant steels.

All types of powder-metallurgical products, e.g. cemented carbides for tools, drill rods, self-lubricating bearings, etc.

Fabricated products, such as steel wire ropes, welded tubes, forgings, compressed-air tools, mill balls, saw blades, tool bits, rock drills, castings (stainless steel); suture wire, welded sheet constructions, magnets, etc.

200-Ton Gear unit for hot Strip Mill

What is believed to be the largest gear unit ever manufactured in Britain has been completed at a plant in northern England. Ordered by the Davy and United Engineering Co., Ltd., of Sheffield, the gear unit will ultimately drive one of the roughing stands of the new hot strip mill now being built at Newport, Wales, for Richard Thomas and Baldwins Ltd.

The main gear wheel and shaft alone weigh 60 tons. This and the other double helical gears for the unit were cut by a combination of hobbing and end milling techniques. The gear wheels were supported on rollers and roughed out on an end-milling machine so as to reduce the amount of heavy cutting on the large hobber.

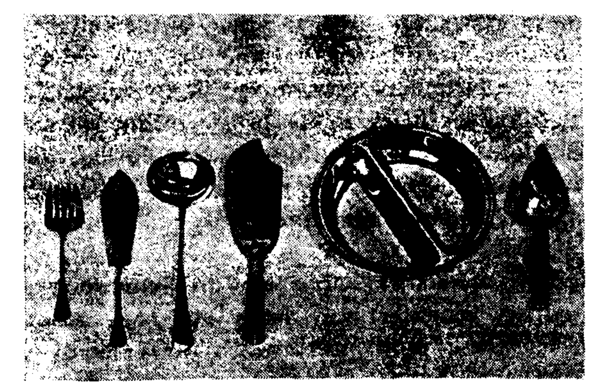
The two reduction sets have gear with face widths of 48 and 55 inches respectively and, in order to handle the largest of these gears in the works, it was necessary to utilise two 35-ton cranes in tandem.

Stainless Steel Catering Equipment

By C. J. Dyche*

SINCE the First World War there has been an enormous increase in mass catering, not only in hotels and restaurants, but also in cafes and canteens. With so much competition, the modern caterer has not only to provide an elegant and attractive setting, but also at an economical cost and in conditions of hygiene, that will not only satisfy the Public Health Authorities but the increasing standards of public acceptance generally.

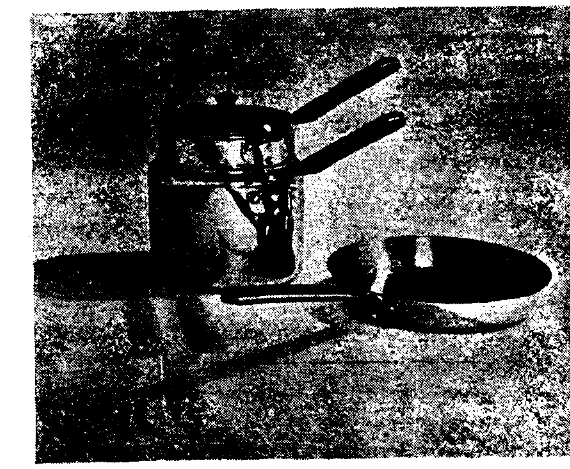
Today's caterer cannot afford to employ staff merely to clean and polish his equipment. He no longer uses utensils made from metals which may not stand up to the hard work of a modern catering establishment. Some metals are usually easily bent, scratched and dented. Apart from being disfiguring, scratches make the equipment difficult to clean pro-

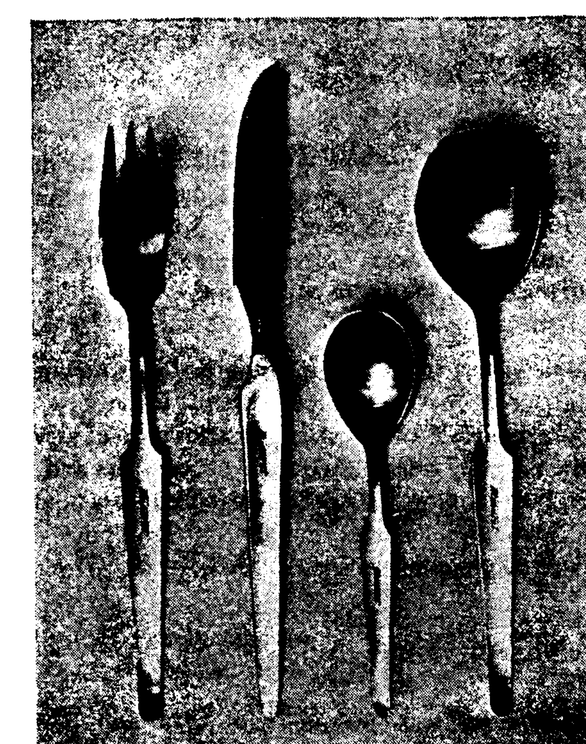


perly. Under conditions of heavy usage, rates of replacement are high. With stainless steel there is no need to fear on this score, and indeed it is changing the face of mid-20th century catering.

Articles such as dishes and casseroles, jugs and trays, tea and coffee sets, sauceboats, condiment sets and a whole host of other articles are being produced today. Not only with a brightly polished finish, but for those who prefer it with a modern satin finish with a lustre which is difficult to imitate in other metals and which is obviously stainless steel. This satin finish stands up to hard usage, well and there is little doubt that their eye appeal increases the success of the catering service.

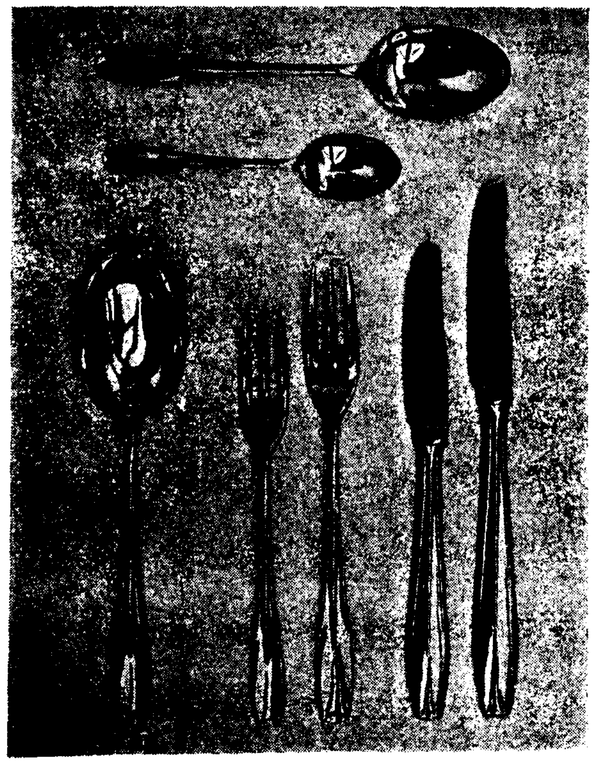
So many examples could be quoted of the extensive use of stainless steel in catering today. One particularly worthy of mention is the British Railways, where stainless steel tableware, counters and fittings





* Publicity & Information Officer, Samuel Fox & Company Ltd., Sheffield.

are very conspicuous in their restaurants and bars. Not seen, of course, by the public, are the kitchens with their abundance of stainless steel equipment. Others worth mentioning are the British Overseas Air-Ways Corporation who have equipped their "Comet" catering service with stainless steel tableware and the



Orient Shipping Line who have put a complete range of specially designed tableware and cutlery in stainless steel into use on their new liner "Oriana". This is a real tribute from catering services which traditionally use only the finest equipment.

Stainless steel is recognised now as being the means not only of attracting greater revenue in catering, but also of reducing the cost of providing the service, because not only does the equipment cost less and last longer, but requires no special cleaning throughout its life. Soap and water in fact represent the only cleaning such equipment should need.

CUTLERY

Stainless steel was invented in 1913 and in fact cutlery was the very first use to which it was put by its inventor. Knives made of any other metal today would be almost unthinkable. Cooks knives with a hollow ground razor sharp edge are also available in stainless steel.

Originally stainless steel cutlery had bone or plastic handles. These are really unsuitable for mass catering where the whole knife must be immersed in boiling water for washing. This has been recognised for some time and caterers have instead been using soft plated metal handles brazed to the blade. The brazing operation can cause a slight band of lower corrosion resistance across the base of the knives, and if such knives are allowed to stand for long periods in dirty water, especially containing salt or vinegar, then the well-known black spots of electrolitic corrosion are likely to appear with time. Moreover, hollow handles made of soft metal may suffer from indentation and even puncture.

Modern caterers therefore tend to avoid such tools and cutlery manufacturers have not been slow to appreciate these problems to which they already have the answers. Firstly for those who prefer hollow handled knives they can now be made from welded stainless steel—these are hard strong and good-looking. Secondly perhaps of even more importance from the mass catering point of view, is the development of the forged stainless steel single piece knife. Many exceedingly good attractive designs are now available, resulting in tools of good balance, more highly functional blades and with the essential requirements that they can be totally immersed in boiling water without distortion.

FLATWARE

The use of stainless steel has been extended to the manufacture of spoons and forks to match the stainless steel knives. These resist scratching and, if well designed, also resist deformation resulting from

hard usage. They have the outstanding merit that they do not normally discolour, yet do not require polishing.

TABLEWARE

One of the major changes now taking place in many countries is the switch from traditional plate wares to stainless steel, not only on account of the considerably lower cost, but also because of the many attractive designs now available. A large number of industrial designers are giving serious thought to the design of most elegant tableware, specially suited to the mass production techniques of the modern age.

This hard modern metal, solidly rust-resisting and without any plated surface to wear away, might have been specially invented for catering, so perfectly does it meet the requirements. Its sparkling, polished surfaces are easily cleaned and obviously clean. It is the inevitable choice of the modern caterer who wants to be up to date.

Indian Studies Modern Foundry Techniques in Britain

An Indian foundry Engineer, Mr. K. A. Neelakantan, of Coimbatore, Madras State, is now at the Rugby works of the English Electric Co. studying modern foundry techniques. He is there under an English Electric Indian Overseas Fellowship.

Mr. Neelakantan is due to return to India in the middle of 1963. He has already spent six months at the Bradford works of the English Electric Co. which makes small-size castings of from 100 lb. to 1,600 lb. At Rugby he is concerned with very heavy castings of up to 40 tons in weight.

Mr. Neelakantan took his degree in mechanical engineering at the Indian Institute of Technology at Kharagpur in 1957, and postgraduated as a foundry engineer there two years later. He then worked as a foundry assistant for 14 months before the English Electric scholarship took him to Britain.

Schneider Guideway Grinding Machines & Surface Grinders

By A Special Correspondent

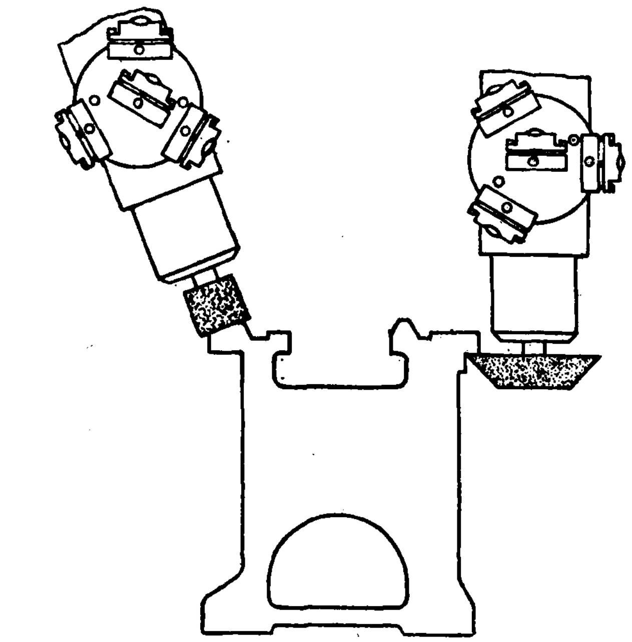
[We publish below a small technical write-up on "Schneider Guideway Grinding Machines and Surface Grinders" and their salient features. The products marketted by the firm 'Schneider Werkzeug-Und Maschinenfabrik' throughout the world have more than twenty years of research, leadership and manufacturing experience in this field. We are sure, in view of Our Country's pledge to industrialise during the Third Plan period, the following write-up will be of considerable interest to our Indian Industrialists and technical personnel of Machine Tool Industry—EDITOR*]*

HISTORY

MR. JOSEF SCHNEIDER, the present Chairman of the Company, has first started to develop surface grinders a few years before the second world war. During the war, more urgent production has prevented any further development. As soon as the war was over, newly designed machines were produced and continuous development was especially concentrated on improvement of Schneider slide way grinders.

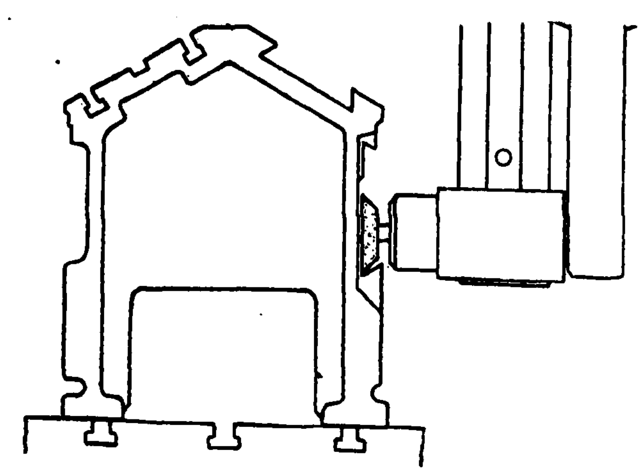
Upto now, the range of machines comprise all types of surface and slide way grinders, necessary to perform all grinding problems—the only firm throughout the world building all types of these machines.

The range of machines being built starts with a small simple single column grinder with either a horizontal or vertical spindle. This machine is being built in different sizes. The same type of machine can also be delivered as a double column surface and slide way

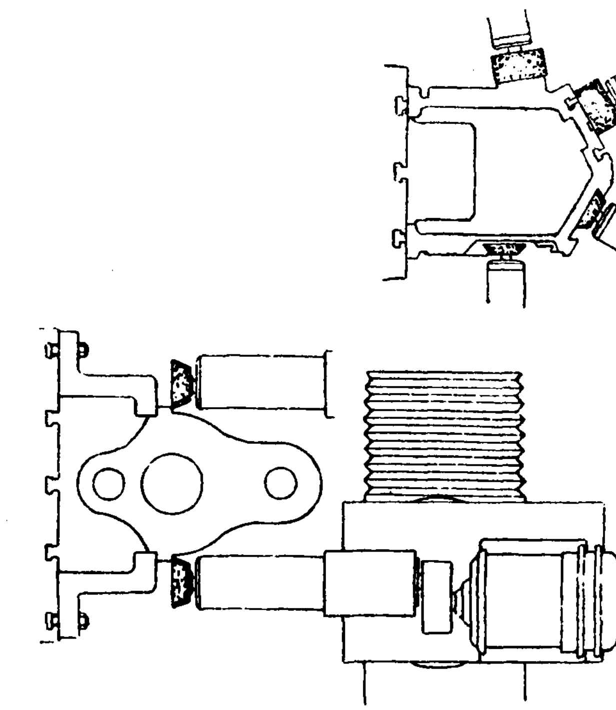


grinder. More variations have been developed of which that slide way grinder is especially noteworthy which allows to grind workpieces with grinding lengths upto 10-20 meter. Also rotary table surface grinding machines have been developed allowing to grind work-pieces upto 3 meter diameter.

As the field of application has been extended, automatics have been required to grind parts to closer



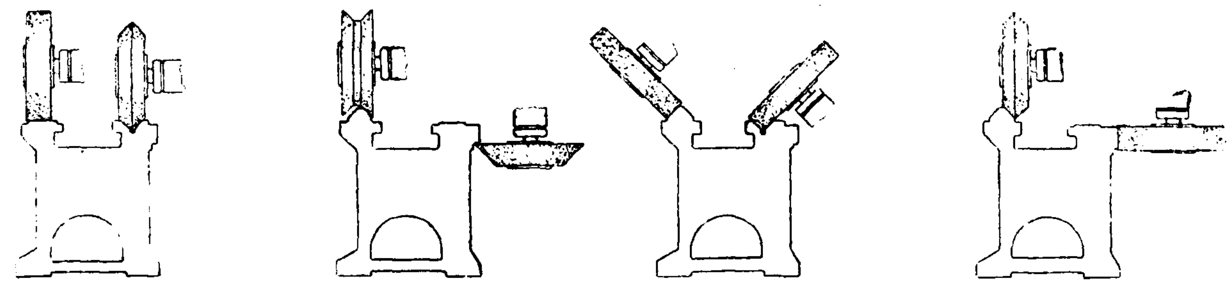
limits of accuracy for long periods with the minimum of attention. The extensive range of program is mainly covered by a few fundamental units allowing to produce the machines most economically. It may be mentioned here again, that the Company is mainly interested on the description of the slide way grinders. Slide way grinding on machine tools and similar machines has proved to be far superior to any other

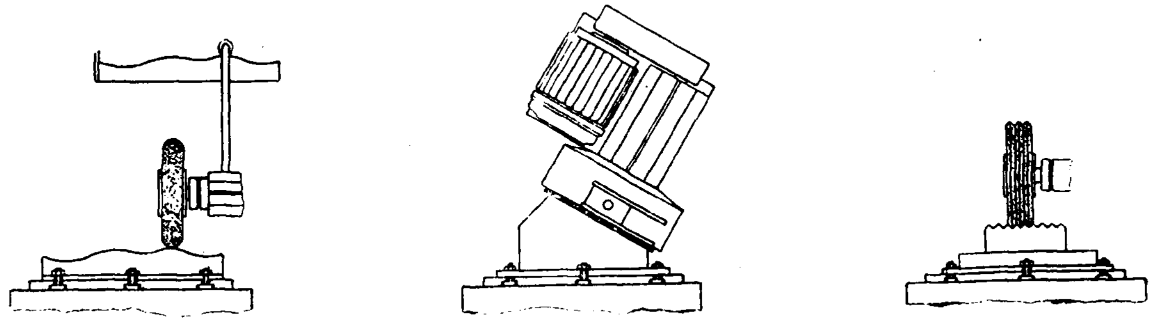


method of finishing. Therefore, all leading makers of machine tools prefer ground slide ways.

On account of the growth of sizes of Machine Tools in recent years the slide ways have grown in length and width. In order to pay more attention for grinding problems, a new type of slide way grinder model by name Schneider JO WFS had to be introduced. Conventional grinding is termed when the workpiece is fastened on the table which slides towards the grinding wheel. This method of grinding is no more applied on the Model JO WFS. Instead the work-piece is placed on a base plate in front of the machine and all movements are concentrated on the grinding wheel. In this case the grinding machine will become more stable and the length of the machine will be shorter.

Slideways on machine tools are often placed in most intricate positions requiring angular setting of the spindle. The universal grinding head delivered with machines if ordered can be swivelled through any angle upto 90 degrees. Using the appropriate grinding wheel all grinding operations can be carried out to





exact requirements. While the dimensions of slide ways on machine tools have been increased, the tolerances for geometrical accurancy and surface finish have become more closer. But the design of the grinding machine is dictated by the requirements of the job and had to stand up to it.

Schneider machines have proved throughout the world their adaptability, efficiency and accuracy. Grinding lengths of 4 meter and more may be finished within tolerances of 0.005.0.01 mm. over the whole length while surface roughness may not exceed 0.8—2. On special request, finer limits may be achieved. However it is to bear in mind that too high accuracy may be very costly and may even be a danger to the life time of the machine. The life time of the machine and accuracy depend very much upon the finish slide ways. If a constant oil film can be maintained between two surfaces sliding on each other a long service life is achieved. On reversing of the sliding parts the oil film will be interrupted, even more, if the surface finish is too high. If the finish is not at its best oil may remain in the fine grinding grooves and lubricate.

The continuous development of SCHNEIDER machines based on the vast intensive research, leadership and manufacturing experience and the close co-operation between engineering service departments and the industries at large will result these machines comply with all requirements as far as shape, stability, efficiency, durability, accuracy and life time is concerned.

All slide ways of SCHNEIDER grinding machines are ground on their own makes. All the sliding parts are lined up with plastic materials creating ideal sliding conditions.

Entrust your Grinding Problems to SCHNEIDER for better results.

A Correction

In our last November 1961 issue we published a very valuable article on "Heinrich Guideway Grinding Machines and Surface Grinders" contributed by Schneider Werkzeug –Und Maschinenfabrik-Siegburg (Rheinland) a reputable firm of West Germany. We would request all our readers to read the headline of that article as "SCHNEIDER GUIDEWAY GRINDING MACHINES & SURFACE GRINDERS". We sincerely regret for the error and inconvenience caused to our Readers—EDITOR.

Birlefco Electrical Melting Furnaces at Ennore Foundries

BIRLEC-EFCO (Melting) Limited (often referred to as " Birlefco "), who are represented in India by Associated Electrical Industries (India) Private Limited, with Head Office at 13, Rajendra Nath Mukerjee Road, Calcutta-1 and having Branch Offices at Bombay, Delhi, Madras, Bangalore, Coimbatore and Nagpur, have supplied one 4-ton Direct Arc Melting Furnace and two 3-ton Mains Frequency Coreless Induction Furnaces complete with tilting frames and busbars, fume extraction, ventilation ducting, etc. to Ennore Foundries Limited, Ennore, near Madras.

BIRLEFCO MODEL NO. 8 DIRECT ARC MELTING FURNACE

This furnace has three automatically adjusted vertical electrodes and a multi-voltage power transformer rated at 2000 kVA for arduous furnace duty. The furnace will operate from three phase 50 cycles supply at 11 kV, having a nominal molten metal capacity of 4 tons. The furnace shell is cylindrical with a dished bottom. It is constructed of heavy gauge steel plates, reinforced with cast and structural steel members. Openings are provided for the launder and a slagging door diametrically opposite the pouring spout.

Two furnace roof rings have been supplied. They are designed to support the refractory brickwork forming the domed roof. A spare roof ring is provided. Each roof ring is water cooled on its outer circumference to prevent sticking or erosion of the refractories at the junction of the furnace side walls. The roof ring is suspended by four link devices. This system permits easy levelling of the roof and ensures correct alignment with the electrodes.

A pair of quadrant rockers, engaging with steel-tracks, support tracks, support the furnace shell structures. The pouring spout is designed for easy re-lining. It can be readily removed from the furnace shell.

The slagging door is situated diametrically opposite the pouring spout so that full advantage can be taken of the furnace back-tilting mechanism for the slagging process. The slagging door is also used for the charging of additives and for fettling. Vertical guides for the slagging door are manufactured to fine limits; thus an effective gas seal is maintained at all times. Water cooling is provided for the door frame mounted on the furnace shell.

A chequer-plate platform around the furnace roof permits easy access to the electrode clamps.

A hydraulic pressure ram is mounted separately at the side of the furnace. It is designed to lift the complete roof structure clear off the furnace shell. A cam and follower device provides the swing-aside movement of the furnace roof and electrode gear for charging operations.

For the pouring operation, a lead screw and nut arrangement, driven by an electric motor, tilts the furnace forward to approximately 45 degrees, backward tilt of 15 degrees for slagging is worked by the same arrangement. Mechanical and electrical interlocks safeguard all furnace operations - the furnace cannot be tilted when the power is on; the roof cannot be lifted when the furnace is in tilting position and when the roof is raised it is not possible to tilt the furnace.

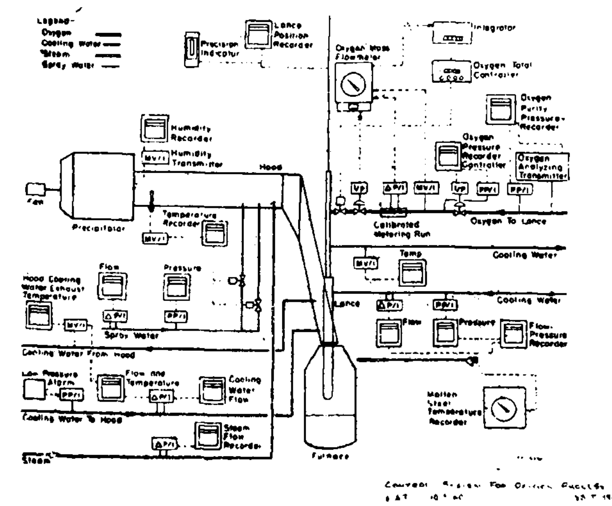
The three electrode masts are mounted at one side of the furnace on the lifting eye bracket. Automatic electrode regulation is by means of well-known rotary amplidyne system. The vertical movements of the electrodes are controlled by a winch and pulley system.

A H. T. transformer of special design steps down the H. T. mains supply to suitable voltages for the furnace electrodes. The transformer is constructed with specially braced windings to withstand heavy current fluctuations and contained in the same transformer tank is the associated iron cored reactor.

TWO BIRLEFCO 3-TON MAINS FREQUENCY CORELESS INDUCTION FURNACES

Each rated at 306 kW, these Birlefco furnaces will be used in the holding and superheating of molten iron. They will be operated from a mains supply of 11 kV, 3 phase, 50 cycles.

The inductor coil assembly has a copper coil of special extruded section. It ensures current carrying



A variety of rugged Honeywell instruments makes up the engineered system for controlling the entire basic oxygen process. All of the variables—oxygen supply, lance position, cooling water to the lance and the hood, and cooling water and steam to the exhaust gases—require fast, precise control. Your Honeywell system makes use of the instruments best suited for your own operation—miniature instruments where space is limited, conventional instruments for those variables the operator must read quickly. For clarity, this schematic shows only the most important instrumentation.

Lance position must be accurately reproduced in successive heats.

To put the lance exactly where it is wanted, the lance cable is connected to a motion transmitter. This, in turn, is connected to two oil-immersed precision potentiometers. One of these measures lance movement during all but the last, most important ten feet of travel into the converter. When the lance is ten feet above the molten bath, a second potentiometer cuts in automatically and transmits lance position to an *ElectroniK* vertical scale precision indicator. On this instrument, the operator can read lance position to within one inch of travel. In addition, a miniature *ElectriK Tel-O-Set* single point recorder can be used to give a permanent record of lance position.

Because it is subjected to temperatures as high as 3,000°F and to splashing from the hot metal, the lance occasionally requires replacement or repair. Frequently, when the lance is repaired, it must be shortened. The Honeywell system provides for manual adjustment to the new lance length without the necessity for recalibrating the entire system.

PROTECTING THE SYSTEM

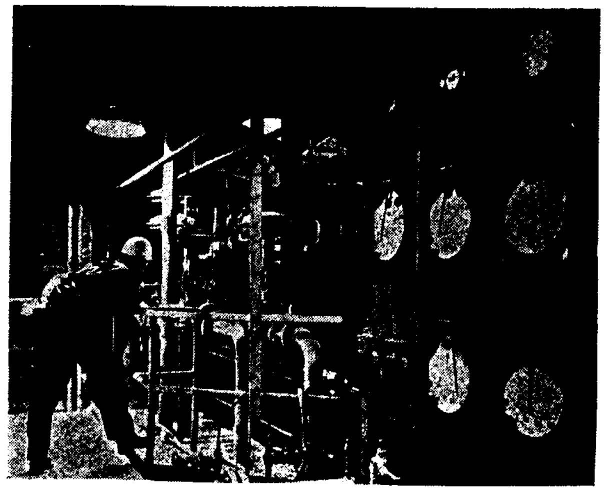
In addition to its function of maintaining the efficiency of the oxygen blow, the Honeywell instrumentation system protects the processing equipment. Protection has three aims—keeping the equipment from being damaged by excessive temperature; assuring that the equipment is always ready for efficient operation; and guarding the safety of the operating personnel.

In order to prevent immediate melting of the lance in the heat of the bath, cooling water is circulated through it. Any change in the pressure of the water supply to the lance or in the temperature of the water leaving the lance must be detected immediately. When water pressure drops, trouble will develop; when the temperature of the water leaving the lance rises, trouble already has developed. These variables are monitored by thermocouples, by *ElectriK Tel-O-Set* millivolt-to-current, and by process pressure-to-current transmitters. These actuate *ElectriK Tel-O-Set* solid state alarms to warn of changes in these variables.

From the window in the control pulpit, the operator can watch the charging of the oxygen converter.

THE DUST COLLECTING SYSTEM

The oxygen blow produces dust-laden gases, which must be withdrawn from the furnace, conditioned, cooled, cleaned, and exhausted to the atmosphere. These gases are collected by a hood which, like the lance, would melt if it were not protected from the extreme heat of the blow. As a first step toward cooling the hot gases from approximately 3,000°F at the converter top to 350°F in the precipitators, water is circulated through the hood. Here too, water pressure and temperature are critical. Because of the large amount of water involved—as much as 7,000 gallons a minute in some converters—it is in the interest of economy to make sure that excessive amounts are not fed to the hood.



On the service floor high above the converter, instruments indicate such variables as oxygen mass flow and lance cooling water temperature and pressure.

Measurements of the water pressure and temperature are transmitted to the control room by an *ElectriK Tel-O-Set* millivolt-to-current transmitter and a process pressure-to-current transmitter.

To protect the precipitator, where the furnace gases are cleaned, thermocouples measure the temperature of the hot gas before it enters the precipitator. For each predetermined increment of temperature increase, *ElectriK Tel-O-Set* solid state sequence controllers turn on an additional increment of spray. This control must be precise. The precipitators are easily damaged if the gas is too hot. On the other hand, if the gas is overcooled, the dust which is carried along with it would form a sludge, which would be hard to remove from the precipitators.

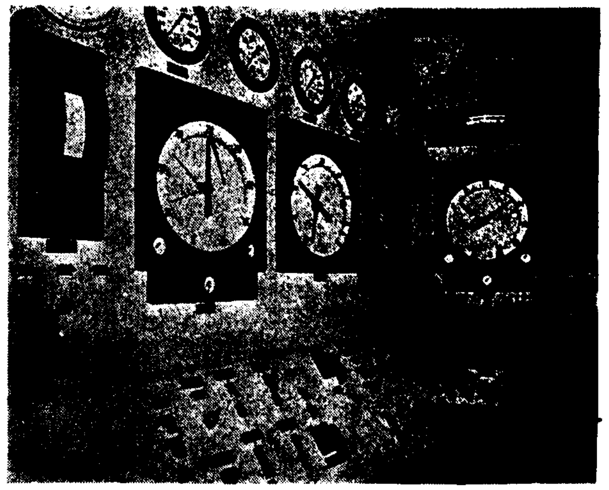
The relative humidity of the gas is also critical. The moisture content must be neither too high, nor too low in order for the precipitator to operate well. The relative humidity is measured before the gas enters the precipitator by an electrical humidity element, and water is added or held back as necessary.

CONTROLLING THE SYSTEM

Although the oxygen process requires a complex system of instrumentation, the final responsibility for successful operation of the process rests on the operator. For this reason, the Honeywell system is custom-tailored to your operator's needs—human engineered to make the most efficient system of instrumentation for *your* plant. Consequently, a specific arrangement of instruments which we might describe here would be only representative. Many details can be modified to fit your particular needs.

The instruments which indicate, record, and control the variables on each converter are usually placed in a separate control cubicle near the converter. The operator is then able to closely follow the progress of a blow.

As we have said, the instrumentation can be varied to suit the needs of the operator and the space available. Whether you choose large, easily read instruments, miniature instruments to save space, or a combination of the two, you get close control of the variables in the oxygen process. Alarm points can be indicated by back-lighted or numbered panels, or by colored lights which show normal and off-normal points, indicate valve and damper positions, and



Lance position, another variable requiring close control, is measured within inches by the Precision Indicator at the left of the panel.

monitor the operation of all important equipment. Honeywell's experience, not only in the basic oxygen process, but in other industries too, is your assurance that your system will be the one best suited for your operation.

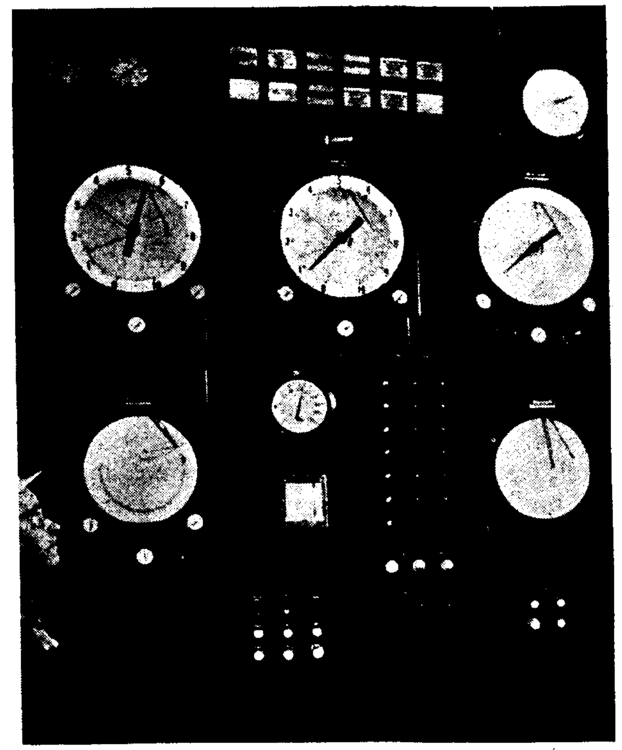
A COMPUTER FOR MAXIMUM PRODUCTIVITY

We have described the various parts of the Honeywell system which will help you get the most from the basic oxygen process. One final component remains before you can really close the control loop—a Honeywell 290 computer. This computer will help you get maximum productivity and uniform product quality through the collecting, processing and computing of data and through fully automatic process control.

The basic oxygen process has several special characteristics—for instance, multiple production units, predictable metallurgical reactions, rapid reaction rates, the use of expensive materials, varying raw material compositions, and the need for precise control of product analysis. All of these point up the need for industrial data processing and computing equipment to give you all of the advantages of the basic oxygen process.

The Honeywell 290 computer is a general purpose, digital process control computer designed for industrial use. It gives high-speed computation at a slow internal component operating rate. The combination of this low internal clock rate and the completely solid-state construction provides maximum reliability. Magnetic core and drum memory are combined with high-speed computing to make programming of the 290 computer a simple operation. These features make the 290 computer the most powerful industrial computer control system available today.

All of the Honeywell instruments used in the engineered system forbasic oxygen have been proved in a variety of industries. They have been chosen for their ruggedness, their accuracy, and their dependability.



In the Precipitator Control Room all the variables affecting the hot gases from the converter are controlled.

But, they are more than just a collection of instruments. From primary process measurement to data handling and computing, Honeywell has built a *complete system* especially engineered for the problems of the basic oxygen process and already proved through use in basic oxygen systems throughout the country.

£ 6,000,000 CAIRO POWER - STATION CONTRACT FOR BRITISH FIRM

The English Electric Co. has been awarded a power-station contract worth £ 6,000,000 by the Cairo Electricity & Gas Administration. An announcement by the company in London said the order—for a 120,000 kW extension to a Cairo power station—was won in competition with other international organizations.

The contract covers the provision of electrical and mechanical equipment, which includes two 60,000 kW steam turbines, alternating transformers, switchgear, and four boilers.

The power station is expected to come into operation early in 1964, and will be one of the biggest in the Middle East.

Since the end of the last war, English Electric has installed complete generating equipment for the Port Fuad power station and supplied locomotives to Egyptian State Railways valued at about £ 4,500,000.

Metallic Recuperators as an aid to Furnace Design and Operation

IN many instances, heat recovery is proposed, as an integral part of furnace design, with the object of fuel saving uppermost in the designer's specification.

The saving of fuel realised by the installation of metallic recuperators is, of course, a most important factor, but, with proper selection of equipment, other equally important advantages can be, and are, obtained. It is for these attendant advantages that metallic recuperators have come to be favoured rather than refractory recuperators during the past 30 years. These advantages may be summarised as follows:—

1. Complete fluid tightness permits accurate proportioning of fuel and combustion air.
2. Improved Pyrometric efficiency.
3. Low thermal inertia.
4. Small floor space requirements.

To enlarge on these basic statements :—

1. FLUID TIGHTNESS

It is important in most applications to control the amount of excess air, not only to improve combustion efficiency but also to control the furnace atmosphere. The maintenance of correct conditions is of great importance to reduce oxidation losses to the minimum and to produce the correct type of scale on steel ingots and billets, such that it detaches easily during subsequent rolling, improving the surface condition of the rolled product. Uncontrolled excess air can also give rise to maintenance problems since scale and slag production on the furnace hearth will be increased.

The final control of air/fuel ratios by means of automatic oxygen content determination has been found very effective in achieving this atmosphere control. Most of the problems (usually concerning sampling methods) associated with automatic oxygen determination have now been solved, and a number of steel works now report very good success in this direction. One particular steel works, for example, operating a soaking pit with the oxygen content of the waste gases controlled at around 1.0%, has found almost no scale accumulation after twelve months' operation.

It will be readily appreciated that, in order to achieve such control, inter-leakage between the air and waste gas systems must be completely avoided. Such inter-leakage is unavoidable with recuperators of the refractory type, whereas with metallic recuperators of all-welded heat resisting steel construction, these are completely free from this disadvantage. An additional advantage, therefore, is that fuel/air proportioning controls can be operated without constant skilled readjustment to allow for leakage errors, thus taking full advantage of their usefulness as an *automatic* control device.

2. IMPROVED PYROMETRIC EFFICIENCY

With some low calorific fuels, such as blast furnace gas, the flame temperature required by the process

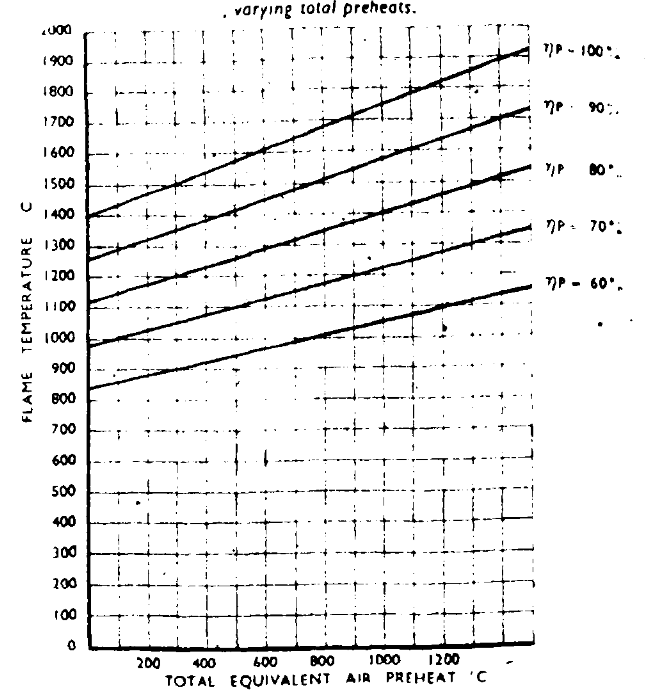


Fig. 1

cannot, even theoretically, be obtained without preheating.

In order to obtain acceptable combustion efficiencies with such fuels, thorough mixing of the air and gas is essential, as is a fairly high gas/air mixture momentum. This, in turn, implies appreciable pressures at the burner inlet and causes, with refractory type recuperators, an increase in the fuel/air inter-leakage. The only alternative is to induce the draught through the recuperator, thus placing the waste gas fan in the hot stream and limiting the attainable preheat temperature because of fan design limitations. With metallic recuperators, the pressure can be provided at the cold inlet end and, therefore, the preheat is not limited by outside influences.

Although of paramount importance far low calorific value fuels, properly designed pre-mix burners do offer advantages for all fuels since they allow proper flame control and avoid the danger of incomplete combustion in the furnace.

