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A Delicate Subject

Harassed foremen are daily being urged by the higher executives to keep their shops cleaner and tidier. They retort, often with good reason, that they have not the labour available. Yet they must somehow or other win through, and we suggest they make either for their own use or for submission to the "high ups," a report on the study of tidiness and "muck." The first effort to make to ensure orderliness in the shop is to list all the items causing trouble and find means for their disposal. No two foundries will produce the same list, but in the actual writing down of the items foremen will find that their proposals for the elimination of a number of sources of untidiness can immediately be written alongside. This will provide a basis for definite action. If some plant has to be dismantled causing heaps of bricks and the like, then early thought given to this subject can minimise the chaos by arranging in good time for transport for removal of the débris. In any case, forethought can perhaps convert temporary unsightliness by confining "rubbish" to a white square painted on the floor and duly labelled. Of course this is showmanship, but that is what the executives want to see.

Next there is the question of general "muck." This can be subdivided into litter, solid process—slag, excess sand and so forth—and dust. Litter is obviously avoidable and by methods open to the foreman, for example, entreaty, bullying and sarcasm (though, in theory, the use of the last and the penultimate are nowadays taboo), this can be achieved. So far as solid "muck" is concerned, we suggest the undertaking of a spot of arithmetic to inform oneself as to the weekly, or monthly, quantity to be handled. The total having been ascertained, then there should be some self-questioning as how best to handle it. Some original nebulous ideas may resolve themselves into helpful mechanical contrivances. Finally, there is the dust question. Some foundry managers allow weekly or daily periods to the semi-skilled men for keeping their machines clean. This is often a little expensive, but it is helpful, and may or may not pay dividends. However, the general effect on the appearance of the shop is worthwhile. Here, it is germane and we hope unnecessary to ask for the provision of smoother-surfaced castings for incorporation into foundry plant. Some we have seen are not too good. Then, of course, there is the incidence of overall dust. We suggest the foreman might usefully place shallow trays strategically around the foundry graduated so as to measure the rate of dust deposited. Then, in his report, he can give in figures the size of his problem. This will focus attention as to the places of emission and steps can be taken towards reduction or elimination. We do not know why, but personal observation has convinced us that a high shop always seems freer from dust than a low one.

Cleanliness and tidiness and the converse are abstract terms and can form the basis of any amount of argument without arriving at anything other than an exchange of acrimonious observations. If, however, the subject can be rationalised in the senses we have indicated, then there is a real chance of getting down to "brass tacks." The problem of keeping foundries and their associated shops in a state of orderliness is not easy, but candidly, if it is logically examined, it is not half so difficult as producing a really complicated casting.

Contents

British Industries Fair

Engineering & Hardware Section at Birmingham

The largest-ever exhibition of engineering products and hardware at the Birmingham Section of the British Industries Fair opened last Monday. This year total space has been increased by 50,000 to 488,000 sq. ft. and the number of exhibitors by 96 to 1,257. A cut of 20 per cent. in the individual stand space has been unable to make room for all the would-be exhibitors. The Fair is open from 9.30 a.m. to 6 p.m. daily (except Sunday) but up to 2 p.m. admission is restricted to trade representatives or buyers. The Saturday is, as usual, the day on which organised visits from works in the Birmingham area take place; the Fair closes on Friday, May 19.

Arrangement of Stands

A voluminous catalogue for the Birmingham section is on sale at the Fair (in addition, intending foreign visitors were issued with an advance edition). There are included alphabetical lists of exhibitors, an index of exhibits and a classified list of products. The main groupings in the Fair are:—A, hardware, ironmongery and brass foundry; B, building and heating; C, electrical; and D, engineering, metals, transport and gas. Perhaps the major interest for foundrymen is to be found in section D; yet it is not safe thus to generalise, for it may be that on a stand unconnected with his own industry an observant foundryman will pick up a useful idea, or discover a tool which just fits his requirement. Directions are included in the catalogue for finding any particular stand and, for those visitors from our industry who are methodically minded, it is perhaps wise to make an itinerary and stick to it. Others will doubtless be content to meander from one stand to another and this group may well be rewarded by finding merit in the unexpected. Exhibitors of castings number 48 firms for ferrous and 26 for non-ferrous; however, many other firms, especially in Section D, are showing castings either incidentally as parts of finished machines or as accessories to their products. Many well-known concerns are exhibiting foundry equipment and supplies. Unfortunately, it is impossible to consider the catalogue list as exhaustive, for other headings, such as:—Furnaces and crucibles; furnace fans, and ingots (non-ferrous), will have attractions for individuals. One concern, whose stand is almost exclusively devoted to the display of resin-bonded cores is not listed amongst foundry-material suppliers. Nevertheless, arming oneself with a catalogue is an insurance against excessive futile searching and serves as a useful directory afterwards for the office.

Unconsciously, when strolling around the Fair, it is the novelties which attract attention and yet perhaps this year they are fewer than usual, though there is much consolidation of earlier improvements in design. An autographic arrangement for drawing the stress-strain diagram for cast-iron test-bars was a welcome innovation shown on one stand. The development of a hot-air recirculatory mould drier on another, a new and larger jarr-squeeze-strip moulding machine of a well-known make, and a large steel bogie casting replacing an assembly on a fourth stand were the sort of things which caught the eye of the writer.

Where there is so much excellence displayed, it would be invidious to single out exhibits for special mention. However, there are apparent a number of general trends which may help the founder to gauge the importance of events and the prospects in the immediate future. First, there is the emphasis on attractions for export markets, this is not at all blatant, but is subtly compounded of technical performance, standardisation and fine finish. Next, there is a sort of "gadget" complex which this year seems to have permeated a larger proportion than usual. Fortunately, the "gadgets" are mainly worthwhile mechanical aids, conveyors, controllers, mechanical small tools and the like, all of which help production. No so much sheet metal and welded assemblies are this year on view; it may be that, now trading conditions are more normal, there is a reversion to more orthodox utilisation of castings. Fears of competition from plastics and the like are killed by the realisation on glancing round the stands of how much more business each new industry has brought to the basic industries. The needs of the small user have received perhaps overweighty attention this year, the safety-in-industry angle has been well stressed and there is by and large a remarkable absence of large machine tools—possibly the staging of separate exhibitions for sections of industry has had an effect in this and several other directions.

Finally, there is everywhere superlative recognition of the importance of good finish, clean design and pleasing colour as objects in themselves. Castings, vitreous-enamelled ware, finely ground and polished components and tiny details alike have been treated with great care and circumspection, not merely as "show dressing" but in an effort to render pleasing to the eye that which used to be accepted "in the rough." It is a feature which will prove a sound augury for the future of British goods in the export markets and will uphold our international reputation for only producing the best.

Transport Charges

The substantial increase in transport charges which is to take effect on May 15 will give rise to an increase in steelmaking costs of approximately 10s. per ton of finished steel. The iron and steel industry is anxious to avoid any action that might further aggravate the spiral of inflationary price increases and, particularly, they wish to avoid any weakening of the competitive position of steel-using industries in the markets of the world.

It has been decided, therefore, not to pass on to steel consumers these increases in transport costs and, for the present, the existing level of steel prices will be maintained. This decision has been made possible by the high outputs now being achieved by the industry which have permitted consequent savings in the import programme.

THE MORGAN CRUCIBLE COMPANY, LIMITED, announce a change of private address of Mr. G. C. Studley, who has represented the company in the Lancashire and Cheshire districts for the last 24 years, to The Cottage, Harrison Drive, New Plate Lane, Goostrey, Cheshire.

A SERIES OF FOUR LECTURES in the field of industrial electronics will be given by members of the staff of the Mullard Electronic Research Laboratories at the Engineering Centre, 351, Sauchiehall Street, Glasgow, C.2, on Thursday evenings, May 11, June 8, September 14 and October 12, commencing 7.30 p.m. They will be illustrated with lantern slides and demonstrations, and questions will be invited.