In actual practice, since combustion does not, in fact, take place instantaneously, and since heat transfer by radiation from the flame is rapid, attainable flame temperatures are always lower than the theoretical value. The ratio of the actual temperature to the theoretical value is known as the Pyrometric efficiency, and its value is largely dependent on the degree of mixing between the fuel and the air.

Actual flame temperatures for various Pyrometric efficiencies are shown (Fig. 1). With properly designed pre-mix burners, values of Pyrometric efficiency up to 90% are obtainable, although, in practice, other factors dictate the need to operate less efficiently. In low pressure, externally mixing burners—or in regenerative furnaces where the burner port alternatively operates as an exhaust port—Pyrometric efficiencies greater than 60% are unlikely to be attainable (although data on this factor are not well established).

The above factors being established, it is fair to summarise by saying that :—

(a) Only all-welded metallic recuperators give the required conditions for efficient operation of pre-mix burners without artificially limiting attainable preheat temperatures.

(b) Low calorific value fuels cannot effectively, and with controlled conditions, be utilised without high pressure pre-mix burners.

(c) Unless these low calorific value fuels, such as blast furnace gas, are used, a steel works cannot be nearly independent of fuel supplies other than the hard coal required by its coke ovens.

This independence of other fuel supplies is likely to prove of paramount importance in selecting plant for the Indian industry, offering as it does capital savings, both in respect of fuel storage capacity and transport investment as well as operating savings through fuel economy.

3. THERMAL INERTIA

Compare with refractory recuperators or regenerators, metallic recuperators are small and light and, therefore, exhibit comparatively very low thermal inertia. This can lead to appreciable fuel savings especially when starting a furnace from cold, but also when changing operating conditions because of the more rapid response of preheat temperature. This is of particular importance in, for example, the case of a hot blast cupola, which customarily operates on a batch basis, requiring daily start-up from cold.

4. SPACE REQUIREMENTS

Although, at first sight, space requirements may seem to be of minor importance in the context of the Indian steel industry, there are several real advantages to be gained in using metallic recuperators:—

1. Due to their relatively small size, they can be pre-fabricated and shipped to site.
2. Foundation requirements are simpler than for refractory recuperators, requiring less site engineering and all that this entails.
3. Because of the above, less time is needed to install furnaces equipped with metallic recuperators than with other types. This is in accordance with the needs of the current five year plan.

SUMMARY

Industrial furnace design has made rapid strides in

(Continued on page 49)

STEEL NOTES & NEWS

HIGH SPEED MACHINES FOR NON-FERROUS METALS

To demonstrate the progress made in techniques for high speed machining of non-ferrous metals, a U. K. firm will be showing two machines at the 7th European Machine Tool Exhibition at Brussels in September (3—12). One is a continuous rotary miller (type L. H. R.) and the other an articulated arm router (type L. C. 6.).

The rotary miller, designed for rapid continuous milling of light alloy components, is being installed in the production lines of the U. K.'s motor industry and in other leading engineering firms where large scale production on milling operations is required. The head unit has speeds up to 4,000 r. p. m. obtained by means of a 6 h. p. two speed motor and two step pulley. The high speed head is mounted on precision slides incorporating a 12-inch vertical adjustment. The table is arranged for three selective speeds of 1 r. p. m., 2/3 r. p. m. and 1/3 r. p. m. corresponding to peripheral feeds of 150 ins. a minute, 100 ins. a minute and 50 ins. a minute. Alternatively, infinitely variable speeds from 10 to 100 ins. a minute are available.

The articulated arm router is an inexpensive medium capacity machine for high speed milling of light alloy components. It will take a large proportion of the work now being done on heavier duty machines and, being more versatile, the cost of many set-ups is reduced. The articulated arm, pivoting from the column, covers the whole surface of the 24-inch square main table and the 36 ins. × 24 ins. base surface. Incorporating a four speed 5 h. p. motor the routing head normally fitted to the machine has spindle speeds of 18,000 ; 12,000 ; 9,000 and 6,000 r. p. m. Alternatively, the machine is available with a four speed heavy duty router head rated at 12, 8, 6, 4 h. p. giving similar speeds.

* * *

FIRST DRY COOLING TOWER

The first dry cooling tower in Britain went into operation recently with the commissioning of the third 120,000 kilowatt turbo generator unit at Rugeley, Staffordshire, power station in northern England. The new system does away with the need for make-up water and, if successful, will mean that power stations would not necessarily have to be sited on a river or other large source of water.

Power stations need large supplies of cooling water

(Continued from page 48)

the past 10/15 years, it now being justifiable to regard them as true pieces of mechanical engineering plant, accurately designed for a specific purpose and with predictable performance.

Advances in instrumentation and control engineering have led to more accurate metallurgical control and a demand for better furnace heating and atmosphere regulation.

At the same time, advances in iron-making techniques have led to a lowering of the calorific value of waste gases, whilst, due to world-wide inflationary trends, there has been increasing demand for more productivity per unit of employed capital. These combined effects have led to increased use of heat recovery devices which, in order to utilise the low calorific value fuels, have had to be of the metallic type.

The development of metallic recuperators has kept pace with all these requirements and has contributed usefully to improvements in furnace efficiency. Pressure tight, all-welded steel recuperators have now become almost indispensable if the full advantages of automatic control and correct burner design are to be achieved.

[Article compiled by W. Ernest, A.M.I. Mech. E., Chief Engineer of Metallurgical Engineers Ltd., London, W.C.I.]

for their condensing plant. Inland rivers may not supply enough cool water for big modern stations, so, unless sited on the coast, stations have to use cooling towers, which enable them to use the same water over and over again.

These huge concrete towers are in effect, simply chimneys creating a natural draught of cold air. Water heated in the power stations condensers is pumped to the towers where it sprays out and falls over a series of wooden slats into a collecting pond beneath. As it falls it is cooled by the draught of cold air being drawn up the tower.

With the new dry cooling tower the water, instead of falling over open wooden slats, is pumped through what are, in effect, enormous car-type radiators built round the base of the tower. Because the water is contained inside the radiator tubes, none of it is lost, and the need for make-up water is eradicated. The Rugeley tower contains, in its radiator elements, more than two million feet of aluminium tube, half-an-inch in diameter.

* * *

SAFETY UNIT FOR TRACTORS

A new safety unit for tractors, which is making a contribution towards reducing the toll of accidents caused by their overturning, has been developed by a British engineering firm.

When the tractor leans over—forwards, sideways or backwards—at more than an angle of 32 degrees, the unit operates to stall the engine and blow a warning horn. The device automatically cuts off diesel engines by pulling the fuel-injector stop rod ; and petrol engines by short-circuiting the ignition.

By this device, the driver is warned that his vehicle is dangerously near the angle of overturn, and he can rectify the situation. The horn will continue to blow until the tractor is righted or until the battery has run out. Thus, if a tractor has overturned into a ditch, trapping the driver, the continuous sound of the horn will bring help.

The unit comes in the form of a small box that can be quickly and easily fitted to any make of tractor.

* * *

INDIAN PERSONNEL OFFICER STUDIES BRITISH TECHNIQUES

In Britain under the Colombo Plan to study techniques in industrial relations and personnel management is Mr. S. N. Majumdar, personnel officer of Hindustan Steel, in Rourkela, Orissa. He belongs to the industrial management pool, a specical managerial cadre created by the Government of India to manage the nationalized industries.

Mr. Majumdar, whose trip was sponsored by India's National Productivity Council, told a reporter that he wanted to see how personnel-management problems had been faced and tackled in a country with such a long industrial tradition as Britain.

He is at present on a course at the Industrial Welfare Society in London, where he is studying the various aspects of industrial relations and personnel management, including interviewing techniques, joint consultation, trade unions, and welfare activities.

" I was particularly impressed with joint-consultation techniques and group dynamics, which showed how to integrate people of various backgrounds into a team," he said.

Later, he hopes to visit steel factories in Britain and see these techniques in action before returning to India some time this year.

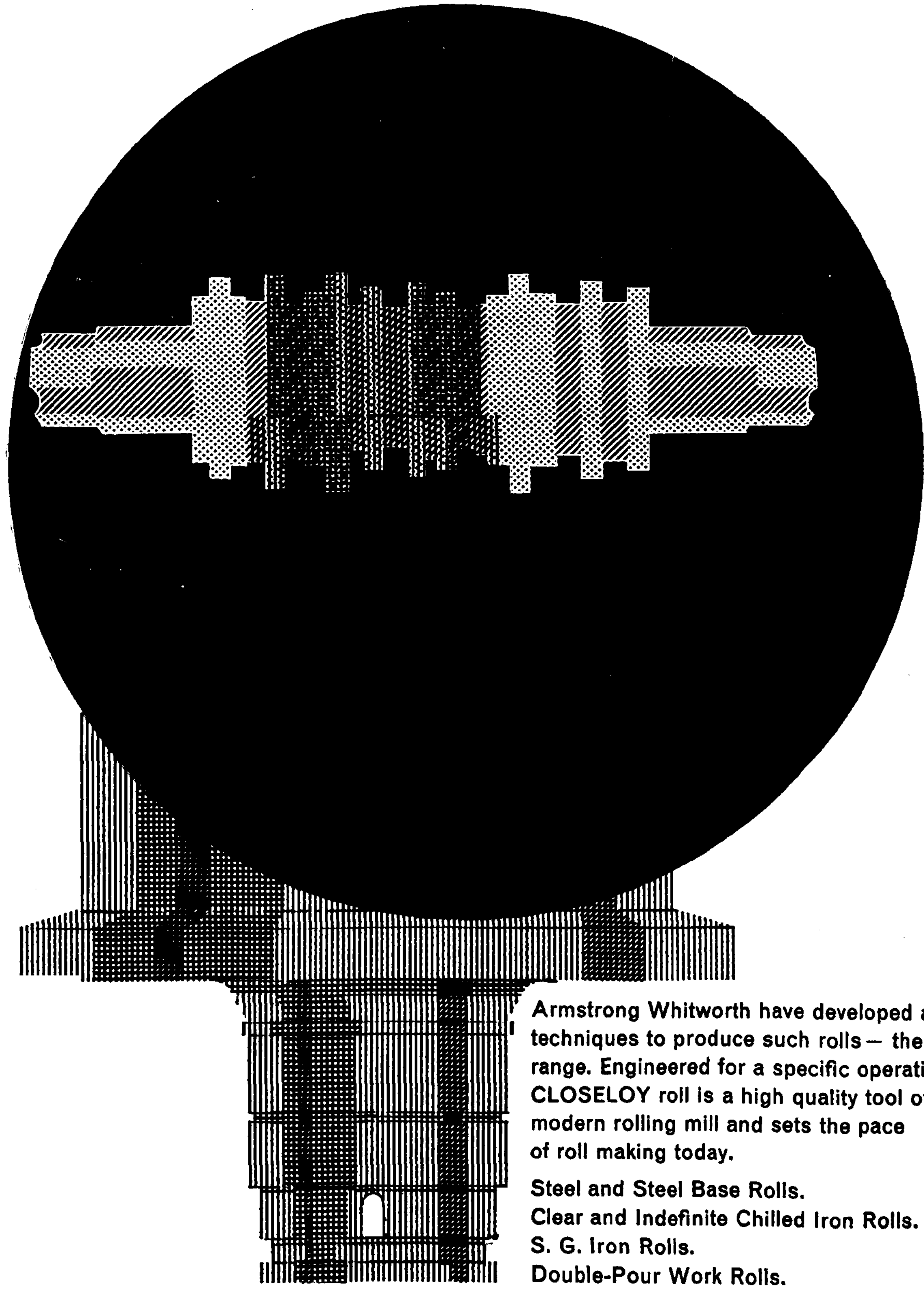
* * *

YORKSHIRE PRECISION GAUGES

Yorkshire Precision Gauges Ltd., of Hatfield, Nr. Doncaster, Yorkshire, England are able to give, from their modern factory, unequalled service in the supply of Plain Plug Gauges, Reversible type Pin Plug Gauges, Thread Plug Gauges, Adjustable Snap and Length Gauges. The products from this factory have already been well sold in India.

The products may be made to the British tolerance system, laid down by the British Standard authority, or the American commercial standard. Alternatively quotations will be given for any special type of gauge tolerance system.

The company is renowned for its large stocks of Reversible Pin Plug Gauges in so far as the majority of Plug Gauge orders of less than $\frac{3}{4}''$ diameter can be supplied from stock.



Their range of Adjustable Snap Gauges, which includes, the Miniature Snap Gauge, as specified by the American standard CS8/61, give universal capacity from 0–36″ diameter.

Their Adjustable Length Gauges and Adjustable Plug Gauges will also be found useful on the larger diameters where weight is normally a limiting factor.

Adjustable Gauges in these categories have the added advantage of easy adjustment when wear takes place or should the modification of a tolerance be required.

The company will be delighted to send illustrated literature to all interested parties.

* * *

COMPUTERS TO CONTROL PRODUCTION AT BRITISH STEELWORKS

The giant £120,000,000 Spencer works now being built at Llanwern, Monmouthshire, is described as the first steelworks in the world to be planned to have a fully automated system for control of production from beginning to end.

A "hierarchy of control" has been evolved by Elliott-Automation in co-operation with Richard Thomas & Baldwins, for whom the plant is being built. The automation plan involves the use of electronic computers throughout the plant, which will be Europe's biggest steelworks.

A statement issued by Elliott-Automation says: "Hitherto, control in steel production has been concerned only with control of sections of the whole process. The Spencer works represents a major advance in that it combines localized controls into an integrated system while retaining the essential flexibility of the individual sections.

"The control system receives a constant flow of demands for a variety of end-products in varying quantities, qualities and delivery schedules, and converts them into instructions. These instructions are broken down and refined by computers in stages in such a way that at each level they can be acted upon. These control instructions are complemented by technical instructions at appropriate levels, so that the entire plant operates at optimum efficiency.

"This flow of control information in the downward direction is then paralleled by a return flow of information which is signalled at all levels in the process, reporting what has actually happened at each stage. This information is assembled and assimilated by the computers and compared with the original instructions given. This enables each level of control to modify its instructions in the light of actual performance."

The computers are said to be organized on the same general pattern as a human chain of command, in that a number of semi-autonomous units communicate to each other information essential for the efficient control of the operation.

* * *

BHILAI MERCHANT MILL PRODUCTION

The Merchant Mill of the Bhilai Steel Works has completed its scheduled production for the current working year sixtynine days in advance.

A target of 1,10,000 tons of rolled products had been fixed for the merchant mill for the year ending the 31st March, 1962. The production figure was reached on 21st January 1962.

The Merchant Mill produces finished steel like rods, small angles and flats, etc.

RECORD PRODUCTION OF RAILS IN BHILAI

The Rail and Structural Mill of the Bhilai Steel Works produced 1,039 tons of 105 lbs. rails in one shift on sunday, March 11, 1962. This was a new production record for one shift in the Bhilai Steel Works.

The Blast Furnace Department also made record production of 3,454 tons of pig iron on sunday the 11th March 1962.

Two new production records were established in the rolling mills of the Bhilai Steel Works on March 7. On that day the blooming mill rolled 536 steel ingots weighing 4,018 tons. This was the highest figure so far for one day since the mill was commissioned more than two years ago. The production of blooms totalled 3,547 tons.

The other record was achieved in the merchant mill which rolled 1,153 tons in two shifts.

Edited & Published by T.S. Sundar Rao and Printed by T.S. Gopal Rao at M.K. Press, Tanjore.

HINDUSTAN STEEL SUPPLEMENT

BLAST FURNACE PLANT BY HETZ CONSTRUTORS, Inc.

[We have pleasure in publishing below an interesting news item which will be of considerable interest to our Indian Industrialists—EDITOR]

Availability of a blast furnace and associated iron-producing facilities as a package for sale outside the United States has been announced by the agent, Hetz Constructors, Inc., Warren, Ohio, USA.

The plant has a capacity of 550 long tons of iron per day. It is comprised of blast furnace with high-speed distributor, cast house and cast house equipment, stoves and complete blast air and gas systems, steam generating system, and a pig casting machine.

The plant is suitable for expanding existing pig iron or hot metal capacity, or for use as the basis for production of domestic pig iron in less developed countries, at a cost much less than that of new capacity. For further information, write *Hetz Constructors, Inc. Warren, Ohio, USA.*

THE FRENCH STAINLESS STEEL INDUSTRY

By M. Maroy
Chambre Syndicale des Producteurs d'Aciers Fins et Speciaux

STAINLESS steel can hardly be considered as a newcomer to the French industrial scene. In fact the steel industry celebrated its fiftieth anniversary four years ago and due in part to French technical achievements, the stainless steel industry continues to invade new fields of application. French works can now offer products with properties suitable for an extraordinary variety of uses.

MINERAL RESOURCES

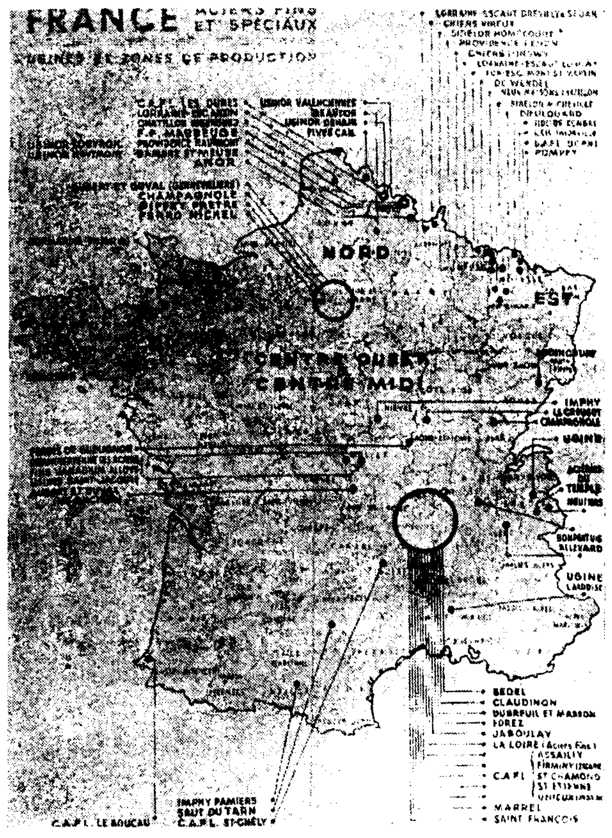
Within the France Zone, there are mineral resources of considerable interest to stainless steel producers. There are, for example, the rich nickel deposits in New Caledonia in the Antipodes. It is true that this area has hitherto been lacking in adequate power, but in 1960 the dam and power station of Yate together with the installation of two electric furnaces, converters and other plant, will enable New Caledonian nickel to be available for sale at world prices. Thus a handicap which the French special steel industry has suffered for many years will be removed.

The washery at Monco and the smelter at Doniambo produce not only nickel, but also cobalt. France draws the latter metal from Morocco as well.

New Caledonia also has important deposits of chrome ore close to the sea. Ore is not only supplied to French ferro-chrome producers, but is also exported across the Pacific to the U. S. A.

After a programme of drilling and trenching carried out since 1958 a deposit of chromite is now being worked at Ranomena near Tamatave, in Madagascar, and recently two prospecting licences have been issued. One for nickel and one for chrome, covering all or part of the districts of Nosy-Varika, Ifanadiana and Mananjary.

France imports uranium and columbium minerals from Africa, manganese from Morocco and will soon bring in the last from Cabon as well.



French Stainless Steel Producers

As for tungsten, nearly half the industry's requirements come from mines in France itself.

ALLOYING ELEMENTS

It is very difficult to separate the consumption statistics of ferro-alloys in stainless steel production from that in special steelmaking generally, but an indication of the growth in the production of ferro-alloys is given by the rise in the use of electricity by this industry in the past twenty years it has increased from 400 to over 1,500 million kwh, or a quarter of the electric power used by the electro-metallurgical industry.

The use of the Ugine-Perrin process of rapid metallurgy for the production of very low-carbon ferro-chrome and ferro-manganese brought a veritable revolution in this field. The process for steel was patented in 1935, but its adaptation to ferro-alloy production (finally achieved by the team directed by M. Andre Greffe) presented enormous difficulties because of the high temperatures involved.

At the end of 1938 a patent was taken out for the production of super-refined ferro-chrome with a very low carbon content. After the war the Moutiers works was set aside for the production of this product and has been able to lower the carbon content to 0.02 per cent. In 1953 the experience gained at Moutiers was put to good use at Ardoise, a works situated near the great Donzere-Mondragon dam on the middle reaches of the Rhone.

The high quality of these ferro-alloys and their perfect suitability for the production of stainless steel sheets not only resulted in exports being made from France to all parts of the world, but led the principal world producers to acquire licences and " know-how " agreements for the Perrin-Greffe process. This was notably the case with Southern Rhodesia, Sweden and the U. S. A. (Vanadium Corporation and Union Carbide) in a similar manner, the Perrin process was licensed to the Hanna Co., which was thus able to exploit the large low-nickel deposits in the Rocky Mountains.

Other French producers, notably Pechiney, also deliver high quality super-refined ferro-chrome, but produced by different processes.

Finally, Ets. Kuhlmann, besides producing ferro-alloys, also makes chromium metal for certain heat resisting alloys.

FRENCH METALLURGICAL RESEARCHES

Without chromium there would be no stainless steel. It was in 1797 that Francois Vauquelin first reduced chrome ore ; and in 1821 Francois Berthier discovered the remarkable resistance to acids of iron-chrome alloys in relation to their chrome content. He was probably the first scientist to interest himself in this problem : indeed in France he is looked upon as the father of this study. At the end of the last century, Carnot and Goutal discovered the effect of carbon on the oxidation of chrome steels.

Leon Guillet studied chrome and chrome-nickel steels. In 1902 Dumas published the results of his researches at Imphy on high-nickel steels. Fifty years later Professor Portevin received the Grand Medal of the Societe d' Encouragement pour l'Industrie Nationale for his internationally-known work on stainless steel, which he had carried on since 1904.

The three-electrode electric furnace, a type in which almost all stainless steel is made, was the invention of Paul Louis Toussaint Heroult. The first furnace was at a works of Pechiney in the Alps over 50 years ago and the second at Crucible steel in the U. S. A. Today the U. S. Steel group makes and sells Heroult furnaces in the States or abroad.

M. Chevenard, member of the Academy of Sciences, whose scientific career has been with Acieries d'Imphy, patented in 1917 the first austentic heat resisting steel and in 1929 the structural hardening of austenites by aluminium-titanium additions. From this discovery has sprung most of the alloys for turbo-reactors and turbines, some with extra low carbon.

An immense amount of vital work is carried through in the laboratories of the steelworks themselves and at the industry's own research organisation, IRSID, at St. Germain-en-Laye, and at the semi-industrial research station at Maizieres-les-Metz.

HANDLING SCRAP

Technical progress has been made in the handling of steel scrap. Before the war scrap merchants were reluctant to touch stainless for fear of their mild steel becoming " contaminated ", but they have now adopted rational classification and have the necessary methods of analysis. There is now available commercially a device which by electrochemical examination of a test piece permits very rapid colorimetric analysis of the constituents.

In France, as in other countries, the oxygen lance in the electric furnace allows the easy utilisation of stainless scrap. However, the principal producer of stainless steel in France, who employs the Perrin process at their Moutiers and Ardoise works, simultaneously producing ferro-chrome introduces this in liquid form without the addition of outside scrap, thereby avoiding any irregularities which might occur through incorrectly classified scrap.

Naturally electric power is very important for the stainless steel industry. Nearly all the French producers are situated in the Alps or on the edges of the Massif Central, areas of big hydro-electric power production. Before the nationalisation of the electricity industry this gave them particularly good facilities which have not yet entirely disappeared under nationalisation. In addition some works have been able to secure long-term contracts with thermal power stations.

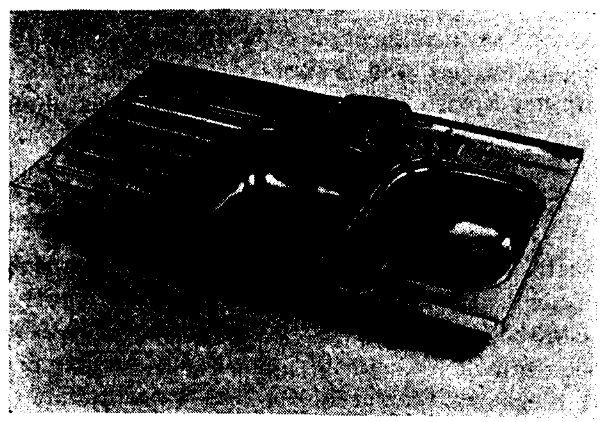
The industry generally has an advantage in that the oil recently discovered at Parentis near Bordeaux, like that of the Sahara, does not contain sulphur, an important factor in its use in certain heat treatments.

Finally, for some months natural gas from Lacq with its advantages of cleanness and adaptability has been reaching some stainless steel producers. Other works will soon be linked to the distribution network.

PRODUCTION METHODS

Melting by the Ugine-Perin process allows a cast every three hours and diminishes the number of large inclusions, an important advantage for stainless steels which are to be polished. Moreover, the improvement of the surface is translated into a higher limit of fatigue. In addition, by using ferro-chrome in molten form, the heat is carried through more quickly, there is a saving in electrodes, the carbon is kept to below 0.04 per cent, there is an economy in electric power and the loss of chrome, inevitable when using an oxygen lance, is kept to a minimum.

Since last year two 90-ton electric furnaces—a combination unique in Europe—have been working at Le Creusot and another stainless steel producer at



Stainless steel sink

Montlucon has a 90-ton furnace. The use of these large furnaces with oxygen lancing for the production of stainless steels has allowed a reduction to 0.04 per cent in the carbon content.

On the question of quality, it will be recalled that at Unieux a plant has been working since 1930 for the production of stainless steels in a vacuum, and to-day regularly produces steel with carbon contents below 0.02 per cent.

At Imphy the plant for vacuum melting and casting of steels and high grade alloys can deal with ingots or castings of over 300 kilos in weight in a vacuum of 10^{-6} mm. of mercury and are therefore completely degassed. The carbon content is sometimes very low.

It can be said that the policy of lowering the carbon content of stainless steels to the point where columbium and titanium are not necessary to stabilise it, is indeed the " French solution ".

CASTING

Continuous casting has made great progress in France. Four plants have been working for several years already and in the next few years the number will grow. One in operation at present gives an increase of over 17 per cent in ingot yield.

HOT ROLLING

For hot rolling, five combination mills are in production and other are projected. This type of very modern mill allows the rolling of bars, flats, strip and wire rod with tolerances impossible to achieve on older mills. Some of them do not consist of a stand in the usual sense; the chocks surrounding the ball bearings of the roll ends are rendered " solid " by a mechanical mounting screw which, at the same time, makes the adjustment.

In every case the stands are prepared in a special workshop and installed in the rolling train by means of overhead cranes. This can be done far more rapidly than the usual method of roll changing and without successive tentative settings of the adjustment. Thus, not only can the quality of the product be improved, but the quantitive output can also benefit from the exceptional flexibility of operation.

With a mill of this type it should be possible to produce about 60,000 metric tons a year working three shifts.

Wire rods leave the mill at speeds upto 70 km. an hour and are coiled and transported without manual intervention. Rods are in increasing demand from the wire drawers who are producing wire down to 0.05 mm.

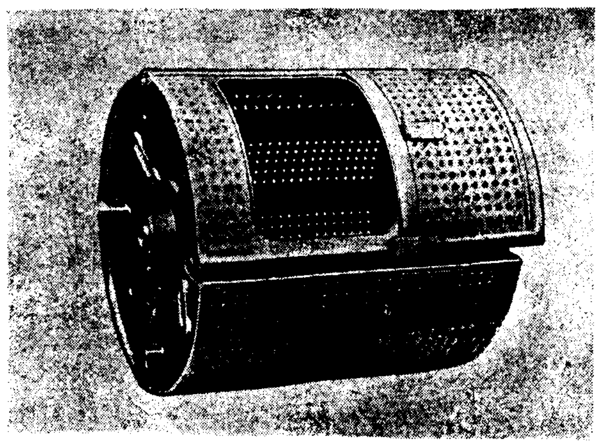
SHEET ROLLING

The rolling of stainless steel sheets and strip is usually done on cluster roll mills, such as the Sendzimir or similar type. One of the first of this type of mill in Europe is located at Pont-de-Roide, and the largest in the world can be found at Isbergues. The works at Gueugnon which at present produces the bulk of the total French annual output of 30,000 tons, is to have a second mill ; it is already under construction and when completed it will be able to roll strip upto 1 metre 30 in width. Naturally these mills have all the necessary ancillary equipment such as annealing, pickling and shearing lines, coil preparation, skin pass mills, grinding and polishing lines. The bell furnaces permit close annealing, especially necessary for coils of 17 per cent chrome steels.

By the beginning of 1961 the Isbergues plants, which are increasing their cold rolling capacity with a third Sendzimir mill, will start the production of cold rolled stainless steel sheets in coil, making a second modern centre for such production.

The two hot strip mills at Sollac and Usinor deal with France's stainless hot coil needs as well as those of the largest Italian producer.

Two works in the Centre produce stainless hot rolled clad plate in the largest sizes for the petro-chemical and nuclear industries. Recently these plates have also been cold rolled with success in lengths of 6 metres, widths of 2m. 100 and in thicknesses from 0.6 to 6 mm.



Washing machine drum

In contrast, the cold mills can produce strip as thin as 0.01 mm. and even 5 microns (0.005 mm) for widths up to 50 mm.

RISING PRODUCTION

Not only has French special steel production improved qualitatively, but also in quantity. It can be seen that the estimates made by professional circles to the Commissariat du Plan have been achieved. Despite the war and its attendant destruction, production of stainless steel in France between 1938 and 1960 increased by 1810 percent where as the total of special steel went up by 176 per cent. The main part of this production was composed of 18/10 grade, with or without molybdenum. The 17 per cent Cr. grades, after a quick development, are now in use in sinks, roofs, bumpers and automobile trim. This steel is less work hardening and if the techniques of working or of welding are studied closely, there can be in some cases considerable price savings.

The stainless steels in which manganese partly replaces nickel have, with the return to abundance of the latter, seen only a rather limited development. This type of steel is used for the making of non-magnetic alternator rotor endbells and also wires.

A biphase stabilised grade with titanium, which welds well, is used especially in the chemical industry.

Heat resisting steels and alloys for aircraft have seen great development, both in the form of structural hardening steels and in the form of nickel or cobalt base alloys.

Among castings mention must be made of the great Kaplan, Francis and Pelton water turbines, lately controlled by betatron. In this sphere considerable progress has been achieved in " remetalling " in situ blades worn by abrasion or pitting : this dispenses with costly dismantling.

There are also the variable pitch propellers of 3 m. diameter in 13 per cent Cr. 1 per cent Ni and 1 per cent Mo destined for the " Compiegne ", built for service in the Channel. It is also worth mentioning the " bulb groups " designed for sea-water turbines in the Rance estuary, the area of the greatest tidal difference. At the other end of the scale are the small

castings made in series in stainless or heat resisting steel by the lost wax process : these find new markets constantly because of the great precision which dispenses with most of the finish machining.

The problems of machinability have been the subject of intense studies and four steelworks produce commercially grades of ferritic and austenitic stainless containing sulphur, selenium, molybdenum and Zirconium.

The glass-lubricated Ugine-Sejournet extrusion process is particularly well adapted to the production of stainless and heat resisting steel tubes. It is especially suitable for the making of seamless tubes in conditions which not only improve the quality but permit the production of sections which cannot be rolled. In addition production costs can be lowered. Recently angles, tees, channels, joists, etc. in stainless have been extruded, this being particularly advantageous because of the more rational distribution of the metal fibres than with formed sheet.

A 3,000-ton extrusion press for tubes has been working for some time at Montbard. The lists of licensees for the process covers the whole world and is expanding rapidly.

There has been a resurgence of interest in stainless steel tubes cast centrifugally, a speciality of the Pamiers works. An example can be found in radiant tubes in heat resisting steel (35/15) designed for heating gaseous cementation furnaces.

Mention should be made of the huge pipes and other forged products in heat resisting steels for the new 250,000 kw. turbines at Champagne sur Oisc, the most powerful in Europe.

For over a year the production of stainless steel powder has been carried on at a works in the Alps ; it is for use in sintered products, filters, pigments, etc. The production of thin cutlery bevels has made such progress that they are now exported all over the world.

New wire rods mills roll stainless steel for producers of drawn wire, welding rods and cold formed nuts and bolts. Alloys of high corrosion resistance to acids of the Hastelloy type are now made in France. The two steelworks which produce clad plates in the large dimensions now deliver veritable armour plate thicknesses for the nuclear industries.

At the other end of the scale of dimensions, unbreakable hair springs in non-magnetic alloys, of a high modulus of elasticity, in iron-nickel-cobalt-chrome, have been brought to a point where the elastic limit exceeds 240 kgs./mm. They are exported all over the world.

French cobalt-base alloys do not deform even under a pull of 15 kgs. for more than 100 hours in temperatures exceeding 950 degree C. The problem of structural precipitation in stainless steels for rockets and high speed engines is a problem under study.

Finally, the needs of atomic energy have brought into existence grades of steels such as 18/10, 25/30 and others of high permeability for neutrons and small induced radiation, containing only minute amounts of manganese, arsenic, cobalt and other metals considered harmful for these purposes.

In contrast stainless steels containing 3 to 4 per cent boron preserve good mechanical properties and lately have been used in the control rods in reactors, and have given satisfactory results in service. Other special grades are resistant to boiling nitric acid ; castings are made perfectly in powerful vacuums and controlled by helium spectograph ; extra fine tubes for the canning of uranium are extruded and drawn.

NEW USES

Among characteristically new applications there is the motor car : Peugeot, which was the first maker in France to employ stainless on a big scale for trim, accessories and for humpers, is now being followed in this way by most of the big names : Citroen, Simca, Facel-Vega, Renault, etc. The radiator shell of the " Arianc " is electrolytically polished in series according to an improvement of the original patents of M. Jacquet. This recent technique is developing rapidly.

The chemical and allied industries continue to be in the first rank of users and complete plants have in the last few years been exported, especially to the Far East. In the sphere of the home, there has been the development of the single-piece pressed sink, while the customer attaches importance to having drums and tanks of stainless steel in washing machines.

Communities, restaurants, etc. are using more and more stainless on a massive scale, as they appreciate particularly its qualities of endurance. Lately the distribution of meals and hot or cold drinks in isothermic containers in stainless has developed rapidly.

In the food industries (dairy, preserves, fruit juice, wine, brewing) stainless steel has made considerable progress.

In building, there are industrial roofs destined to resist corrosive vapours constructed in 17 per cent Cr. plate, 0.4 mm thick and more than 15 m. long, assembled by butted joint.

The finest example of glass walls is that of the Plais des Expositions in the west of Paris in which 250 tons of glass are supported by 40 tons of stainless sections representing one of the most beautiful technical success in this field. The glazed surface represents more than 10 times the non-glazed area.

Most of the carriages of the sleeping cars on the fast railway trains, such as the "Mistral", the world speed record holder, are composed of stainless steel; even those which are not completely made of the metal, carry stainless accessories such as steps, luggage racks, etc.

Among original and recent applications is the non-magnetic mine-sweeper constructed at Cherbourg, some of which have been sold to the German navy. Production of the stainless steel used has been done under the strict surveillance of Prof. Neel of Grenoble, one of the most eminent specialists in the world on magnetism.

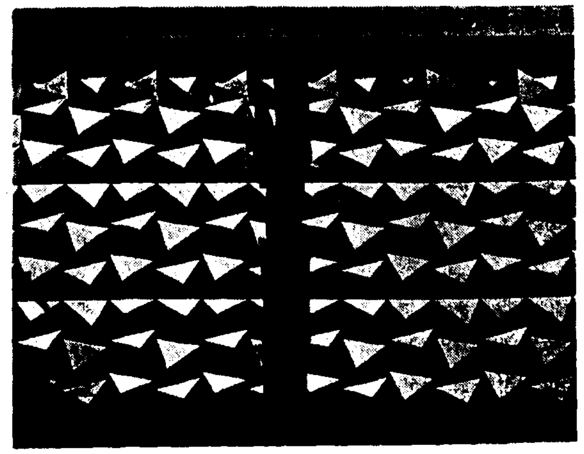
The Danis Hereng process is of interest concrete is poured into a framework of welded stainless steel strip to form pillars, quickly and soundly.

Finally, on 6th December, 1959, despite a storm of exceptional violence, 24,000 square metres of building with windows, etc. of stainless steel clad compressed fibre panels were erected in 24 hours at Orly Airport.

Before ending this list of applications it is worth mentioning some of the professional efforts aimed at developing the uses of stainless steel.

In building, the Chambre Syndicale des Producterus d'Aciers Fins et Speciaux has constantly tried to stir the imagination of users by spectacular demonstrations.

First, a Signal 26 metres high was built and taken to various sites in Paris. It stood for several years within the Paris Fair at a point subject to winds carrying the maximum corrosive agents from neighbouring factories as well as from a large electric power station. This Signal, whose casing was formed of a cold worked corrugated sheet half a millimetre thick and spot welded, gave outstanding proof of the



"Facade Diaminox" stainless steel curtain wall for an exhibition building. (Photo: Larsen)

resistance of this metal to the worst atmosphere conditions that could probably be found in France. It now stands on the "Autoroute du Sud" at the gateway to Paris.

At the Brussels Exhibition, a Grand Prix was awarded to the stand of the Chambre Syndicale des Producteurs d'Aciers Fins et Speciaux for a structure in the form of a nacelle composed of welded stainless steel wire; it was 12 metres long and about 4 m. in diameter. This was designed to show the great possible lightness of the material : the air inside weighed 1½ times more than the stainless steel itself. The Nacelle was brought to the heart of the Exhibition from Paris suspended under a small "Alouette" stainless jet helicopter.

Last year units of stainless steel sheet stamped "Diaminox" electrolytically satin-polished, presented as "the brick of the year 2000", made possible the building of the facades of an exhibition pavilion of the Ministry of Construction near the Champs-Elysees.

It is not possible to say with certainty how much stainless steel goes abroad as indirect exports, but in 1959 direct exports (to 37 countries) were more than 21 per cent of total deliveries and the proportion for the early part of 1960 looks as if it will be higher.

With the object of providing information on French stainless steel production the Chambre Syndicale des Producteurs d' Aciers Fins et Speciaux has published brochures and a book, the first giving the better known current grades, the second analysing all the types and indicating their standards and principal applications. These are available to those interested and indeed the Chambre Syndicale is always ready to give any information within its sphere.

Advantages of Stelvetite in the office

By A Correspondent

IN and around the office, and in a host of places, Stelvetite is at your service. The furniture at which you work and the walls around you can all be made—and so much better made—from Stelvetite. Stelvetite, plastic-coated steel, combines the strength of steel with the qualities of high-grade plastic—warmth, colour and corrosion-resistance.

Stelvetite is a laminate of the best sheet steel and vinyl. This firmly bonded plastic coat is highly resistant to abrasion, to acids, to alkalis, to weather and humidity, and to oils and greases.

Important to the office is its warmth to the touch, which makes a desk attractive even on the coldest day. To the colour-conscious (and who, in the office of today, is not?) Stelvetite will appeal, for it is fade-free. It stands up to the hardest wear and needs no maintenance—a quick wipe with a damp cloth will bring it back to an "as new" appearance. We show a few examples of the way in which Stelvetite is ready to serve you in your office.

STELVETITE HAS EYE-APPEAL AND TOUGH HARD-WEARING QUALITY

"It's the eye-appeal of Stelvetite which attracts customers to it," says Mr. Michael Bates, of Luxfer Ltd., London, makers of movable walls.

But Stelvetite does not sell on sight alone, for an interested customer becomes doubly interested when he learns of the hard-wearing properties of Stelvetite.

Luxfer are finding that Stelvetite itself is a good salesman, for they have had a number of repeat orders for partitioning in this material.

In one brand new office block, standing in the shadow of St. Paul's, in the City of London, another 3,000 square feet of Stelvetite in grey tweed pattern has been ordered. This will complete the partitioning of the building, which has already used some 28,000 square feet Stelvetite.

Lewis's Ltd. chose Stelvetite for the partitioning of their Central Buying Office in Duke Street, W. 1, and have called on Luxfer again with a substantial order for similar partitioning in their premises in Glasgow and Liverpool.

In Glasgow, the colours chosen are light green, light grey and limed oak and in Liverpool light green and light grey have been selected.

Mr. Bates, who has his own office decorated in Stelvetite blue leather and grey tweed finish, says: "I believe there is a big future for Stelvetite as a partitioning material.

"Very important, from the customer's point of view, is the wearing quality. If a customer has any doubt about ordering Stelvetite, I point out how well it withstands knocks and scratches."

COMFORT FOR THE OFFICE WORKER

Arclight "Warm Tops" mean comfort for the office worker. And the built-in comfort is provided by Stelvetite, which is used for the working surfaces of desks and tables manufactured in the Arclight "Warm Top" range by E. N. Mason & Sons Ltd. of Colchester, Essex.

Masons explain to customers that Stelvetite is steel with the "feel of wood." and point out that Working tops made from it are never cold to the touch.

As a result, the "Warm Top" ensures comfort at work, and Masons invite a comparison between the Stelvetite top and any others.

The Stelvetite tops of this range are slim, with tapered front and back edges, and are pine green in colour. End capping is in light bronze, which matches the drawer handles.

Arclight warm grey or green is used for the body finish of the furniture. All unit tops are of exactly the same width and ends fit flush together, so that units may be used in rows with no waste of space.

When Masons introduced the "Warm Top" range earlier in the year, they described it as the "brightest news in office furniture design for years."

The first complete suite of office furniture made entirely from Stelvetite, shown here, consists of executive and secretary's desks, filing cabinet, bookcase and table. The suite is made by Metal Details Ltd. of Mead Road, Cheltenham, from the vinyl-steel laminate Stelvetite produced by John Summers & Sons Ltd.

Structurally, the desk and tables, which are offered with a wide range of pedestal arrangements, have been designed to reduce weight, but to increase strength.

One of the patented features eliminates the drumming noise which is often caused when typewriters are used on steel office furniture.

AIDS FOR COMPUTERS

Pioneer users of Stelvetite are the manufacturers of Jay-Eff steel equipment: Jenkins Fidgeon Ltd., of Talke, Staffordshire. From the introduction of Stelvetite some four years ago the firm has used it in the great majority of its products.

Now it is offered as the working surface on all equipment the firm produces and it is put at the head of the list of special features on specification sheets put out by the company.

In addition, Jay-Eff filling and other cabinets which are subjected to hard wear, although not regarded as working surfaces, also have Stelvetite tops.

Jenkins Fidgeon manufacture not only the usual office furniture, but many special lines for computer

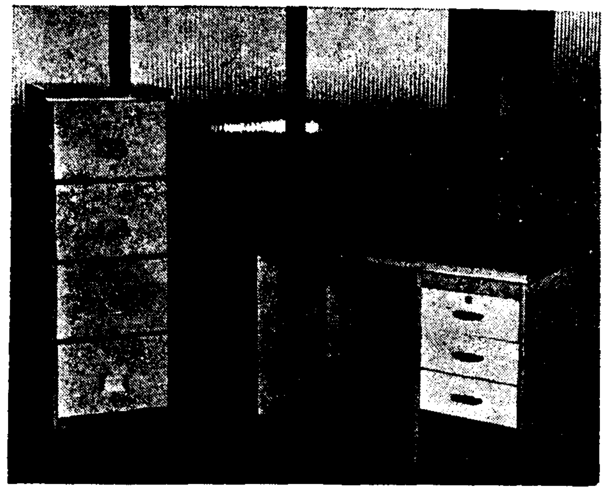
users. Their ancillary equipment for computers is well-known, as is their readiness to produce special "tailor-made" aids for the computer user. Needless to say, Stelvetite is listed for these.

Mr. J. Fidgeon, Managing Director of the firm, has designed his own edge finish and trim for Stelvetite. The long edges are bent under while an extruded trim is affixed to the ends. In addition to a neat finish, this method of trimming means that desks and tables can be put together to form larger unbroken working areas, if necessary.

Mr. Fidgeon sees a big future for coloured Stelvetite, in addition to the shades of grey at present favoured for offices, but he feels that there is a good deal of resistance to be overcome before any big break-through in coloured furniture can be made.

THE COMPLETE STELVETITE OFFICE

The complete Stelvetite office is now possible—partitioned and furnished in the sheet steel with the luxury look. For the first time, a complete suite of office furniture in Stelvetite is available; it is the Modena Suite.



Its makers, Metal details Ltd., of Mead Road, Cheltenham, anticipate that this latest application of Stelvetite will be in big demand at home and abroad.

The Managing Director of Metal Details, Mr. W. A. Colley, had the export market especially in mind when planning the suite. "I think office furniture in Stelvetite will be a great attraction overseas," he said, "particularly in countries with humid climates, for the plastic coat on the exterior and the protecting coat of zinc inside the furniture ensure a high degree of corrosion resistance.

Coupled with this important feature is an attractive appearance difficult to equal in steel office equipment.

This first suite is styled in three colours, two-tone grey with pale green for the tops, achieved without three expensive finishing runs, because Stelvetite is already a surface-finished metal before it reaches the manufacturer.

Said Mr. Colley: "Apart from the plastic coat enhancing the appearance of the furniture, its use means that the expensive and time wasting processes involved in surface finishing can be eliminated and I can do away with a paint shop."

Cost of the suite, which comprises executive desk, secretary's desk, filing cabinet, bookcase and table, is slightly more than for a stove-enamelled product. "But," said Mr. Colley, "this is more than offset by the enhanced appearance and the longer life which Stelvetite gives to the furniture."

CREATING A COOL, RELAXED ATMOSPHERE IN A HOT CLIMATE

Stelvetite is equally at home in Britain or overseas. It stands up to severe climatic conditions overseas, as is shown by experience in Kuwait. After nearly a year's wear in the intense heat of this centre of oil production, Stelvetite is fulfilling all that is required of it.

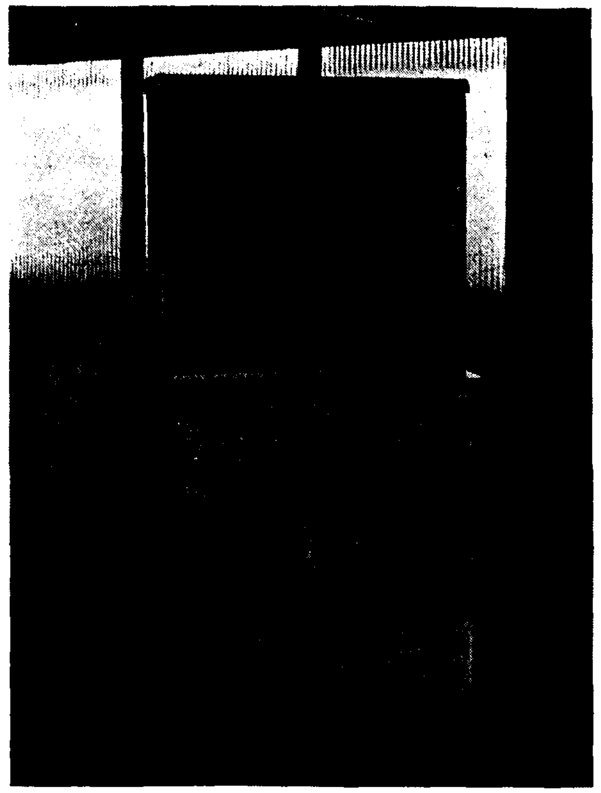
This plastic-coated sheet steel was specified as a material which would be in keeping with one of the country's most modern office blocks, owned by one of its leading merchants.

In this climate the cool, relaxed atmosphere given to an office by the unique finish of Stelvetite is readily apparent and throughout the six-storey Al Mulla office building the rooms are formed by Stelvetite partitions.

These partitions are of double plate and are finished in grey, with mullions and skirtings in black Stelvetite. The doors are also fabricated from Stelvetite.

The firm which supplied the partitioning, the Crittall Manufacturing Co. Ltd., Manor Works, Braintree, Essex, sent out a representative from England to supervise its installation, but it was erected by local labour.

Altogether some 13,000 square feet of Stelvetite were used for the partitioning and its appearance has attracted much favourable comment.



With polished chrome trim, this bookcase completes the first suite of office furniture produced wholly in Stelvetite, the vinyl-steel laminate made by John Summers & Sons Ltd. The furniture is made by Metal Details Ltd.

A representative of Crittall's said : " Already this job in Kuwait has led to other inquiries for similar partitioning.,'

Another application for Stelvetite was found in the same building, in which one of the floors is occupied by the British Bank of the Middle East. Stelvetite was found to be an eminently suitable material for the construction of paying-in booths at the cashiers' counters.

Kuwait provides a severe test indeed of the corrosion-resistant properties of this plastic coated steel.

TECHNICAL TOPICS

Steel sheet is the most popular material used to make office furniture and equipment today.

With the introduction of Stelvetite, manufacturers can now obtain the strength and rigidity of steel with the colours and textures available in plastics. Thus freed from the smooth plain surface, so often associated with steel office furniture, designers can specify a variety of easily cleaned, tough embossings and finishes that enhance the appearance of their products.

For desk tops and other horizontal surfaces, a smooth matt surface is available, but the range of hide effects in which Stelvetite is supplied gives a look of greater quality.

Colour combinations can be obtained with Stelvetite, not easily produced in other finishes, and the wood grains being developed are of interest both for desk tops and the general cladding.

On the constructional side, Stelvetite lends itself to the usual methods employed in office furniture manufacture.

Folding, lockseaming, revetting and bolting do not present difficulties ; and stiffners and studs may easily be welded to the reverse side of Stelvitite, without damaging the P.V.C. using a series resistance projection welding technique.

Stelvetite is produced in the gauges and sheet dimensions normally employed for office equipment.

The reverse side of Stelvetite is electro-zinc plated. Where visible this can, if desired, be painted, either air drying or stove enamelled, using a low temperature stoving paint.

While the cost of Stelvetite as a raw material is greater than that of, say, cold reduced sheet steel, the economies in manufacture which it introduces by eliminating pre-treatment and finishing, and a great deal of handling, invariably result in the final selling price of the manufactured article being little different from that of equipment finished in the conventional manner.

The difference in appearance and resistance to wear and tear is, however, most marked.

by using brushes, the machines are provided with a polishing unit, comprising of 7, 5 to 15 H. P. motor, 300/1500 r. p. m.

The automatic operation of the polishing process is the same as that of the grinding operation with contact rollers.

The pressure for the buffer wheels is by means of oil hydraulic cylinder; which is accurately adjustable.

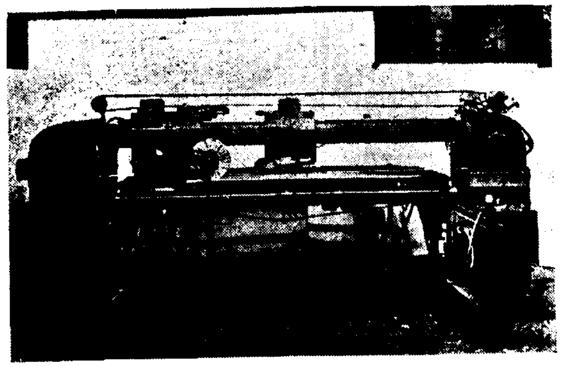
The complete hydraulic system, i. e. hydraulic pump, motor and operating levers, is housed in a cabinet, containing all the switch gear, located on the right of the machine body. The stroke of the table and the setting of the pressure of the contact rollers for grinding and polishing—(if polishing is carried out) is controlled from this cabinet.

The electrical equipment, automatic star—delta starter of pole reversing contacts (in accordance with the type of motors built into the machine), are located in a visible cabinet (protection type P 43) built on to the machine body.

The operating switches for all the electrical equipment, are located on the machine table within easy reach of the operator.

EXTRAS FOR MAXIMUM CAPACITY

In accordance with individual requirements: hydraulic height adjustment of table, is not only



required for plate, but also for grinding and polishing parts of various heights.

Wet grinding equipment for economic working of aluminium, zinc, brass and copper.

Oscillating table for obtaining mirror finish—to meet the most exacting requirements.

The oscillating movement of the table is infinitely variable, enabling it to be adjusted in accordance with the speeds of the feed of the polishing wheels.

The use of Oxygen in Steelmaking in France

By M. Gombert

THE development, since the last war, of the application of oxygen to the various techniques of steelmaking certainly constitutes one of the most characteristic aspects of recent and current evolution of the world's iron and steel industry.

Foreseen a century ago by BESSEMER, whose particularly inventive genius it is appropriate to salute in passing, this development has only become industrially possible following a lowering of the cost of production of gaseous oxygen, itself the consequence of the development of economical methods of fractional distillation of liquid air.

Among the very varied techniques used by the steel industry, the production of crude steel from pig iron and scrap constitutes a particularly fertile field of use for oxygen.

Tests on enriching the blast of the basic Bessemer converter were made in Germany as early as 1925, and since 1945 we have witnessed everywhere a considerable increase in the use of oxygen in the classical methods of steel preparation: in the open hearth furnace, in the Bessemer converter and in the electric furnace. But, not content with somewhat revolutionizing these techniques by bringing them considerable improvements, oxygen has also given rise, since 1953, to the appearance of new procedures for converting liquid pig iron to steel. One of these, the LD process developed in Austria for treating low-phosphorus irons, has taken an important place in world steel production.

* * *

After having devoted all its efforts, in the years which immediately followed the last war, to putting its main installations back into shape, the French steel industry, in bearing in mind its own particularities, took interest in 1948-1949 in the possible uses of oxygen in its steelworks.

For a very long time French production of crude steel, which reached a little over 17 millions tons (*) in 1960, has been schematically distributed between the various classical methods of production in the following way:

Basic Bessemer Steels	:	60%
Open-Hearth Steels	:	30%
Electric and other Steels	:	10%

The existence of the large Lorraine deposits, from which France extracts at the present time 64 million tons of phosphorus iron ore per year, explains the predominant position of the basic Bessemer process in the steel industry of this country.

These ores, in suitable mixtures, are self-fluxing and provide naturally a low-sulphur pig iron with a high phosphorus content of 1.8%, but with a generally low silicon content, less than 0.5%; now the refining of such a pig iron is particularly economical in the basic Bessemer converter, which easily allows one, without special techniques, to obtain steels whose phosphorus, sulphur and nitrogen contents are regularly as follows:

P	:	0,030% to 0,050%
S	:	0,020% to 0,040%
N_2	:	0,008% to 0,012%

These steels, in the mild and semi-mild rimming varieties, are perfectly suitable for all ordinary uses which do not demand a metal of considerable ductility, high ageing resistance or particularly good weldability. In the killed, hardened varieties they are particularly adaptable to the fabrication of rails, which constitutes for them a severe test, above all in France where the high speeds on the railways are well-known.

However, refining phosphorus pig iron in the basic Bessemer converter using an ordinary blast only allows for the melting of a small amount of scrap, generally of the order of 110 lb to 220 lb per ton of steel produced: it follows that the re-use of the rolling mill scrap available in French steel mills is made principally in the open-hearth furnace.

French open-hearth steelworks thus systematically consume a large proportion of scrap—75% to 90%

(*) The tons used in the text are long tons (2240 lb) particular problem posed by the conversion into steel of the phosphorus iron produced in France.

For this reason special research was necessary in order to develop methods of refining with pure oxygen suitable for basic Bessemer pig iron with phosphorus contents in the range 1.6 to 2%.

This research was brought to a successful end in our country : on the one hand by a large steel company, the Societe des Acieries de Pompey which, in agreement with the promoters of the Austrian LD process, undertook at the end of 1955 a study of the application of this process to phosphorus irons ; on the other hand, by the Institut de Recherches de la Siderurgie Francaise (French Iron and Steel Research Institute), which developed in 1957 the OLP process (Oxygen-Lime Powder) which likewise uses a vertical lance while possessing some completely original features, and which can just as well be used for refining low-phosphorus pig iron as for those with high phosphorus content.

In addition the invention by Professor Bo KALLING of the Kaldo process, and its industrial exploitation in Sweden since 1956, induced the Societe Lorraine de Laminage Continu (SOLLAC), which operates in France a large industrial complex devoted to the production of sheet and plate, to construct a Kaldo furnace of 120 tons, together with its standby, which has been in operation since April 1960.

We will quickly examine in the following section the principal aspects of these important French developments on the domain of refining liquid pig iron by the use of pure oxygen ; we will consider successively :

—the operation of the Kaldo process at Sollac,

—the adaptation, achieved at the Pompey steelworks, of the LD process to the converstion of phosphorus iron into steel,

—the characteristics of the OLP process and the results which it is now giving in the steel works where it is employed, those of the Societe Usinor at Denain and those of the Societe des Forges et Acieries de Dilling in the Sarre.

* * *

Already possessing a basic Bessemer plant of 4 converters of 55 tons blown by an oxygen-enriched blast, and capable of producing almost 1.500,000 tons of steel annually, and an open hearth plant constituting 2 furnaces of 140 tons and 2 of 200 tons producing 500,000 tons per year, the Societe Lorraine de Laminage Continu (SOLLAC) decided, in 1957, to further increase its means of production of steel in order to guarantee an adequate supply of metal for the increasing needs of its wide continuous strip mill.

Aerial view of the laboratories IRSID (Institut de Recherches de la Siderurgie) – Research Institute of the French steel industry

The prospect of new availability of basic pig iron and the problem of producing a high-quality steel for deep-drawing led this company, after deep study, to choose the Kaldo process.

A rotating Kaldo furnace, plus a standby, was thus installed at one end of the open-hearth shop at Sollac and began operating in April 1960.

This furnace, of 120 tons capacity, constitutes a very important advance on the Swedish unit of 27 tons at Domnarvet.

It rests by two circular trunnion belts on 4 rollers, two of which are motors, and is supported axially by 4 other rollers on which the lower belt rests laterally. The whole of this roller system is itself arranged inside a cradle capable of pivoting around a horizontal axis. The furnace can thus :

—swing through a complete revolution about this axis,

—and revolve on itself, inside the cradle, at a maximum speed of 30 revolutions/minute, the revolution axis being inclined at 17° to the horizontal.

The charging of the liquid pig iron, by means of a ladle suspended from a travelling crane, and of scrap introduced by hydraulically-tipped charging pans carried on cars circulating on the furnace floor, is made from the tapping side, while the charging of lime and ore, the oxygen blowing and the slagging are carried out from the opposite side.

The oxygen lance and the mobile hood for collecting the red fumes are placed on an electrically and pneumatically controlled carriage which allows them to be withdrawn during sample taking and slagging.

The water-cooled lance can be introduced from 0 to 6½ feet into the interior of the furnace and, during blowing, it oscillates in its vertical plane in sweeping through an angle of 7°, which allows the impact of the oxygen jet to be spread over the bath and avoids the localization in too small a zone of the high temperatures resulting from the reactions. The dust-control equipment for the fumes is of the Pease-Anthony pulverized-water type and its size is considerably reduced : thanks to the rotation of the furnace, the heat produced by the combustion above the bath of the carbon monoxide emitted is largely absorbed, first by the lining, then by the metal, which greatly diminishes the temperature and, consequently, the volume of fumes, which is much less than that produced by the other methods of refining pig iron with pure oxygen.

It should be added that the furnace cradle is arranged in such a way that the unit, after wear of the refractory lining, can be easily removed from its seating and replaced by the standby furnace within an hour.

Since going into service, the Sollac Kaldo furnace has already provided a certain number of remarkable results.

Its thermal balance is excellent and allows one to obtain on the average, without external heating, a ton of good ingots starting from 1455 lb of pig iron containing 0.5% silicon and 1.8% phosphorus, and 1010 lb of scrap.

The transmission to the bath of the heat provided by combustion of the carbon monoxide within the furnace is possible due to the rotating movement, and explains this remarkable result.

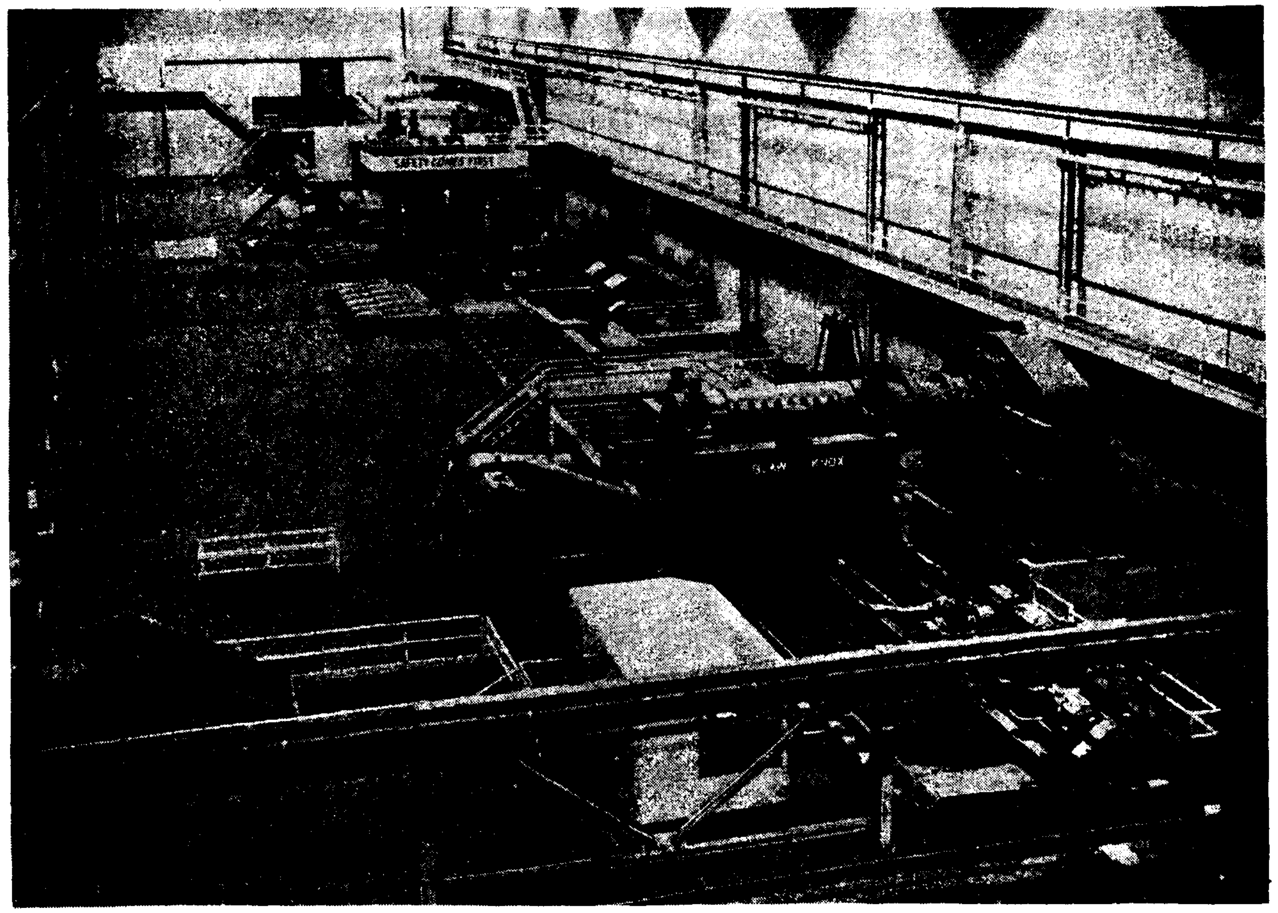
The metallic efficiency of the process is also very good : it attains 96% between iron contained in the charge and liquid steel poured into the ladle. This is due to the complete absence of metallic projections during the blowing, to the small quantity of iron carried away in the fumes, and to the easy recovery, for the following charge, of the final slag which is high in iron oxide.

Command of the operation is very precise and very flexible thanks, in particular, to the influence of the speed of rotation of the furnace on the respective speeds of decarburization and dephosphorization. Although the oxygen is injected into the furnace under relatively low pressure, blowing times are not excessive—22 seconds per ton of steel—which limits to very close to an hour and twenty minutes the average time separating the beginning of charging from the pouring, this despite scrap charging times which are at present too long, and two slaggings during the refining.

The Sollac Kaldo furnace produces almost exclusively extra mild steels intended for the fabrication of sheets for very deep drawing. The analyses obtained for these steels are remarkable, as may be judged from the table below which gives the results of 20 successive heats :

n°	C,%	Mn,%	P,%	S,%
20.387	0.046	0.330	0.009	0.013
20.388	0.045	0.280	0.009	0.013
20.389	0.063	0.355	0.009	0.012
20.390	0.052	0.390	0.012	0.012
20.391	0.046	0.345	0.009	0.011
20.392	0.076	0.390	0.011	0.010
20.393	0.092	0.440	0.014	0.007
20.394	0.073	0.380	0.013	0.013
20.395	0.069	0.380	0.010	0.009
20.396	0.075	0.390	0.009	0.007
20.397	0.067	0.315	0.009	0.009
20.398	0.078	0.335	0.009	0.012
20.399	0.082	0.385	0.010	0.011
20.400	0.057	0.400	0.012	0.011
20.401	0.089	0.340	0.011	0.010
20.402	0.087	0.415	0.011	0.009
20.403	0.053	0.405	0.011	0.010
20.404	0.080	0.390	0.011	0.009
20.405	0.089	0.395	0.012	0.014
20.406	0.080	0.375	0.012	0.013

Although the pig iron employed contains 1.8% phosphorus, the contents of his element in the steel are extremely low.



The sulphur contents are likewise very good, as a result of the high desulphurization co-efficient of the process (about 75% between the sulphur in the charge and that in the poured melt).

In these conditions, the sheets of Kaldo steel cold rolled by Sollac have mechanical properties similar to those obtained from melts of open hearth steel prepared under the best possible conditions.

The weak point of the process lies in the mediocre life of the refractory linings of the furnace, which undergo considerable thermal and chemical wear. In the case of the Sollac Kaldo furnace, and for the very low phosphorus contents obtained in the steel, this life is at present only between 60 and 70 heats, while the linings of the 55-ton basic Bessemer converters of the same company often exceed 600 heats.

* * *

The study of the application of the Austrian LD process to phosphorus pig iron was undertaken by the Societe des Acieries de Pompey at the end of 1955.

At that time, serious doubts still hovered around the possibility of refining this type of iron by the use of pure oxygen.

The tests were carried out on a converted basic Bessemer converter until such time as the planned objectives were achieved when the installation was equipped with a dust-catching unit for the fumes and proper means of handling the raw materials; since that time it has been operated in entirely industrial conditions.

The furnace itself, of 20 tons capacity, is composed of an old Bessemer converter whose upper section has been modified so as to obtain a symmetrical profile.

The installation is provided with hoppers fed by conveyor belts which weigh the charge, thus permitting the addition during the blowing of precise quantities of two different types of mineral or metallic material.

The dust-catching equipment for the fumes, made of bags of filter cloth, is original and is particularly efficient.

The lime used is crushed to a size of 0 – 1.57 inches (0 – 40 mm).

The cooling materials are made up both of scrap and of mill scale: the latter, which contains 70% iron, has the advantage of introducing a considerable amount of oxygen, of the order of 7200 cu. ft. per ton.

The operating procedure is as follows :

— charging of 1.8% phosphorus pig iron onto the oxidized slag of the preceding heat, which is retained in the furnace ;

— blowing of oxygen at 1770 cu. ft. per minute accompanied by adjustment of the height of the lance above the bath in order to control the formation and the composition of the slag ;

— slagging of the slag formed, from the side opposite that used for pouring : the metal, whose temperature is of the order of 2912°F (1600°C), contains at this stage about 0.7% C and 0.2% phosphorus ;

— scrap addition ;

— blowing of the remainder of the oxygen necessary, at a rate varying from 1340 to 1770 cu. ft. per minute according to the type of steel required ;

— checking of the final melt composition, its temperature, and the iron content of the slag ;

— pouring of the liquid steel into the ladle through the tap hole with which the furnace is equipped.

The process allows remelting of up to 675 lb. of scrap per ton of steel produced (or 900 lb. per ton of iron treated); if mill scale is used as at Pompey, it is possible to consume an average of 180 lb. per ton of steel, with a scrap balance also of 180 lb.

The metallic efficiency between the iron contained in the charge and the liquid steel poured into the ladle is 94% ; this result is still capable of improvement.

With the use of mill scale as practised at Pompey the consumption of gaseous oxygen per ton of steel treated falls to the low value of 1860 cu.ft.

The refractory linings of the furnace, which consist

of tarred dolomite, last on the average 125 heats for a usable thickness of 18 to 20 inches.

The current production of the furnace varies, including :

— 30% rimming steel with less than 0.10% C,

— 40% rimming steel with carbon between 0.10% and 0.20%,

— 30% killed steel with carbon less than 0.20%.

For the production of steels with carbon contents in the range 0.11% to 0.17%, the refining is stopped directly at 0.12% carbon, which in most cases avoids any recarburization in the ladle.

The following median properties are obtained from steel of this type :

C : 0.13%
P : 0.021%
S : 0.015%
UTS = 25.2 tons/in²
YS = 18.1 „ „ on a forged test-piece
El = 33.7% normalised at 1650°F (900°C)

UTS + 2.5 El = 109.5

The development of its production of LD steel starting with phosphorus pig iron enabled the Societe des Acieries de Pompey to stop operating an open hearth furnace which was becoming uneconomical to use.

* * *

The OLP process is also of the vertical lance type and was developed during 1957 and 1958 by the Institut de Recherches de la Siderurgie (IRSID) in collaboration with the Societe Usinor. Its originality lies in the fact that all the lime necessary to form the slag is suspended in the oxygen jet, after having been reduced to the pulverized state : the presence in the oxygen blown in of a certain concentration of lime powder, which can be regulated according to the nature of the pig iron to be refined and the phase of operation, modifies the behaviour of the jet striking the surface of the melt, facilitates dephosphorization even at high carbon levels, and gives good flexibility to the process, which can just as well be applied to low-phosphorus pig irons as to high phosphorus irons.

For treating iron at 1.8% phosphorus, the insufflation of lime powder with the oxygen is continued throughout the whole of the refining, and the concentration of lime in the jet at any given moment is adapted to the desired evolution of the composition of the bath and slag, and also to the type of steel to be produced.

The furnace charge includes no lump lime but, as in all processes for refining phosphorus iron with pure oxygen, the slag from the previous melt is recuperated.

At the present time the OLP process is exploited industrially by the Societe des Forges et Acieries de Dilling in the Sarre, with two 25-ton furnaces, and by the Societe Usinor which owns in northern France a large steel complex oriented, amongst other things, to the production of flat products.

The Denain steelworks of this company installed in 1960 an initial 50-ton OLP furnace which will soon be accompanied by another unit of the same capacity.

This furnace has the shape of a symmetrical retort and is equipped with a tap hole.

The lime, crushed in a plant with an output of nearly 7 tons/hour, is carried pneumatically to a hopper which feeds the distributors used to put the powder into suspension in the oxygen. These units, the principals and details of which were studied by IRSID, enable all the lime necessary for the refining to be injected in an extremely regular manner at the desired input rate and in conditions which can be both checked and regulated at will, a very important requirement for satisfactory evolution of the operation.

Precise quantities of iron ore in lump form can be continuously added to the furnace during blowing by means of an appropriate installation.

The fumes are collected by a hood, cooled in a stack acting as a heat-exchanger, and purified by the Pease-Anthony pulverized water system.

Since this furnace was only recently put into use, the results of its operation have not yet reached their ultimate level ; we may however note the satisfactory life of the refractory lining during this first phase of operations, lying between 200 and 300 heats.

At the Societe des Forges et Acieries de Dilling, two

25-ton OLP furnaces, constructed in close collaboration with IRSID, are in service, one since April 1960 and the other since 1961.

This installation is also highly refined, and includes in particular a lime-crushing plant which operates entirely automatically with no manual intervention ; in addition there is a very complete range of measuring systems, and instruments for checking and regulating the flow of oxygen and of lime powder blown in.

The technique of OLP refining as it is carried out at Dilling can be summarized in the following way :

— charging of the pig iron onto the slag of the preceding heat, this slag having been previously cooled by addition of 1 to 2 tons of scrap ;

— blowing of 2472 cu.ft. of oxygen per minute, the lance being raised and the flow of lime powder fixed at 88 lb. per minute ; after 4 minutes, this flow is increased to 265 lb. per minute, then the lance is lowered at the 11th minute and held there until the end of this first phase of blowing, which lasts 14 minutes.

— slagging, rapid analysis of the carbon content of the bath, and checking of its temperature;

— second and last phase of blowing, characterized by an oxygen input of 1766 cu.ft. per minute, with which is injected the remaining lime powder necessary.

The total blowing time is normally from 17 to 22 minutes and the time from heat to heat 45 minutes.

On the average 220 to 265 lb. of scrap and 88 to 110 lb. of ore are remelted per ton of steel produced, which is thermally equivalent to a total of 660 lb. of scrap, and the metallic efficiency between the iron in the charge and that in the liquid steel attains 94 to 95%.

The oxygen consumption is 2120 cu.ft. per ton of ingots, that of lime between 225 and 250 lb. per ton of pig iron, which is low for phosphorus iron.

As for the life of the tarred dolomite refractory lining of the furnace, this lies in the neighbourhood of 200 heats.

The phosphorus contents of OLP steels easily fall below 0.025%, and the sulphur contents to about 0.015%, the desulphurization co-efficient between pig iron and steel being very good as in the other methods of refining with pure oxygen. Nitrogen contents are very low, only 0.0015% to 0.002%.

Used in the extra-mild condition for the production of sheets for deep drawing, the OLP steels give results equivalent to those of excellent quality open hearth steels.

In the aluminium-killed state for use in welded construction (strengths greater than 26,7 to 31,8 tons/in^2), they have V-notch impact strengths between 71 and 142 lb/in^2 at — 40°C (−40°C) which are at least equal to those of corresponding very good open hearth steels.

In finishing, we wish to point out that OLP furnaces of 130 tons capacity will be employed in the new steelworks being built at the present time by Usinor at Dunkirk, and that several French and German steel companies plan to install OLP plants equipped with units of 100 to 150 tons.

* * *

This rapid tour of the horizon shows the importance which oxygen takes in France in the techniques of steel production.

The French iron and steel industry has set itself the target of 24,6 million tons of steel for production in 1965 ; the increase which this figure represents over the 1960 result (17 million tons) must be obtained principally from pig iron (above all phosphorus iron), since scrap has become relatively rare and expensive in this country.

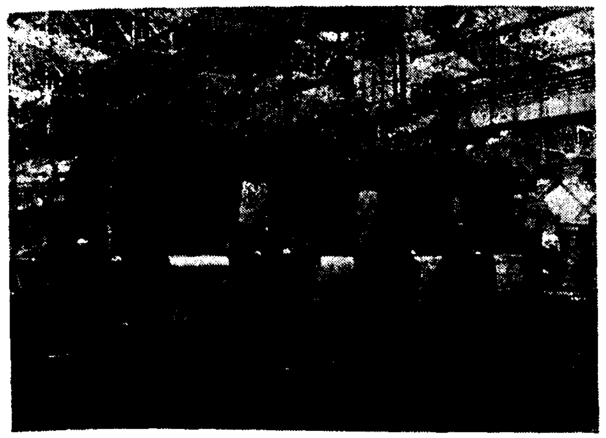
One can thus foresee a rapid development in France in the next few years of the new methods of refining with pure oxygen ; as we have seen, the presence of a high phosphorus content in the pig iron produced by the majority of French blast furnaces will certainly not constitute an obstacle for this development ; several techniques are possible, each with particular advantages and which all of them provide steels whose properties are in every way comparable, sometimes even superior, to those of open hearth steels of the same type ; these properties losing nothing, besides, in comparison with those of LD Steels obtained from low-phosphorus pig iron.

(Continued on page H.27)

New Cold Reduction Mill at Gartcosh – Lanarkshire

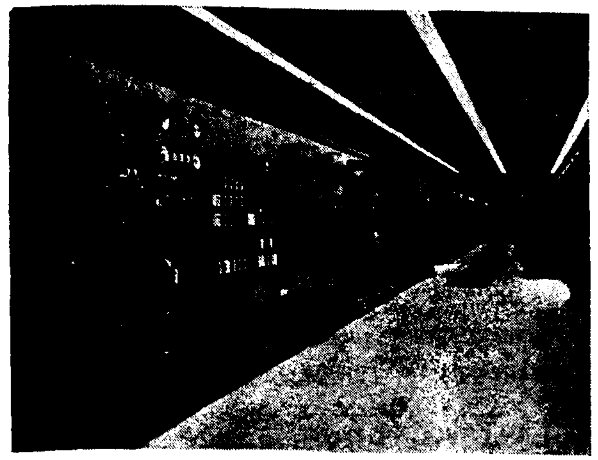
£100,000,000 STEEL STRIP MILL

SCOTLAND's largest industrial project in the 20th century—the Colville group's £100,000,000 steel strip mill plan—is nearing completion. The new cold reduction mill at Gartcosh, Lanarkshire, is now in

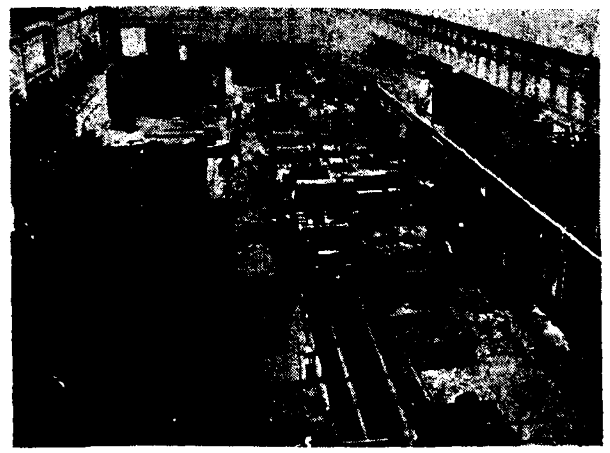


The 4-high 4-stand Tandem Mill at Gartcosh

The 4-high single stand Temper Mill at Gartcosh



The Tandem Mill Control Room at Gartcosh



The entry to the Pickle Line at Gartcosh

(Continued from page H.26)

Until recently only the basic Bessemer process was capable of converting into steel large quantities of phosphorus iron, which explains its spread in France between 1880 and 1960.

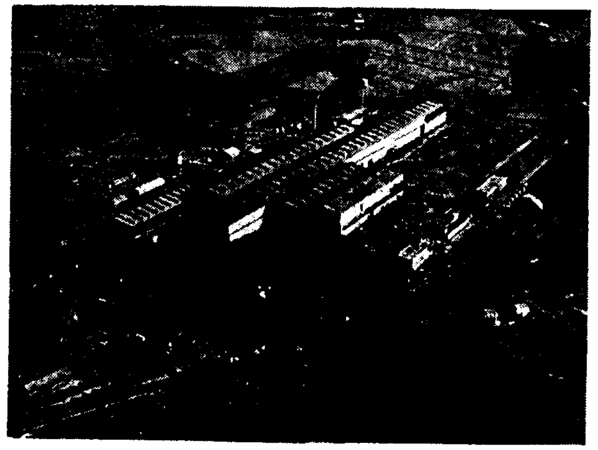
The new processes of refining with pure oxygen appear at the present time capable of converting liquid iron with 1.8% phosphorus in conditions which are also very economical : their foreseeable development will no doubt halt the expansion of the basic Bessemer process, but will not hinder its continued use in existing steelworks.