THE ANNUAL CONFERENCE of the Women's Advisory Council on Solid Fuel will be held from 2 to 4 p.m. on May 17 at the Henry Jarvis Memorial Hall, Royal Institute of British Architects, Portland Place, London, W.1. Speakers include Viscount Hyndley, G.B.E., Chairman, National Coal Board; Dr. A. C. Monkhouse, B.Sc., Ph.D., F.R.I.C., deputy director of fuel research, Fuel Research Station, Greenwich; Miss E. M. Leigh, technical officer of the Council, and the Countess of Elgin and Kincardine, D.B.E.

Refractories in the Foundry*

By Dr. W. F. Ford and Dr. J. R. Rait

Research on refractories for lining and patching cupolas and other foundry melting units is long overdue, mainly because, with these materials, quality has been regarded by suppliers as subordinate to price. Also, results in service were said to depend much upon the mode of application, without adequate realisation of what was good and bad practice. With this Paper, the Authors have done much to dispel the old ideas and have provided a wealth of data and critical comment which should lead to considerable improvement. Foundrymen should be able in the future to specify more clearly their requirements and put the control of application on a firm footing.

THE title of this Paper covers a wide field, but it is not proposed to survey the application of refractory materials, generally, in foundries, since this has been adequately carried out in the past. Instead, it is believed that a far more useful purpose would be achieved by considering in detail one particular type of refractory which is in daily use in most foundries—silica/clay mixtures.

Mixtures of silica and clay have for many years been the "Cinderella" or "poor relation" of the refractories industry, in that little attention has been paid to them, mainly owing to their low resistance to fusion. Comparatively recently, however, extended trials on side-blown converters have shown that monolithic silica/clay linings perform as well as silica-brick linings. This equality in service life is due to the formation by the refractory of a viscous melt which produces an almost impermeable glaze on the working face of the monolithic lining, and which slag can penetrate only by diffusion—a slow process. The "veneer" forms continuously ahead of the slag, moving towards the outer shell of the furnace as erosion proceeds.

In order to illustrate the factors which influence the service life of such monolithic linings it is convenient, as a basis for discussion, to examine seven proprietary mixtures intended for lining cupolas, converters, rotary furnaces, ladles, etc. The discussion will be concerned with chemical and grading compositions, constitutions, installation, and finally control of the properties of the mixtures.

TABLE I.—*Composition of Proprietary Brands of Converter Lining Refractories.*

Material.	SiO_2.	Fe_2O_3.	Al_2O_3.	TiO_2.	CaO.	MgO.	Loss.
A	88.4	1.0	7.0	0.5	0.2	tr.	2.4
B	89.5	1.4	5.2	0.4	0.9	tr.	1.5
C	89.6	1.2	5.0	1.2	0.2	tr.	2.1
D	88.4	1.6	5.0	0.5	0.4	0.3	1.8
E	88.3	3.0	4.8	0.6	1.1	tr.	2.4
F	88.0	1.0	6.4	0.7	0.5	0.3	3.0
G	93.0	1.0	3.2	0.3	0.9	0.2	1.2

Chemical Analyses

Table I shows that the chemical analyses of the seven mixtures under consideration are very similar. It must be realised that the analysis results indicate the average chemical compositions of the mixtures, no distinction being made between the chemical compositions of the coarse silica grains ("grog") and the fine grains, partly clay. This is an important point, to which reference will be made later, but at this stage it can be shown that definite conclusions can be drawn by considering the average chemical compositions only.

Since over 90 per cent. of the total weight in all the mixtures consists of silica and alumina, the latter mainly derived from the bonding clay, their melting behaviour can fairly adequately be deduced from the SiO_2-Al_2O_3 binary thermal equilibrium diagram, which is shown in Fig. 1. This diagram shows that progressive addition of alumina to silica lowers the temperature of final melting from 1,728 to 1,595 deg. C., and then raises it again. The composition having the minimum melting temperature—the eutectic composition—contains 94.5 per cent. SiO_2 and 5.5 per cent. Al_2O_3. All silica/alumina mixtures up to the composition of mullite (71.8 per cent. Al_2O_3) start to melt at the eutectic temperature of 1,595 deg. C. under equilibrium conditions. The percentage weight of "melt" in any mixture at the eutectic temperature depends upon the nearness of the composition of the mixture to that of the eutectic. For mixtures lying on the silica side of the eutectic point, the percentage of "melt" is given by the expression:—

$$\text{Per cent. } Al_2O_3 \text{ in mixture} \times \frac{100}{5{\cdot}5}$$

while the percentage of "melt" in mixtures lying on the alumina side of the eutectic point is given by the expression:—

$$\frac{(71.8 - \text{per cent. } Al_2O_3 \text{ in mixture})}{(71.8 - 5.5)} \times 100$$

Since the amount of "melt" formed at the eutectic temperature is the major factor in determining the softening behaviour of silica/alumina mixtures, it is to be expected that the silica/alumina ratios of the seven mixtures should be a fairly reliable guide to their resistance to fusion, i.e., to their refractoriness. Table II shows that this expectation is realised to a fair extent in that the four mixtures whose compositions are practically those of the eutectic have lower resistances to fusion than the others, with one exception. Perfect agreement cannot be expected, owing to the influence of impurities and the effect of grain size, but the increase in refractoriness exhibited by the two extreme compositions will be noted.

TABLE II.—*Refractoriness of the Materials Detailed in Table I.*

Mixtures.	SiO_2/Al_2O_3.	Refractoriness in deg. C.
A	92.7/7.3	1,700
B	94.5/5.5	1,550/1,600
C	94.7/5.3	1,600/1,620
D	94.6/5.4	1,600/1,620
E	94.9/5.1	1,580/1,600
F	93.2/6.8	1,550/1,600
G	96.7/3.3	+1,720

* A Paper presented to the Birmingham Branch of the Institute of British Foundrymen, Mr. H. G. Hall presiding.

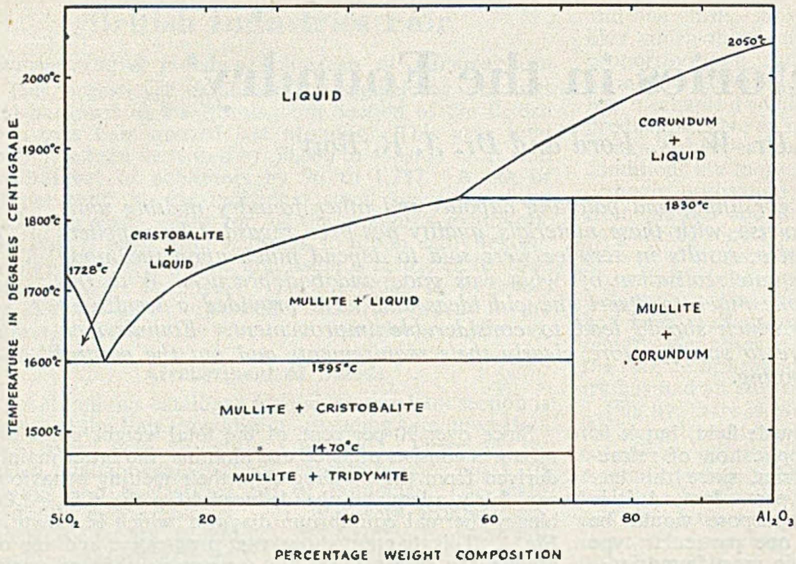

FIG. 1.—BINARY THERMAL EQUILIBRIUM DIAGRAM FOR SiO_2/Al_2O_3.

The amount of viscous " melt " produced on heating is obviously the first important factor influencing the formation of a " veneer." The fact that the compositions of four of the mixtures are such as to produce minimum refractoriness may be fortuitous, of course, but it appears that the manufacturers may have aimed at the eutectic composition. However, consideration of the behaviour of the mixtures in contact with slag cannot be eliminated, for reaction with slag probably plays some part in " veneer " formation.