The properties of basic Bessemer steels are suitable, in fact, for a large number of uses, just as those of open hearth or oxygen steels ; they will thus continue to find many traditional outlets.

The steels produced in the new pure oxygen steelworks will therefore complement, and not replace, the steels produced in France by the classical processes.

They will also allow the French iron and steel industry to meet the legitimate demands of its clients in the field of quality and to maintain, in consequence, the enviable place which it occupies in the world.

production and fulfilling the first export contract of highly finished sheet steel. The semi-continuous hot



An aerial view of Gartcosh

strip mill at Ravenscraig, near Motherwell—which together with the Gartcosh mill will cost £64,000,000 —will be completed in the autumn.

Planned initial production of the Ravenscraig mill is 750,000 tons a year, of which 250,000 tons will be hot rolled sheets and light plates. The balance will be sent to Gartcosh for cold reduction. The output of the hot strip mill could be raised to 2,000,000 tons a year. A new slabbing mill will also be completed at Ravenscraig in April at a cost of £8,600,000.

The first phase of the project, completed at the end of 1957, cost £25,000,000 and provided for new primary producing plant.

The chairman of Colvilles, Sir Andrew McCance, said on January 8 that the Gartcosh plant would produce the sheet steel required for the motor, domestic appliances, steel furniture, and container industries.

G.E.C. HEAVY MEDIA SEPARATION PLANT

G. E. C. (Engineering) Ltd. has received instructions from Colvilles Ltd. to proceed with the manufacture of a heavy media separation plant at a cost of £ 20 000. This plant will be installed at a small mine at Blanchland, Co. Durham for upgrading fluorspar. The mine is operated by Blanchland Fluor Mines Ltd,, a wholly-owned subsidiary of Colvilles Ltd., and supplies metallurgical grade fluorspar to the Ravenscraig steelworks where it is used as a flux in the blast furnace.

Jigs and concentrating tables are used in the existing plant for upgrading the fluorspar but the jigs are to be replaced by the G. E. C. heavy media separation plant. This is the Company's standard H. M. S. system with slight modifications to suit the particular conditions, and it will be able to handle a feed of 12 tons per hour from the existing crushing plant.

A 5 ft. diameter conical separator vessel is to be incorporated in the plant and it will be fitted with a tubular steel agitator frame having non-return air valves which are used for re-activating the ferro-silicon medium. The slurry pumps, medium recovery system, and Eliptex screens for feed preparation, sink and float drainage, and dewatering are all included in the G. E. C. contract. In addition to this equipment, G. E. C. is also supplying a 3 ft. diameter rotary table feeder, a 20-ton capacity storage bin, a 12 in. diameter wet cyclone and a slurry pump for a froth flotation plant. It is intended to use the froth flotation equipment to produce an acid grade fluorspar from the 25 mesh fines which will be removed by the feed screen ahead of the H. M. S. cone, and from the 1/16 in. float fraction of the H. M. S. plant.

TWENTY ONE YEARS OF ENGINEERING — A BRIEF HISTORY OF DISTINGTON

By An Engineering Correspondent

IT is not generally recognised that the Chapel Bank Works of Distington Engineering Company Limited, Workington, Cumberland, England, came into existence only 21 years ago and that Distington Engineering Company Limited, now a subsidiary of the United Steel Companies, Sheffield, only began to exist as an engineering works in 1946.

Most company histories can begin somewhat nostalgically amid the smoke and grime of the Industrial Revolution, pointing to long years of steady growth and development. Distington's history is brief and to the point showing spectacular rather than steady growth but always showing final success.

The Works began as a Government concern, commissioned during World War II as an electric steel making plant, designed to safeguard Britain's supplies of special steels which had been mainly imported from Scandinavia. As a camouflage and to confuse enemy intelligence the Company was given the name of an existing, but moribund, Company called the Distington Hematite Iron Company. In 1941 operations started and in the next few years six electric arc furnaces were installed. On 31st December 1944 the Government ceased to operate the plant which was then taken over by the United Steel Companies Limited, to be developed into its present form, changing the name to Distington Engineering Company Limited.

An interesting point to note is that during its short lifetime the new Company, Distington Hematite Iron Limited, achieved a very high standard of efficiency and was the first works to make stainless steel in a 20 ton electric arc furnace. Previously it had been thought impracticable to do so and production had been carried out mainly in small high frequency furnaces. In its day D.H.I. Limited was the largest electric steel plant in the United Kingdom, and probably in Europe, and the same building by a strange coincidence now houses Europe's largest Iron Foundry.

Distington has now established its reputation as a supplier of foundry products, mining machinery and general engineers—a reputation which has been built up by sales to all five Continents of products of the highest quality within the short space of time since its formation. More recently the progressive outlook has been maintained by branching out into the field of continuous casting of steel. An agreement was signed with Concast AG Zurich covering the design, manufacture and selling of machines and this new field has enhanced Distington's reputation even further following sales of continuous casting machines in Europe, Africa, Asia and Australia.

* * *

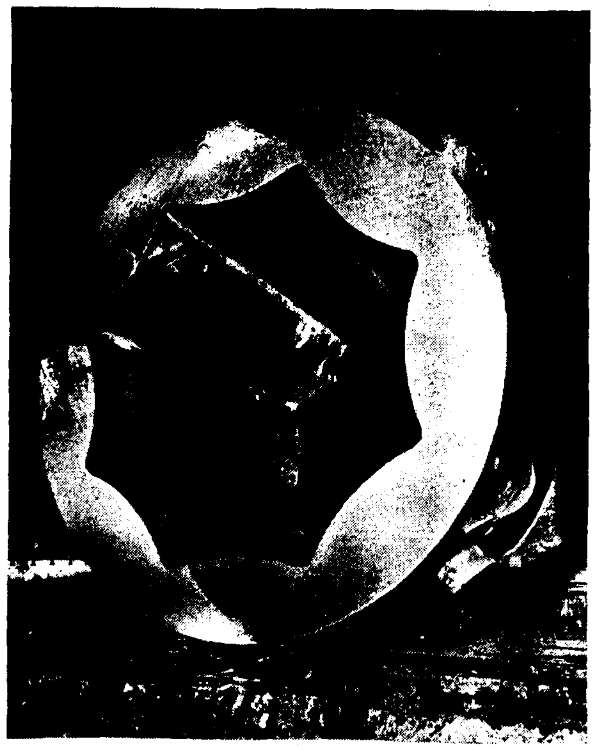
The Chapel Bank Works are situated on the Solway coast between the Workington Iron & Steel Company and the Workington Dock and Harbour—both of which form part of the United Steel Company's Group and provide Distington with raw material (pig iron) and import/export facilities. This part of the Solway Coast fringes the famous and beautiful Lake District which is within easy reach of Workington.

Workington itself derives its present size and importance primarily from the coal and hematite iron ore mining in the area which led to the local manufacture of iron and steel and now to the medium and heavy engineering works of Distington.

The Works at Distington consist of the largest and most modern iron foundry in Europe, the Steel Fabricating Shop and the Machine and Assembly Shop. All the Company's resources are co-ordinated in a modern production flow system which ensures not only economic and efficient handling but also products of the highest quality.

THE IRON FOUNDRY

The main Works building consists of five bays, each a quarter of a mile long. The foundry occupies approximately half of the plant and was the first ingot mould foundry in Europe to achieve a production of more than 2,800 tons of finished castings in any one week. Since then, capacity, has been raised by increased modernisation of 3,000 tons per week, The foundry specialises in steelworks castings in hematite iron, including ingot moulds, bottom plates and slag ladles. The upper limit for castings which can be produced at Distington is 120 tons. The most modern techniques in production, modern equipment and a highly developed system of quality control, have made Distington's foundry the efficient unit it is to-day.



75" Octagonal mould for forging ingots

Ingot moulds of every type and design are produced in the foundry—moulds for uphill or direct teeming practice; with plain or corrugated inside faces ; taper topped or recessed moulds for brick top practice ; moulds with cast-in reinforcing bars ; and eight and twelve-sided moulds for forging ingots.

Flow production techniques are used and working is on a continuous three shift system. In most other foundries production is confined to single day shifts but Distington is able to enjoy the economies of continued operation.

Bottom Plates on which the ingot moulds sit during the teeming operation are the main product of the medium castings section of the foundry, which is capable of a weekly output in excess of 400 tons using the best production techniques.

In the heavy castings section many types and sizes of slag ladles for use in Steelworks, Melting Shops and Blast Furnaces Plant are made regularly. Like all Distington products they are well-known for their good design and long life in service. Among other heavy casting handled are outsize machine and engine bed plates, blocks for mechanical hammers, heavy castings for pumps, fans and other machinery, rolling mill housings and heavy castings for hydro-electric installation equipment. A wide range of castings for the chemical engineering industry is also regularly produced.

All castings made by Distington are produced in either hematite grey or low alloy iron, depending on the ultimate use for which the casting is intended. Patterns for castings are made by skilled pattern makers who in addition to making patterns for internal use make master patters for foundries outside Distington's organisation.

Technical assistance along these and other lines was given by Distington for the Hindustani Steel Company Foundry at Durgapur to assist the foundry staff there during the initial stages of ingot mould production. A high level of co-operation was achieved during these stages and Distington was pleased to welcome Indian Technical Staff to Workington.

An interesting point to note in the operation of Distington's foundry is the fact that the Company pioneered the use in Britain of hot blast cupolas in an ingot mould foundry. One of the results of this has been a marked improvement in mould performance besides economies in operation and control. Three 30-tons per hour hot blast cupolas, one 20-tons per hour cold blast cupola and one 8-tons per hour cold blast cupola are used for melting.

Oil-fired drying stoves incorporating the most modern recirculation techniques ; full facilities for heat treatment ; comprehensive cleaning and dressing facilities ; and extensive machine shops complete the production side of the Foundry.

* * *

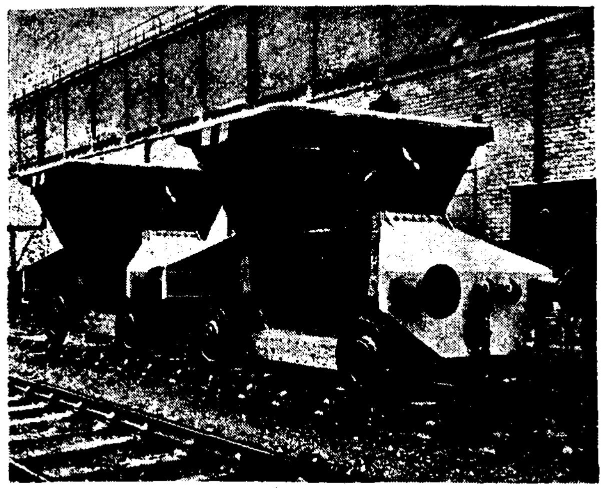
GENERAL ENGINEERING

In this field Distington has built up its capacity until it now has an experienced and growing design staff, accustomed to working to customers' requirements and specification, and to designing equipment to serve special purposes. It is well equipped to help in the

development of new methods of production in the heavy industries.

The machine shops, fabricating shop and assembly bays cover approximately 5 acres and are equipped with a complete range of high capacity modern machine tools.

Electric welding is carried out by hand and by automatic processes. The most up to date methods of non-destructive weld testing including radiography are available and mention has already been made to the fully equipped heat treatment shop. In the fabricating shop, fabrications up to 40 tons can be handled and plates up to 1.¾" thick x 10' wide can be bent.

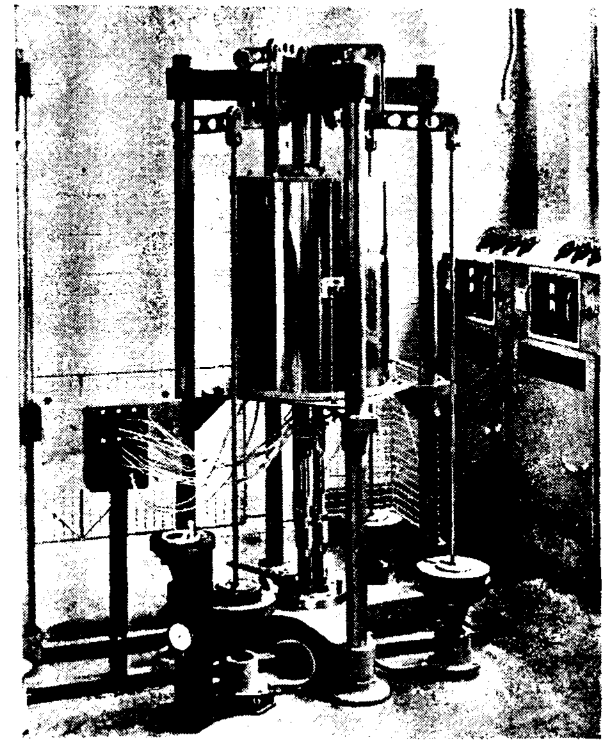


Distington slag ladles and slag ladle carriages

A wide range of work is made in the engineering shop, much of which is equipment for Iron & Steel Works. This range covers the widest field and includes sinter plant storage hoppers, slag ladle carriages, scrap box bogies, charging boxes, hot metal ladles and casting carriages, ingot bogies and air operated dual side tip cars. Other work includes rolling mill equipment, electric arc furnaces, electro-hydraulic jack cars for converter bottom plugs and hot metal ladle transfer carriages for use in melting shops.

There is also a precision machine shop which manufactures wiedemann turret punch presses under licence from Dowding & Doll Limited, who are the licensees and distributors in Britain.

A new machine which has been developed and has proved immediately successful in steelworks laboratories and research establishments throughout the World is the Unisteel Multi-Specimen Creep Testing Machine. This is a highly compact unit designed to accommodate twelve stress to fracture or four long time creep speci-



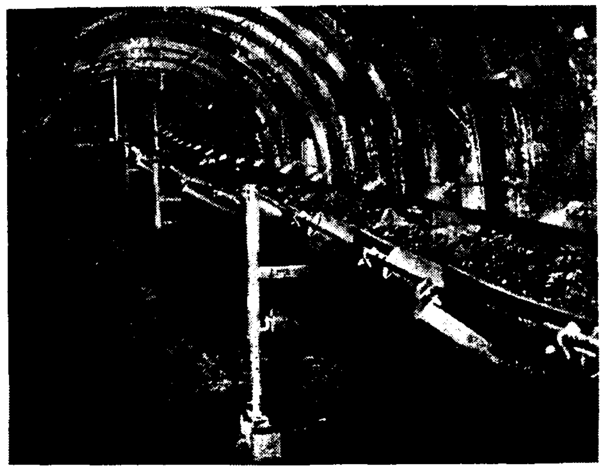
The unisteel multi-specimen creep Testing Machine

mens in a single furnace. The machine is the result of the close co-operation between the Company and the Research & Development Department of the United Steel Companies and has attracted great attention.

MINING MACHINERY

In association with the Goodman Manufacturing Company, Chicago, Distington has established its reputation in the supply of mining machinery both to the National Coal Board and to customers throughout the world. This machinery includes Conveyor Structure, Duckbill Loaders and Shaker Conveyors, Tunnellers and Continuous Miners.

In 1958 the Company introduced to Britain the principle of Rope Framed Conveyor Structure and considerable success has been met in marketing the structure at home and overseas. This Distington-Goodman 'Ropebelt' Rope Framed Conveyor Structure has evoked such interest that Distington's senior mining development engineer was invited to read a paper on the subject at the recent mining Symposium held at Dhanbad and subsequently visited



Dual purpose Distington-Goodman ' Ropebelt' rope framed conveyor structure both floor mounted and roof slung

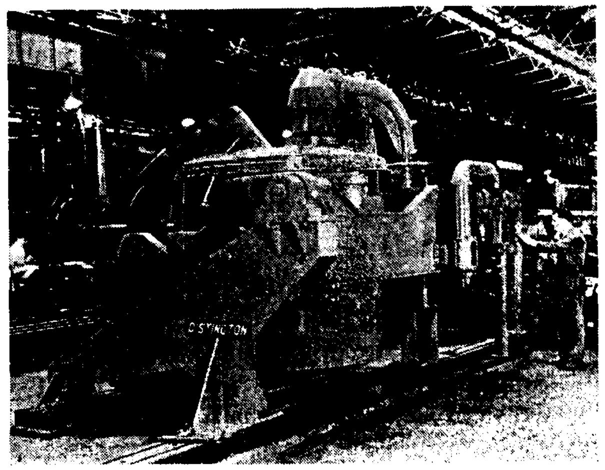
Mining and Steelworks Officials in India to discuss Distington products. Thus the Company is keen to obtain orders from overseas and by personal visits from senior executives, a widespread agency network, and comprehensive after sales service the Company is able to serve the overseas customer as well as it serves its home customers.

CONTINUOUS CASTING

Nowhere is this export consciousness shown more clearly than in the manufacture of continuous casting machines. This is one of the most modern concepts in the production of semi-finished steel products and one in which Distington has been interested since its earliest days. Distington has maintained the closest links with Barrow Steelworks Limited—now another member of the United Steel group—during the extensive research programme into the continuous casting of steel, a programme which is still continuing.

As a result of this and other investigations into the possibilities for Continuous Casting Plants, Distington entered into an agreement with Concast A.G. Zurich for the manufacture of continuous casting machines. Other members of the group are Schloemann A.G. Dusseldorf and the Compagnie des Ateliers et Forges de la Loire, Paris.

The principle of continuously casting steel from the ladle direct to a semi-finished product is one which attracts immediate attention due to the economies of operation. It virtually eliminates the need for re-heating furnaces for ingots and for primary reducing mills and is an especially attractive proposition since the continuous casting machine is itself relatively economic to install.



Ladle tilting cradle, Ladle, and oil burner for the continuous casting plant for Canara workshops, India.

Distington has designed, manufactured and erected (or is in the process of so doing) machines throughout England, in Australia, South Africa and also one in India for Canara Workshops Limited for the continuous casting of square billets. A single strand machine which will cast billets in killed carbon and low alloy steels.

These Distington-Concast machines are designed to cast a wide range of continuously cast sections from 3.5/8" square billets to 60×5 in. slabs and one of the British installations, at Shelton Iron & Steel Limited, will make it the first integrated steelworks in Britain to depend entirely on continuous casting for its semi-finished steel.

This reflects the measure of confidence which modern steelmakers are placing in the continuous casting of steel. With existing production rates of over 250,000 tons per annum it seems likely it is only a matter of time before steelworks producing 2 to 3 million tons per annum or even more, from a suitable small number of continuous casting machines, become a reality.

* * *

Distington Engineering Company then has come a long way since the end of World War II and has established the sales of its foundry and engineering products at home and abroad. As a Company it is still expanding rapidly and it seems likely that in continuous casting it has backed a principle which will serve to establish its reputation even further. However, despite the story of successful growth the Company has never departed from its prime aim which will always remain the same, namely the service to the customer both before and after any sale to ensure his continued satisfaction in a Distington product.

Meehanite — A Special Cast Iron that Bridges the Gap between Cast Iron and Steel

By A. C. Bhattacharya, A.M.I.P.E., A.M.I. Loco.E., A.M.A I.I.E.

COMBINING the best properties of both cast iron and steel, Meehanite is a series of high-duty irons produced by the Meehanite system. By offering unique combinations of the better properties of both iron and steel, Meehanite castings have met many unusual demands and specifications.

The ability to control both the quantity, size and form of the graphite as well as the nature of the pearlitic matrix of Meehanite metal, provides the means of pre-determining engineering properties so as to meet exacting specifications.

It is named after Meehan, an American malleable iron founder, who produced a grey iron with superior strength and physical properties in the nineteen-twenties. This was subsequently developed by Smalley and others to the present stage.

CONTROLLED PROCESS OF MANUFACTURE

Produced in foundries under special rights, the manufacture of Meehanite involves accurate control of the type and quantity of raw materials, of melting processes, of pattern-making and moulding. Control of the actual physical make-up of the iron instead of the more or less indefinite attempt to control its chemical composition, is fundamental to the Meehanite process.

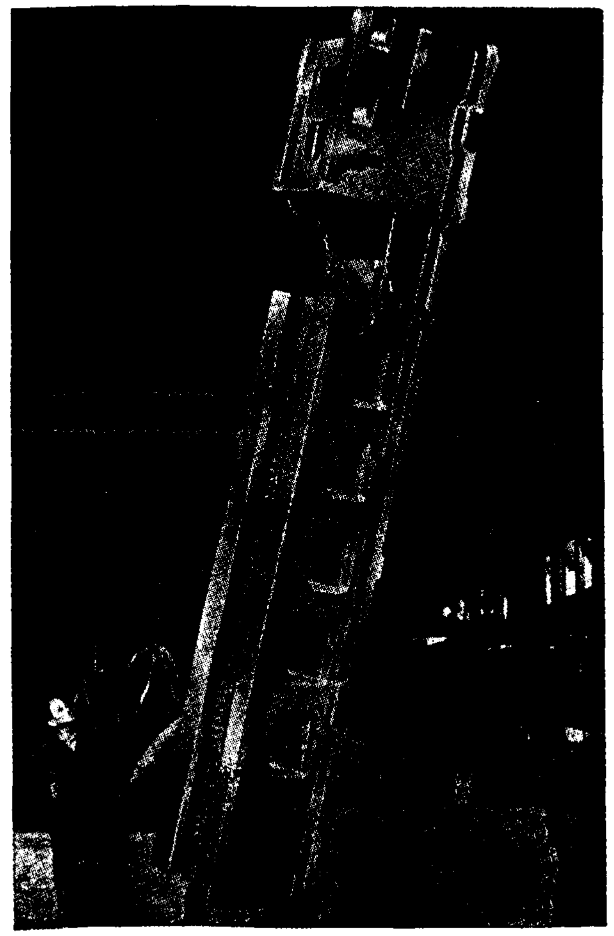
The actual metallurgical structure of Meehanite comprising a combination of pearlite and fine graphite, is predetermined in molten metal, and the metal structure itself is controlled and regulated so as to produce the exact physical properties required. Every ladle of molten metal is tested for structural composition before pouring into the mould. The entire manufacturing procedure is scientific and as a result the castings provide greater assurance of dependability, uniformity, and extremely close adherence to the engineering specifications.

In ordinary cast iron, mass effect largely influences its strength and structural uniformity. Heavy sections, causing slow cooling, show a serious loss in strength and density. The higher strength Meehanites on the other hand show remarkably little mass effect, due to the process of graphite deposition. In consequence, good strength properties are maintained even in heavy sections.

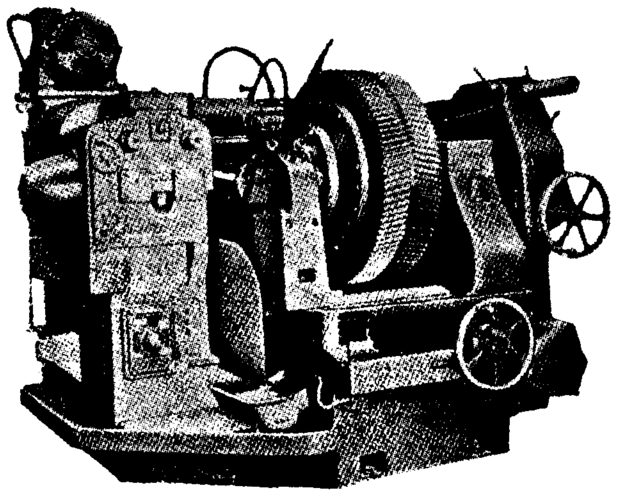
GRADES OF MEEHANITE

Meehanite castings are generally made in four grades—Heat and Wear Resisting, General Engineering, Thermal Shock Resisting, and Maximum Machinability. Among these grades there are different types to suit varying service requirements.

Heat and Wear Resisting Castings—Most Meehanite castings resist the penetration of steam and gases at



Automatic Lathe Bed in Meehanite



Gear-cutting Machine using Meehanite Castings

relatively low temperature, but for higher temperature suitable types are made under this grade to suit varying degrees of temperatures. The types generally made are HB, HR, WB and WA with the structure consisting of Pearlite-Graphite plus some Cementite. HB Meehanite can resist heat and abrasion up to 875 deg. C.

Wear resistance cannot be measured, as it is the only the service requirement which is the guide to the type of metal most suitable. Typical installations include lathe bed ways, milling machine tables, slides, gears, brake drums, cams, dies, etc. These parts in Meehanite are processed to give a harder, less graphite structure. In many cases this increased hardness is limited by the need to machine the parts in the as-cast condition and then subject them to heat treatment. The parts can be hardened locally by flame or induction surface hardening. They can as well be heat treated by oil quench and tempered to a high hardness. Some of the types under this grade are practically non-machinable and have properties comparing with those of manganese steel.

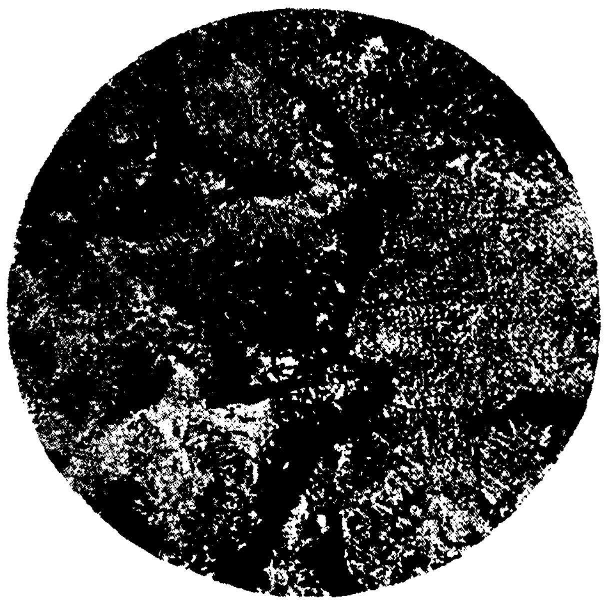
General Engineering Castings—Most castings in Meehanite for the engineering trade are in this grade with Pearlite-Graphite structure and having tensile strengths from 13.5 to 24.5 tons per square inch. minimum. All these types can be heat treated in the same way as carbon steels, when tensile strengths up to 31.25 tons per square inch. can be obtained with hardness up to 600 B. H. N.

The types available in this grade are GM, GA, GB, GC, GD and GE. In this grade good machining properties are obtained even in the high strength range. This is due to the uniform Pearlite-Graphite structure for the whole series and the close control of structure to suit the casting section. Table below shows strength properties and machinability of this grade of Meehanite castings

Material	*Tensile Strength Tons/sq. in*	*Compression Strength Tons/sq. in*	*Brinell Hardness*	*Machinability Rating*
Meehanite	Min.	Min.	Min.	Tool Pressure-lbs.
GM	24.5	90	230	55
GA	22.5	80	220	51
GB	20.0	75	210	49
GC	18.0	70	195	48
GD	16.0	65	185	44
GE	13.5	50	170	38

N. B. Machinability ratings are based on tool pressure tests, compared with strength and hardness values. Low rating values represent easier machinability. The absence of hard, abrasive particles gives easier machinability for Meehanite castings even at a higher hardness value.

Thermal Shock Resisting Castings—This grade consists of Pearlite-Graphite plus some Ferrite and is capable of withstanding thermal shock. Available in HE type, the castings cater for intermittent temperature service.



Micro-structure of Type GC Meehanite consisting of fine graphite in a pearlite matrix

Maximum Machinability Castings—Available in types GD and GE, this grade of Meehanite castings have excellent machining characteristics. This is due to the control of structural constituents, which eliminates the hard carbide and phosphide particles.

MACHINING PROPERTIES

The ready machinability of Meehanite castings has in itself been sufficient to justify its use in many instances. Machining practice is often limited by the condition of the casting skin rather than the metal properties. Consideration should be given in such cases for the removal of the skin by chemical or mechanical treatment which include pickling, sodium hydride process and sharp grit blasting. These treatments are different from annealing in that they do not alter the metal structure or properties. A general guide to machining speeds and feeds using carbide tools is given in the tables below.

ROUGH TURNING

Type Meehanite	*Speed* *Surface ft/min.*	*Feed in./rev.*	*Metal Removal Rate sq in./min.*
WA	50–100	.006–.012	4– 14
GA	150–200	.015–.030	27– 72
GC	200–250	.015–.030	36– 90
GE	250–300	.015–.030	45–108
GE (Annealed)	350–550	.020–.045	84–297

FINISH TURNING

WA	100–150	.060–.010	7– 18
GA	200–250	.010–.020	24– 60
GC	250–300	.010–.020	30– 72
GE	300–350	.010–.020	36– 84
GE (Annealed)	400–600	.010–.025	48–180

MILLING

Type Meehanite	*Roughing* Speed s. f. m.	*Roughing* Feed in. per tooth	*Finishing* Speed s. f. m.	*Finishing* Feed in. per tooth
GA	150–200	.005–.010	200–250	.005–.015
GC	180–220	.010–.020	225–275	.010–.015
GE	200–250	.010–.025	250–300	.010–.015

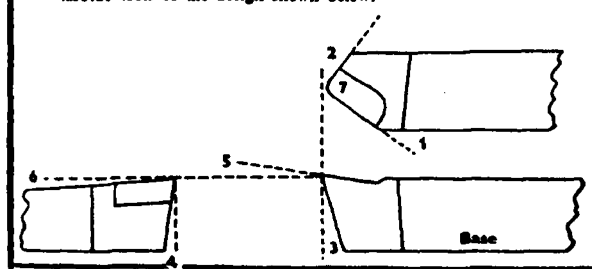
BORING

Type Meehanite	*Roughing* Speed s. f. m.	*Roughing* Feed in./rev	*Finishing* Speed s. f. m.	*Finishing* Feed in./rev.
GA	120–180	.010–.015	175–200	.005–.015
GC	180–220	.010–.015	200–250	.005–.015
GE	220–250	.015–.020	250–300	.005–.015

Besides the metal properties, other factors such as type of casting, section thickness of metal, machine condition and production requirements are to be considered in determining speeds and feeds set for any particular job. The data given in the tables represent a guide for average workshop conditions using carbide tools.

Tool Design

Machining practice for Meehanite is based on use of cemented carbide tools of the design shown below.



Tool Angle	Lathe	Planer	Boring Mill
1 Approach Angle	8—10°	5—10°	6—10°
2 Trail Angle	8—10°	8—10°	10—12°
3 Front Clearance	4— 6°	4— 6°	2— 6°
4 Side Clearance	4— 6°	4— 6°	4— 6°
5 Top Rake	0— 4°	0— 8°	0— 2°
6 Side Rake	2— 6°	2— 6°	2—10°
7 Nose Radius	1/8"	1/8"	1/16"—1/8"

Fig. 1

TOOL DESIGN

Correct tool shape obtained by grinding accurately to a jig, keen tool edges and highly-polished surfaces largely influence the standard of surface finish. The tool is to be designed as shown in Fig. 1.

Tool life is affected primarily by cutting speed but also to some extent by feed, The influence of feed is largely dependent on the speed. Best cutting efficiency is obtained by using high feed and adjusting speed to the maximum for tool life desired. The accompanying graph (Fig : 2) depicts the speed-feed relationship for General Engineering types GA and GD Meehanite based on turning tests.

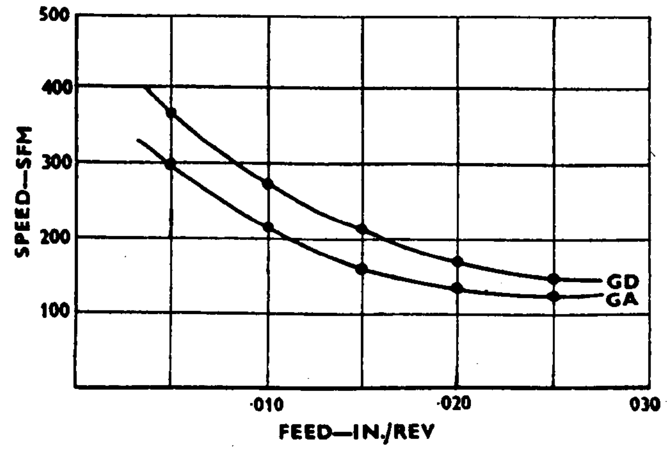


Fig. 2. Graph Showing Speed-feed Relationship

Illustrated in Figs. 3, 4, & 5 is the effect of cutting speed, feed and depth of cut on tool life. It will be seen that tool life is not greatly influenced by depth of cut.

HEAT TREATMENT

Meehanite types GM, GA, and WA are peculiarly responsive to all types of heat-treatment in the same way as Carbon steels. Suitable treatment imparts improved strength and wear resistance. The effect of heat treatment on Tensile strength and Hardness of type GA Meehanite is quoted below from the Maker's literature on the subject :—

" Maximum toughness and strength are obtained by quenching in oil from 870 deg. C., followed by tempering at 350 deg. C.—450 deg. C. Where maximum hardness and wear resistance are required, the tempering temperature should be reduced to 200 deg. C,—250 deg. C. The casting should be pre-heated to 600 deg. C., and then brought rapidly to 870 deg. C. When the casting temperature blends with the furnace, quench in oil and temper as indicated."

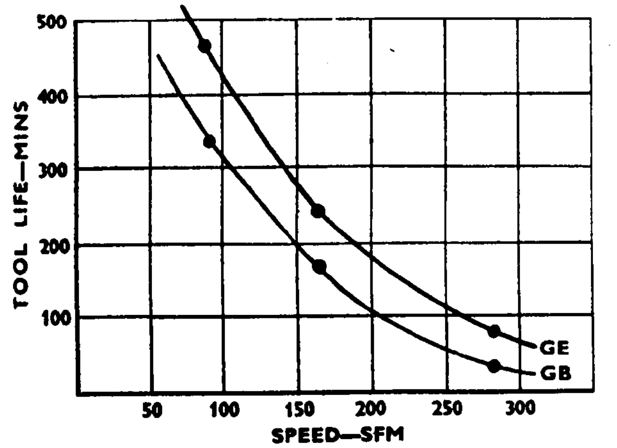


Fig. 3.

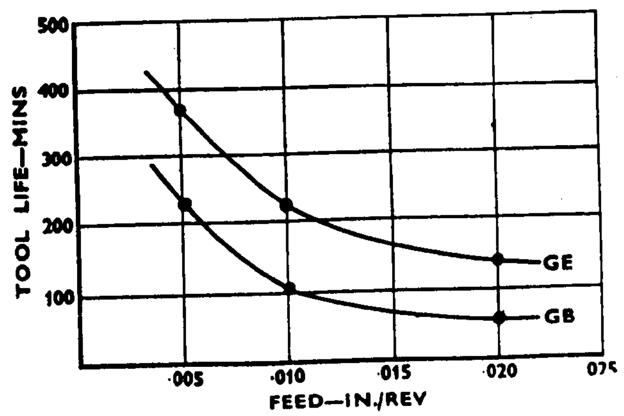


Fig. 4.

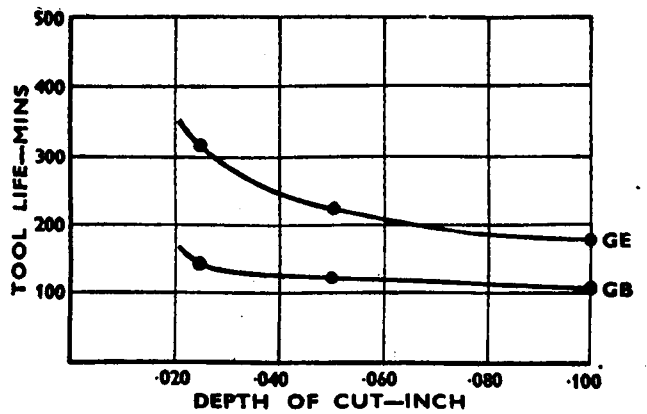


Fig. 5.

When local hardness is preferred, the same can be developed on wearing faces by flame-or induction-hardening.

For improved machinability annealing may be done. Low temperature anneal improves machinability without serious loss of strength or hardness but high temperature anneal gives maximum machinability with loss of strength and hardness to a considerable extent

and is used only in exceptional cases where high metal removal rates are essential.

The recommended annealing temperatures are charted below :—

Type of Meehanite	*Low Temp: Anneal Deg: C.*	*High Tem: Anneal Deg: C.*
GE and GD	665–680	845
GC and GB	670–695	860
GA and GM	675–705	870

N. B. Heating time should not exceed one hour per inch of casting section, followed by slow cooling.

MEEHANITE FOR MACHINE TOOLS

Because of its consistent strength properties, a high degree of damping capacity, good resistance to wear, complete stability and easy machinability, Meehanite has established itself in the manufacture of machine tools.

The versatility of Meehanite casting goes much beyond the range of mechanical properties which can be developed by processing it as required. GA and GC Meehanite provide high modulus and fatigue values required in machine tool parts.

The damping capacity of the metal gives it an advantage over steel where it is desired to absorb vibration. The instances in point are such parts of the machine tools as beds, columns, gears, gearboxes, head and tail stocks.

Freedom from movement or any distortion after machining is essential in most machine tool parts. Besides possessing a high degree of stability, the movement due to internal stress is negligible in Meehanite castings.

A fascinating metal such as Meehanite, it is doing duty in forest, field and factory and there is no major industry not already using it.

ACKNOWLEDGEMENTS

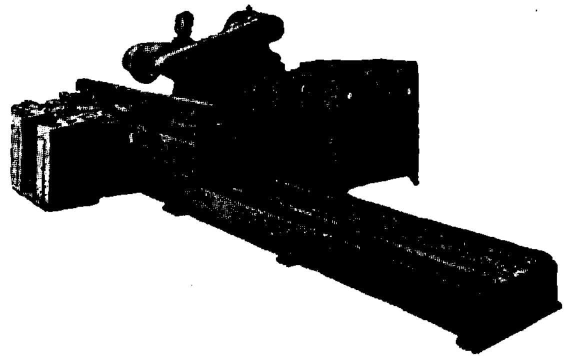
The auother wishes to make acknowledgements to the International Meehanite Metal Company Limited for making use of their literatures, illustrations and Machining Chart, in preparing this article.

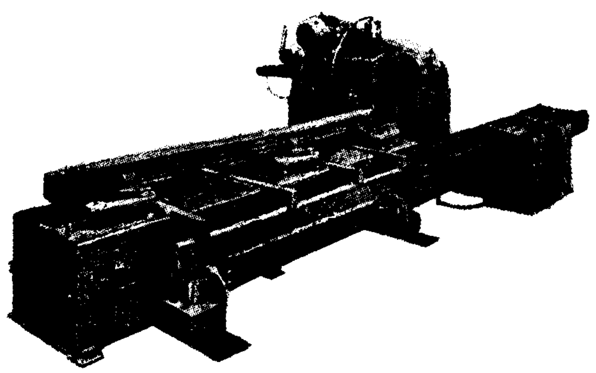
A Range of Brookes Machine Tools

By A Correspondent

BILLET GRINDING MACHINES

BROOKES are able to produce a Billet Grinding Machine to suit customer's particular needs. Their standard range of machines will accommodate billet and slabs of varying dimensions and a machine can be supplied to meet most requirements. Where

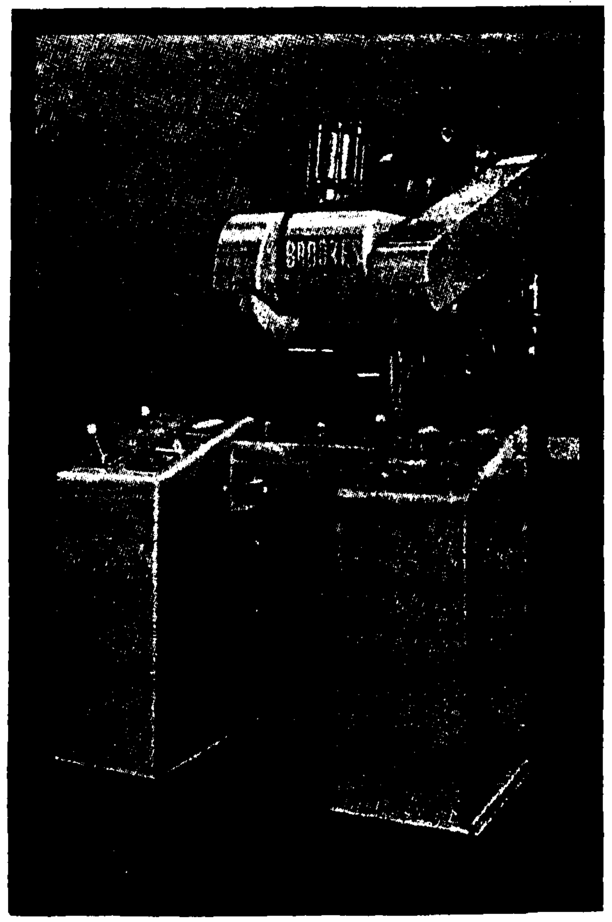




this is not the case, they are always very willing to modify and design special features to suit their customers.

The machine illustrated is fitted with equipment to facilitate the handling of billets on and off the table, this being controlled from the control desk.

Brookes Billet Grinding Machines have been developed to meet a specific need in the steel Industry. Many steelworks have found that with increased output they are finding difficulty in meeting ever-growing demands on their billet dressing capacity. Both the hard physical effort and the expense of time normally involved in the overall grinding of billets



Control Desk

and slabs can now be reduced considerably by the automatic operation of the Brookes Billet Grinding Machine. Localised faults revealed during this operation can be given special attention at any time by operating the manual control levers and concentrating the grinding head in particular areas until the faults are removed. Immediately the manual levers are released, the automatic feature takes over and overall grinding resumed. The split control desk is designed to give the operator immediate control of the machine with

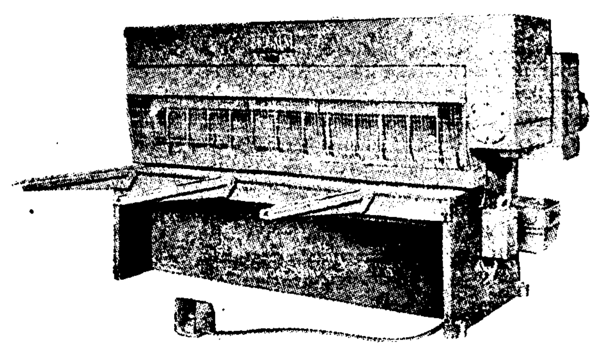
all the levers directly to hand. Where billet handling equipment is fitted, the controls for this are also incorporated in the desk. Special care has been taken to ensure that the operator has a clear vision of the billet while grinding, at the same time remaining in complete control of the machine.

SPECIFICATION OF STANDARD MACHINES

Maximum Billet Length	16′0″	20′ 0″	30′ 0″
Minimum Billet Length	To suit customer requirements		
Maximum Billet Section	10″×10″	10″×10″	14″×14″
Minimum Billet Section	To suit customer requirements		
Table Traverse (to load outside of head)	18′ 6″	22′ 6″	33′ 0″
Table Traverse (to load either side of head)	● 21′ 0″	25′ 0″	36′ 0″
Table Feed	5—60 f.p.m.	5—60 f.p.m.	5—60 f.p.m.
Wheel Head, Horizontal Traverse	22″	22″	36″
Wheel Head, Vertical Traverse	12″	12″	18″
Wheel Head, Transverse Feed	⅛″—2″ per stroke	⅛″—2″ per stroke	⅛″—2″ per stroke
Grinding Wheel Size	20″ dia.×2½″ face	20″ dia×2½″ face	20″ dia×2½″ face
Grinding Motor	50 h.p., 1,440 r.p.m. T.E.F.C.	50 h.p., 1,440 r.p.m. T.E.F.C.	50 h.p., 1,440 r.p.m. T.E.F.C.
Hydraulic Pump Motor	7½ h.p., 1,440 r.p.m. T.E.F.C.	7½ h.p., 1,440 r.p.m. T.E.F.C.	10 h.p., 1,440 r.p.m. T.E.F.C.

BROOKES MECHANICAL GUILLOTINE SHEARS

To-day's production requirements demand high output, accuracy and reliability from machines of low capital cost. All these points have been borne in mind in the production of Brookes new range of Mechanical Shears.

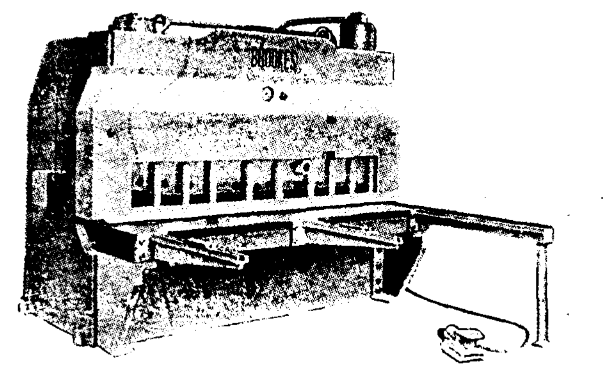


The all-steel welded construction of this range gives strength and rigidity coupled with a clean and efficiently guarded design. Brookes have built in as standard equipment all those features which their past 30 years' experience has shown them to be desirable.

These machines are manufactured in widths of 6′, 8′, 10′ and 12′ and thickness capacities of ⅛″ and ¼″.

BROOKES HYDRAULIC GUILLOTINE SHEARS

Brookes range of Hydraulic Shears have been designed with accuracy, Reliability, high output and



safety in mind and the result has been to produce a shear of clean and modern appearance that is, both robust and easy to operate. These hydraulic guillotine shears are manufactured in widths of 6 ft., 8 ft. and 12 ft. and thickness capacities of ⅜″, ½″, ⅝″, ¾″ and 1″.

The Visit to India of Mr. Paetzold - Member of the Board of Directors of the Deutsche Messe-Und Ausstellungs-AG., Hanover, West Germany and his Colleague Mr. Rohereke

DIPL. ING. ERNST PAETZOLD, member of the Deutsche Messe-Und Ausstellungs-AG., and his colleague Mr. Rohereke have just returned to Germany after a successful goodwill tour of India and Ceylon where he showed a colour documentary film of the 'Hanover Fair' and also lectured to large gatherings of Industrialists and Businessmen of Bombay, New Delhi, Calcutta and Madras. After a successful career in Civil Service and later, on the executive board of the Central Association of the Electrical Industry, Frankfurt-on-Main., at 43, Dipl. Ing. Mr. Paetzold joined the board of Deutsche-Messe-Und Ausstellungs-AG., Hanover in 1953. He takes a prominent part in the development of the Hanover Fair and in promoting its International character, a matter which has come especially to the ore in recent years. On his frequent travels he has gained an intimate knowledge of the problems of International Trade, having visited most of Europe, The U. S. A., Canada, India, Iran and various African countries.

An export fair was established in 1947 to enliven foreign trade after the Second World War and give work to millions of unemployed. Nobody foresaw that this city would one day become the *venue of a world-wide fair*. Since suitable halls happened to be available in Hanover on a one-time Industrial estate scheduled for demolition, the main intention was to promote a much-needed economic development.

The formation of the Deutsche Messe-Und Ausstellungs-AG., in Hanover followed and this Company since 1947 have been the organisers of the annual fairs held there. Only German exporters exhibited in Hanover in the early years, but the Fair developed so quickly into an important International market that foreign exhibitors soon hurried to rent space and take advantage of the continuously increasing International demand. Thus the first forty-five foreign manufacturers were already represented at Hanover in 1950.

The Hanover Fair is now a *meeting place of International trade and Industrial experts* which none wishes to miss, not least the buyers from all parts of the world. In the German and foreign Industrial groups represented they have a comprehensive display which offers the best opportunity for close comparison in each branch of Industry.

The area of covered halls available at Hanover in 1947 amounted to 322,900 sq. ft. In contrast, the Hanover Fair in 1961 required 3,358,000 sq. ft. of covered halls (1962 : 3,789,000 sq. ft.)

The open air space rose from 86,000 sq. ft. in 1947 to 2,228,000 sq ft. in 1961. During this period, the number of exhibiting manufacturers reached a total of 5,400 compared with 1,300 in the first year. Of these, over 1,100 are foreign firms. The number of visitors all over the world amounts to well over one million annually, of whom more than 10% are buyers from Europe and Overseas. Mr. Paetzold stated here that nearly 100 countries were represented at the last fair with vast displays of their production along with representative collection of the products of German Industry. Thus he added, Hanover Fair is a unique medium for buyers of all nations and Continents to study the latest developments in various Industries and countries on the competitive basis of world production.

Mr. Paetzold while in Delhi requested the Govt. of India to set up an Information Booth in the International Centre of the Hanover Fair where there are Information stands of over twenty European and Overseas countries. Here information on export matters relating to the countries is given. The countries of the Eastern bloc, Czechoslovakia, Poland and Soviet Russia are also represented.

The Prime Minister, Mr. Nehru, whom Mr. Paetzold met during his stay in Delhi agreed that the Hanover Fair was the best medium to foster and promote trade relations between India and West Germany. The Prime Minister also expressed that he is greatly in favour of India having an Information Booth in the Hanover Fair. The Commerce Ministry has now taken a positive decision and our Indian Embassy in Bonn has been intimated to give the final acceptance to the German Industries Fair authorities.

Mr. Paetzold in his talks to Industrialists and businessmen said that they should participate in the Fair and thus provide a glimpse of Industrial progress in the country to the business community abroad. The character and atmosphere of the Hanover Fair was beautifully portrayed in the colour documentary film that he showed to large gatherings in all major cities of India and thus conveyed their message in a much better way than any words of theirs could do.

You can have all further details and particulars concerning the German Industries Fair, Hanover, from their official Agents in India viz., Ajanta Advertising, Bombay, Calcutta, Madras.

World's first Computer for Steel Process Control

A Sheffield (England) steelworks is the first in the world to employ an electronic digital computer for the control of an actual steelworks process. The computer has been installed at the billet mill of Samuel Fox & Co., Stocksbridge, Sheffield, for the control of cutting up steel billets up to 450 ft long.

The firm states: "A major problem in dealing with billets of this length is to avoid wastage, the lengths required varying from 30 ft down to 18 in. Previously it was the practice for billets to be cut at the judgment of the cutter—a job calling for considerable skill. By using the computer, however, the necessary calculations can be made very much faster and with greater economy than by a human operator."

The sequence of operations is that the billet length is measured during the final passage through the mill, and this length is fed into the computer. Details of the customer's requirements have already been set up on the input board of the system by the cutter and, within seconds, the computer completes its calculation based on the information and transmits the result to the various cuttings.

Continuous Casting of Steel— the Path of Development and Current Status

By Bruno Tarmann
BOHLER BROS & CO. LTD., VIENNA

IN Austria, the smelting and processing of ferrous and non-ferrous metals has been a tradition for many thousand years. The Austrian iron and metals industry has always been ready to adopt new smelting and processing methods, and in addition to this, has always given special attention to research and development.

After some theoretical investigations concerning the continuous casting of steel during the Second World War, already in 1947 practical tests and development work were carried out with the object of developing a method and suitable equipment for the continuous casting of steel. The work was carried on with great energy and in 1952 resulted in the construction of a big scale pilot machine at the steel mill of Boehler & Bros. Co., Ltd. in Kapfenberg. The steel mill at Kapfenberg produces special grade steels. This first continuous casting machine was followed by another production machine at the steel mills of the Eisenwerk Breitenfeld Ltd. at Wartberg in the Murz-valley.

FUNDAMENTALS OF THE DEVELOPMENT

In Austria, the research and development work was not conducted by one single firm but was established as a co-operative venture of several Austrian steel mills. Consequently, the work was not intended to meet the specific requirements of a single steel mill but was planned to cover a wide range of objectives. Owing to the fact that the practical tests were carried out at the steel mill of Boehler & Bros. Ltd., emphasis was put on the casting of special steels. The steel mill offered the best conditions for a broad scope of research and development since the range of steel brands embraced all grades of steel from the technically pure iron to highly alloyed brands containing iron only as an impurity. Moreover, the diversity of the subsequent manufacturing processes by which the steel are made into all kinds of finished and semi-finished articles, such as sheet, bars, rolled or forged billets and drop-forgings, necessitated the extension of the scope of research which was carried out in connection with the machine at Kapfenberg.

The investigations were divided into four groups such as

Metallurgy
Thermal Investigations
Engineering Design and
Teeming Practice.

Of course, all investigations were carried out in close connection to each other and thus the fundamental data were gained very rapidly and after a development period of only five years large scale production was started.

There is no denying that the experiences which were available at the time where just enough to permit the starting of the plant. In the following years these experiences had to be supplemented and enlarged in order to obtain the high standard which the continuous casting practice has reached to-day.

TEAMWORK

It was of great importance for the development of the continuous casting that the Austrian development group joined a German group in 1952. The latter is since the death of Dr. Junghens headed by the Mannesmann Company, which is of international importance.

Since 1952, the German and Austrian groups have been working together and have succeeded in studying and solving a great number of problems concerning the continuous casting of steel. The combined groups have now constructed a number of plants which meet all requirements.

The German group emphasised the development of large scale production units for the casting of large and medium sized squared and round sections of commercial quality steels and the Austrian group supplemented the program with high and special grade steels and the casting of smaller round, flat and square sections, the flat sections ranging from small sheet bars to big slabs.

The co-operation of the two groups, concentrating on the metallurgical problems and casting practice was later on extended to the Demag which carried out the design and construction of continuous casting machines in accordance with the furnished data.

The main concern of the German and Austrian groups was the adaptation of the continuous casting process and the development of the plants to the specific properties of the steel. The change from the orthodox teeming practice to the continuous casting was not to interfere with the usual practice of the melting shops. The equipment and the melting practice were to remain unaltered as far as possible. The second fundamental requirements of the development of the continuous casting was the maintenance of the quality of the steel. The latter was not to be impaired by an exaggerated rate of cooling in order to obtain a higher rate of casting.

DIRECTION OF DEVELOPMENT

Thus the direction of development was already determined.

As the orthodox melting practice and the usual teeming temperature, in addition to the conventional ladles and the preheating practice of the ladles had to be maintained, the rate of casting had to be in accordance with the teeming rate of ingots. At the same time, as the rate of casting was to a certain extent limited by quality considerations, multiple stranding was considered from the very beginning. Thus the continuous casting machine at Kapfenberg incorporated a twin strand arrangement.

The soundnees of the development carried out by Mannesmann and Boehler has been proved by a number of machines which have been installed by other firms. Special mention should be made of the machine which was put up at the Societaper Industria e l' Elettricita at Terni in Italy. This machine comprises 8 strands and is capable of handling heats upto 75 tons, obtained also from an open hearth furnace. It is a well-known fact that the temperature of an open hearth furnace is much more difficult to control than the temperature of an electric arc furnace and it is especially difficult to obtain extreme temperatures in the first type of furnace without shortening the life of the lining and impairing the quality of the steel. It should be noted here, that the ladle is not preheated whereas the tundish is preheated by means of oil burners to a temperature of 1800°F. Thus the teeming temperatures which were applied for the teeming of ingots are retained at the Terni steel mill.

SUB-DIVISIONS OF DEVELOPMENT

In the following explanations, some decisive steps in the development of the continuous casting shall be explained in order to show the extent of the work which was carried out. Of course, no complete report can be given within the scope of this talk and a short review of the results obtained by the application of the continuous casting process shall finally conclude this report.

DISTRIBUTION PROCESS OF STEEL

Various methods of distribution of the steel among several moulds were investigated and it was found that control by means of variable nozzle bores and variable heads required excessive teeming temperatures. Moreover, this method was found to be too uneconomical and sensitive. Control by tilting the ladle in connection with open or covered runners was substituted or supplemented by the control of the flow rate by means of a stopper and nozzle arrangement. In addition to a broad range of control, this arrangement permits the rapid adjustment of the rate of flow and has the special advantage of being very economical in respect to heat

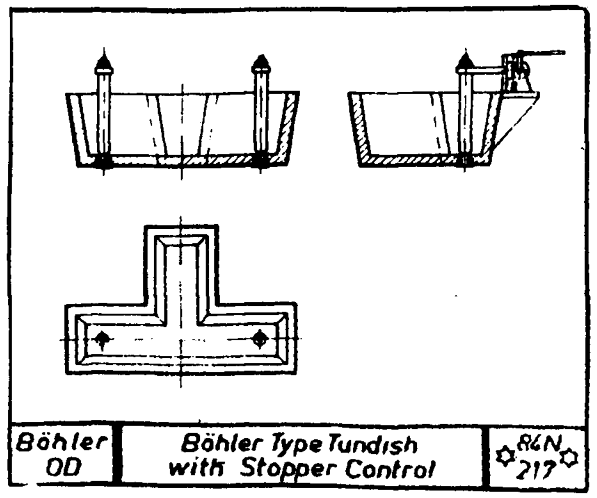


Diagram No. 1

(Continued on page H.45)

The Possibilities of the Large Tonnage arc Furnace

AT the " Electric furnace symposium " organised in 1959 by the A. T. S. F., the large arc furnace occupied pride of place in the discussions between users and furnace makers (1). In turn, the A. I. Lg. in 1960 organised a " Symposium on the large-capacity arc furnace ", which again produced an interesting exchange of views between specialists on various aspects, concerned with this current problem (2).

Without repeating the points discussed there in detail, it will nevertheless not be without interest to examine the possibilities of this type of furnace for the manufacture of high-quality steels—steel plate for welded fabrications, the automobile industry and armourplating, forgings for turbine and alternator rotors and castings for the hydro-electric industry.

METALLURGICAL EXPLOITATION

Success in any metallurgical operation can only be achieved by strict control over the reactions taking place in the steelmaking equipment. The first requirement in achieving control is to obtain perfect reproducibility in the course of the process. Whichever method is used, open-hearth furnace or electric furnace, *one can be certain that the first step on the road to quality has been achieved when one is no longer trying to catch up with events determined by the whim of the melt, but can regularly make things go in a given direction. The direction will not necessarily be the optimum at first, one would be very lucky if it were always so. But once control is established, it will then be possible to make modifications that will bring about the reactions directly required and intended.*

(1) (2) See Bibliographie

Large arc furnaces are now in use on a sufficiently wide scale to justify the statement that they are up to the standards set by steelmakers as regards uniformity of metallurgical functioning. Initially it seemed that the mass of metal involved would have sufficient inertia to inhibit certain operation considered to be the special province of small furnaces, such as the attainment of a given temperature, an exact composition or a specified property. Nothing of the sort; one must bear in mind that although furnace capacities have been and still are growing continuously, the means of controlling them have likewise made great progress. The reactions themselves are much better known, but more important than that, they are much more reproducible.

Temperature determines the speed of numerous metallurgical reactions. Force of circumstances invariably compels one to aim at a number of objectives at the same time and in a single operation, some of them being diametrically opposed; for example, high ingot-pouring temperatures are favourable to the elimination of surface scabbing, but may cause cracking which is just as deleterious as the scabbing one set out to avoid. Each of the objectives demands different temperature values, the differences often being extreme. One must therefore select a compromise temperature. The more exactly this is maintained, the better will the set of requirements be satisfied. The large arc furnace is already capable of very well meeting this requirement. On the one hand it has a very high superheating potential, providing the steelmaker with the means of attaining at will the temperature he needs for any type of steel. On the other hand, optical pyrometers and empirical methods have become quite obsolete and the steelmaker has at his disposal sensitive and accurate immersion pyrometers, leaving little room for subjective

(Continued from page H.44)

losses. This method is also superior to other methods as far as the quality of the steel is concerned. The reason for this lies in the fact that the steel in the tundish is covered with slag whereby a loss of heat by radiation and the oxidation of the steel can be limited to a minimum. The multiple distribution by means of stoppers, introduced by Mannesmann in 1954 has proved its excellence in actual service for the casting of sections up to more than 85 mm square and up to 8 strands. (Diagram No. 1) Of course, extensive co-operation with the manufacturers of refractory materials was necessary in order to secure the required thermal resistance and life of the nozzles and stoppers.

(To be Continued)

estimates. The case of the vacuum pouring of large forging ingots is a particularly striking one in this respect. To obtain satisfactory degasification in ingots weighing up to 150 tons or more, the temperature must be at once high and accurately controlled. The high temperature is required to compensate for the temperature drop during degasification ; it must be accurately controlled in order to ensure pouring conditions that will produce an inclusion-free ingot.

As for the accuracy of composition control, some idea of the achievements can be obtained when it is appreciated that it is possible to meet the narrow specification ranges laid down by automobile constructors (carbon content ± 0.02%, Cr content ± 0.1 %, Ni content ± 0.1%, etc.), as readily in the large arc furnace as in the small, under the same conditions. Certainly the achievements under this heading have more than fulfilled the hopes of the protagonists of large arc furnaces.

METALLURGICAL POSSIBILITIES
SULPHUR AND PHOSPHORUS

Ease of desulphurisation, by virtue of the reducing atmosphere present, is one of the characteristic features of arc furnaces. A highly reducing slag, combined with metal-slag reaction during teeming into the ladle, further improves the efficiency. The large arc furnace is thus capable of producing a wide range of steels with sulphur contents less than 0.02%, and high-quality steels with sulphur contents less than 0.01%. On this point, mention may be made of one steelworks where brittleness problems due to the presence of sulphur disappeared on changing over from open-hearth furnaces to large arc furnaces.

Dephosphorisation offers no special difficulties. The use of ore, combined with the normal use of oxygen, makes it possible to reduce the phosphorus content to below 0.015% if the specification requires. This is important in all steel intended for forging.

INCLUSIONS

While the problems we have so far touched upon can be described with a certain degree of precision, there is one problem which is by no means so amenable, namely the problem of inclusions. Is it in fact possible in the large arc furnace to make a clean steel, that is to say a steel meeting certain definite specifications as to the type and amount of oxide inclusions ? To answer this it is necessary to analyse the methods open to the steelmaker.

The manufacture of a steel ingot can be divided into two operations, steelmaking in the furnace and teeming in the pit. When making a high quality steel, the steelmaker may have various aims, such as a given degree of decarburisation, the selection of various tapping times to give a pre-determined level of oxidisable elements (C, Mn, Cr), the controlled deoxidation of metal and slag, the attainment of adequate temperatures, etc. When these aims are considered, it is readily obvious that there is nothing in them to prevent the use of a large arc furnace, since they all make use diffusion phenomena, and diffusion is invariably extremely rapid.

When the metal is judged to be finished it is poured, first into a ladle and then into the mould. Here it undergoes a certain number of sudden physico-chemical changes, which, however, the steelmaker can control by the classic methods of controlling temperature, pouring rate, and additions of deoxidisers to ladle and mould. All these methods are perfectly applicable on the industrial scale when a large arc furnace is used.

Some examples will serve to illustrate the point. The success of large forgings, from the steelmaker's viewpoint, is a matter of microscopic inclusions. By controlling the pouring conditions and using special refractories a satisfactory solution can be obtained to this problem.

Steels for rolling are examined microscopically, and their entire value depends on limiting the microscopic inclusion content. Successful trials have been made in converting from a 30-ton arc to an 80-ton arc furnace for making such steels, adhering simply to the techniques tried and tested in the smaller furnace.

HYDROGEN

The hydrogen contents of steels made in large arc furnaces are typical of the values found in all arc-melted steels,and are perfectly acceptable. By using oxygen during the oxidising period and taking the normal precautions to dry all the materials that come in contact with the molten metal, hydrogen contents of between 4 and 7 cm^3/100g are obtained. These contents are still high for large components (forgings, thick alloy steel plates). To lower them rapidly and with certainty there are now available various methods of vacuum degasification, an indispensible adjunct to all electric steelworks of any size. In this respect it should be added that the large-capacity electric furnace makes it possible to derive maximum profit from the application of these techniques to large masses of steel, by virtue of the reasons already stated with regard to temperature effects.

NITROGEN

One of the drawbaks currently attributed to the electric furnace is the alleged difficulty of attaining low nitrogen contents; it is quite evident that the large-tonnage furnace is no exception to this rule. Nevertheless, the nitrogen contetht can be minimised by adopting a certain number of precautions, so that values of the order of 0.010% are not exceeded. On the other hand, it is agreed generally and with just cause that the quality of a steel is determined more by the method adopted for stabilising the nitrogen than by the total nitrogen content it might have. Consequently, the judicious addition of a deoxidiser and denitrider can effectively eliminate the effects of this tendency on the part of arc furnaces.

A SPECIAL CASE : STAINLESS STEELS

For making these steels, the large arc furnace is in no way inferior to the 10-ton furnace. Here again, progress in the size of furnaces has gone hand in hand with progress in another direction, namely the availability of oxygen in large quantities at favourable prices. Experience has shown that stainless steels can be made with a guaranteed maximum carbon of 0.08% and a figure of 0.06% C is usually attained.

The only problems the steelmaker has in this connection are technical ones of the very high temperatures required, the attainment of homogeneity after the slag has been reduced, and the heating and handling of large quantities of ferrochromium. The latter problem has been solved by the adoption of fully automatic handling on the charging platform ; this is impracticable with small furnaces, but with large furnaces it offers the advantages of flexibility and speed.

CONCLUSION

In conclusion it is useful to recall that the aim of the steelmaker is to reduce his selling prices at the same time as he improves the quality of his steels. On this view, the large arc furnace is very much a piece of equipment that, by virtue of its high production rate and technical facilities, enables customers to have products of no lower quality but an advantageous prices.

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—The 80-ton Furnace at the Montlucon Works of Usines Saint-Jacques—by Monsieur SAUVAGE—and numerous references in other publications.

(2) Symposium on the large-capacity arc furnace, LIEGE, 24th March 1960: Revue Universelles des Mines, Series, 9 Vol, XVI. 1960 (September).

£54,000 Orders for AEI Motors

Orders totalling £54,000 for electric motors for use in a steelworks extension scheme in Turkey and a British refinery are announced by Associated Electrical Industries Ltd. The motors will be supplied by the Company's Motor & Control Gear Division. Burla Biraderler of Istanbul has placed a £24,000 order for both a.c. and d.c. electronic motors. They are to form part of the extension scheme at Karabuk Steelworks.

Flameproof high-speed electric motors worth £30,000 have been ordered for the new B. P. California Aromatics Plant being built at the British Petroleum Company's Kent Oil Refinery.

DURGAPUR STEEL PLANT SECTION

IRON-MAKING IN INDIA

By P. C. Neogi

General Manager, Durgapur Steel Plant

[Below is the summary of the presidential address of Shri P. C. Neogi at the Seminar on "Iron-making in India", jointly organised by the Durgapur Chapter of the Indian Institute of Metals and Hindustan Steel Limited at Durgapur on March 5 & 6, 1962]

IRON making in India started as early as 500 B.C. and the Iron Pillar in Delhi stands as a historic symbol of monument of the art of iron making known to the people of this country probably even several centuries earlier. Although a modern blast furnace with a capacity of manufacturing as much as 5,000 tons of pig iron per day is a colossal apparatus compared to those tiny primitive furnaces, it is surprising that the essential principle of making iron by charging iron ore and coal or coke from the top and blowing air from the bottom in a vertical shaft furnace has remained more or less the same. However, quite some amount of quantitative scientific information is available today so that man has no longer to attribute failures to smelt the desired quality of iron to the wrath of evil stars. Even a decade ago the blast furnace was a kind of unpredictable and temperamental apparatus. Today, however, the situation is somewhat different.

A decade ago iron making was more an art than science. Today it is more a science than art. With considerable improvement in the control of raw materials, in the distribution of burden in the stack, in the nature of the injecting system through the tuyers and with some of the modern instrumentation and automation systems, blast furnaces have been converted to a more steady and closely controlled apparatus today. Moreover, from a mere few tons a decade ago to about 5,000 tons per day, the blast furnace has considerably increased in size during the last several years. However this size itself, particularly the height of nearly 100 ft., has put serious limitations to the type of fuel that could be effectively used in the modern blast furnace. The physical and chemical characteristics of coke within certain specified limits can only be obtained provided such a coke be manufactured from particular grades of coal—the so-called coking coal.

CONSERVING COAL

To be able to conserve the stock of comparatively good grades of coking coal, several methods like preferential crushing and screening, blending, mixing with oil, control of inorganic materials in the form of ash, etc. have been proposed from time to time. While these have produced encouraging results and have contributed to a better and more economic use of coking coal, the problem cannot be said to have been satisfactory solved yet, particularly for this country, where the resources of coking coal are extremely limited.

Another serious disadvantage in this country is that the quality of coking coal has been deteriorating and it is reliably known that it will progressively deteriorate in future years due to the progressively increasing ash contents of deeper seams. To reduce the ash content of coal, washeries have been constructed and are proposed to be constructed in future. But keeping in mind that this country may have to produce many times of steel than produced now towards the end of this century (to keep up with the speed of demand of steel per capita and the increased rate of growth of population), the washing of such colossal amounts of coal to feed all the blast furnaces does not appear to be the ultimate final solution to the problem.

LIMESTONE

The limestone situation in the country is equally serious. As with coal washeries, while the beneficiation of limestone may fetch temporary relief, such beneficiation processes themselves may not solve the problem on a permanent basis.

It is not necessary for me to deal in this address the question of possible measures to be adopted for the solution of these two vital problems (namely, deficiency of good grade coking coal and limestone) facing the iron and steel industries of the nation. But one fact is certain that we have to devote a more serious attention to those two problems not only to get temporary relief but to get permanent cure, if possible, of this chronic malady. This is a challenge which the Research Laboratories of the steel industry in collaboration with the National Laboratories have to face and eventually offer a firm solution.

Pending such long time development, it is necessary that some of the recent improvements like preparation of raw materials, injection of fuel, oxygen and steam through the tuyers, better instrumentation and automation systems, are gradually incorporated in our blast furnaces with a view to increase the rate of production and decrease the rate of fuel consumption per ton of iron. For this purpose we propose to modernise our iron ore mines at Bolani with a view to crush and screen the ores and also the utilise fines for sintering purposes.

The problem of manufacturing a suitable grade of self-fluxing sinter has also to be successfully solved with indigenous raw materials. This may well be done in stages in the plant itself based on the experiences gained with different blends of mixtures for the sinter.

IMPORTANT PROBLEMS

It will be very helpful if the deliberations of the symposium could be consolidated in the form of definite recommendations with particular reference to:—

(1) modernisation of our existing blast furnaces by incorporating some of the well-established industrial practices abroad keeping in view the raw materials and conditions existing in this country :

(2) some form of immediate relief to the problem of coking coal and limestone both with regard to quality and quantity :

(3) a long term solution on a somewhat more permanent basis including making iron by processes other than conventional blast furnace practice.

608, MINING MACHINE FACTORY TO EXHIBIT IN INDIA

India is one of the best purchasers of the products of the Budapest Mining Machine Factory. From among the products of the factory, several hoists, reel crabs, Kota loaders, etc. have been delivered to India by the export company NIKEX of Budapest. On the invitation of Indian specialists, the Budapest Mining Machine Factory will take part in the international exhibition, in December 1961, on the occasion of the inauguration of a mining university, in the mining town of Dhanbad. Almost all the big mining machine factories of the world display their products at this exhibition. The Budapest Mining Machine Factory will exhibit a loader by Hidasi, and also the model of the front—end loader type F-5. These two machines are not yet known in India. A special model, corresponding to Indian standards, of the Hidasi loader will be manufactured for the Dhanbad exhibition.

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FURNACE MODELS FOR INDIAN INDUSTRIES FAIR

One of Britain's leading industrial furnace builders, the Incandescent Heat Co. Ltd., of Smethwick, Birmingham (a subsidiary of the Wellman Smith Owen Engineering Corp. Ltd.), will be exhibiting at the Indian Industries Fair, to be held in New Delhi this winter.

On show will be a model of a large oil-fired bogie hearth furnace, for the normalizing, stress-relieving, and annealing of mill rolls, forgings, and fabricated structures. A number of these furnaces have already been installed in leading Indian steelworks.

Another model will show a furnace for sheet mills. This heats 10 tons of bars each hour for feeding into a breakdown mill.

A third model is of a Metalectric direct-arc melting-plant, and shows the furnace, control room, and transformer house. This type of furnace can melt up to 100 tons of steel at a time, using electricity.

Scale models and photographs of other types of plant used in heavy industries are also being sent to New Delhi.

With installations in 50 countries—including India, where Incandescent furnaces have been in successful operation for over 30 years—the Incandescent group ranks high among furnace builders of international repute.

HSL Management Training Institute, Ranchi

By A Special Correspondent

THE Management Training institute of the Hindustan Steel Limited was declared open by Shri J.M. Shrinagesh, Chairman of Hindustan Steel, on 18—2—62 at the HSL Colony at Ranchi.

First of its kind in the Public Sector, the Institute promises to be one of the best in the country. Hindustan Steel has a plan to have an Institute Building costing about Rs. 8 lakhs in the near future. The Institute is presently housed in a modest building at the HSL Colony.

The Institute has come into being not a day early. Employing about half a lakh, Hindustan Steel has the toughest Management job known to India. Besides the three Steel Plants, Hindustan Steel has to run its own iron ore mines, its own coal washeries and its own quarries, each of which is a big undertaking in its own rights.

The largest industrial undertaking in Asia and third in importance and size after the country's Defence Organisation and the Railways, Hindustan Steel has the greatest disadvantage of too sudden a growth. And, as is expected, one of the most serious limiting factors in the progress of the undertakings run by Hindustan Steel from its very birth is the lack of trained Managerial personnel.

Keenly alive to the problem of Management Development, the Hindustan Steel appointed a Training Plan Development Team consisting of Mr. M. P. Jones, Asst. Vice-President, Personnel Division, United States Steel Corporation, Mr. Blickenstaff, Director Programmes, Instep, Carnegie Institute of Technology Mr. N. Rath, the then Deputy General Manager, Rourkela Steel Project, Mr. K. A. Shenoy, the then Deputy Chief (Manpower & Training) and Mr. B. L, Fernandez, Asst. Superintendent of Training, TISCO. The present Management Institute is a result of the recommendations of the above team.

Though the experiences of the advanced countries of the world have been drawn upon in planning the training in this Institute and the most uptodate methods of training are adopted, the specific conditions and requirements of the country have not been lost sight of.

All the courses will be conducted mostly in the form of group discussions in which the participants will take an active part. The Training Officer might use case studies and other techniques in order to bring out the

Shri J. M. Shrinagesh, Chairman, addressing the gathering at the time of inauguration of the Institute

desired objectives, syndicate discussions, Role-plays, individual problem—solving assignments, will also form part of the Training techniques used. Attempts are being made to build up the necessary audio-visual material viz. Film strips, films, charts, etc. for the different programmes. A well-equipped Library on the various subjects of Management is also expected to be equipped in due course. The methods used in the training programme will lay stress on the principle of " LEARNING BY DOING ".

The Management Training Programme will consist of (a) Individual management Training and (b) Group Training for Management and the functions of the Institute will fall broadly under two categories (1) Prepare supervisory Training Courses for implementation at the Plants and (2) Prepare and conduct Company Management Training courses.

The Management Training Institute will also serve as a clearing house for Management Information on the latest techniques and results of research conducted elsewhere. It is expected that such information will be

(Continued on page D.6)

AVB PLANT — A SPLENDID EXAMPLE OF INDO-BRITISH PARTNERSHIP

SIR PAUL GORE-BOOTH'S SPEECH AT DURGAPUR

THE following is the full text of the address delivered by the British High Commissioner in India, Sir Paul Gore-Booth, at the opening of the AVB (ACC-Vickers-Babcock Ltd.) heavy-engineering plant at Durgapur, West Bengal, on 6—2—62.

" It has given me the sincerest pleasure to be present on this great occasion. I understand from the programme that it is my privilege today to speak for Britain as a whole—not just for the Government, but for Government and industry alike. So that at this notable gathering it can be said with literal truth that the public and private sector speak with one voice.

" Like others here, I have driven several times past the AVB gateway and felt a little like a child who has arrived too early for the party. Of course, one could have peeped in and had a look at the preparations and decorations, but it was probably better to go past and come back again on the right day—today. I can assure everyone that the party will be no disappointment.

" The project which we see around us is the largest in the Indian private sector in which British companies are participating. Speaking with my public and private voice, I might mention that it also happens to be a neighbour of the largest enterprise in the public sector with which the British are also associated—the Durgapur steel plant. I like to think of this coincidence as a happy and substantial exchange of compliments between the people of Britain and the people of West Bengal, whose sensational economic and industrial progress will always be linked with the name of their perennially youthful Chief Minister, Dr. B. C. Roy.

ROLE OF PRIVATE INVESTMENT

" The British companies co-operating with the Indian Associated Cement Companies in this project, Vickers and Babcock & Wilcox, are household names throughout the world. The project is evidence, on the one hand, of the welcome which the Government of India gives to private investment, and to the contribution which such investment can make to the economic development of India. It is also heartening evidence of the readiness of British private companies to invest in India and to continue the contribution to her economic development which British companies have been making for so many years.

" Government loans and assistance are all important, and rightly attract great publicity. It becomes easy to overlook what private investment can do as well. Many British companies, large and small, are forming associations with Indian companies, either through licensing agreements or by contributing part of the equity.

" I think I am right in saying that during the last year or so about one-third of all such collaboration agreements between Indian and foreign companies have been with British companies, and the rate at which British companies are entering into this kind of association is well over 100 a year. This is a very high rate when you consider how many such arrangements exist already. British investment in India has doubled in the last 10 years and now stands at more

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(Continued from page D.4)

made available to the Management levels of Hindustan Steel in the form of available bulletins.

The Management Training Institute set up by Hindustan Steel Limited seeks to fulfill the great need felt today in developing Managers on whom the success of various development plans depend. In fulfilling this, the Institute seeks the co-operation of agencies throughout the world who are interested in Management Development.

The course began on 18—2—62 with 20 trainees drawn from different levels of executives and supervisory personnel in the three Steel Plants.

than Rs. 400 crores, or about three-fourths of the total foreign investment in India.

MANY ADVANTAGES

" Foreign investment brings many advantages. It helps India financially because, in projects such as this one, investment means in concrete terms the supply of needed equipment without any immediate outlay of scarce foreign exchange. It provides employment. This project has provided work for those who planned and built it. In future, it will provide jobs for the people who work in it and for those who provide services for it.

" Foreign investment also brings with it technical knowledge and expertise. It gives India overnight, so to speak, the advantage of technical developments which may have taken years or even generations in the West to develop and perfect. By providing training for Indian staff, it adds to the technical resources of the country and helps to broaden the base on which future development can be built.

" There has been recently in Delhi a highly successful international industrial exhibition. The British pavilion had as its slogan the one word 'partnership'. We sought to show not what we do by ourselves, but what India and Britain do in partnership. A splendid example of such partnership is displayed before us today. It proves once again that this partnership is real and live, and looks to a vigorous and prosperous future.

" And so I should like to congratulate Lord Knollys, the Chairman of Vickers, and Sir Kenneth Hague, the Chairman of Babcock & Wilcox, who are happily with us today, for the vision and enterprise shown by their two companies in entering into this great undertaking. Equally, I should like, if I may, to congratulate Mr. Dharamsey Khatau, who adds to his foresight in launching this project the burden of serving as its Chairman. We all know enough of Mr. Khatau's experience, acumen and distinction in business to be assured that the undertaking has the leadership it needs.

" Chief Minister, we all join in wishing this enterprise, this partnership, god-speed. In doing so, we unite in a larger, more universal wish—the prosperity and happiness of the people of India."