Slag Resistance

For simplicity, it will be assumed that the slagging agent the siliceous lining will mainly encounter will be ferrous oxide. The conclusions reached will not be vitiated by this assumption, for similar relations hold with other slagging agents such as lime and manganous oxide.

Binary Thermal Equilibrium Diagram

It is instructive at the outset to consider the SiO_2-FeO binary thermal equilibrium diagram, shown in Fig. 2. Although the first reaction of ferrous oxide with silica causes " melt " to be formed at the low eutectic temperature (E_1) of 1,179 deg. C., the resistance of silica to this slag is comparatively high for two reasons: (1) the composition of the eutectic is far from the silica end, and (2) at a temperature of 1,705 deg. C. liquid immiscibility develops, *i.e.*, two liquids are formed which do not mix. The importance of the first point is that a large amount of ferrous oxide can be absorbed before eutectic melt content becomes excessive. The second effect causes " melt " content to rise only slowly with rising temperature, owing to the fact that the liquid immiscibility causes the " liquidus curve " to be displaced away from the silica end of the system.

The broken-line curve in Fig. 2 shows the probable path of the liquidus curve rising from the eutectic point had not liquid immiscibility developed, while Fig. 3 shows the effect on melt content at various temperatures. It will be seen that, in the absence of liquid immiscibility (broken lines), the absorption of only about 20 per cent. of ferrous oxide would have caused complete solution at 1,600 deg. C., whereas actually

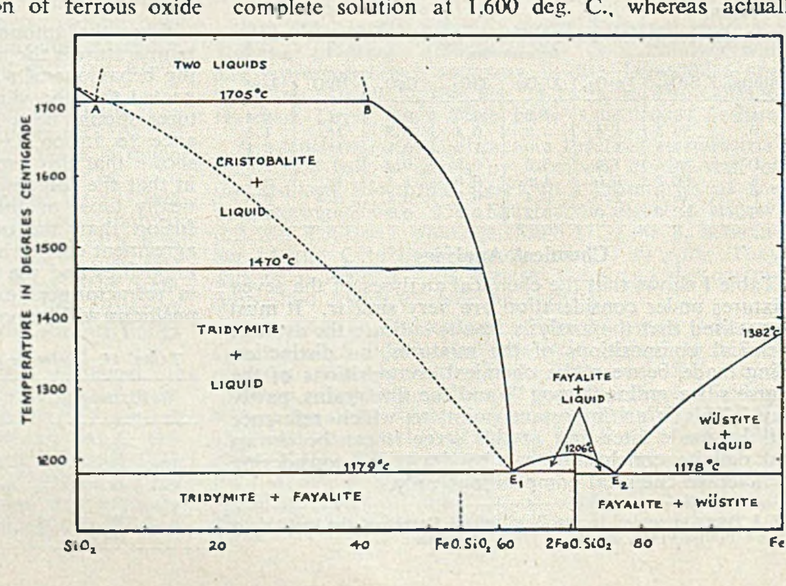

FIG. 2.—BINARY THERMAL EQUILIBRIUM DIAGRAM FOR SiO_2/FeO.

over 50 per cent. of the oxide is required for complete solution.

Ternary System

The presence of only a small amount of alumina, however, causes liquid immiscibility to disappear, as shown in Fig. 4—the SiO_2-Al_2O_3-FeO thermal equilibrium ternary system. The area in which liquid immiscibility occurs in the ternary system is limited to that labelled "two liquids." In general terms, this means that the advantages of liquid immiscibility are reduced, although its presence does steepen the liquidus surface in the relevant part of the ternary system.

In considering the ternary system, one is at a disadvantage in that the melting temperatures indicated on the version of the diagram generally accepted are limited to invariant points. However, this does not prevent general conclusions being drawn. The mixtures under discussion lie on the silica/alumina edge of the diagram of Fig. 4, near the eutectic composition at 1,595 deg. C. The theoretical melting behaviour of any mixture can be obtained by first drawing a straight line from the FeO corner to the composition of the mixture on the binary edge. The amount of iron oxide in the ternary mixture is proportional to the distance of the ternary composition along this straight line; thus, if the straight line is 5 in. long and the ternary composition lies 0.5 in. from the binary edge, then the ternary composition contains 10 per cent. FeO.

Ternary mixtures high in silica content can be divided into two classes. Those whose compositions fall on the right-hand side of the "tie-line" joining silica to hercynite (FeO . Al_2O_3), start to melt at the ternary peritectic point of 1,205 deg. C., while those on the left-hand side of this line start to melt at the ternary eutectic of 1,073 deg. C. It will be seen that very little ferrous oxide is required to shift the compositions of the highly-siliceous mixtures to the left of the line, more FeO being needed as the alumina content rises. At first sight, this suggests that the resistance of silica/clay mixtures to ferrous oxide should rise

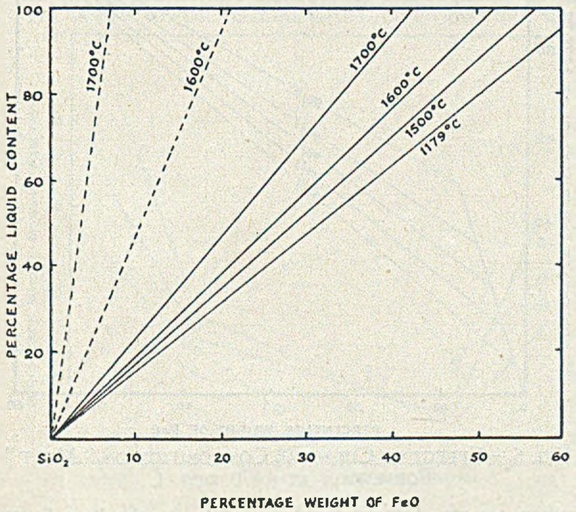

Fig. 3.—Effect of "Melt" Content at Various Temperatures.

with alumina content. However, calculation from the diagram gives the relationships shown in Fig. 5, which illustrates the variations in liquid content with ferrous oxide content for mixtures whose compositions range from 99 per cent. SiO_2, 1 per cent. Al_2O_3, to 90 per cent. SiO_2, 10 per cent. Al_2O_3.

Fig. 5 shows that, generally, the "melt" content increases, or the slag resistance decreases, with rise in alumina content. The difficulties inherent in considering the overlapping part of the relationships may be resolved by noting that for all mixtures the melt content falls after a certain amount of ferrous oxide has

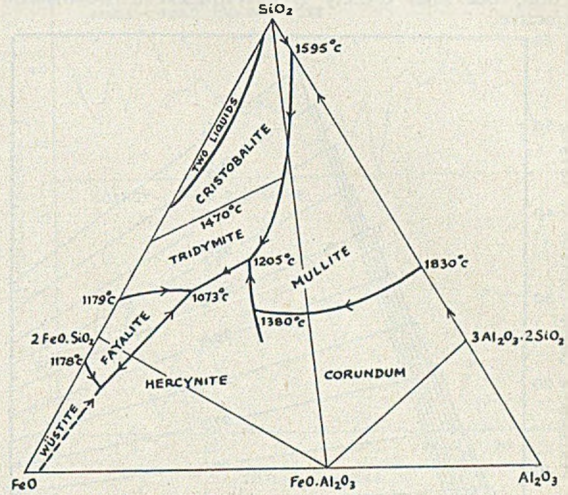

Fig. 4.—Thermal Equilibrium Ternary System for $SiO_2/Al_2O_3/FeO$.

been absorbed. It can in fairness be imagined that a reaction to produce "melt" will take place more readily than further reaction to reduce "melt," and it is possible that a reaction will tend to stop at the point where the optimum "melt" content is reached. The inference that resistance to iron oxide will decrease with rise in alumina content is supported by the data of Fig. 6, which show the effect of chemical composition on melt formation at 1,470 deg. C.

Constitution

It appears, therefore, that the bonding clay in the refractory mixture, which supplies most of the alumina, must be present in as small a proportion as possible, consistent with the development of adequate green- and dry-strength for ramming purposes. The logical use of a bentonite bond is prevented on the score of cost in this country and resort has to be made to clays of the kaolinite type, from which the required plasticity can be obtained by adequate sub-division.

A most important point arises here. In the absence of fine silica in the mixture there will be a great difference in the chemical compositions of "grog" and "bond," the lower slag resistance of the latter resulting in a tendency for the grog grains to be leached out of molten matrix. If, however, the composition of the fine bond is made that of the silica-alumina eutectic, then the bond will be fairly resistant to slag attack, which will be further reduced by the existence of optimum conditions for "veneer" formation. This adjustment of composition can best be achieved by the use of siliceous clay for bonding, the high content of fine quartz in such clay guaranteeing that the bond composition will not be far removed from that of the eutectic. Mixture G, the composition of which accords with these principles, was found in practice to give superior "lives" to the other ramming compositions.

Grain-size Distribution

The higher the density of the rammed lining, the longer its service life. High density produces two

Refractories in the Foundry

effects: it presents a larger mass for the slag to dissolve and it hinders penetration of the slag by reducing porosity. In the case of silica/clay mixtures the latter may be unimportant, owing to "veneer" formation, but high density is nevertheless a worthy objective.

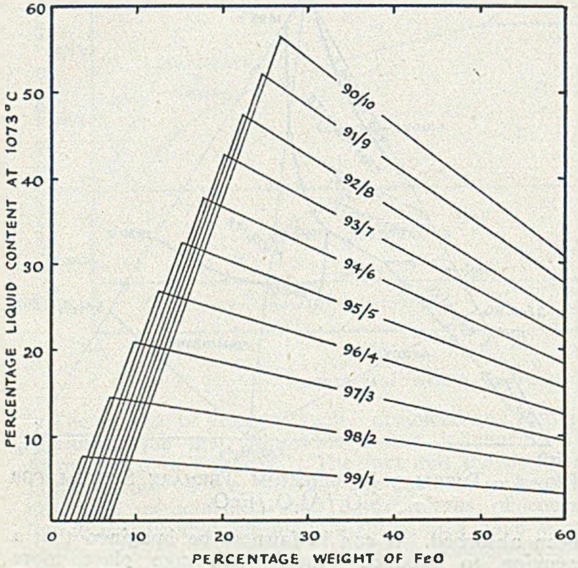

Fig. 5.—Variations in Liquid Content with Ferrous Oxide for Mixtures with a wide SiO_2/Al_2O_3 range.

In a moulding sand, the variation in grain size must be small, for the structure produced by packing grains of equal size contains a high proportion of voids and hence has a high permeability to gases. The opposite is the case for the monolithic lining and it is essential that the mixture should contain medium and fine grains to fill the voids between the coarse grains.

In Fig. 7 the bold lines represent the theoretical grading limits for giving optimum density for the grain sizes used in the mixtures under discussion. It will be seen that mixture D most closely approaches the theoretical grading; the grading of mixture G (not shown) is very similar. Mixture A is badly graded, containing far too high a proportion of medium-sized particles. Mixture E contains too much "silt" grade and will give a poor packing density.

The principles laid down in the last two sections suggest that the ramming composition giving optimum service life should consist of (say) 40 per cent. coarse silica, 10 per cent. medium-grained silica and 50 per cent. siliceous clay. If the composition of the fine bond were, or could be adjusted to, that of the silica/alumina eutectic composition, then the clay content would be about 7 per cent. and the average chemical composition of the mixture would be, neglecting impurities, 97.2 per cent. SiO_2 and 2.8 per cent. Al_2O_3.

Installation

The principles laid down favour the use of compositions of low moisture content, *i.e.*, those mixtures used for ramming round a former. For such mixtures, full advantage can be taken of the high packing density, owing to the far higher ramming pressures employed. Mixtures intended for "slabbing on" must inevitably contain higher clay contents to make for ease of working and hence cannot give optimum results.

An interesting point arises in connection with the drying of the rammed lining. At Sheffield University it has been shown that the moisture retreats from the face being dried and hence a moisture gradient is built up inside the lining. This tends to hinder the drying procedure, since it is difficult for the moisture to get away from the back of the lining in contact with the shell of the furnace. It might prove advantageous, therefore, to dry the rammed lining by applying heat from the outside and using a current of air through the inside of the lining to sweep away the moisture evolved.

Here again the drier type of rammable mixture is best adapted to such applications, for the higher moisture contents used in the other type of application may cause slumping of the lining, particularly in the case of a rotary furnace, owing to the increase in plasticity of the inner face caused by water migration.

Bursting

Quartz rock theoretically becomes unstable above 870 deg. C., but heating to 1,200 to 1,300 deg. C. is usually required before the rate of conversion of quartz into the other forms of silica, cristobalite and tridymite, becomes appreciably accelerated. The quartz in the working face of the lining quickly becomes converted to cristobalite, and, since a large expansion results from this conversion, the structure of the lining tends to open up, facilitating the ingress of fluxes. For this reason, manufacturers often add crushed silica bricks, consisting mainly of cristobalite, to the lining mixture so as to reduce the growth of the working face.

Occasionally, the shells of rotary furnaces burst owing to the expansion of the refractory lining. This is not due to the growth of quartz, which is confined to the inner zone of the lining where the temperature is sufficiently high for rapid quartz conversion. Nor is the bursting due to the expansion which occurs when quartz changes from the alpha to the beta form at 575 deg. C. Instead, it has been found, by consideration of the relative thermal expansions at different points in the lining thickness, that the bursting is due to the presence in the lining mixture of excessive cristobalite. This form of silica undergoes a marked expansion in the 200 to 275 deg. C. temperature range. With a given temperature gradient through the lining, it can be shown that the thermal expansion falls off towards the cold end much more slowly with mixtures

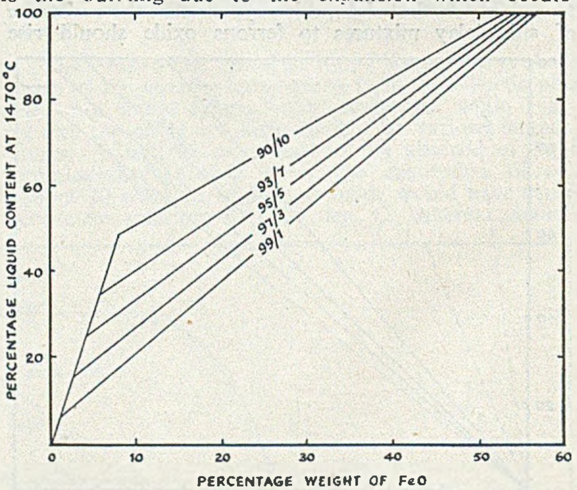

Fig. 6.—Effect of Chemical Composition on "Melt" Formation at 1470 deg. C.

containing cristobalite than with mixtures containing only quartz. It is apparent that excessive expansion at low temperatures, where there is no pyro-plasticity to take the strain, is responsible for bursting. The remedy is to limit the amount of cristobalite in the mixture.

Control

The importance of alumina content, constitution and grading composition has been stressed. To determination of these three factors must be added tests for the "rammability" of the silica/clay mixture. Routine A.F.S. tests for moisture content, green- and dry-strengths will provide adequate control here.

Alumina content can, of course, be determined by chemical analysis, but, even with the rapid methods available now, this is an expensive and time-consuming test and for routine control must be replaced by simpler methods. If it be assumed that the clay bond is kaolinite, then the clay content can be derived from the alumina content by multiplying it by 2.5, and from the loss-on-ignition by multiplying it by 7, provided that this loss is due solely to evolution of combined water from the clay. Table III shows the clay contents of the seven mixtures, calculated in both ways.