AVB Plant Inauguration — Durgapur — Mr. Dharamsey M. Khatau's Speech

A NEW CHAPTER IN INDUSTRIALISATION

THE inauguration of the AVB workshops by Dr. B. C. Roy at Durgapur on February 6, 1962 marks the opening of a new chapter in the industry of the country.

Construction of this modern major industrial plant and housing colony on a 700-acre site in West Bengal has been completed in only two years...a truly remarkable achievement and in itself an outstanding example of industry and planning. AVB, equipped with some of the world's most up-to-date machine tools, will be one of the largest engineering units in Asia.

An outstanding example of international collaboration, AVB brings to India the varied and extensive knowledge of three leaders in industry.

The Associated Cement Companies Limited—pioneers in India of the manufacture of cement and cement-making machinery.

Vickers Limited—internationally famous builders of ships, aircraft and heavy industrial and mining equipment.

Babcock & Wilcox, Limited—world-renowned designers and manufacturers of steam-raising plant for industry and thermal power stations.

These famous enterprises have joined together in establishing in the industrial heart of the country a large and modern heavy engineering works to tailor-make cement-making machinery, steam-raising plant, pressure boiler plant and heavy equipment for mining and other industries.

Of tremendous importance to the country, the inauguration of AVB reflects the confidence of the industrial nations of the West in the industrial future of India.

POWER AND POTENTIAL OF AVB

The real power and potential of AVB lies not only in the vast technical knowledge and experience at its disposal, but also in the up-to-date equipment and machine tools installed in the workshops.

The manufacture of AVB products will be carried out in four 700′ long bays, two 400′ long machine shops and one 200′ long forge shop, all designed on the most modern lines. Built into their structure are 13 electric overhead travelling cranes, the biggest of which have a lifting capacity of 70 tons each. The shops have been designed to allow for progressive expansion in the future, so that it will be possible to lift single pieces weighing about 200 tons in the heavy fabrication bay without necessitating any structural alterations. The works comprise a structural plating shop, a tube shop, two vessel shops, an X-ray bay, a test room, a stores building and the works offices.

MODERN MACHINE TOOLS

Among the modern machine tools is a 3000-ton vertical hydraulic plate-bending machine, capable of bending 5-inch thick steel plates employed in the manufacture of high pressure boiler drums, atomic heat exchangers, and pressure vessels required for the Fertiliser.

Chemical and Oil Refining Industries. This equipment will make it possible to manufacture steam-raising equipment in the high pressure range for the first time in India.

The many boring, milling and turning machines include a 22 ft. vertical borer, which is one of the largest of its kind in India. Among the pressing equipment are a 1000-ton heavy duty dishing and flanging press and an 800-ton plate edge curving press.

CEMENT-MAKING MACHINERY

Through the manufacture of cement-making machinery equal to the world's best, AVB will help increase the production of cement for which the Government of India have set a target of 15 million tons per year by the end of Third Five Year Plan. Orders have already been received for cement-making machinery which will be manufactured by AVB according to the designs developed by ACC and

Vickers, whereas specialised items will be manufactured according to the design of the Fuller Company of America.

INDUSTRIAL STEAM-RAISING PLANT

The scope of AVB's contribution through the manufacture of steam-raising plant for Thermal power stations and industry is likely to be very substantial; for it must be remembered that power is the basic need of an industrial nation.

To ensure that industrial steam-raising plants give optimum performance, it is necessary to 'tailor-make' them to suit varying local conditions and the type of fuel to be employed and, in certain cases, to make supplementary use of waste product as fuel. This calls for vast experience, careful analysis and the employment of special designs to obtain the maximum economy and performance, as well as excellent manufacturing facilities.

AVB offers all these to world standards. The industrialist can rely on AVB to supply a fully integrated installation comprising the steam-raising plant itself and a wide range of equipment from the fuel handling and preparation plant to the dust handling and ash disposal plant. He can also be confident of obtaining the finest after-sales service.

THERMAL POWER PLANT

Under the Third Five Year Plan, the installed power generation capacity in the country is proposed to be stepped up from 5.7 million KW to 13.4 million KW. A substantial portion of this additional power is proposed to be obtained by installing thermal plant for which Government have set a target of Rs. 35 crores of equipment per year by 1966.

In this field also AVB can draw on the vast technical knowledge of the U. K. partners and the manufacturing resources available in its own shops to supply the finest equipment.

Indeed, the importance of AVB to the country is tremendous and far-reaching. By providing in India the world's finest facilities for the manufacture of machinery for cement-making, mining and industrial steam-raising, AVB will make possible the expansion of several Indian industries through the years to come.

The following is the text of speech made by the Chairman, Mr. DHARAMSEY M. KHATAU:

"As the name ACC-Vickers-Babcock indicates, we are a 50 : 50 joint Indian/British enterprise. This Company was formed in January 1959 with the idea of establishing a heavy engineering Works to manufacture heavy machinery such as cement-making machinery, steam-raising plant, heat-exchangers, pressure-vessels. At the time of the formation of the Company the whole of the site on which we are now standing was jungle and it was the end of 1959 before we took possession of the major portion of our 700 acres of land although we actually started work on the building of our first 18 two-room quarters in June of that year.

This is one of the largest new heavy engineering Projects approved by the Central Government for the Second Five-Year Plan and in terms of modern power station boilers, the yearly manufacturing capacity is estimated at 500,000 kW per annum and the combined cement machinery manufacturing capacity of A.V.B. with the assistance of ACC will be approximately four to five plants per year on the basis of such plants having a capacity of 600 tons per day. This new project will therefore assist materially in supplying the heavy engineering plant and steam-raising plant which is so essential to India's industrial expansion. Moreover, this will also be achieved while conserving the country's most important commodity—foreign exchange, although in the initial phase we shall still require a considerable element of foreign exchange until such time as the complementary industries which will supply our needs have been developed in India.

These works, which have been designed on the experience of the three partners, have been laid out so that there is ample room for progressive expansion and although these Works are only being opened today we are already giving thought to this question of expansion. Some of the non-technical people amongst you may not be particularly impressed with the "sheds" you see around you but let me advise you that when you are in the vicinity of my engineers you should be most careful to term these sheds "Shops" as otherwise it might leave these engineers with the impression that you do not appreciate that these "Shops" have been specially designed so that they can handle heavy engineering products of a large variety.

Apart from the Works itself, we decided that we would station our main Administrative offices at Durgapur and you will see the modern Administrative block of offices which will house the engineering and accounts side of the business as well as act as the main Administrative centre for A.V.B.

Just across the way from these Works is our housing colony where we are building our own dispensary, club, shops, sports ground and children's playground. One special feature is the effort that has been made to retain as many trees as possible thus providing shade during the hot months and at the same time retaining the natural beauty of the area. In this garden city, where in the first phase of development we have built 800 quarters, will live the workers of A.V.B.—from the man on the shop floor to the skilled technician and design engineer.

We have ensured that all the plant and equipment in these Works is of the latest and most modern type in the world today but we have well in mind that men are more important than machines and because of this we have given first priority to the question of training of staff and operatives. This I think is emphasised to some extent by the fact that the largest building on our Colony is the " Apprentices Hostel " which is a modern block designed to accommodate 80 apprentices.

Somo time ago A.V.B. selected a certain number of apprentices from its partner Companies and these people are now working at Durgapur but it is our intention in the future to recruit local labour for training to the maximum possible extent.

Of course, in a modern Works such as this the percentage of operators to design type engineers is lower than is found in most other industries in this country and on a long term basis a high proportion of our total employees will be well qualified and specially trained design engineers. In this connection a few specially selected Graduate Engineers were sent to the U. K. for special training in the Works of Vickers and Babcock soon after the formation of the Company. This process of training will be continued and A.V.B. will rely substantially on the assistance it obtains from its three partners during the first few years of its existence. I am sure that I express the feelings of Lord Knollys, Chairman of Vickers and Sir Kenneth Hague, Chairman of Babcock & Wilcox Limited when I say that no effort will be spread to ensure the success of this new undertaking.

As a new Company we are particularly fortunate insofar as the Partner Companies were all running well organised training schemes for Graduate Engineers before A.V.B. was formed and because of this the A.V.B. Works start with a number of Graduate Engineers who have had several years training in the various aspects of the products A.V.B. will manufacture. We are firmly convinced that this question of training is one of the most important in India today, more especially for projects such as this.

In deciding on locating this Industry at Durgapur, one of the most important considerations was that of transport. We would therefore like to emphasise the importance of the new " Express Highway " between Durgapur and the Port of Calcutta being completed as soon as possible. It was on the assumption that this road would be available that we located our Industry at Durgapur and for our products such as cement-making machinery, steam-raising plant, heat-exchangers, pressure-vessels this question of transportation of large pieces of machinery is of vital importance.

Now that Durgapur is developing into what I am sure will be one of the main industrial centres of India it is essential that apart from this question of road transport more attention should also be given to improve the postal, telegraph and telephone facilities here.

We are sure, Sir, that with your help and that of Central Government this project will be a success and we hope that before long we shall be planning for the expansion of these Works.

BRITISH STEEL EXPORT RECORD IN 1961

The British Iron & Steel Federation reports that in 1961 Britain's steel industry achieved a post-war record in direct exports — about 21½ per cent. of output. A marked fall in imports contributed to a rise in net exports from 2,500,000 ingot tons to an estimated 3,700,000 ingot tons.

DURGAPUR NEWS

INDIAN ENGINEER TRAINS IN BRITAIN FOR DURGAPUR POST

A 28-year-old graduate of Calcutta and Jadavpur universities, Mr. Jagannath Saha, sails for home from Britain to take up the post of junior refractory engineer at the Durgapur steelworks. Before joining Hindustan Steel Ltd., he was a shift engineer with Sourashtra Chemicals at Porbandar, Gujarat.

As a Durgapur trainee, Mr. Saha has been in Britain under the Colombo Plan since last May. He has been visiting steel plants in different parts of the country and, for the past four months, has been studying maintenance and construction of steel melting furnaces with Dorman, Long (Steel) Ltd. near Middlesbrough, in north-east England.

In an interview, Mr. Saha said : "I have visited some of the most modern steel plants and been able to study operations, such as the maintenance of furnaces, which I shall be performing in India."

Mr. Saha spent the first four months of his visit studying furnaces at a steelworks in the Midlands. He was with another company, in Derbyshire, to see something of the manufacture of furnace linings. Before moving north to Dorman, Longs, he took a course in management arranged by the British Iron & Steel Federation.

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REVIEW

DURGAPUR STEEL TIDINGS *(Issued Fortnightly)*

We have received the Inaugural copy of "Durgapur Steel Tidings" fortnightly bulletin published by the Public Relations Officer, Durgapur Steel Plant, a few months back. The aim of this newsletter, it is stated, is to disseminate information on the progress and achievements in the plant, in the township and in the sister plants and projects.

The inaugural issue contains messages from top ranking personalities such as General Manager, Durgapur Steel Plant ; Resident Director, ISCON ; Chairman, Hindustan Steel Ltd. and the Hon'ble Minister for Mines & Fuel besides several interesting news items. We wish the enterprise all success.

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DURGAPUR TRAINING OFFICER STUDIES BRITISH METHODS

Methods used by Britain's iron and steel industry to select and train recruits are being studied by Mr. Sudhindra Kumar Das, a training officer at the Durgapur steelworks.

Mr. Das, who is spending a year visiting major plants in Britain, has just ended a six-week stay at the Scunthorpe (Lincolnshire) works of Richard Thomas & Baldwins Ltd., which employs more than 4,000 people. He has now moved to another of the company's works at Ebbw Vale, in Wales.

At Scunthorpe, Mr. Das studied the company's overall approach to recruiting and training. Speaking of the methods of selecting recruits, he said : "I have been particularly interested in some of the aptitude tests, and hope we shall be able to introduce similar selection techniques at Durgapur."

Fifteen skilled trades are taught at the Scunthorpe works, and much of the training is operated in conjunction with the area technical college. Craft apprentices, whose training lasts five years, divide their time between the company's own well-equipped apprentice school, the shop floor, and the technical college. Technical apprentices, who can begin a five-year course at 16 or a three-year course at 18 if they have suitable qualifications, are prepared for careers in the fields of chemistry, metallurgy, fuel or chemical engineering.

The Scunthorpe works aims to provide highly skilled workers in cokemaking, ironmaking, and steelmaking.

Mr. Das also studied the schemes for training students and graduates for executive positions.

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THE ISCON PAVILION UNITED KINGDOM AREA—INDIAN INDUSTRIES FAIR, 1961 NEW DELHI

The face of a small obscure village Durgapur in the heart of West Bengal has been transformed into a vast industrial potential with the help of the best British Engineering and Technical skill in constructing the One Million ton capacity Steelworks.

This Exhibition states this story.

The Metallurgical Equipment Export Company, which was responsible for the formation of ISCON and in initiating the Durgapur contract, is included in the ISCON Exhibition showing its work in the same field in other parts of the world.

The Durgapur story is told by means of a scale model, blown-up photographs, animation, sound, colour and lights of how the Steelworks were constructed and the stages of progress. The display is on platforms of varying heights from which there is a view of the focal point of the pavilion—a scale model of the whole Steelworks.

The Pavilion has a 80 ft. frontage with a 35 ft. high pylon. The interior has an open plan and provision for the continuous showing of a film of the construction of the Steelworks.

Finally there is the relation of Durgapur, in its changed role—from rural to industrial—to the economy and life of the people of India and its contribution to the Indo-British partnership.

The Pavilion has been designed by Mrs. Eileen Sen and architecturally it claims to show the economy, strength and grace of steel. Photographs are by Ahmed Ali.

THE CONSORTIUM

Plant Manufacturers :

Davy and United Engineering Company Limited

Simon-Carves Ltd.

Head Wrightson & Co. Ltd.

Wellman Smith Owen Engineering Corporation Ltd.

Civil Work :

Cementation Co. Ltd.

Electrical Work :

Associated Electrical Industries (Rugby) Ltd.

Associated Electrical Industries (Manchester) Ltd.

The English Electric Co. Ltd.

The General Electric Co. Ltd.

Structural Work :

Sir William Arrol & Co. Ltd.

Cleveland Bridge & Engineering Co. Ltd.

Dorman Long (Bridge & Engineering) Ltd.

Joseph Parks & Son Ltd.

Each of these firms are specialists in their own field and have world-wide reputations.

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VARIED TRAINING IN BRITAIN FOR DURGAPUR ENGINEER

A chemical engineer from Calcutta who will soon be joining the Durgapur steelworks as a refractory engineer is now receiving varied training in steel plants in Britain. He is Mr. K. Ray, who arrived in Britain last May for training under the Colombo Plan.

After spending over three months at a steel plant in the Midlands, Mr. Ray moved on to another plant in Derbyshire to study the manufacture of linings for steel furnaces. He also attended a management course arranged by the British Iron & Steel Federation. In February he is with Dorman, Long (Steel) Ltd., near Middlesbrough.

Mr. Ray is due to return to India shortly and will then become a junior refractory engineer in the furnace maintenance department at Durgapur.

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DURGAPUR ALLOY STEEL PLANT HANDS BEING TRAINED AT BHILAI

Twenty graduate apprentices from the Alloy Steel Plant Durgapur are now undergoing training in the Bhilai Steel Works.

A total of 347 trainees were on the rolls of the Bhilai Technical Institute at the end of December, 1961. Of these 96 were graduate apprentices, 48 senior operative-trainees, six junior operative trainees, one skilled worker trainee and 196 artisan trainees.

The Bhilai Technical Institute, which is now running two shifts, started functioning from June, 1959 for training technical hands required by the Steel Works.

A course of "Training Within Industry" has been started at the Bhilai Technical Institute for supervisors from December 25, 1961. Shri H. C. Taneja, Workshop Supervisor, was deputed for T. W. I. course conducted by the National Productivity Council, Calcutta.

Shri D. K. Sood, Production Engineer, Bhilai has been sponsored for training in the United Kingdom under the National Productivity Council. Shri B. N. Trehan, Personnel Officer, was sent to the Indian School of Public Administration, New Delhi, for training in personnel management. Shri G. Radhakrishnan, Graduate Apprentice has been sponsored for a refresher course training in the University of Rourkee.

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INDIAN STEEL ENGINEER STUDIES FURNACE MAINTENANCE

Studying the methods used by British workmen for the speedy repair of steelworks furnaces is Mr. S. K. Bagchi, who is an assistant refractories engineer at the Durgapur steelworks.

Arriving in Britain early in March, Mr. Bagchi joined the Stewarts & Lloyds works at Bilston, Staffordshire. There he is working with the maintenance men making a close study of the latest type of equipment they use for the speedy repair of furnaces. "The fewer hours we spend on maintenance, the more steel we will produce," Mr. Bagchi said in an interview.

When he leaves Stewarts & Lloyds later this month, he is to visit other British steelworks. He expects to return to Durgapur some time in July.

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A SHOW WINDOW FOR STEEL

The HSL pavilion at the Indian Industries Fair in New Delhi, which was opened on November 14, had been a central place of attraction for a large number of visitors every day.

Durgapur Steel Plant was represented with a working model of rolling mills. There was also a static model of the rolling mills, showing the process of steel rolling from ingot to intermediate sections and sleeper bars. The process was further explained with several enlarged photographs and monograms. Samples of our finished products like sleeper bars and also raw materials were kept on display.

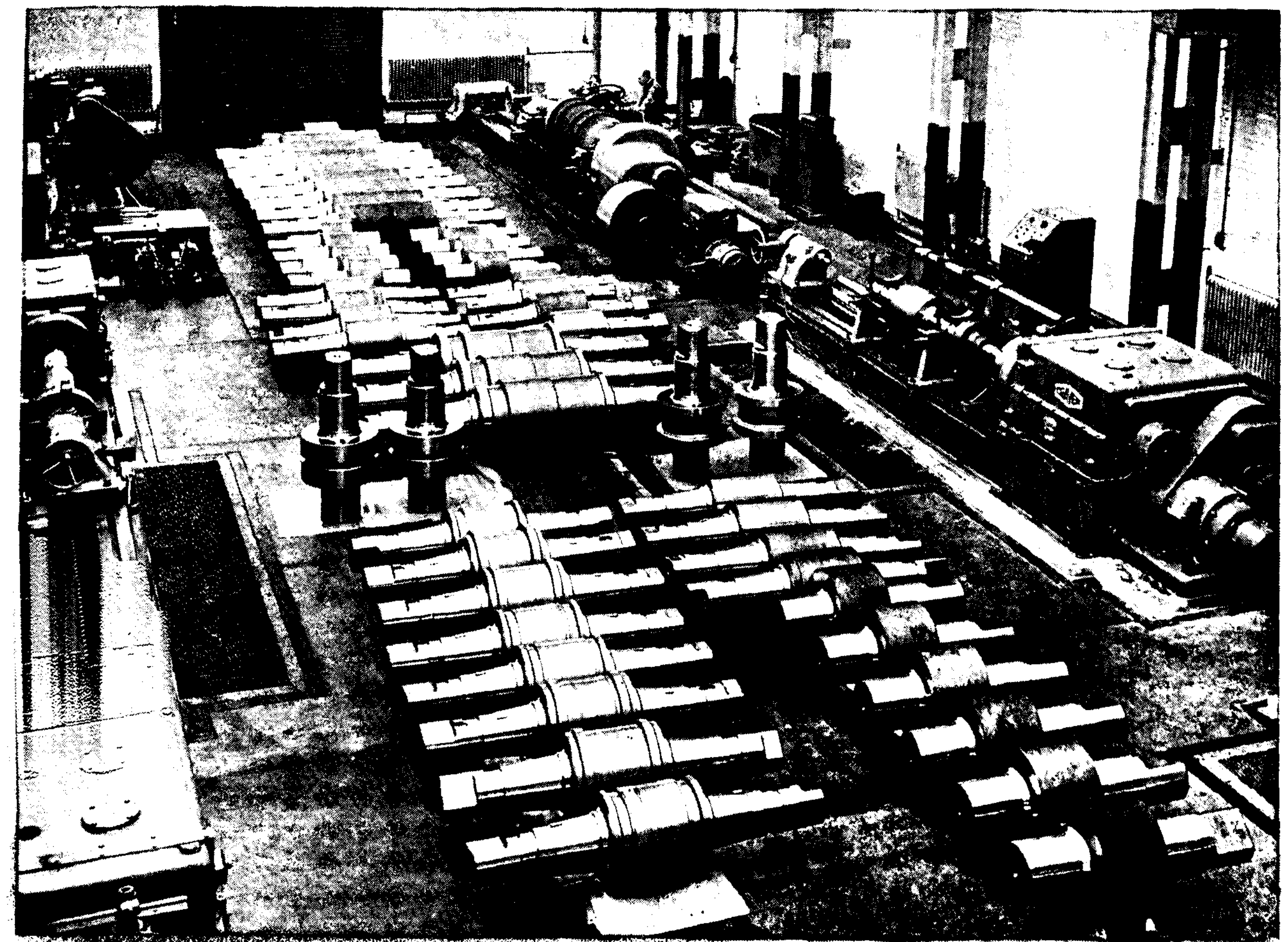
The social and cultural life in the three steel towns, including Durgapur, was illustrated through a number of photographic panels.

Six members of the Durgapur Steel Plant operation staff, including three engineers, explanined the rolling process to the long and continuous stream of visitors every day. The Steel Plant also arranged to send a selected number of its engineers, operatives and officers to visit the Fair and to gather some knowledge of the country's industrial progress.

* * *

BRITISH MACHINE TOOLS IN GREATER DEMAND OVERSEAS

Oversea demand for British machine tools in January was 16 per cent. upon the figure of a year



The above is one of the many consignments of rolls forming part of the complete initial fillings and spares we have manufactured in Our Specially Toughened Alloy Spheroidal Graphite and Mooralloy Qualities for the Morgan Billet, Sleeper Bar and Slab Mill at DURGAPUR WEST BENGAL.

Considerable economies in materials, production time and maintenance costs can be effected by using OUR SPECIALLY TOUGHENED SG ROLLS or in conjunction with our well known SUPER METAL MOORALLOY ROLLS for Continuous Billet Mills. Idle time resulting from the need for redressing is reduced to a minimum thereby giving increased tonnage. It is necessary to select the correct quality from the very wide range now available to suit the conditions and requirements in modern mill practice.

On the opposite page we show the principal grades of OUR SPECIALLY TOUGHENED SG ROLLS and OUR SUPER METAL MOORALLOY ROLLS but each of these quality ranges are again subdivided to suit requirements.

PLEASE CONSULT US SO THAT WE CAN ADVISE YOU

THE ROLL MAKERS

Part consignment of Finish grooving tools and precision master gauges manufactured and supplied by us for the Morgan Billet, Sleeper Bar and Slab Mill at DURGAPUR WEST BENGAL.

S. G. RANGES

SPECIALLY TOUGHENED ALLOY SPHEROIDAL GRAPHITE PEARLITIC RANGE

Very tough
Tough and Medium hard
Tough and hard
Tough and very hard

SPECIALLY TOUGHENED ALLOY SPHEROIDAL GRAPHITE ACICULAR RANGE

Very tough
Tough and Medium hard
Tough and hard
Tough and very hard

SUPER METAL MOORALLOY RANGES

The Range of Tough Metal

The Range of Tough Medium Hard Metal

The and Ranges of Hard Superfine Close Texture Metal
hard texture
Acicular Flake

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TELEGRAPHIC ADDRESS: CHILROLS SHEFFIELD 9 earlier. The value of orders received during the month was estimated to total £ 2,908,000.

Figures issued in London show that deliveries were 28 per cent. higher than a year earlier.

The value of outstanding orders from overseas is put at £ 32,357,000, representing a 31 per cent. improvement on a year earlier and taking the total value of the order-book to £ 116,612,000—7 per cent. up on a year earlier.

The Machine Tool Trades Association said that the industry had maintained a high level of initiative in oversea markets and looked to the future with confidence.

One of the major factors contributing to the oversea successes of the British machine tool industry is that producers are able to quote earlier delivery dates. Prices, too, are lower than those quoted by some competitors.

* * *

A. E. I.'S CONTRIBUTION TO INDIAN INDUSTRIAL PROGRESS

Main theme of the display arranged by Associated Electrical Industries (AEI) at the Indian Industries Fair in New Delhi is the firm's contribution both to India's industrial progress and to power developments throughtout the world. AEI has its own stand in the British pavilion, and is also represented in the exhibits arranged by the Society of British Aircraft Constructors.

Working models, photographs, films, and other devices will be used to show some of the 3,500 types of equipment which AEI makes for markets on the five continents.

Dominating the central section, which deals with the part the company is playing in Indian development, is a large map giving the locoation of eight main projects with which the firm has been concerned. One of these is the giant heavy-electrical plant being built in Bhopal by the Indian Government with AEI as consultants. Stress is laid here on the special training scheme the company is establishing for this project, which enables over 3,000 men to be trained at a time.

Other important schemes are the Durgapur steelworks, where the firm, as a member of the British consortium known as the Indian Steelworks Construction Co. (ISCON), has supplied half the electrical equipment; the great Bhakra dam, where AEI supplied five 90-megawatt generator sets; and electric railway and traction developments, including those in Bombay and Calcutta.

PRODUCTS MADE HERE

Among products made in India by Associated Electrical Industries (India) Private Ltd. are motors ranging from 1 hp to 500 hp, transformers, tap-changing switches, switch fuseboards, and a wide range of light electrical equipment. Examples to be shown at the Fair include a working model of a 56-inch ceiling fan, a 30 amp triple-pole switchfuse, and a drip-proof six-pole motor.

Surrounding the Indian section of the AEI stand is a perimeter display giving a comprehensive guide to the firm's activities throughout the world. An illuminated map pinpoints the company's 70 factories and four research laboratories in Britain. A rotating drum with the flags of the nations to which equipment has been supplied gives details of work in five continents.

The firm's work in Asia includes generating equipment and electric trains for India, a gas-turbine power station for Iran, synchronous condensers for Ceylon, and generator sets for Burma, Singapore, and Hong Kong.

To demonstrate the firm's activities in electronics, visitors to the stand will see a 21-inch Ekco television set operating; a computer plug-in board; and a comparison between the size of a metal rectifier, a valve rectifier, and a silicon rectifier, all of similar output. They will be able to test a burglar alarm with transistor circuits operating with photoelectric relays.

BHILAI STEEL PLANT SECTION

Bhilai Steel Works—Expansion programme

THE capacity of the Bhilai Steel Works is to be expanded now from one million tons of ingot steel to two and a half million tons of ingot steel per annum with Soviet technical and financial assistance as during the first phase. A contract for the supply of Soviet equipment and materials worth Rs. 54.2 crores for the expansion was signed in New Delhi on the 9th February, 1962, by Shri J. M. Shrinagesh, Chairman of the Hindustan Steel Limited, and Mr. A. E. Nikitin, on behalf of Tiazhpromexport, suppliers from the USSR.

In addition to the supply of equipment and materials for the expansion of the Bhilai Steel Plant, the contract also covers the expansion of Project's iron-ore mine at Rajhara and the limestone quarry at Nandini. These were originally developed for supply of raw materials to the Bhilai Steel Plant and are being expanded now to meet additional requirement of raw materials.

Under the expansion programme, the Bhilai Steel Works will have three more Coke Oven Batteries of 65 ovens each in addition to the existing three batteries (total six), two more Blast Furnaces of 1718 cubic metres each in addition to the three existing 1,033 cubic metre furnaces (total five); and five more Open Hearth Furnaces of 500-ton capacity each and convertion of an existing 250-ton furnace to 500 tons. Bhilai will have in all, ten Open Hearth Furnaces to produce 2.5 million tons of ingot steel per annum, which will be rolled into 1,650,000 tons of finished products and 315,000 tons of billets for sale to rerollers. In the Rolling Mills, the existing mills will be enlarged and renovated. One new Wire-Rod Mill will come up to produce 400,000 tons of wire rods per annum.

The pattern of products to be produced at Bhilai annually after expansion will be as under :—

(i)	Heavy rails	500,000 tons
(ii)	Light rails	20,000 tons
(iii)	Railway sleeper bars	82,500 tons
(iv)	Structurals	386,500 tons
(v)	Merchant Mill products	261,000 tons
(vi)	Wire-rod Mill products	400,000 tons
(vii)	Billets for sale	315,000 tons
	Total :	1,965,000 tons

Under the latest contract, the Soviet Union will depute specialists for rendering technical assistance in the designing construction, erection and commissioning of the new Units to be put up. They will also provide facilities for training of Indian engineers in the metallurgical works in the USSR.

The contract is in pursuance of two agreements signed in 1959 and 1960 between the Indian and Soviet Governments, under which the USSR extended about Rs. 180 crore credit to India for financing certain specific projects under the Third Five-Year Plan. Expansion of Bhilai Steel Works was one of the items for this assistance.

Bhilai is the first public sector steel project to go ahead with its expansion programme. It has already reached its rated capacity of one million tons of steel ingot production.

RATED CAPACITY REACHED

The Bhilai Steel Plant reached its rated capacity of steel production during January 1962.

The steel production during January, 1962, was 85,300 tons, which was the highest monthly production figure so far and above the average rated capacity of the plant of one million tons of steel ingots per year.

The production has also been up in other departments of Bhilai Works since the first month of the New Year.

Production & Despatches During January 1962 :

	Production	*Despatches*
Pig iron	92,029 tons	31,978 tons
Ingot steel	85,300 „	Nil
Ingot rolled	75,400 „	Nil
Blooms	65,075 „	Nil
Billets	31,599 „	19,804 tons
Rails	15,010 „	16,081 „
Structurals	8,878 „	9,420 „
Merchant products	15,347 „	11,960 „
Coke	97,526 „	3,017 „

Sintering Plant of Bhilai Steel Works

By M. Chandrasekhar
Assistant Superintendent, Sintering Plant, Bhilai Steel Works

Sintering is one of the most important methods of ore treatment in steel industry. Usually the iron ore charged in blast furnaces have to be of the size bigger than 12 millimeters. Ores of smaller size — called fines — are sieved out. Similarly coke charged in the blast furnaces, must be bigger than 25 mm. size. Smaller sized coke — known as breeze coke — is screened out.

Now, had it not been for sintering plant, iron ores and coke of smaller size than are required for blast furnace, would have gone waste. In the sintering plant the ore fines coke breeze, together with limestone and dolomite, are crushed, mixed and then by heating at high temperature, fused into lumps of the required size.

Thus, by the process of sintering the maximum utilisation of natural resources is ensured, leading to greater economy in the production of pig iron and steel.

In the following article, the author describes in detail the Sintering Plant of the Bhilai Steel Works, and its important advantages.

SINTERING may be defined as " the agglomeration of fine mineral particles into a porous mass by incipient fusion by heat produced by combustion within the mass itself ". The material to be sintered together with sufficient combustible material to generate the heat necessary for sintering, is placed on a bed through which air can be sucked. The material is ignited and then the sintering of the mass proceeds automatically.

Since sintering can be regarded as an oxidizing or burning process, the volume of air passing through the charge to be sintered is an all important factor. The air must be passed through with sufficient rapidity to produce the necessary heat, as lack of sufficient heat—intensity will result in a poor sinter. The first essential, therefore, of successful sintering, is that air passes through the charge in sufficient volume and with rapidity to produce a sintering temperature in the mass. This condition depends on two factors :—

1. The porosity of the charge ; and
2. The suction applied to draw the air through the mass.

The porosity of the charge depends on several factors such as—moisture, sinter returns or return fines and coarse materials and the fineness of the raw materials.

The sintering plant of the Bhilai Steel Works, comprises the following shops mutually connected by conveyer galleries into a single process flow :

Raw material storing yard ;
Bin plant ;
Raw material and fluxes screening plant ;
Fuel and flux preparation plant ;
Charge bins and sinter screening plant ;
Sintering shop ;
Sinter loading bins.
To produce fluxed sinter, the following raw materials are used :
Iron ore fines or low moisture concentrates ;
Flue dust humidified and cooled ;
Rolling Mills scale ;
Limestone and dolomite of required sizes and of low moisture ;
Coke breeze.

In sinter the ratio of the base contents (calcium oxide and magnesium) to the acid content (silica and alumina) is usually kept close to unity.

The sintering plant at Bhilai supplied by USSR., provides for the production of high-quality fluxed sinter of the required ratio of the base content as well as lump size. It is obtained by through grinding of limestone and dolomite prior to sintering.

Crushing limestone and dolomite up to the lump size required is provided (alternately) by a reversible hammer mill while a four-roll crusher provides for obtaining coke breeze.

Necessary materials are conveyed to the crushers by means of pendulum feeders and conveyer belts.

Raw materials are usually delivered to the bins in dumper cars. Disc feeders provide for unloading the bins. Choking materials in the bins are obviated by reliable operation of automatic vibrators.

Classifying of ore fines is provided by vibrating bar screens, whose output is determined by the handling capacity of the sinter belt. Such screens provide for separation of foreign impurities from flue dust and mill scale.

After ore fines have been screened and the 18—12 mm. size fraction has been separated for the bed, they are delivered by conveyers to the return bins, while the bed fraction is conveyed to the Sintering Machine.

Limestone and dolomite prepared to the lump size required are conveyed from the fuel and flux plant to the charge bins. Crushed fuel is also delivered into respective cells of the charge bins by a system of conveyors.

Constant composition of mixture is one of the decisive conditions of successful process of sintering and obtaining high quality sinter. For that purpose special dosing weighing devices are incorporated in the process flow and they accurately maintain the required proportion of the charge components. The weighing dosing devices installed under each bin cell discharge the charge components to conveyers which deliver them to the sintering shop, the main one of the sintering plant.

Before it is placed on the sinter belt, the charge is thoroughly mixed by special mixers so as to provide for uniform composition and optimum moisture.

Ready sinter is delivered into the crusher to be crushed to lumps of the size desired (under 80 mm). After screens, the sinter passes on conveyor belts into the loading bins wherefrom it is directed to the blast furnace shop.

Control of equipment and automatic regulation of process have great importance for successful operation of sinter plant.

The instruments supplied by U.S.S.R. provide for control and recording of the sinter machine, exhausters, flue gas fans, automatic recording of consumption of the charge components, fuel, the quantity of returns and sinter produced. The latter is done by automatic conveyor scales and electric computers. The temperature in the hearth of sinter machine is controlled automatically as well as the temperature of returns and sinter.

SINTER MACHINE

The sinter machines of continuous operation can produce fluxed sinter by sintering iron ores with fluxing additions. In the process of sintering, partial removal of injurious impurities (sulphur and other) is provided.

SPECIFICATIONS OF SINTER MACHINE

Output of sinter machine	40—90 ton/hrs.
Effective sintering area	50 sq.m.
Length of working surface	25 m.
Width of working surface	02 m.
Number of pallets	70
Speed of pallets, m/min.	1.4—4.2
Overall dimensions of machine, mm.	37,000 × 6,840 × 10,420 40,650 × 7,375 × 9,627
Total weight of machine (with housing)	326 412

We have two such machines in Bhilai.

The advantages of producing and using sinter in the Blast Furnace charge are as follows :—

(a) During the mining of the iron ore 30 to 40% fines are obtained. This waste material containing a high percentage of iron content is converted into a useful product of high quality.

(b) Coke Breeze 0—25 mm. produced during the production of coke in the Coke Ovens is used as a fuel for the manufacture of sinter, otherwise this product is going as a waste.

(c) Flue-dust collected in the dust catchers of the Blast Furnace which otherwise will go waste is again utilised for the production of sinter to reclaim the iron content and also partly as a fuel.

(d) Mill-Scale which is a by-product in the Rolling Mills is utilised to increase the iron content of sinter which otherwise will go waste.

(e) Here in Bhilai, the waste from the Refractory material shop in the form of raw dolomite, burnt dolomite and burnt lime is used as a flux for the production of sinter. It is worth mentioning here that lime is a very good intensifier for the sintering process. The use of dolomite ensures the production of sinter of increase mechanical strength and better reducibility.

(f) Excess gases produced in the Blast Furnace and Coke Ovens are used in the Ignition Hood for igniting the material.

So it will be seen that sintering enables the fullest possible use of all waste materials.

Advantages of Sinter in the Blast Furnace are as below :—

1. Increase in the productivity of Pig Iron : Production increases with increase in the basicity of sinter and with the use of increasing amount of sinter in the blast furnace burden. As part of the fusion of the iron bearing materials takes place on the Sinter Strand itself, melting in the blast furnace is accelerated resulting in increased production.

2. Decrease in the Coke Rate : The coke consumption in blast furnace will be decreased considerably. Partial reduction of iron ore will take place during sintering process itself. Hence the coke rate will decrease in the Blast Furnace.

3. Improvement in the Thermal Balance of Blast Furnace : The use of fluxed sinter makes better the thermal balance of blast furnace. Addition of limestone to the sinter charge decreases the quantity of its addition to the Blast Furnace. As crushed limestone is added on the sinter strand, decomposition takes place easily. Hence the amount of limestone to be added in the Blast Furnace for fluxing will be decreased.

4. Smooth operation of Blast Furnace : The use of fluxed sinter ensures smooth operation of Blast Furnaces. For this sinter should be mechanically hard. The disadvantages of using ore burden only are the occurrence of hangings which will diminish with the use of sinter. A smooth descend of the charge is ensured. The gas permeability of sinter is much better than that of ore due to the sinter porosity. This would mean easy flow of the upward rising reducing gases and better gas-solid contact.

5. Control over the Quality of Pig Iron : As a result of smoother operation of Blast Furnace, closer control over the quality of pig iron can be exercised. Sulphur removal is very efficient on the sinter strand. As the quantity of coke addition will decrease in the Blast Furnace with the use of sinter closer control is possible over the sulphur content in pig iron.

BHILAI FULFILS RAILS PRODUCTION TARGET FOR CURRENT YEAR

The Bhilai Steel Plant has fulfilled its target production of Rails for the current financial year ahead of schedule. A target of 1,20,000 tons of rails for the current year ending the 21st March 1962, had been laid down. This target was completed on March 21st, that is ten days ahead. Production till that date was 1,20,420 tons, including 89,214 tons of first class rails and 31,206 tons of second class rails.

* * *

PIG IRON RECORD PRODUCTION

There was record production of pig iron in the Blast Furnace Plant of the Bhilai Steel Works on March 20, 1962, when 3,537 tons of pig iron were produced in one day, the highest for one day so far.

Another record was also made in the Blooming Mill on March 20, 1962, when 225 steel ingots were rolled in one shift.

* * *

Energy and Economy Department of the Bhilai Steel Project

By H. Sahai
Chief Fuel Engineer, Bhilai Steel Project

THE Energy and Economy Department in the Bhilai Steel Project started functioning in early 1960. The main function of such a department, in an industrial undertaking, is to ensure that energy and power, in their various forms such as steam, electric power or combustible gases are utilised to the best advantage. However in the wider and more comprehensive sense, it includes consideration not only of fuel efficiency but also of Works' productivity, quality of product, manufacturing cost, etc. The main sections, which come under the utilisation of gaseous and liquid fuels, are—

(1) Gas Cleaning Plants

(2) Gas distribution including mixing and boosting operation

(3) Liquid fuel section

(4) Gas safety organisation.

The main functions of the above sections are described, in brief.

GAS CLEANING PLANT

There are three plants located behind the Blast Furnaces No. 1, 2 & 3, which serve the purpose of cleaning and cooling the hot dust-laden gases from the blast furnace by a process of wet cleaning in gas washers, and ventury washers followed by fine cleaning in electrostatic precipitators. So, while the gas is cooled from its original temperature of 150 to 250°c to 30—40°c its dust content is reduced from 35—50 mg/M^3 to a value less than 10 mg/M^3. Thus the gases, after cleaning, become suitable for use as gaseous fuel in the stoves of the Blast Furnace, boilers of the power station, for under-firing of coke oven batteries, or heating of soaking pits or reheating furnaces in the Rolling Mills. The amount of blast furnace gas handled by these plants is as much as 300,000 to 400,000 M^3/hr. and its efficient utilisation as a gaseous fuel depends on the correct extent to which it is cleaned from dust.