TABLE III.—*Clay Content by Calculation of the Materials Detailed in Table I.*

Mixture.	$Al_2O_3 \times 2.5$.	Loss × 7.
A	17.5	16.7
B	13.0	10.0
C	12.5	14.4
D	12.5	12.6
E	11.9	17.1
F	16.1	21.3
G	7.1	7.0

The clay contents derived from loss values are subject to serious error where the material contains carbonaceous matter, as in mixtures C, E and F. A better method in such cases is to determine the water evolved on ignition by absorbing it in calcium chloride.

A rapid test for determining constitution, in particular the proportion of cristobalite, is difficult to devise. The X-ray powder method is the most rapid but, since

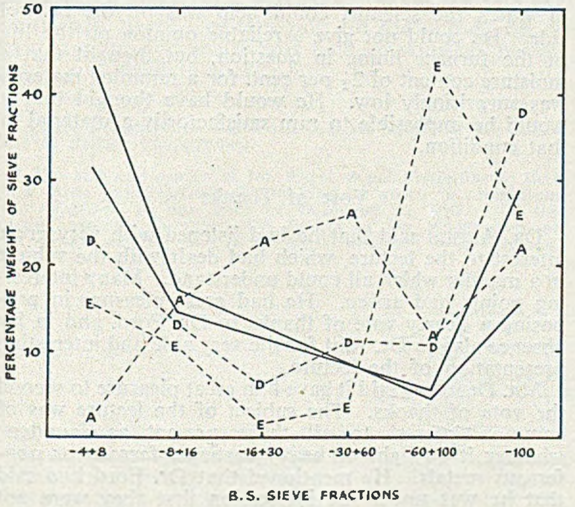

FIG. 7.—THEORETICAL GRADING LIMITS FOR OPTIMUM PACKING DENSITY OF GRANULAR SOLIDS.

quartz gives a very strong X-ray pattern, the limit of detection of cristobalite in its presence is high and quantitative determinations require the development of "standard" mixtures and a calibrated photometer. With experience, it is possible to obtain a fairly reliable estimation of the quartz/cristobalite ratio by microscopic examination of the powdered mixture. The results of microscopic and X-ray examination of the seven proprietary mixtures are shown in Table IV. Both methods show that all mixtures except A, C and F contain crushed silica brick, but only qualitative estimations of the proportions are possible.

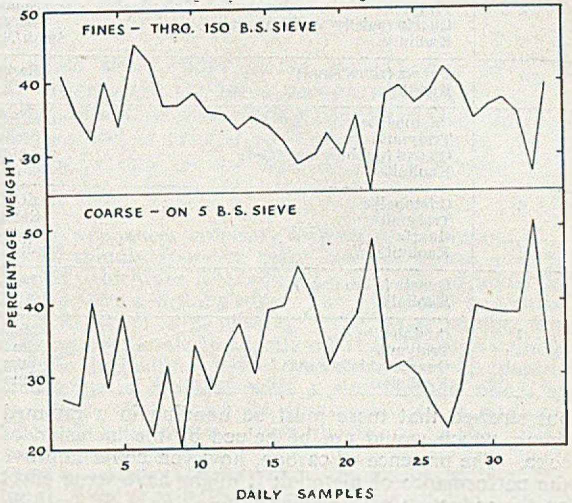

FIG. 8.—GRADING TESTS ON A CUPOLA PATCHING GANISTER.

Grading compositions can quickly be determined on every batch of the mixture being used, by washing a representative sample free from clay, drying the residue and feeding it through a bank of standard sieves on a vibrating machine. The clay content cannot be determined this way, for the clay fraction washed off inevitably contains fine quartz. The results shown in Fig. 8 are for a cupola patching ganister, on the preparation of which very little control was exercised. The products from edge-runner mills can be far more consistently graded than this, merely by controlling the batch weight and the time of milling.

DISCUSSION

MR. DOLPHIN said he had been particularly interested in the lecture on refractory materials because in endeavouring to learn more of the subject from books, one quite frequently became confused, and the lecture had cleared up many points. He was particularly interested in refractory materials used in rotary furnaces, but thought that if it was proposed to dry linings from the outside, a great deal of heat would be necessary, as it had to be perfectly dry inside as well as outside, the inside being more important. He thought that an interesting point was that drying could be tried both from inside and out, by putting the furnace body into a large stove.

DR. FORD said that many books had been written on the subject of refractories, which he agreed could be very confusing, and he himself recommended the book by J. H. Chesters—"Steel Plant Refractories" as having a balanced viewpoint.

Coke Additions

MR. MARLES thanked Dr. Ford for his very interesting remarks, and would like to ask about a new method of lining cupolas. He said that about two years ago, the Birmingham Branch had had a Paper presented concerning a suggestion that a rammed lining, using ganister mixed with fine coke could be used. Could Dr. Ford give any information about this?

DR. FORD said that he had not heard of the suggestion,

TABLE IV.—*Constitution of Rotary Furnace Lining Materials.*

Sample.	Phases observed by the microscope.		Phases identified by X-ray.	
A	Quartz (quartzite rock) Kaolinitic clay	Large Medium	Quartz Kaolinite	Large Medium
B	Cristobalite Tridymite Quartz (chiefly as silica sand) Kaolinite	Small/Medium Small Large Small/Medium	Cristobalite Tridymite Quartz Kaolinite	Small/Medium Small Large Small/Medium
C	Quartz (silica sand) Kaolinite	Large Small/Medium	Quartz Kaolinite	Large Small
D	Cristobalite Tridymite Quartz (pebbles and sand) Kaolinite	Small/Medium Small Large Small/Medium	Cristobalite Tridymite Quartz Kaolinite	Small/Medium Small Large Small/Medium
E	Cristobalite Tridymite Quartz Kaolinite	Small/Medium Small Large Small/Medium	Cristobalite Tridymite Quartz Kaolinite	Small/Medium Small Large Small/Medium
F	Quartz (silica sand) Kaolinite	Large Medium	Quartz Kaolinite	Large Medium
G	Cristobalite Tridymite Quartz (chiefly sand) Kaolinite	Medium Small Medium/Large Small	Cristobalite Tridymite Quartz Kaolinite	Medium Small Medium/Large Small

but stressed that there must be bonding in a rammed lining, which would not be helped by the inclusion of coke. The presence of carbon, however, could improve the performance of material; it might have some effect on the reduction of the silica.

MR. HANSON asked if bentonite could be used, as this was far more plastic. He did not think that it had ever been used for bonding the silica/clay mixtures, probably because of its very high cost.

DR. FORD replied that although bentonite could be used, it introduced a quantity of alkali into the mixture which could reduce its refractoriness. He agreed that the high cost was a serious objection.

Bricked Linings

MR. H. G. HALL, branch president, said that it seemed obvious that many of the failures in regard to rammed linings of cupolas could be attributed to the use of the wrong grade of material, and asked if the Authors agreed that was the case. Furthermore, would Dr. Ford confirm that his arguments on the necessary amount of clay applied equally to a brick lining. He asked if there was very much difference in life between the so-called super-bonding clay and the ordinary fireclay, when used as a jointing material in bricked cupolas.

DR. FORD said that he could confirm fairly definitely that the siliceous clay was important and the production of a viscous "melt" was equally important with a brick lining. Regarding bricked cupolas, in Sheffield it was considered entirely wrong to operate with the original brick lining. The practice was to start off with a brick lining and then continually add cupola ganister in the melting zone, so that, theoretically, one never worked back to the brick lining.

MR. DUNNING referred to Dr. Ford's remarks regarding silica linings not producing a "veneer," and asked if Dr. Ford had thought of painting a silica lining with a siliceous clay, in order to produce a veneer.

DR. FORD said he had not tried it himself, but he thought it was a very good idea.

MR. HALL suggested that the question as to the effect of the iron-oxide content on the slag was important. Many linings had failed, not because the refractory materials were at fault, but because the furnace had been run badly.

DR. FORD agreed with this.

What is a Reasonable Life?