GAS DISTRIBUTION

Cleaned blast furnace gas as well as coke oven gas which has also been cleaned elaborately in coke oven by-product plants after recovery of valuable by-products such as tar, ammonia as ammonium sulphate, and crude benzol, are conveyed to all the shops by a net work of highly branched gas mains.

Further, they are mixed in required proportions in Gas Mixing Stations for supplying to soaking pits or sintering machines, and pressure boosted up in the gas boosters for re-heating furnaces of Rolling Mills. As open hearth furnaces, coke ovens, soaking pits and reheating furnaces of Rolling Mills, small furnaces of Forge and Foundry as also the boilers of Power and Blowing Station, depend upon one or other, or both the gases, rational distribution of gases among the above gas consuming installations is essential so that there are minimum losses and maximum utilisation. Further, as there is no gas holder and gas may vary from time to time, depending on the working of blast furnaces and coke ovens, there has to be a continuous check on the production by a gas despatcher who is in constant contact with all the consumers and thereby controls the proper distribution of these gases in accordance with well defined rules.

LIQUID FUEL SECTION

This station has two tanks for storing liquid fuel, which at present is furnace oil (Bunker C oil). This oil is pumped by steam operated or electrical pumps to open hearth and boilers. Being a costly material, oil fuel is used only in emergencies by boilers or open hearth furnaces, when gaseous fuel is insufficient. It is proposed that when Tar Distillation Plant starts supplying pitch-anthracene oil mixture, it would replace the present furnace oil, which is being purchased from the petroleum refineries.

GAS SAFETY STATION

Since both the blast furnace and coke oven gases are poisonous and explosive, continuous check of atmospheric conditions inside the plant is essential to determine the absence of gas leakages from gas handling installations. Further, when maintenance work has to be carried on in gas handling equipments or gas mains, work in gaseous atmosphere becomes necessary. This necessitates the use of gas masks by the workers. The main functions of gas safety stations are firstly to keep watch over atmospheric conditions to detect leakage etc., secondly to train the workers in the use of gas masks, and thirdly to keep the gas masks always in good working order. There is another aspect of gas safety work, namely in case of occurrence of any case of gas poisoning to provide the rescue service. Hence gas safety station is an essential section in the steel works, where gaseous hazards are common.

A more important aspect of the energy and economy department is to have continuous check on the operating plants of all the shops as well as to pinpoint the causes which cause interruptions in production and to take steps to remove them. This involves firstly to collect all the operating data and keep records for every unit of plant. The above objects are achieved by the sections, which come under production and planning namely Production Control, Planning and orders, and statistics.

PRODUCTION CONTROL ROOM

This section has been functioning from early 1961, and is manned shiftwise by an Assistant Production Engineer and Production Assistant. A special commutator set has been installed with direct lines to all the plants and sections of plants as well as to all the heads of different shops, Chief and General Supperintendent, General Manager.

The functions of the Production Control are not only to collect the operating data every hour or two and enter them in the given charts and performs, but also to render help by coordinating the different shops to achieve streamlined production. In case of occurrence of breakdowns, it is the duty of the Production Control to give the necessary information to the persons concerned in the shortest time so as to ensure their quick removal. The staff at the production control room has to be always alert and should be able to give a correct picture of the working of all the plants at any moment to the General Superintendent or to the General Manager. Further, the production control has to keep check on the output of every plant so as to determine whether they are fulfilling the targets that have been set.

PLANNING SECTION

This section has a very important role in the preparation of monthly, weekly and daily production schedules for every plant keeping in view the orders as well as operating limitations of the different units of every shop. It has to take into consideration the scheduled stoppages of different plants and equipments for preventive as well as regular maintenance, in drawing up production schedules.

TECHNICAL CONTROL AND STATISTICS SECTION

The functions of the Technical Control & Statistics Section are to collect, analyse and interpret all technical data of different units in a rationalised form so as to provide a continuous check on operating efficiency and also to enable the progress made to be assessed.

The data for purposes of costing is also worked out every month and the cost statements analysed, which assist the works units in the employment of cost control methods.

From the data so collected, indices of productivity are worked out and calculated and reports are prepared analysing trends, commenting on variations noticed and pointing out the factors responsible for high/low performance.

This department is expected to introduce statistical quality control techniques wherever applicable and design experiments for the purpose of statistical study of special problems.

The various functions of Energy & Economy as enumerated and briefly described above, give an idea of the importance and the necessity of having such a department in an industrial undertaking like the Bhilai Steel Works.

ENGINEERING EDUCATION IN INDIA

By Phiroz H. Kutar *
Director, Hindustan Steel Limited

I feel, and honestly so, that the future of our country in the industrialisation rests in the hands of young engineers. It is a big challenge to our country because we are industrializing at a pace which has not been followed by some of the western countries of the world. We are going very fast and I think it is a challenge to us, Engineers, that we fulfil our part and help our country in every way possible to industrialise as quickly as possible.

The Engineering education which we give to our young Engineers must be such that we have real good Engineers and not just an average. In this connection, I think the most important thing is to have proper number of colleges for the engineering education; then they must have proper accommodation, they must have proper equipment in the laboratories to train properly the engineers and they must have qualified Lecturers and Professors. You will realise that the education most of us get and the benefit we derive from it depends largely on the Professors and the Lecturers. I think our country is doing whatever it can to increase the number of engineering colleges. But I feel that in trying to give Engineering education without proper equipment, without proper teachers, I think the Engineers that we produce will not be able to take the responsibility and, therefore, I put so much stress on the engineering education, in the Engineering colleges. I have to say that the real education that we get in these institutions depends upon the system of teaching. Unfortunately due to shortage of space you have the classes crowded and it is not possible for the Professors and the Lecturers to give the attention they should give to individual students. But as long as the Professor or the Lecturer teaches very well the fundamental principles of any engineering, may be Electrical, may be Mechanical, may be Metallurgical, may be Industrial Engineering, and if these fundamentals are grasped by the students, Ithink they can then further study or further make progress in Engineering.

I think we have been accustomed to put a lot of stress on the memory of the students. Our examinations are such that if a man with very good memory appears, he comes up crammed in the subject and answers the questions very well. But that is not what we want. Because if a student after cramming answers the questions you can rest assured that when he has to tackle engineering problems in his profession and in his life he will not be much good. I think our system of examination requires certain modification. You find that the students, instead of really studying the subject and grasping everything that is important at the examination, he goes through the question papers for the last 5 years and then he gambles that Oh! this question has come last year, this won't come this year, and therefore he reads up some of the things he thinks are likely to come. Now if he has not guessed right, you can see his dilemma at the examination hall. You find in the examination halls for the last minute the students are reading books, thinking this question may come, that question may come. No, this is not the real object of examination.

I think the method of study also by the students is not what it should be. Instead of studying the subject regularly they have a good time for practically the whole term or one term and they start burning the midnight lamp in trying to read up—in trying to cramp. That kind of study I don't think produces good first class engineers. You just cannot study what is stocked in a year in a month's time at the examination time.

Now the other thing which we require in our country is the aptitude test which is a very important thing because the student after Matriculation or after his Inter Science thinks that he likes to study, say, Mechanical Engineeering or somebody says there are more chances in the Electrical engineering so he should take Electrical engineering or somebody asks him to take the Civil engineering. This is the kind of selection of the subject, which is going to be the most important thing to his life. I think in some places I know these matters are adopted but not to the same extent as they are adopted in other foreign countries, is to give the boy an aptitude test. If the boy takes engineering for which he has got an aptitude, you can rest assured that the wastages will be less. You see just to pass an examination and get a degree in

Engineering is not everything. A degree will help you to get a job but it won't help you to hold the job; so you should know the job. Therefore, I think just getting a degree is not everything. It is not good for the individual, neither it is good for the country. So I think and strongly recommend that these aptitude tests be developed as much in our country as it is in the foreign countries because it will save crowding in the colleges; also it will save the educated unemployed as I call it because just getting a degree and not knowing much about the subject is not going to get him a job and therefore, he is really unemployed and that creates a lot of problems for the country.

Then I consider, as part of the engineering education, a great deal of importance in the works visits. Now unfortunately before we did not have very many places where the Engineering students could go and spend sometime to see for themselves what they read in the books and what they studied. But now, with the so many public sector steel plants, and more to follow, I think the electrical, civil as well as mechanical engineers will have a good chance to visit the Works. In foreign universities this is the most fundamental thing that they put the stress on. In fact they don't give the degree till you have visited so many works and made a report as to what you have seen. That gives you a chance to observe things for yourself and at the same time it bring to your mind, in actual scene, what you have studied. This works visit should be given very much importance and I think the students in the country can be sent out to different works to improve their knowledge and to see things for themselves.

Now I must say a few words about the teaching profession. It is very unfortunate that in our country the teachers, the lecturers and the Professors are not paid adequately though the whole future of the country depends upon these young men who are getting their training from these teachers or Professors. As a result, our brilliant men do not go into the teaching profession. It is either the second grade or the third grade men, who cannot get a job elsewhere, go into the teaching. It is rather unfortunate. But I think and I strongly recommend that we pay our Professors, our Lecturers, specially in Engineering subjects, very well so that the brilliant sons of India can go into the teaching profession instead of going and working in a steel plant or factory. There are certain numbers required for teaching and I think they should be placed at par with people who are actually producing things because they are playing a very important role in producing good Engineers. I think it is very important that the same thing applies to any kind of education.

Now the other tendency which is sometimes prevalent amongst Graduates is this: they think they know everything after passing the examination and they are not very willing to work with their own hands. They want supervisory jobs but at the same time, to supervise a number of people you must know how to do the job yourself. Therefore, the most important thing for an Engineer is to learn how to do a job. That cannot be done by standing and watching other people doing the job. That can be only done well by doing the job yourself and I think that the Engineers must not think too much about their degree and must not be afraid to do their works with their own hands. In the steel plant if you have an engineer to place at the open hearth, now by looking or watching other people making the banks at the bottom he cannot learn that. He has got to do the job himself. He has to learn how to make the bottom, how to make the bank, otherwise what would happen is that the workman will not get any real instruction from his Supervisor. Now it is a very common saying in the Army that "To become officers you have got to be soldier" and there is also another saying in the army that "There are no bad soldiers but there are bad officers". Therefore, I think that the operation of a steel plant depends mostly on the supervisors and the supervisors who are going to do the job are engineers to start with but then they must work with their own hands and learn the job. Once they do that and any workman who makes a mistake he can show him how to do the job. I think it is a very important thing from the point of view of the engineer as well as from the point of view of the country.

The other important thing is to encourage our young engineers. I see in some quarters they feel that a young engineer does not know anything and unless a man has got 20 years' or 30 years' experience, he is not much good. I think that age is no criterion for intelligence and experience. Most of you who are fathers, probably know that your children at a certain age ask you questions which you never thought of asking at that same age. This means that the present generation, and I think we are all happy to say that, is more intelligent than what we were at that age. If that is the case, I don't want anyone to put too much stress on the age and pay the man according to age, because one man can get experience in 2 years which will take five years to another man. It depends upon your powers of observation, it depends upon your

BHILAI NEWS

USE OF ATOMIC ENERGY IN BHILAI STEEL WORKS

Radio-active isotopes are now being used in the Bhilai Steel Works for controlling various production processes.

Atomic energy has found a wide application in the Soviet Union for peaceful purposes, particularly in the steel Industry. Therefore, the project Report for the Bhilai Steel Works envisaged the functioning of a specialised laboratory to deal with radio-active isotopes. The laboratory is equipped with uptodate equipment and instruments. The work with isotopes is carried out with the help of special machinery equipped with mechanical and pnuematic manipulators enabling the persons to control the process from a safe distance.

At the present moment, the isotopes are being used in the following departments of the Bhilai Steel Works:

1. To control the level of charging the bins in the Sintering Plant;
2. To control the level of liquid in closed tanks in the coke ovens and bye-product plants;
3. To control the wearing off of the roofs of the open hearth furnaces and mixture-lining.
4. To control the quality of welding in important steel structurals.

In the near future the isotopes are planned to be used for other purposes, such as, to control the speed of movement of the charge in the Blast Furnaces and in the cupolas of the Foundry, etc.

* * *

ORDER DEPARTMENT AT BHILAI

An Order Department has been set up in the Bhilai Steel Plant with immediate effect. The Order Department will liaise between the Sales Department of the Hindustan Steel Limited at Calcutta and the Steel Works at Bhilai. The Sales Department will send the sale orders to the Order Department after completing all the formalities. The Order Department will supervise and check the progress of the orders ultimately placed on the Mills and other units in the works in close liaison with Despatching Department.

The Order Department will also have a unit to advise the Sales Department on technical points raised by customers after holding consultations with the works. The duty of the Unit will also include giving rolling programmes and to advise the Commercial Wing as and when necessary of the necessity for procurement of special orders to enable optimum production in most efficient manner.

* * *

NEW RECORD IN BHILAI COKE OVENS

The coke ovens at Bhilai touched the highest ever production on the 23rd March, 1962 when 248 ovens were pushed in one day. The gross output of coke was 3283 tons and the production of metallurgical coke was 3016 tons.

* * *

BHILAI BLOOMING MILLS PRODUCTION RECORD

The Blooming Mill of the Bhilai Steel Works produced 3,664 tons of blooms on the 24th January 1962. This was the highest record production for one day so far achieved since the Blooming Mill went into operation in November 1959.

* * *

INGOT STEEL PRODUCTION CAPACITY REACHED

The Steel Melting Shop of the Bhilai Steel Works has now reached the monthly production rate of 84,680 tonnes of ingot steel. This is a little above the monthly average of one million tonnes, yearly production capacity of the Steel Plant.

* * *

ROURKELA STEEL PLANT SECTION

Facts about Rourkela — Some comparative notes

ANY straight comparison between the Rourkela steelworks and the other two plants in the public sector in India is well-nigh impossible. But still People love to compare. So the comparative facts about the three steel plants are given here in a nut shell, to help the reader to appreciate the achievements regarding the Rourkela project. There may be differences in opinion. But there cannot be any difference in facts. So what are the facts?

Final orders for the steel plants were placed as follows:

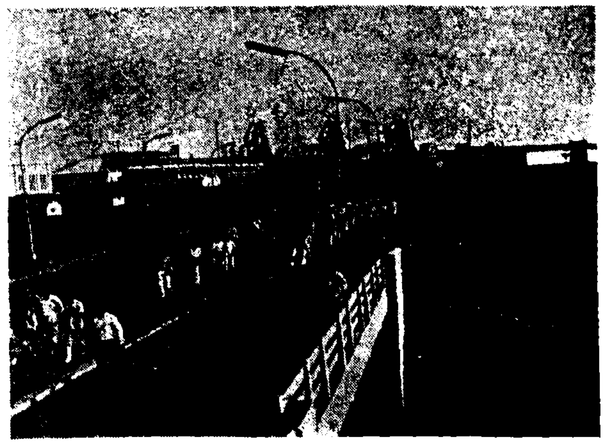
Bhilai — April 1956
Rourkela — April/Oct. 1956
Durgapur — October 1956

About 75% of the tenders for Rourkela were accepted during the last three months of 1956 and some tenders were accepted as late as March 1957. While the orders for Bhilai and Durgapur were placed all at once, the orders in respect of Rourkela were placed in stages. Orders for some major items like the steel melting shop, the power plant, etc. were placed at about the same time that the orders for Durgapur were placed. But the completion schedule for such items for Durgapur were some 9 to 12 months later than Rourkela.

The work involved in digging the foundations at Rourkela has been considerably more than that of any of the other two plants. Besides, because of the uneven and rocky site the work of levelling at this site, correspondingly, was more difficult. The concrete and foundation work of this plant is much bigger than that of the other two steel plants, comparative figures of Rourkela and Bhilai will show the difference:

	Rourkela	*Bhilai*
Concrete works and foundations:	850,000 cu. m.	650,000 cu. m. —or 24% less than in Rourkela

Concreting and foundation work at Durgapur is even smaller than that of Bhilai. In concreting work, output at Rourkela during peak periods reached upto the figure of 33,000 cu. m. whereas record output at Bhilai reached the mark of 16,000 cu. m. only. These higher levels of concrete and foundation work at Rourkela were achieved with a variety of smaller contracting firms whereas one single top Indian civil engineering firm took the responsibility for the construction of the foundation and auxiliary works at Bhilai. The progress in construction work at Rourkela would have been faster but for, to quote the Steel Minister, " the delay in site formation due to the rock strata being higher than originally envisaged; delay in civil engineering work due to difficulties in finding suitable contracts with adequate equipment and organisation; labour strikes at the Calcutta Port and erection sites; transport difficulties in the movement of machinery and equipment, and defective quality of the cement supplied and used for some time ". There were about three to four months of delay in completing foundation work of the Rolling Mills due to defective supply of cement.



Rourkela — Main Access

Except for the blooming and slabbing mill, the Rourkela steel project was ahead of the other two steel plants in the speed of construction. During peak time, erection figures upto 12,000 tons per month have been achieved at Rourkela, whereas the highest figure obtained by the other steel plants was 9,000 tons per month at Bhilai. Blooming and slabbing mills at Bhilai were commissioned only two months ahead of Rourkela. However, the slabbing mill at Rourkela would have been completed much earlier but for the delays in laying foundations due to the reasons quoted by the Steel Minister above.

In Rourkela, all units are completed. The plant was ceremoniously inaugurated by Prime Minister Nehru on March 28, 1961. Awards for the Rourkela sintering plant were made in August only.

* * *

Rourkela is designed to produce exclusively flat products, such as plates, sheets and strips (hot & cold) and tin plates, whereas the other two plants are meant for producing rails, structurals, sleeper bars, rounds, squares and billets for rerolling.

The production of high-priced flat products calls for the installation of more complicated, efficient and robust machinery; better co-ordination in laying a complex network of interconnecting services ; and a much greater tonnage of equipment and machinery compared to the steel mills which produce ordinary merchant steel, bars,rods, rails, structurals etc. A comparison of the rolling mills of Rourkela with those of Bhilai and Durgapur will show the magnitude of work involved at the former :

STRUCTURAL & EQUIPMENT

Rourkela	*Bhilai*	*Durgapur*
110,000 tons	80,000 tons (20% less than Rourkela)	49,000 tons (45% less than Rourkela)

COVERED AREA

200,000 Sq. meter	170,000 Sq. meter (15% less than Rourkela)	138,000 Sq. meter (30% less than Rourkela)

CONCRETE WORK FOR FOUNDATION

420,000 cu.m.	250,000 cu.m. (40% less than Rourkela	Exact figure of Durgapur is not available; but it is much less than that of Bhilai.

The power plant of Rourkela with a generating capacity of 75,000 KW is one of the biggest in India—it is much bigger than those of the other two steel-works :

Rourkela	*Bhilai*	*Durgapur*
75,000 kW (Three 25,000 kW turbo generators)	25,000 kW	15,000 kW

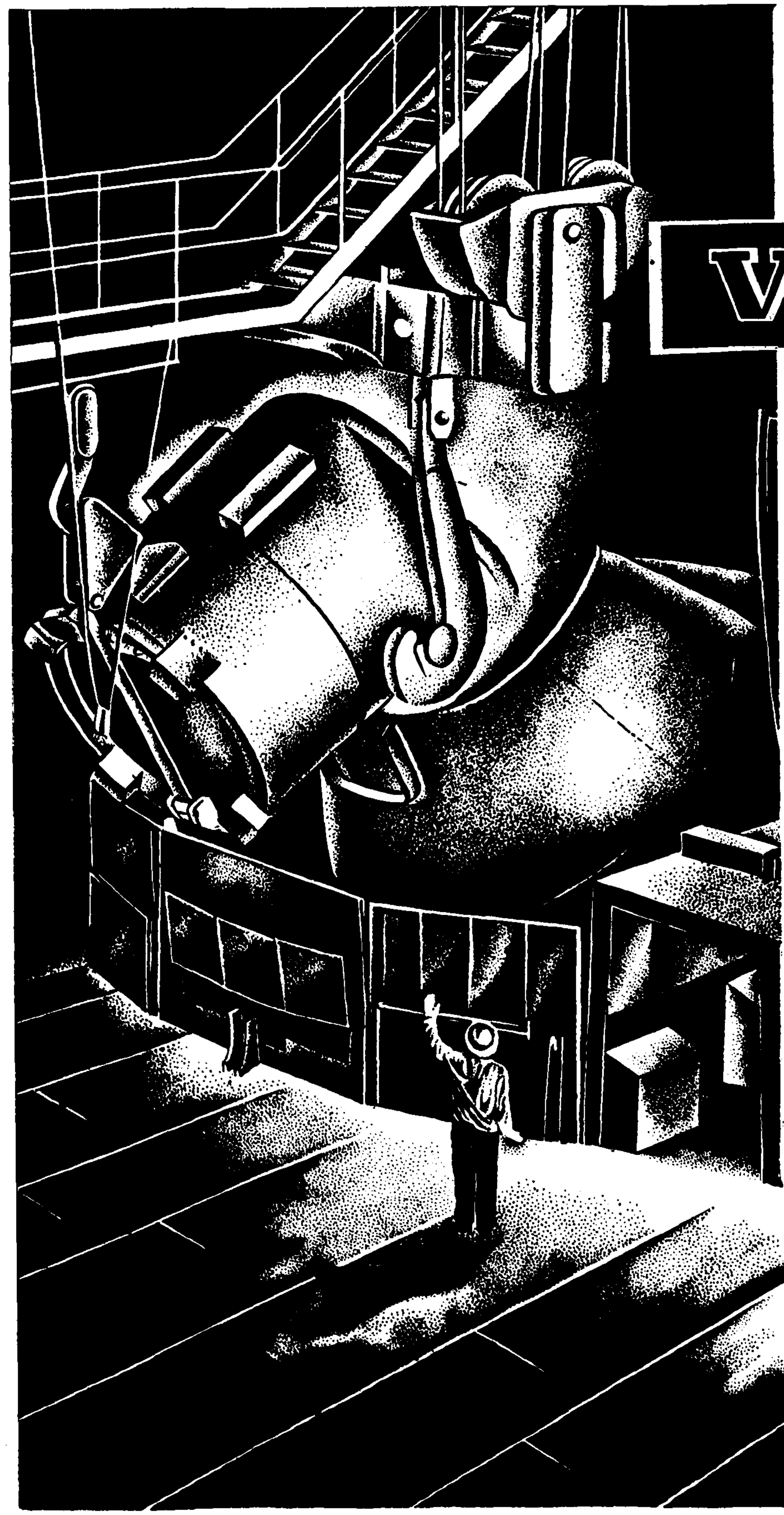
Incidentally, the same German company which built the Rourkela Power Plant constructed the outside power systems from which both Bhilai and Durgapur receive most of their power supply.

Maximum recovery of by-products is another feature of the Rourkela steel works which distinguishes it from the other conventional types of India's steel-works. The by-products plant at Rourkela will produce as many as 14 by-products costing Rs. 8 crores. It will be much bigger than those of the other two steel plants.

Photo shows the four-high plate mill in Rourkela

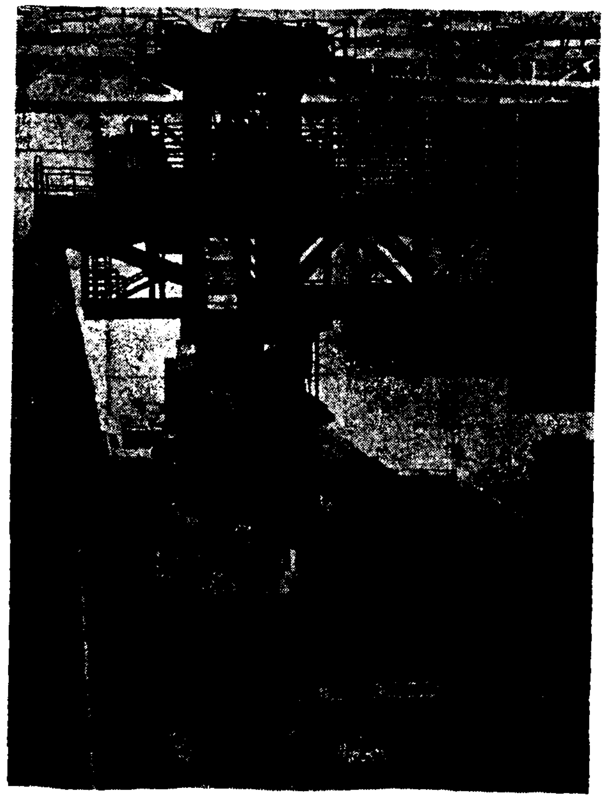
However, the more spectacular example of utilisation of by-products in this plant is the Nitrochalk Fertiliser Plant. This plant with an annual capacity of 600,000 tons Nitrochalk fertiliser is believed to be the first plant in the world of that size to be associated with any steel plant.

Indisputably, in design, in size and in complexities and volume of work involved in erection, the steel-works at Rourkela have no parallel in the country. Also, evidently, in speed of construction it has so far not been matched by the other two steel plants. Even if Rourkela was completed by the middle of 1961 it surely was a great achievement.



But this is only half the story. What is of more importance is that (a) by introducing the superior technique of the LD-process this steel plant has started a new age in steel production in the country and (b) by bringing into being the most ultra modern rolling mills for producing flat products only, the steelworks is adding new dimensions to the Indian steel industry. The fast modern continuous strip mill of this plant is the first of its kind in Asia.

Furthermore, the introduction of the LD-process of steelmaking has proved so successful both in efficiency and economy that the Government of India has already decided to employ this process at the Bhadravati steel works at Mysore. The fourth steel plant in the public sector to be erected at Bokaro is also designed to produce the bulk of its steel through the LD Process. Even in the Bhilai and Durgapur expansion schemes it is intended to modify the open hearth process by utilising oxygen injection. Production cost of LD steel at Rourkela has proved to be 25% less than the steel produced by Open Hearth Furnaces at the other two steel plants. Besides, due to non-availability of adequate quantities of scrap the LD process, which needs a lower percentage of scrap, has proved to be singularly advantageous under Indian conditions.



Rourkela — Soaking Pit Hall

Noted foreign authorities in Steel technology have also admitted that, technologically, " Rourkela is more balanced " than the other two steel plants and that the introduction of the LD process at this stage will place the Indian steel industry in a more favourable position than the other steel producing countries of the world.

* * *

The Indian steel industry is about 50 years old. It has the necessary skill and experience to roll common items of steel like structurals, rails, rods, bars, etc., known as merchant steel. What was unknown to India until Rourkela, is the skill to roll flat products. The absence of heavy platemills and wide strip mills in the country has been a serious shortcoming of the Indian steel industry.

The Rourkela plant was designed to end this inadequacy. W-Germany was alone in those days in offering a steel plant to India for exclusive production of flat products and it can be said that the Indian steel industry came of age only with the commissioning of the Rourkela plate mill in September 1960.

With the taking into operation of the Rourkela wide strip mill last March and the cold rolling mills recently (August '61), India has joined the rank of advanced steelmaking countries in the world.

The difficulties of installing such a plant in India cannot be exaggerated. The other two public sector plants are just replica of already existent conventional steel plants. The Rourkela plant is a " tailor-made " plant, and as such, it has little similarity with any other steel plants in the world, including in W-Germany.

The main job is organising production in this plant. Not only the rolling mills at Rourkela are new, the LD-process is also new to the country. Moreover, the other two steel plants have the advantage of immediate disposal of their semi-finished products. But until all the rolling mills of this plant are ready neither the pig iron nor the ingot steel can be produced in quantity.

The pig casting machine at Rourkela has an annual capacity of only 40,000 tons whereas at Bhilai and Durgapur it is 350,000 tons and 300,000 tons respectively. There are billet mills both at Bhilai and Durgapur to produce semi-finished steel to meet the demand of the indigenous rolling mills. But at Rourkela there is no billet mill, because the steelworks at Rourkela are not meant for semi-finished products. Ingots and slabs produced at Rourkela, due to their weight and size, are not marketable in the country. Luckily for India it has been possible to export these slabs in sizable quantity to Europe and earn a tidy sum of foreign exchange. In fact Rourkela's foreign exchange earnings constitute a record for any Indian steel plant.

Another handicap which has never ceased to worry the management of the Rourkela plant is the lack of adequate technicians in this plant. According to a former Resident Director of the Rourkela Steel Project, 90% of the technicians are "raw" "and there are at least 40% of unfilled high technical posts". The other two steel plants are adequately staffed by foreign technical personnel on the operational side but at Rourkela there is none. According to the contract, the foreign firms at Rourkela were to hand over the different units of the plant after running them to the satisfaction of the authorities for three months. The operation of the plants was to be put completely in the hands of the local technicians, unlike in the two other steel plants. However, it goes without saying that the opportunity of running such a modern plant independently has been invaluable to the Indian technicians. They might have committed some mistakes but, as the General Manager of the Steel Plant, Mr. Sambasivan, put it in an interview with the press, "what they have learnt within the last six months by committing mistakes they would not have learnt in six years if they were not allowed to handle the plants independently. But if the output of this plant is to be stepped up the necessity of importing foreign supervisory technical personnel is inescapable".

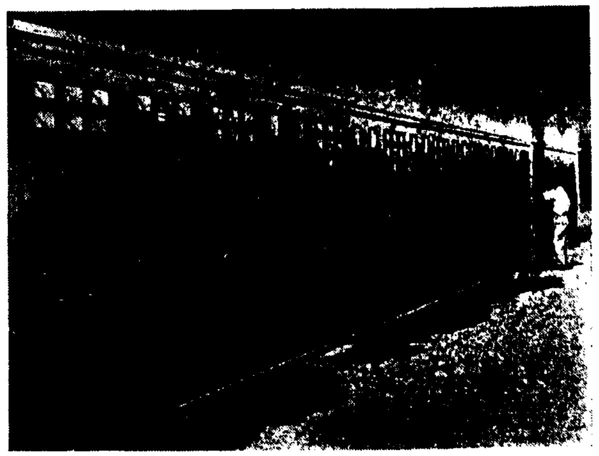
Indeed, negotiations are being finalised between the Indian Government and West German firms for about 225 German technicians, to be contracted for periods of upto 3 years. It is expected that with their arrival the production in Rourkela will pick up soon to its optimum capacity.

The Rourkela project is by its very nature costlier because it is designed to produce flat products and in steel flat products are costlier to produce. Its rolling mills alone cost about Rs. 72 crores, which is about Rs. 30 crores more than that of Bhilai and some 39 crores more than that of the Durgapur plant, according to original estimates. But according to the Steel Minister "while the cost of the Rourkela plant will hold good, the cost of Bhilai and Durgapur will have to be raised upwards". At present the difference between cost of the rolling mills at Rourkela accounts for practically the whole of the difference between the cost of this plant and that of either of the other two plants. But with the upward revision of cost in respect of both the steel plants at Bhilai and Durgapur the difference in cost will be narrowed down and there is little doubt that Rourkela will prove ultimately to be the most economical plant amongst the three plants.

Indeed, one fact which has received less than adequate notice is that while the Rourkela plant will cost more, its finished products on a ton-per-ton comparison will fetch comparatively much higher prices. The average price of the end products of Bhilai and Durgapur will not exceed Rs. 500 per ton whereas the average of finished products of Rourkela will be between Rs. 800—850 per ton.

* * *

In planning the Rourkela steel works emphasis was placed on designing a "tailor-made" plant to suit specific Indian conditions incorporating latest developments in steelmaking and rolling techniques. Generally speaking, the basic pattern of Rourkela and Bhilai up to the steel melting stage does not show any major difference.



Rourkela — Switchboard of the Blooming Mill

However, the adoption of the LD-process of steelmaking in Rourkela as compared with the conventional process of steelmaking in the open hearth at Bhilai clearly indicates that the designers of the Rourkela steel plant have taken full advantage of the latest development in steel production techniques.

Even British authorities, like G. Reginald Bashforth, F.I.M., in an article of the "Iron and Coal Trades Review" (dated 23.10.1959) admitted the superiority

of the LD steelmaking process as compared with the straight open hearth method :

"The Bhilai plant consists of six 250-ton fixed open hearth furnaces and one 60-ton mixer," he said. "In order to achieve its target of 1 million ingot tons per annum, this plant, operating on a furnace availability of 90%, must attain in productivity rate of approx. 22 ton/furnace/hr. The rates of productivity anticipated therefore, would appear to be some what high if these furnaces would have to be operated at..."

On the other hand, Mr. Bashforth pointed out that "the Rourkela plant appears more balanced, since 75% of the output will be produced by the LD process, in which the scrap consumption should not exceed..."

"In some circles, Mr. Bashforth continued, "it has been suggested that Durgapur and Bhilai are perhaps the last, large straight open-hearth plants to be installed. The remarkable progress of the newer oxygen processes, together with their many distinct advantages, support this contention. The possibilities of these new processes must be reviewed with special reference to India's economy and her geographical aspects. The suggestion to increase the capacity of the Bhilai plant by additional open-hearth furnaces seems to be contrary to modern trends and not entirely in the interest of the Indian economy..."

In view of these statements made by an authority on steelmaking in 1959, it is evident that the designers of the Rourkela steel plant showed considerable foresight when they advocated the adoption of steelmaking by 75% according to the LD process, and 25% in the open hearth. Compared with that, the conventional method adopted at Bhilai for a modern, new integrated plant appears obsolete or, with the words of Mr. Bashforth, "a thing of the past."

The introduction of the LD steelmaking process for the first time in India at Rourkela places Rourkela in the long run in a favourable position, as lower operating costs of LD steel-making—on the basis of comparable data available from other plants—indicates that the production cost per ton of ingot steel produced at Rourkela will be approx. 25% lower than at Bhilai.

Another distinct difference in the public sector steel plants consists in the layout and the products to be derived from the rolling mills. Rourkela is designed to produce exclusively flat products, such as plates, sheets, strips and tin plates, whereas the Bhilai rolling mills are laid out for the production of rails (standard and narrow gauge), light and heavy structurals, rounds and squares, etc.

For a nearly equal tonnage of finished products the machinery and equipment required for flat product rolling, particularly if this is being done in a highly mechanised continuous strip mill, are of a much higher tonnage than that required for the products of Bhilai.

Rourkela — Fertilizer Producing Plant

The total tonnage to be erected at Rourkela for the rolling mills is 20% heavier than that at Bhilai. The high degree of automatic controls and mechanisation of all manipulations is also clearly reflected in the electrical equipment used in these two plants. Whereas in Rourkela 12,000 tons of electrical equipment for operating the Rolling Mills are installed, the comparative figure for Bhilai is only 7,800 tons, or roughly 1/3 less.

As a result of the much heavier and robust equipment required for the production of flat products as in the case of Rourkela, the foundations, the structural steelworks, etc., are much in excess of the Bhilai requirements.

While these figures are of interest for the Rourkela—Bhilai comparison, relevant figures of the Durgapur plant should be mentioned also, in order to indicate the special position Rourkela occupies among the three public sector steel plants.

The rolling mills of Durgapur, which predominantly produce rails and light and medium structurals, have a total structurals and equipment tonnage of 49,000 tons only, or not even 45% of the total structurals and equipment tonnage of Rourkela. The covered area of the Durgapur rolling mills is only 138,000 sq. meters or less than 70% of that of Rourkela.

OVERALL PROGRESS

Concrete

The total civil engineering works in connection with concrete works and foundations are estimated at Rourkela to be of the order of 850,000 cu.m. whereas at Bhilai, for instance, this quantity amounts to 650,000 cu.m. only, and is about 24% less than at Rourkela.

To date the total quantity of concrete laid for foundations etc. is 645,000 cu.m. at Rourkela and 540,000 cu.m. at Bhilai. This is a difference of approx. 100,000 cu.m. which at an average rate of output of 15,000 cu.m. a month corresponds to 7 months of concreting which Rourkela was ahead of Bhilai. (It may interest that a quantity of 100,000 cu. m. of concrete corresponds to the entire concrete demand of the complete blast furnace plant with high bunkers, consisting of 3 blast furnaces.)

Structurals, machinery and equipment

The total tonnage of structurals, machinery and equipment amounts to 262,000 tons at Rourkela, whereas in the case of Bhilai the total tonnage of these materials amounts to 254,000 tons.

When considering that the two steel works were completed at approx. the same time, a comparison on the tonnage basis, therefore, indicates that progress has been appreciably faster at Rourkela.

It would also not be out of place to mention that during peak-time, erection figures of upto 12,000 tons per month have been achieved at Rourkela, whereas Bhilai could never show an erection tonnage higher than 9,000 tons per month.

Similar is the picture in the concrete sector, where maximum output up to 33,000 cu. meters of concrete has been achieved at Rourkela per month, whereas at Bhilai 16,000 cu-meters appear to be a record output.

It is worth repeating that these high concrete outputs were achieved at Rourkela with numerous Indian contracting firms, whereas at Bhilai one single top-ranking Indian civil engineering firm was engaged for the construction of the Bhilai foundations and associated works.

* * *

With the dawn of independence, India found herself confronted with many shortcomings of which the

The Rourkela wide strip mill will be controlled from a single control pulpit. The picture shows the control pulpit of a similar wide strip mill delivered by DEMAG for a West German Iron and Steel Plant.

meagre domestic steel production was the most pressing one. In importance, steel was perhaps second to food only.

But the task of increasing steel output in the country was hampered by many difficulties of which the problem of securing foreign technological and financial collaboration proved to be quite intractable at the time.

India is fortunate in having one of the largest high-quality iron ore deposits in the world. But how to process this ore into the finished product of iron and steel was the top-most pre-occupation in the minds of her planners.

When India launched her First Five-Year-Plan, these planners never stopped in their quest for securing a suitable foreign partner who could undertake the job which was considered enormous by any standard.

Long before anybody else considered it feasible to help India in this field, two German companies (Krupp and Demag) came forward in 1952 with a proposal to

erect a steel plant on a joint partnership basis with the Government of India. The proposal was then hailed as a gesture setting a new postwar pattern for international economic co-operation, and the Government of India appeared glad to collaborate with the West German firms which had to their credit a century-old steelmaking record.

The pattern set by this Indo-German venture was subsequently followed by two more offers from the USSR and the UK. With that, India was capable of increasing her steel output capacity from one million tons to six million tons within the Second Five-Year-Plan ending March 31, 1961.

But the German firms not only pioneered in offering technological and financial aid for the expansion of the steel industry in India. They took upon themselves the toughest assignment in steelmaking;

The Rourkela steel plant will be producing exclusively flat products, whereas other plants in India will produce ordinary merchant steel. Technical methods for producing the former type of products were not unknown in India, since her steel industry had been producing merchant steel for the last half a century. So what India needed most was the technical know-how of producing flat products like plates, sheets and strips. The development of so basic industries as that of ship building, automobile manufacture, heavy machine building, and even the desired production of armaments, are dependent on the availability of these flat steel products.

Herein lies the importance of German collaboration which should not be lost sight of in any evaluation of foreign collaboration for developing the Indian steel industry.

German collaboration gains added importance in the economic advancement of this country, when considering that the Rourkela steelworks constitute a revolution in steelmaking in India. The adoption of the LD-process for steelmaking offers a unique economic advantage inasmuch as both the capital and operating costs are lower due to higher productivity.

It is estimated that LD-steel will be at least Rs. 30, cheaper per ton compared to steel produced by conventional methods. So when India chooses to enter into export markets, which she will inevitably do due to her huge iron ore deposits, India will be in an advantages position to her competitors.

The ultra-modern German-designed rolling mills of Rourkela are another proof of India's determination to keep abreast of latest progress in world steel technology. A complete utilisation of available raw materials along with the recovery of industrial wastes as well as the maximum recovery of by-products and coal chemicals is another characteristic feature of the Rourkela plant. From the basic chemical will be produced in this plant many products like dye-stuffs, synthetic resins, insecticides and pharmaceuticals can be produced to form the nucleus of a thriving chemical industry based on coke.

In fact, these by-product plants are an example of industrial planning which aims at the maximum utilisation of the natural resources of the country. In this respect also, Rourkela will remain an outstanding achievement.

The Rourkela steel project stands completed—Prime Minister Nehru himself was celebrating the occasion by commissioning India's first wide strip mill. Undoubtedly, the plant will prove to be the most economical one in India. The prices of the end products of this plant, on a ton-per-ton comparison, will fetch almost double the prices of the end products of other steel plants in India.

Because of that, the plant is already being earmarked for expansion. Plans call for an ultimate output capacity of 1.8 million tons annually.

The financing of these plans is guaranteed: This year, the German industry collected and handed over for distribution approx. 1.5 billion rupees to the German government to be used for long-term credits under deferred payment arrangements. Part of the money will be used in the continued task of aiding the development of the Indian steel industry.

(Contributed by Press Bureau of German Industry)

SIEMENS IN ROURKELA

THE name of Siemens is closely connected with electrical engineering for over a century. This is due to the pioneer efforts of Werner von Siemens and his brother—popularly known as Sir William—in the progress and development of electrical engineering.

More than 200,000 persons are employed today by the House of Siemens and they have achieved a lot of development in the entire field of electro-technology. Products ranging from the largest turbine to the smallest transistor set belong to the scope of activity of this working community. Their factories produce electrical equipment worth over Rs. 450 crores annually. This equipment is supplied all over the world.

The supply includes complete power stations with their ancillary equipment, such as generators, switchgear, transformers, cables and overhead transmission lines. It also includes complete electrical equipment for steelworks, rolling mills, textile, paper and other factories—as also for power stations for railway electrification, rolling stock, signalling and overhead lines. Electrical equipment for the shipping industry, as well as lighting and various power equipment for offices and factory buildings are also included.

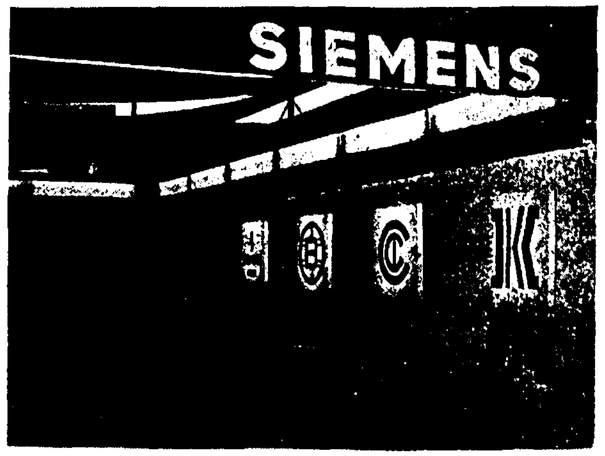
In the field of telecommunication, Siemens equipment such as wireless transmitters, telephone and telegraphic systems, teleprinters, coaxial cables, etc., is installed all over the world.

To face new problems arising in the field of electrical engineering, more than 10,000 Siemens engineers and scientists are occupied with tasks of serving to promote technical progress mainly. Every employee of Siemens is proud of the contribution made by him to the development of electro-technology.

SIEMENS IN INDIA

Siemens' connection with India dates back to the past century. The first communications link between London and Calcutta was forged by Werner von Siemens, the founder of the organisation, in the years 1867—1870. Even before World War II, the contribution of Siemens towards the electrification of the country was not inconsiderable. Indian independence and the national aspiration for quick industrialisation gave Siemens further scope to serve the nation more effectively, and within this decade, Siemens has taken gigantic strides forward in India.

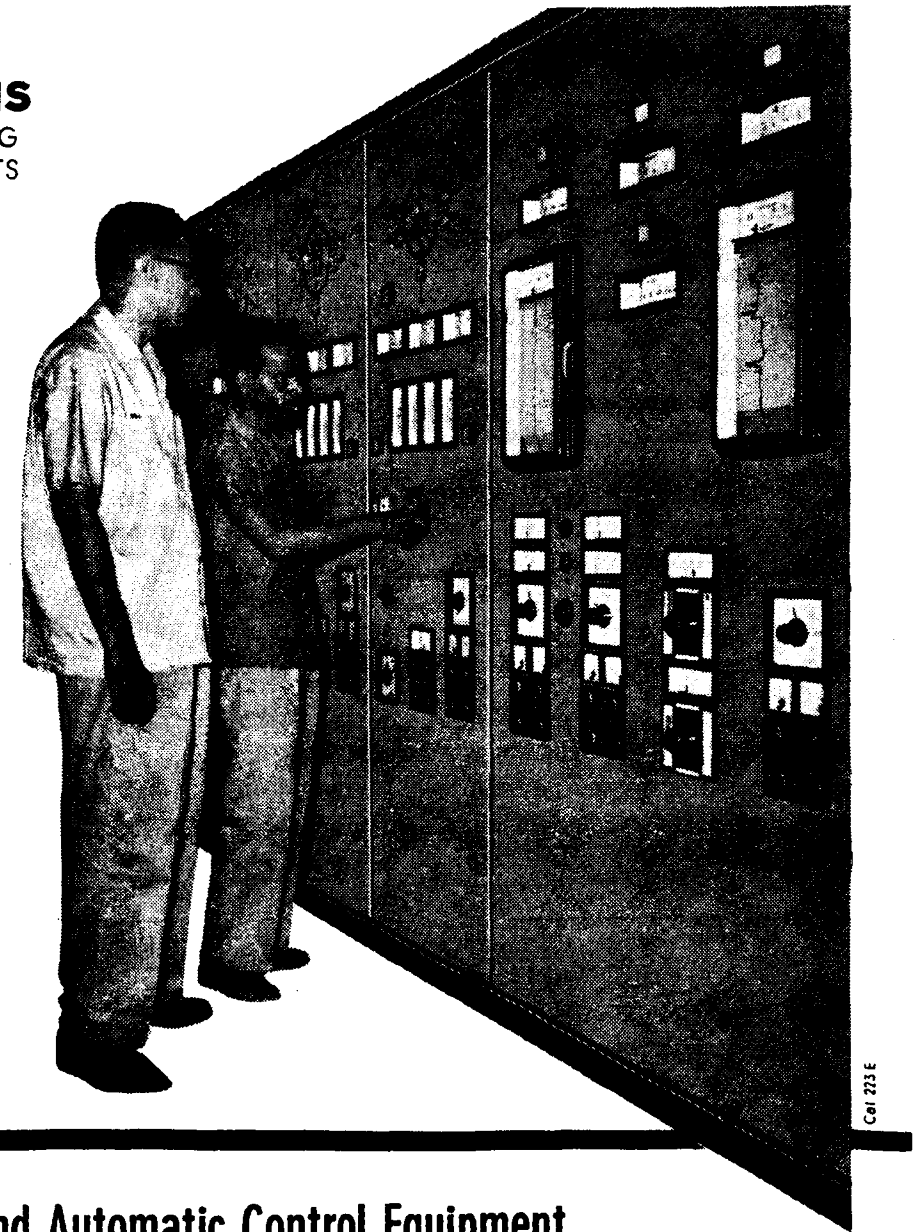
Their long list of contracts includes the power stations of Pathri, Hirakud, Chambal, Durgapur—including extension programme-Mau, Gorakhpur, Sohawal, Khaperkheda, Paras, Korba, Maithon and the power station for the **Rourkela steel plant** and the Chole power station. Large high tension switching stations were supplied and installed at Ernakulam, Trichur, Nangal and several other places.



Siemens Equipment manufactured in India

Substantial supplies of electrical equipment were made to all kinds of industrial enterprises in India, such as factories for textiles, sugar, paper and cement industries, etc. The introduction of a new technique for the electrical equipment of ships made a major Indian shipping company decide to instal Siemens equipment in all of their new ships. In the field of telecommunication equipment, considerable orders were carried out by Siemens in the lines of telegraph equipment, coaxial cables, carrier systems and HT telephone equipment.

The marked expansion of the activities of Siemens of India and its policy of developing indigenous facilities wherever possible has led to the formation of Siemens Engineering and Manufacturing Company



of India Ltd., in April 1957. The new company began its activities in India with offices in Bombay, Calcutta and New Delhi. Later, more offices have been opened in Madras, Bangalore, Ahmedabad, Visakhapatnam, Lucknow, and the latest in Rourkela. Investigation on site, planning, production, installation, subsequent servicing and repairs... all these facilities for which highly qualified engineers and technicians are employed by Siemens of India, are now available to clients.

In order to help the clients for repairing equipment supplied by Siemens from Germany, a small workshop was established at Worli, Bombay, in 1955. To save foreign exchange—as also to take part in India's rapid industrial progress, it was further decided to increase the activities of the workshop by incorporating its own manufacturing programme. It is now a full-fledged factory, employing more than 400 workers, with a modern design office, manufacturing HT and LT switchgear, switchboards, fuses, railway signals and X-ray equipment. A workshop has been opened in Calcutta for the repair of motors and transformers. By enlarging its activities and by manufacturing and increasing range of electrical equipment, the factory at Worli and the workshop at Calcutta will serve the needs of the growing industries in India.

The one special feature of Siemens in India is that this company—which has manufacturing licences for a wide range of Siemens products—is in turn encouraging independent Indian industries by granting licences and technical know-how to Indian firms—the manufacture of motors and transformers in collaboration with Messrs. Bharat Bijlee Limited, wires & cables with Messrs. Cable Corporation of India Limited, meters with Jaipur Metals and Electricals Limited, radios with Eastern Electronics Limited. The products thus manufactured are distributed by Siemens throughout India.

Under their training programme Siemens have not only trained several of their employees in their administrative and technical departments in Germany, but have also provided training facilities for the personnel of Government and other industrial organisations.

Over hundred years' experience gained by the House of Siemens in Germany thus contributes to the progress of India's industry as well.

HOT DIP TINNING PLANT SUCCESSFULLY TESTED

The Rourkela Steelworks' 3-train hot dip tinning plant passed its guarantee test successfully.

During a total of 28 hours of operation on January 24 and 25, two shifts of HSL operators converted sheets coming from the cold rolling mill into 51,161 tonnes of tin plate—an average hourly production of 1,827 tonnes. Sheet thickness produced was 0,28 and 0,32 millimeters.

Calculated on contract basis which stipulated a thickness of 0,35 mm, the hourly output average achieved was 2.7 tonnes, or 60% higher than the guaranteed rated capacity of 1,7 tonnes.

The test was run on the tinning plant's train number one. The plate arrives there via a two-way conveyor from the electrolitic pickling plant, where it was cleaned in a hydro-chloric bath. After the hydrochloric acid is rinsed off with softened water, the plate is put into the tinning pot, withdrawn from the bath, and when cooled down mechanically cleaned, graded, weighed and transported to the storage bay.

Rourkela's hot dip tinning plant, designed and constructed by DEMAG AG of Duisburg, has an annual output capacity of 50,000 tonnes. The electrical part of the installation was provided by AEG, Frankfurt.

* * *

ROURKELA PRODUCTION UP AGAIN

The last month of 1961 saw another production increase in the Rourkela steelworks :

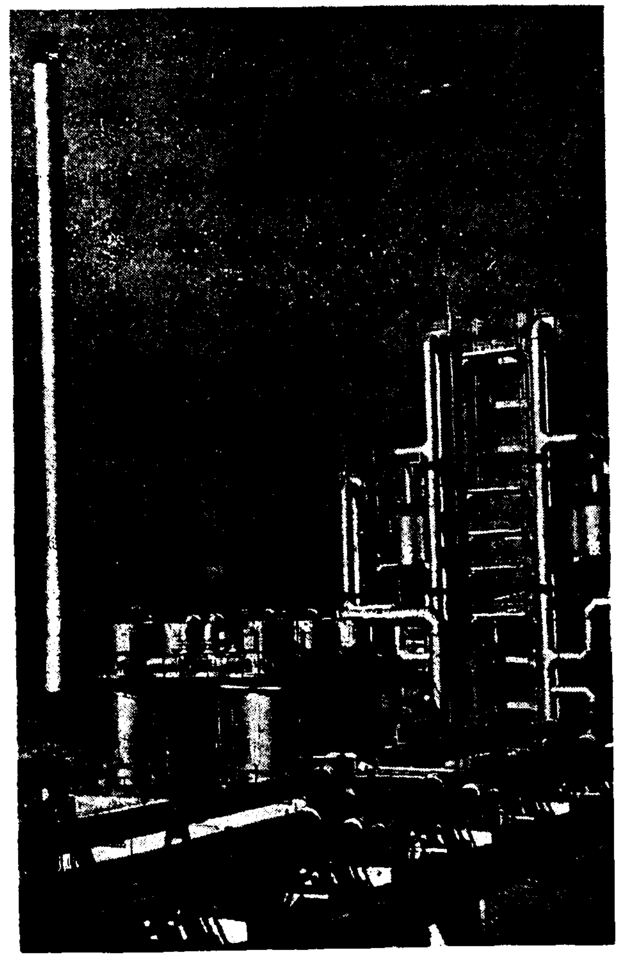
Pig iron output is reported from Rourkela to have exceeded 47,000 tonnes, while the production of steel ingots passed 40,000 tonnes. Both figures are monthly production records for the Rourkela steelworks.

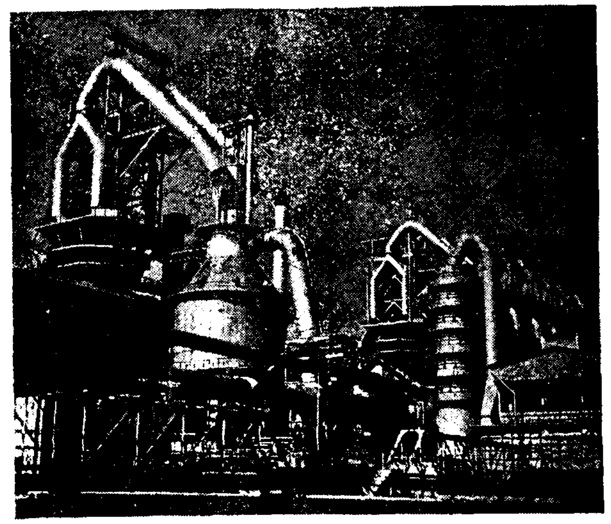
In the meantime, it is reported that Rourkela's blast furnace number three will be commissioned. This blast furnace was completed in June 1960 by its designer and constructor, GHH of Sterkrade. Blast furnace number one in Rourkela, commissioned on February 3, 1959, was the first blast furnace lighted up in India's public sector steel plants.

A Modern Plant with A Modern Finish

By A Correspondent

NO VISITOR to the modern steel plant at Rourkela can fail to notice its new look—new, as compared with other steel plants. Rourkela has employed a modern finish to protect its steel structures,

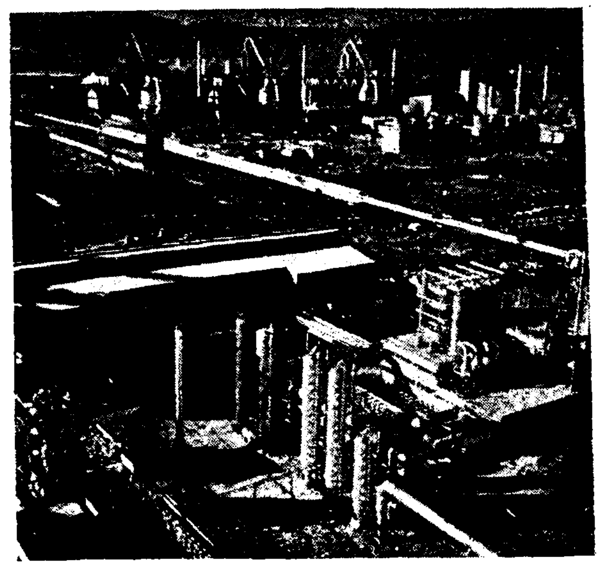




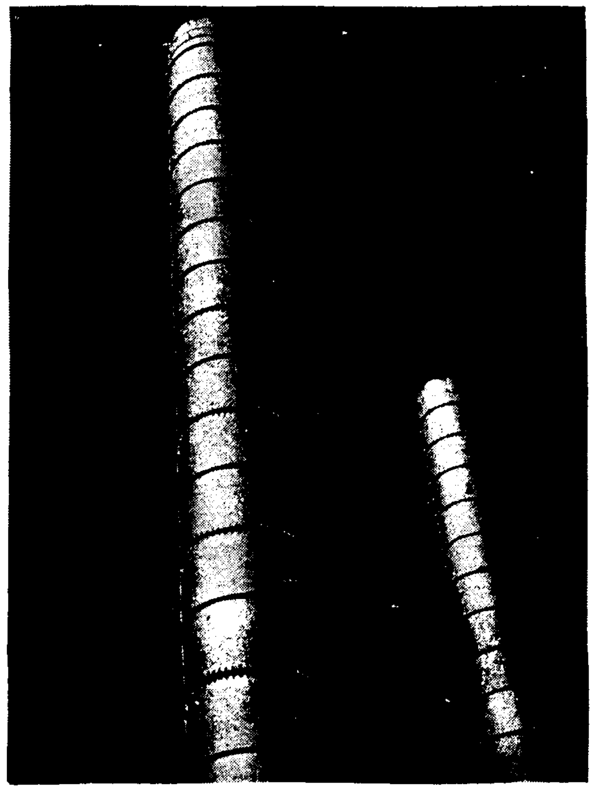
pipes, etc., and the pictures you see on these pages will give you an idea of the extent and variety of the surfaces which are protected and decorated by aluminium paint.

At the end of June 1961, over 16 million sq. ft. had been painted and 50,000 gallons of aluminium paint had been used, and painting was still in progress. No doubt Rourkela's maintenance engineers selected aluminium paint for its exceptional properties and economy and they reaped the additional benefit of giving the entire Works a neat, bright, pleasant appearance.

It would pay you to adopt a painting scheme in your works, identical to the one employed by

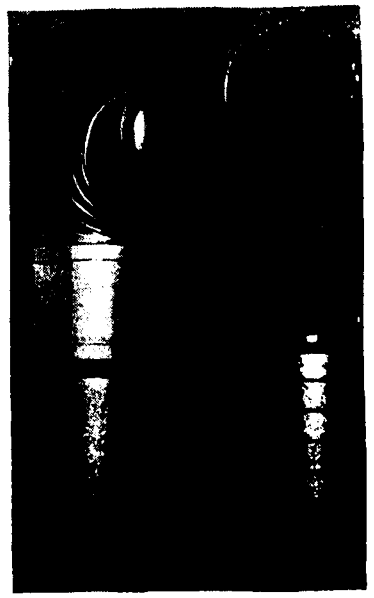


Rourkela's engineers. Aluminium paint, apart from being bright and attractive in appearance, is superior to other paints because it combines excellent resistance to the weather and to many types of corrosive atmospheres with high reflectivity to light and heat, and



good hiding power; and it is unsurpassed in the protection it affords to all kinds of surfaces, and, not least, in economy of use. It is a versatile paint suitable for a variety of surfaces; but, for special applications such as priming steel and wood or coating chimneys, special formulations are necessary; and paint manufacturers in India offer such special formulations.

The unique property of aluminium paint is 'leafing'. The pigment is made up, not of fine granular particles randomly dispersed throughout the vehicle, but of minute flat plates of pure aluminium which rise to the surface of the paint film, where they arrange themselves in overlapping layers. They thus form an opaque metallic coating that presents a barrier to the penetration of moisture and sunlight and also possesses much of the brightness and corrosion-resistant properties of the metal itself. It is to this that aluminium paint owes the most important of its characteristics.



An outstanding example of the durability of aluminium paint is Howrah Bridge, Calcutta. It was repainted in 1960 after a lapse of nine years, the last painting having been done as far back as 1951. A coverage of over 900 sq. ft. per gallon was obtained—as you know, the coverage of most other finishing paints is much lower, around 600 sq. ft. per gallon. Aluminium thus paints a larger area per gallon than other paints, and if you add to this its exceptional protective and decorative properties, we feel sure, you will have no hesitation in emulating Rourkela's example.

Do write to any of their Sales Offices if you require more information.

The Siemag Cold Mill in Rourkela

By A Special Correspondent

WITHIN the frame of the whole of the Rourkela project the West German company SIEMAG Siegener Maschinenbau GmbH, Dahlbruch (Westphalia) was entrusted with the installation of the cold mill. The entire planning of these rolling mill plants has been based on the latest engineering knowledge of rolling mill industry. SIEMAG can call back upon more than a hundred years' experience in rolling mill manufacture. The enterprise together with its three affiliated companies is family owned, and is nowadays one of the leading rolling mill manufacturing companies. SIEMAG are linked up with the American companies UNITED Engineering and Foundry Company, Pittsburgh (USA) and Morgan Construction Company, Worcester (USA), by agreements on a close technical co-operation and a complete exchange of all technical know-how.

On this wide basis of abundant experience SIEMAG built the Rourkela Cold Mill as per up-to-date aspects of rationalization and qualitative production of rolled stock. The West German company already supplied a similar wide strip cold mill to Huttenwerke Siegerland. There Indian rolling mill engineers envisaged to supervise the SIEMAG mill in Rourkela were given the possibility of gaining practical experience.

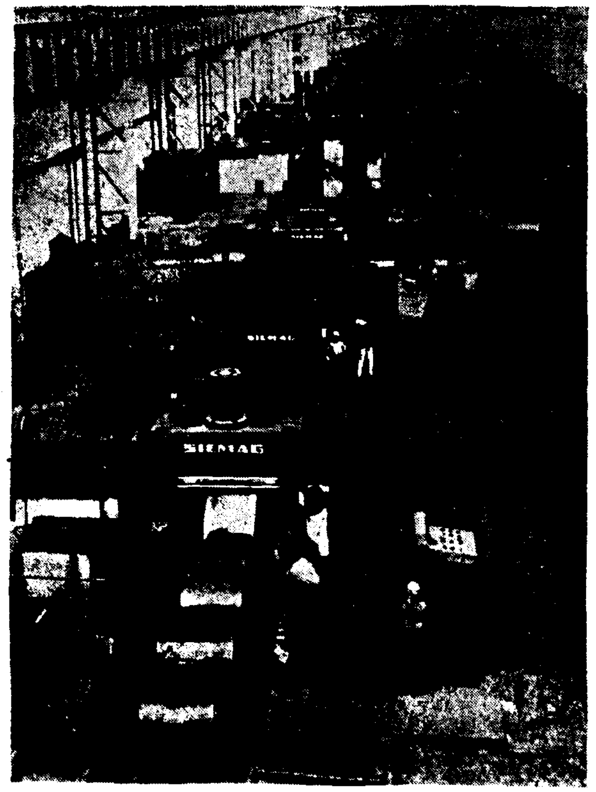


Fig. 1. Continuous pickling line 1575×4 mm strips.

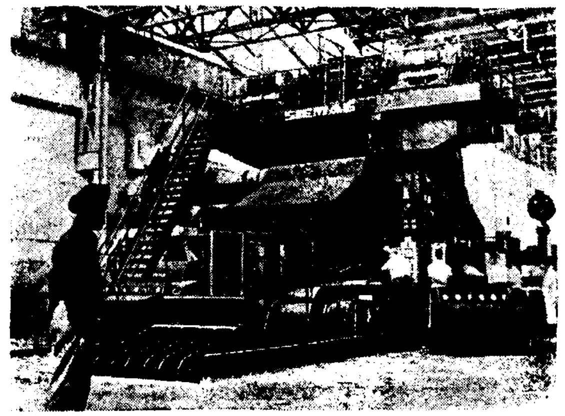


Fig. 2. 4-High reversing strip cold mill roll dia. 1380/460 mm, barrel length 1700 mm.

The SIEMAG Cold Mill in Rourkela now being started up comprises the following equipment:

pickling line,
autobody sheet cold mill,
tinplate cold mill,
tinplate degreasing line,
annealing line,
autobody sheet skin pass mill,
skin pass stand for tinplate,
and corresponding strip shearing lines.

Rating of the mill was based on the desired annual production of about 200,000 tons of autobody sheet at widths ranging from appr. 630 to 1525 mm. and final thicknesses ranging from appr. 0.35 to 1.6 mm. The coils being used have a max. weight of 15 tons. As to tinplate a yearly production of 50,000 tons was asked for at strip widths ranging from appr. 600 to 1040 mm. the minimum final thickness being 0.19 mm. The weight of coil provided for this kind of strip is appr.

10 tons. Layout of the rolling mill bays, arrangement and installation resp. of the individual machines and sets were planned in such a way that smooth sequence of operations and flow of material from the hot rolled coil storage through the pickling line to the finishing line, i.e. from the raw to the final product is ensured.

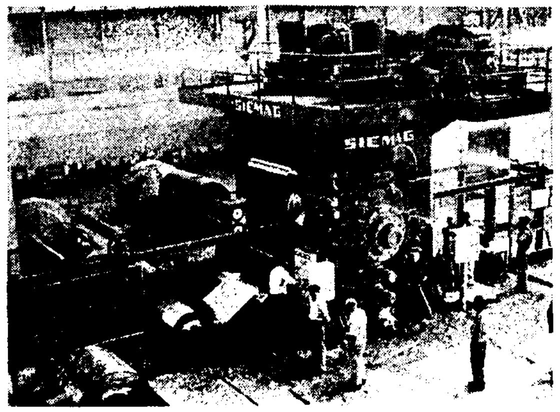


Fig. 3. 4-High skin pass strip cold mill roll dia. 1240/460 mm. barrel length 1700 mm.

The hot rolled coils coming from the hot mill are brought to the coil storage and from there they are conveyed to the pickling line. Adjacent to the pickling line bay, figure No. 1, the cold mill bay is arranged, figure No. 2, followed by the annealing line joined by the skin pass mill bay, figure No. 3, and additional shearing lines, figure No. 4. This arrangement allows for short transport ways of material and moreover, for favourable cable—and pipe laying within the whole of the plants. Taking into consideration the capacity required, planning, design, and arrangement of the Rourkela Cold Mill correspond to the latest knowledge of rolling technique for producing rolled stock of irreproachable quality. Particular attention was paid to a continuous sequence of operations and to transport of material to be largely mechanized, which result in rational rolling and economical treatment of material.

The three affiliated companies of the SIEMAG enter-

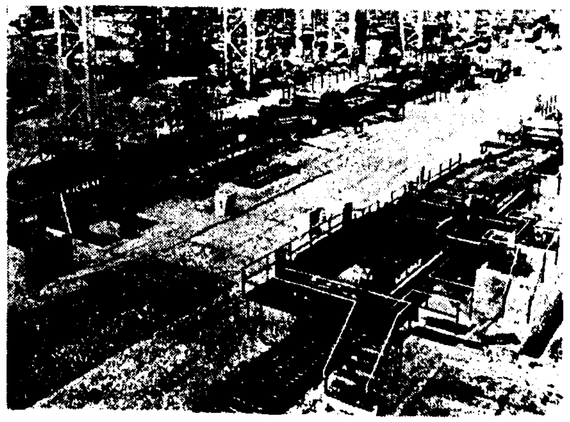


Fig. 4. Shearing line for autobody sheets 1530 × 1.6 mm.

prise in Dahlbruch, which were mentioned at the beginning, concentrate on other lines of production. One of these affiliated companies builds crane equipment, steel mill cars of special design, and mining equipment. The second affiliated company is exclusively engaged in manufacturing heavy chains of high quality. For the extension of the Assuan dam said company, namely SIEMAG Kette GmbH supplied among other things the heaviest chains ever built in the world for weir equipment. The chains for the Maithon dam in India were also supplied by SIEMAG. And finally, the third affiliated company manufactures office machines. Today it is numbered among the largest European manufacturers of book-keeping machines and billing machines and the development of the first electronic book-keeping and billing machines is owed to this affiliated company. At present about 6000 people are employed in the group of SIEMAG companies.

COLD ROLLING MILL TESTS COMPLETED

Three months ahead of schedule, the Rourkela cold rolling mills passed their last three guarantee tests. Commissioned last October, the installations tested now were the reversing stand, skin passing mill and the tin plate shearing line. (The hot dip tinning plant was tested already before.)

With the skin passing mill the test established an output of 165 tons per shift—about 57% more than rated capacity. These were the last test before the cold rolling mills are definitely handed over to the HSL operators, but technical consultants of the supplier company shall remain in Rourkela until September this year. The latter are delegated from SIEMAG GmbH, Dahlbruch, the constructors and suppliers of the mills. The electrical part was provided by AEG, BBC (lion's share) and Siemens.

ROURKELA NEWS

RECORD SLAB PRODUCTION IN ROURKELA

240 slabs were rolled into plates within one 8-hour-shift in Rourkela's heavy plate mill on February 26. This was possible when the slabbing mill created a record by rolling 2,435 tonnes of steel ingots that day. During the same 8-hour-shift 248 plates were sheared in the finishing department. Maximum production of the mill was 40 slabs per hour rolled into plates, i.e. one finished plate every one and a half minute.

There was a total production of 15.141 t of strips, the maximum ever achieved during one month in Rourkela. 10,505 t of heavy plates and 3,505 t of cold rolled sheets were also produced. The pipe plant touched a new high of 4,924 t of pipes, surpassing the previous record by 800 t.

Slabbing mill : Average production in February was 210 t/hrs., compared to its rated capacity of 235 t/hrs. (Maximum production achieved was 315 t/hrs.)

Heavy plate mill : Average production in February was 62.5 t/hrs., compared to a rated capacity of 65 t/hrs.

* * *

BHADRAVATI STEEL PLANT GETS GERMAN CO-OPERATION

The foundation stone for the Rs. 7-crore Mysore Iron & Steel Works expansion at Bhadravati, South India, was laid on 22—12—61 by Shri B. D. Jatti, Chief Minister of Mysore.

Three W–German companies DEMAG AG, Duisburg; AEG, Frankfurt, and OFU, Duesseldorf—have entered an agreement with the factory for the supply of equipment and for technical co-operation to boost present steel output capacity of 30,000 t/a to 150,000 t/a of steel ingots and 135,000 t/a steel sections. Further additions of machinery to increase capacity to a quarter million tons of steel ingots annually are contemplated.

The Bhadravati works will be the second Indian steelplant (after Rourkela) to be equipped for steel production under the revolutionary LD–process.

Sardar Swaran Singh, Union Steel Minister, called the Bhadravati steelworks "a symbol of pioneer effort". Prime Minister Nehru sent a message of greetings and good wishes.

* * *

DR. HERMANN KLINAR

Dr. Hermann Klinar, Technical Adviser, Hindustan Steel Ltd., Rourkela, left Rourkela after more than seven years of untiring service during which he took an active part in guiding and co-ordinating the construction work carried out jointly by the HSL and the German supplier companies. Dr. Klinar has earned a reputation in India's steel industry already during the years 1932—38 when he acted as chief fuel and economic engineer for TISCO at Jamshedpur.

* * *

Mr. T. C. M. Eneli, Dy. Permanent Secretary, Ministry of Commerce and Economic Development, Federal Government of Nigeria, visited the Rourkela steelworks. He reported that his Government is contemplating to erect a steel plant with a capacity of 250,000 tons annually. At Rourkela Mr. Eneli wished to study problems encountered by developing countries in the establishment of steel mills.

* * *

Dr. Ernst W. Meyer, former W-German ambassador to India, received a personal message from Prime Minister Nehru on occasion of the former's 70th birthday. The Prime Minister thanked Dr. Meyer for his valuable services in the field of Indo-German co-operation. (The Rourkela steelworks construction was initiated during Dr. Meyer's term.) The Indian Prime Minister's letter is considered a rare distinction.

* * *

Shri G. Ramanathan, Dy. Secretary in the Ministry of steel and Heavy Industries, N-Delhi, during his present visit of W-Germany was received by DEMAG Vice-President J. Schueller at the Duisburg headquarters of the steel concern. Mr. Ramanathan inepected the DEMAG workshops where parts for Rourkela's wide strip mill had been manufactured. He appeared particularly impressed by the DEMAG training facilities.

LINDE IN THE STEEL INDUSTRY

By A Special Correspondent

GESELLSCHAFT für Linde's Eismaschinen A. G. (Linde/Western Germany) was founded in 1879 by Professor Dr. Carl von Linde, whose pioneer scientific work provided the basis for an industry of world-wide significance: the manufacture and control of low temperature processes.

In 1901 the Linde division for gas liquefaction was founded in Höllriegelskreuth near Munich. One year later Carl von Linde succeeded in making the step from air liquefaction to air separation by applying the rectification step in the low temperature process. The first oxygen producing plant constructed in 1902 was followed in 1904 by the first unit to produce nitrogen. This air separation process was further improved in 1910 by the introduction of the double rectification column which greatly improved the yield of oxygen to almost theoretical proportions.

Another important step was the development of the low temperature separation process for the production of hydrogen by liquid nitrogen washing from water gas. This enabled Linde to construct in 1912 a gas separation unit for the first synthetic ammonia plant working on the Haber-Bosch process. A short time after the end of World War I improvements in the construction of air separation plants were realized and the first apparatus for the simultaneous production of pure oxygen and nitrogen were constructed. The most important development of this period was a successful process for the low temperature separation of coke-oven gas into its many components.

At the end of the twenties, Linde in co-operation with the Augsburg engineer Matthias Fränkl constructed a radical new type of oxygen plant in which the tube heat-exchangers were replaced by automatic reversible regenerators. These regenerators provided the means for production of oxygen at both, lower plant capital and labor costs. The previous necessity for air drying and purifying was eliminated. The oxygen production capacity up to this time, the so-called "classical plants", was greatly surpassed by the production capacity of the new Linde-Fränkl plants.

After the Second World War Linde was able to maintain its position as a leading firm in low temperature processes by further progress in the manufacture of units to produce pure ethylene and by the erection of the first unit to produce high purity hydrogen and heavy water by liquefaction and rectification of hydrogen.

The practical application of the latest developments in low temperature processes combined with many years of experience of a group of highly skilled workers and the choice of the best materials available have been combined by Linde to guarantee plants which demonstrate very favorable production capacities and lower operating costs. A dynamic proof of the capacity and life of Linde's plants is demonstrated by one of the oldest gas separation units still in operation such as the plant T 218 supplied for Bayer, Leverkusen, which was placed in operation in 1916. The first plant erected in the United States in 1912, T 124 Buffalo, is still in operation today. At present time, there are 280 Linde-Fränkl tonnage oxygen plants and more than 1290 classical type air separation plants for the production of oxygen, nitrogen and rare gases such as argon, neon, krypton and helium, constructed by Linde and in operation throughout the world. In addition more then 480 gas separation plants for the production of pure ethylene, methane, propylene, hydrogen-nitrogen-mixtures, hydrogen-carbon monoxide-mixtures and benzene were erected. The Linde-Fränkl plant TR 136 erected in the United States in 1954 was the world's largest tonnage oxygen plant at that time.

GHH in India

In January, 1962 Rourkela's third 1000-ton blast furnace was commissioned, setting another GHH-built cornerstone in India's rapid industrialisation.

FEBRUARY 3, 1959, is a date of special importance in the history of India's industrialisation. On this day, with the official inauguration of the country's first public-sector blast furnace by President Prasad, the Rourkela iron and steel works, the first of three new steel plants completed within the Second Five-Year-Plan period, started production of pig iron.

This first blast furnace, as the third one (completed in June 1960 and commissioned on Jan. 6, 1962), was designed and constructed by Gutehoffnungshuette (GHH), Sterkrade AG, W-Germany, one of the oldest firms among the Ruhr enterprises in the field of heavy industry.

Before cutting open the tapping hole, President Prasad told the assembled Indian workers and engineers, and his German guests: "The going of the Rourkela steelworks into production... encourages one to feel that this region known for its mines' wealth bids fair to become in course of time the Ruhr of India. With the wheels of industry moving from Rourkela... one can be sure that the times are soon going to change for the better... Rourkela is a national undertaking and its working is going to have an impact on the economy of the whole country."

Since then some years have passed. The Rourkela works have been completed as originally planned. With the third of three 1000-ton blast furnaces in production now, the plant can produce about 1 million tons of pig iron annually, which is worked up into high quality products in the adjacent steel and rolling mills. GHH, with its wealth of experience accumulated during over 200 years, could ensure the setting up of the most modern blast furnaces with high economy.

THE ROURKELA BLAST FURNACES

The ores for the Rourkela blast furnaces are generally graded at the ore mine itself and from there transported to the blast furnace bins without any intermediate storage. The same is true of the coke, which comes from the coke oven plant in suitable sizes and is carried through a covered conveyor installation direct to the blast furnace bins. There is also a small ore and coke storage yard for emergencies.

From the Indian-manufactured bins the raw materials is discharged into GHH-supplied scale cars of which there is one for each furnace. A fourth scale car serves as a stand-by. The cars travel underneath the bins at a speed of about 150 m/min. Each of them has two receptacles of a holding capacity of 6 cu meters, wherein the required ore grades are weighed. The discharge flaps of the cars are so designed that the ore receptacles cannot be emptied until they stand over one of the two skips of a particular hoist.

The load is then carried in the skips to the furnace top, where the skips are emptied. The charging is effected automatically and can be supervised by one man from a control stand. However, the various charging operations, e. g. the filling and emptying of the scale cars, the skip travels and the bell movements, for an even distribution of the load in the blast furnace, can also be manually controlled.

The blast furnaces have a hearth diameter of 7.4 meters and a useful capacity of 1000 cu meters; their height is 65 meters above floor level. Each of them has one iron and two slag tapping holes. The tapping platforms are covered by a roof, the casting bays are equipped with cranes of liberal capacity. The hot metal flows into ladles which are carried on special cars to the steel mill or to the pig casting machine. The slag is carried to a heap. To each blast furnace belongs a group of three hot-blast stoves. In each of these 140,000 cu m./hr. of air is preheated to a temperature of 950°C before being blown into the furnace. The stoves have a diameter of 8 meters, a height of 37 meters and a heating surface of about 34,000 sq. meters.

For the transport of men and material there is a lift going up to the top of each furnace. Walkways between the furnaces, hot-blast stoves and bin installation permit easy inspection of the entire plant.

The liquid metal produced in the blast furnaces which is not for direct use in the steel mill, is

GERMAN EXPERTS APPRAISE ROURKELA

The 6-member German expert delegation who came to New Delhi with the purpose of studying working conditions of the Rourkela steelworks met with Steel Secretary Mr. N. N. Wanchoo.

The unanimous opinion of the German experts who had never been connected, either personally or through their organizations, with the construction of the steelplant in Rourkela, was that this steelplant compares favourably with the latest developments in Germany proper. The German supplier companies have always maintained that the equipment and machinery for the Rourkela steelworks were designed and manufactured according to up-to-date technological know-how and that they consider this equipment on the level with any other steelplant. There are no variations in the quality of these supplies.

Teething troubles during the running-in periods of any such technically complicated large units are normal. But, according to the German experts who visited Rourkela, once the operation personnel has gathered sufficient experience, production achievements and its economy will be that much more impressive. The running-in period for a plant like Rourkela must be calculated to last at least two years.

To help bridge this apparent gap from the time of the commissioning of the various plant installations to the time when rated capacities may be reached, or surpassed even, the German industry has put at the disposition of the Hindustan Steel Limited a supervisory team of experts for the plant's operation and maintenance. This personnel has been delegated by the German Industry at rather short notice and at a time when there is an extreme shortage of trained steel personnel in Germany. Provisions for such a team were not included in the original contracts. But now, German supplier companies have contributed substantially towards the costs of this team.

The members of the visiting experts' group, each of whom is holding a top-ranking position in the German steel-producing industry, emphasised their complete agreement to a continued support of the Hindustan Steel's efforts to bring Rourkela up to rated capacity production.

ADVERTISERS INDEX