MR. CALLAGAN said that he thought that not enough tudy was given to the theory and chemistry of refractories, and as a result there was a tendency to take materials offered by the suppliers, and judge from the results obtained. Using a rotary furnace, such as had been mentioned in the lecture, he had obtained 250 melts from a 9 in. lining, melting high-duty irons with medium percentages of nickel and chromium, he would like to know if that was a reasonable life. He had not encountered the expansion bursting described.

Mention had been made of moisture content of 8 per cent. and up to 15 per cent, for rammed linings. He was always very keen to have moisture content of the order of 2½ per cent., and to ram it in one continuous operation, ramming very hard and taking something like 24 hrs. over the drying, so that there would be a uniformity of moisture content throughout.

DR. FORD said he thought the more one delved into the refractory field, the more it was realised that there was still much fundamental ignorance. The only way in which the scientist could help was on the control side. He could not give a reliable opinion on the life of the furnace lining in question, but thought that a moisture content of 2½ per cent. for a ramming material was surprisingly low. He would have thought that it would be impossible to ram satisfactorily a material in that condition.

Vote of Thanks

DR. ANGUS said that he had listened with very great interest to the lecture, which had dealt with the subject in a manner which all could understand. Many interesting points had arisen. He had great pleasure in proposing a hearty vote of thanks to Dr. Ford, and in his absence also to Dr. Rait for the very able and interesting presentation of the lecture.

MR. DUNNING said it gave him great pleasure to second the vote of thanks. The subject of the lecture was of common interest to all those present as founders, whether it be light or heavy castings, ferrous or non-ferrous metals. He mentioned that Dr. Ford had said that he was under the impression that they were not very interested in control, and he thought that if that were so, the lecture had made everyone realise that they ought to be. He congratulated Dr. Ford on the excellent way in which he had presented the lecture.

DR. FORD in responding, said that the science of refractories was expanding rapidly, since the last war especially. Up to then, no-one had a very great knowledge of refractory materials, but the war had stimulated interest, and progress was being made.

Casting of Large Gear Wheels*

By *W. H. Hopkins, J. H. West, and H. G. Goyns*

Three Authors discuss in turn the manner in which they would tackle the founding of large gear wheels in cast iron, bronze and steel. Comparing the three accounts brings out the differences in foundry practice according to the moulding and casting characteristics of the metals under consideration. In each case, the method is related to "one-off" production, and the Author assumes the tackle available to be that of the type of foundry with which he is associated.

TWO designs of spoked gear wheels, 8 ft. 2 in. diam., were considered in these accounts. Their main dimensions are shown in Fig. 1, the difference being in the shape of the wheel spokes, the upper wheel having spokes with a section in the form of a simple cross, and the lower H-form spokes. An isometric view of the wheel with simple-cross spokes is shown in Fig. 2. Many foundrymen might disapprove of the rather complicated design, but for the purposes of this discussion the job was assumed to have been accepted for production.†

MOULDING FOR CAST IRON

By W. H. Hopkins

Two gear wheels are to be made in high-duty cast iron; the H-arm wheel will be dealt with first.

The most suitable method for making such a gear wheel would be by the sweeping-up method. This is an instance when it is possible to dispense with the expensive method of making full patterns. The cost of making a full pattern would be approximately £190, as against the cost of strickles, etc., of about £50. This job requires the provision of striking boards for preparing the cope and drag parts of the mould; core-boxes for the arm cores, slot cores in the rib and the centre-boss core, a pattern ring for the outside rib, a pattern print for centre-boss core, making-up pieces, gauge and levelling sticks.

* Paper presented to the South African branch of the Institute of British Foundrymen.

† The size and design of the wheel is not dissimilar to that of a large pulley wheel, the making of which in aluminium was described in our issue of December 29, 1949. In the earlier example, however, the spokes of the wheel were of box section and the face of the wheel was very wide.—EDITOR.

The appliances necessary to prepare this mould consist of spindle, footstep, collar, and, of course, striking boards, which are levelled-off to an angle of about 20 deg. to form a striking edge. The board will be rotated with its bevel edge leading. The strap holding the striking board will be slightly offset so that the striking edge of the board is central with the axis of the spindle. The strap is provided with a slot through which to pass bolts when fixing the striking boards in position. The collar is used to adjust the board to the height required and is set by means of a set screw. Both striking boards will be made to extend beyond the limits of the mould, the purpose of this extension being to form the mould joint. The upper surface of the striking boards in each case should be planed at right angles to the vertical surface which abutts on to the spindle. If the spindle is upright the top and straight parts of the board will be truly horizontal. A spirit level can thus be used in setting the spindle in an upright position. Owing to the very considerable overhang of these boards the spindle diameter would be 3 in. It is better to err on the heavy side, as a consequent increased rigidity produces more accurate work. It will be noticed that a collar is used instead of revolving the spindle; the reason for this is that, unavoidably, when the spindle is revolved particles of sand find their way into the footstep and cause undue wear. The spindle consequently becomes a loose fit.

Moulding Operations

The drag part of the mould for this gear wheel will be prepared in the foundry floor over a cinder bed, this bed to be laid about a foot below the bottom surface of the mould. A hole is dug in the floor of a suitable size and depth, the cinders laid, and the footsteps placed in position. The striking board and collar the then attached and the spindle is set upright. The

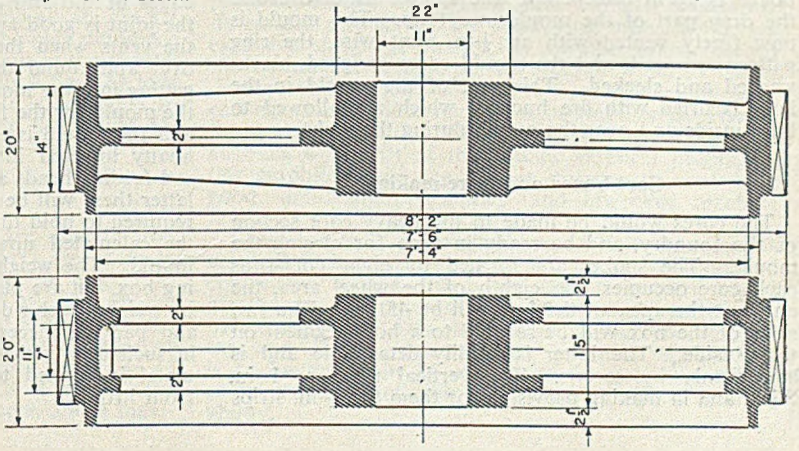

FIG. 1.—SECTIONAL VIEW OF GEAR WHEEL SHOWING METAL THICKNESSES: SIMPLE-CROSS-SPOKED WHEEL (TOP) AND H-ARM WHEEL (BOTTOM).

Casting of Large Gear Wheels

striking board, when rotated, should be horizontal in all positions. Pipes are then laid from the cinder bed to above floor level, outside the area to be occupied by the cope. Floor sand is then rammed over the cinders to within a few inches of the lower edges of the striking board. A ¼-in. vent wire is then used freely over the area rammed. Facing sand is then rammed over the floor sand until the striking edges of the sweep are reached. One course of bricks is then laid in a circle round the inside of the mould, using the strickle as a guide. The strickle is then removed. The bricks are then built up to mould height, at the same time ramming up the mould; facing sand is used freely where the mould will eventually be swept up. The whole being rammed up nearly to floor level, the top or reverse mould striking board will be set in position. The top contour of the mould will then be swept up and the joint made.

The running and risering must be considered at this stage. In this case five Meehanite-type risers would be used as it is proposed to cast this wheel in "C" grade Meehanite. Four riser sticks will be placed at 90 deg. over the outside section where the teeth will eventually be cut, the other riser to be placed on the centre boss. It should be mentioned here that ⅜ in. machining is allowed on the outside of the wheel and ¼ in. in the bore. The four risers on the outside will be 3 in. by 5 in. at the bottom and shaped up to 6 in. in. at 3⅛ in. from the casting. The riser on the centre boss will be 3½ in. by 6 in. at the bottom and shaped up to 7½ in. at 3½ in. from the casting. The mould will be run with two downgates 2-in. dia., 12 in. between centres.

The ring rib pattern is then secured in position, parting sand is thrown on the mould, and the cope is lowered into position and staked as if a pattern were embedded in the sand. The cope is then rammed up with the riser, runner and vent sticks in position, hooks are used where necessary and the cope is vented freely. The cope is then taken off after first drawing all sticks. It is then rolled over, the ring pattern is withdrawn, and the mould is finished, blackwashed and sleeked ready for the drying stove. The risers will have a Vee made on the part adjacent to the casting to prevent breaking in.

Finishing the mould in the floor is the next operation. The sand is removed from the centre down to the required depth and the bricks are removed. The centre core print is now positioned over the spindle and the ring pattern is secured into position. The bottom board is again attached to the spindle as before and the drag part of the mould swept up. The mould is now freely vented with an ⅛-in. vent wire, the ring pattern removed, and the mould cores sprigged, blackwashed and sleeked. This part of the mould in the floor is dried with fire buckets, which are allowed to burn inside and over the mould during the night.

Core-boxes and Core-making

The cores would be made in the heavy core section of the foundry, and be ready in time for closing the mould. The spokes are formed by eight cores; as each core occupies one eighth of the wheel area, the angle at the apex of the box will be 45 deg. The two sides of the box will be secured to a boss segment on the outside. The latter is readily detachable and is held firmly by screws. The vertical ribs are 1 in. thick, and in making provision for them two ½-in. strips

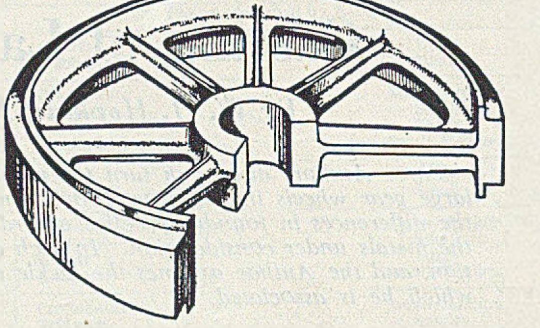

FIG. 2.—ISOMETRIC VIEW OF GEAR WHEEL, DIAMETER 8 FT. 2 IN., SHOWN IN FIG. 1 (TOP).

are fixed permanently on each side of the core-box. The box consists of six loose pieces, one set of three for the bottom and three for the top to form the ribs.

To make the core, the box is first assembled without the top set of loose pieces, sand is then rammed against the bottom and outer walls of the box; and a grid which has previously been cast to a suitable shape in open sand is then placed in the core box, the inner part is filled with cinders and sand is rammed round almost to the top of the box, when the top set of loose pieces are put in position and the core is finally rammed up. The box is then dismantled, finished and dried in the usual way. The core for the centre and the core for hole in the rib will be made in half core-boxes and vented with a wire through the centre. Provision will, of course, be made in the mould and spoke cores to take the gases away.

Coring Up and Closing

With moulds and cores dry, the coring of the mould is commenced, the centre-boss core being first lowered over the spindle down to the print. The eight cores are located accurately either by measurement or preferably by means of gauge sticks. The space between each core will be 1 in. and four strips of this section will be used at each diagonal corner at the side. A gauge stick will be used across the arm cores and joint to see that the former are correctly set to height, otherwise there may be a crush when the top is placed on. The cores to form the holes in the rib are now put in position, care being taken to see that no metal can get into the vent. Sand is now sprinkled round the edges of the arm cores and centre core to make sure the joint is good and to ensure that no metal runs into the vents when the mould is cast. Oil is used freely over and round this loose sand to prevent the sand getting into the mound. The cope is then lowered over the mould for the first time. The cope is then removed and the mould is examined; if satisfactory, the cope is finally lowered into position. The runner box and and feeding heads are then made up—in the case of the latter these will be 18 in. above the casting. The weight required to hold this mould down is 12 tons, this being the calculated upward pressure of the metal in the mould. The weights are not supported by the moulding box, but are placed on girders, which are supported by weights each side of the mould. Convenient weights and packing pieces are then placed under the girders in such a way that when the upward pressure of the metal is applied to the cope the latter is prevented from lifting.

Casting

This casting will weigh when fettled approximately 6½ tons; 7¼ tons of metal will be required for casting, this extra metal to provide for the runners and risers. Two iron stops will be placed in the downgates. The metal in the ladle should be 1,400 deg. C. and well skimmed. Pouring is commenced, skimming the metal at the same time. When the runner basin is nearly full, the two cast-iron stops are removed. Care must be taken to see that the runner basin is kept full throughout the cast to prevent any slag or dirt entering the mould. When the mould is full the runner box should be about three quarters full; sand is then thrown over the metal in the basin and a plate is put over it and weighted. Metal is then poured into the risers until all have 18 in. of metal above the casting. It is better to put a little metal into each riser to ensure that each head is of the same temperature. Flux is then stirred into each head with a hot rod. All heads are then covered with dry sand and the mould is allowed to cool. All this is done with the object of obtaining progressive solidification, and the metal should set in the head last.

Simple-cross-spoked Gear Wheel

Turning to the moulding of the gear wheel with the spoke sections in the form of a simple cross (Fig. 1, top), the mould would again be struck-up with strickles, but in this case the arm cores would be dispensed with. The mould will be struck up to form the top contour; parting sand will then be sprinkled on and centre lines will be drawn across the mould, each line being at an angle of 45 deg. to the other. Provision would be made for eight patterns the shape of the rib. These will be placed accurately on the centre lines and secured in position. The ring rib pattern is then placed in position, facing sand is then rammed around these patterns and the cope is lowered over and rammed up as in the first instance. The cope is then rolled over, the ring pattern and rib patterns are removed, and the cope is finished ready for drying.

The bottom mould is then swept up with the bottom board, at the same time securing the ring and rib patterns in position, using as a guide for the rib pattern the centre line drawn across the joint. The strickle will determine the correct height. A frame is provided to make the core for the holes in the arms, and this frame has sides at 45 deg., which are placed on the centre lines of the arm rib patterns. When the frame is correctly positioned, it is secured to prevent movement and the core is rammed up to form part of the bottom mould; this is repeated eight times to provide the eight holes in the arms. The rib and ring patterns are then removed and the mould is finished in the usual way. The moulds are dried and closed in exactly the same way as in the first instance, the only difference being that there are no arm cores to put in the mould. As this casting will weigh approximately 6 tons, 6¾ tons of metal will be tapped to cast it. It is advisable to allow these types of castings to stay in the mould for a lengthy period to make sure that no undue stresses are set up in the casting on cooling.

Sand Mixtures

Wide variations of sand mixtures are used in iron foundries, but the bulk of heavy castings are made in natural-bonded sand, to which coal dust is added. In all heavy dry-sand work, facing sand is used on the mould face and backing or heap sand is used for the other parts of the mould. In general, the larger or heavier the section of metal the coarser the grade of coal dust used. A good quality coal dust would have a volatile matter not less than 30 per cent. and a maximum of 10 per cent. ash. A good facing mixture for heavy work will have about 30 per cent. new sand, 64 per cent. return sand and 6 per cent. coal dust. The moisture content would be between 6 per cent. and 7 per cent.; green bond, 8 lb. per sq. in.; permeability, 30 to 40; dry strength, 90-100 lb. per sq. in.

For dry-sand moulds, plain carbonaceous blackings are generally used, with the addition of clay, molasses or core gum as binder. Where a particularly good surface finish is required, a proportion of fine plumbago, or silica flour, is added. Since plumbago is considerably more expensive than most blackings, its use is naturally restricted. A small proportion of common salt is sometimes added to a blackwash to assist in bonding the blackwash to the mould surface. The viscosity of blacking when swabbed should be around 45 to 50.

Metal Properties

These wheels can be made in high-duty irons, all of which will have excellent properties. However, as the Author is working in a Meehanite foundry, and has selected grade "C" Meehanite as the metal most suitable in this instance, the physical properties and general characteristics of this metal are:—

Tensile strength	18 tons per sq. in.
Modulus of elasticity ...	17.5×10^6 lb. per sq. in.
Transverse strength on 1.2-in. bar with 18-in. centres	2,900-3,300 lb. breaking load.
Compressive strength ...	67 tons per sq. in.
Impact strength	4.5 ft./lb.
Shear strength	18 tons per sq. in.
Brinell (as-cast)	200. (It would be possible to bring the surface up to 500 Brinell by flame hardening)
Patternmakers' shrinkage...	⅛ in. per ft.

Closeness of grain and uniform solidity through all sections are the basic essentials of good castings, though the one is not necessarily the complement of the other.

The relative densities (specific gravity) of steel, grey cast iron and Meehanite are respectively 7.90, 7.02, 7.48, according to type. Steel has a higher density than grey cast iron or Meehanite, but since steel shrinks some 9 to 12 per cent. during the process of solidification in the mould, it presents certain obvious difficulties in the way of producing uniformly solid castings. Meehanite, although structurally similar matix to an 0.85 per cent. carbon steel, contains 7 to 10 per cent. by volume of graphite flakes, a substance whose specific gravity is only about one quarter that of steel. The presence of this light voluminous material, uniformly distributed throughout the solidifying mass, neutralises excessive shrinkage—hence, by careful adjustment of the manufacturing process, the cycle of volume changes during solidification, and is so controlled that solid castings are possible regardless of form or dimension. Besides compensating for excess liquid shrinkage and enabling a control of the specific physical properties, this graphite serves the further purpose of conferring good anti-friction qualities and improved machine finish.

Exact control of composition and of structure is essential if gears are to wear well and give good and continuous service. Ordinary cast iron often varies greatly in its physical properties, and even with Meehanite metal some knowledge of the type of gearing and service demanded is essential if the best is to be got from its use. Iron for gears should be as hard as is practicable consistent with good machinability.

Casting of Large Gear Wheels

MOULDING FOR BRONZE

By J. H. West

Before presenting his contribution as to how the casting under discussion could be manufactured in a non-ferrous foundry and cast in bronze, the Author would like it to be appreciated that he does not claim to be an expert in the production of large non-ferrous castings. He has had no experience with anything heavier than about 1,200 lb. in weight.

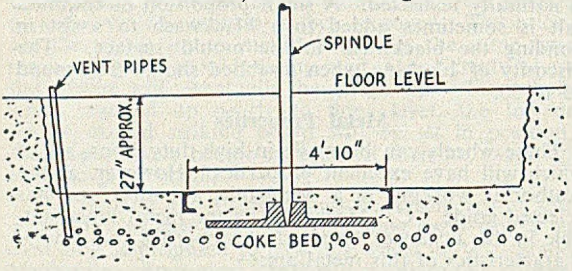

FIG. 3.—SHOWING THE DRAG HALF MADE IN THE PIT AND THE STRICKLE SPINDLE PLACED INTO THE CROSS-ARM, FOR THE CASTING OF THE H-ARM WHEEL IN BRONZE.

Knowing that some founders will differ from him on many points, he looks forward to some constructive criticism—which is, after all, the object of this Paper.

The job is a large one, approximately 6½ tons, so it must be assumed that the foundry about to tackle it has the necessary melting and lifting facilities. The next thing to be considered is box parts, and the making of a two-part box (*i.e.*, a drag and a top) is suggested; the size would be 9 ft. 6 in. square, with the drag depth 24 in. and the top depth 8 in., both parts strong enough to ensure rigidity and both provided with, say, 16 lugs on each half (*i.e.*, four on each side of each half). These lugs are for locating and also for bolting the two halves together before casting.

Equipment

The pattern-making consists of constructing a strickle board, making-up pieces and core boxes, and is quite common practice, as is the moulding method. These will be described briefly later on.

With the moulding box to hand, the first thing is to dig out a shallow pit in the foundry floor and bed-in two channel irons or girders, approximately 12 ft. long and placed 4 ft. 10 in. apart and rammed into position along with a strickle spindle cross-arm, which would be placed in the centre. A coke or cinder bed would be laid and the whole bottom of the pit

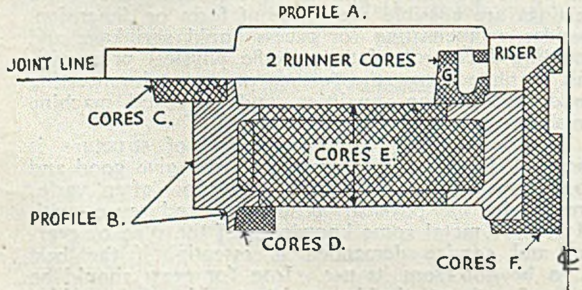

FIG. 4.—SECTIONAL VIEW OF THE MOULD AND CORES.

rammed hard and level, and the necessary venting arrangements made. Next, the drag would be placed into the pit, the strickle spindle placed into the cross-arm and the bottom box or drag rammed with Barkley Bridge sand, as shown in Fig. 3.

The Author's choice of design would be the H-section arm, and the strickle board shown in Fig. 4 gives a sectional view of the mould and cores—leaving a cavity which, when filled with metal, forms the wheel.

Obviously to foundrymen, profile A (Fig. 4) on the strickle board would strike out a dummy pattern on to which the top box could be rammed; this is shown in Fig. 5.

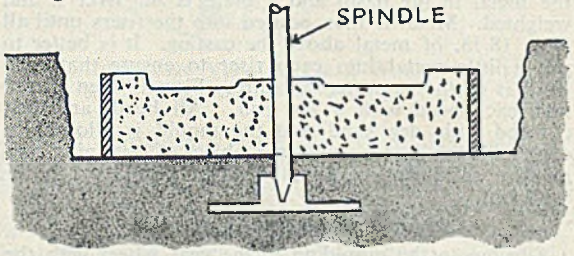

FIG. 5.—PROFILE A ON THE STRICKLE BOARD WOULD STRIKE OUT A DUMMY PATTERN.

Before ramming the top, however, the whole dummy is covered with parting sand, and a circle is described equal to the rim diameter and divided off into eight equal parts—this is for the purpose of locating the position of eight risers, which it is proposed to put on the rim where the spokes intersect. Naturally, the top box would have been planned to allow pockets for these risers. The moulder would be supplied with a pattern for the risers, which would be oval in section—12 in. by the full thickness of the rim at the bottom, tapering to about 10 in. thick at the top. A 21-in. diam. bush pattern, domed on one end and 24-in. over-all length, with a spindle hole through the centre, would be placed over the spindle. Two runner cores would be placed against the bush, opposite each other. This bush would also have a small core print 1½ in. diam. by 2½ in. long, projecting on the dome and somewhere near the spindle hole.

The top box would then be lowered into position, well hooked and rammed, using the riser pattern to form each riser, after which a mid-type of box, 9 ft. 6 in. by 2 ft. 0 in. by 18 in. high, would be placed on top of the top box. This would serve to take two of the risers, the pouring basins and the runners. Small boxes would take care of the other six risers. A plan view of this is shown in Fig. 6.

The runner box would then be lifted and then the core. A bad lift would not be expected as the designer would have allowed quite a nice taper. However, a making-up piece would easily enable the moulder to rectify any defects. Profile B of the strickle board would strike out the mould, as shown in Fig. 7.

Coring and Closing

Segment cores, which are so simple that they need no description here, would be placed in position, as shown in Fig. 4, marked C and D. The only reason for putting cores, D, in the mould is because it is thought that it is easier than strickling the narrow projection, which is only 1½ in. wide by 3 in. deep. The next procedure is to place eight cores marked E into position, the usual pointer in the strickle board being used to determine rim thickness.

The spindle would now be removed, and the centre core marked F lowered into position. A small core

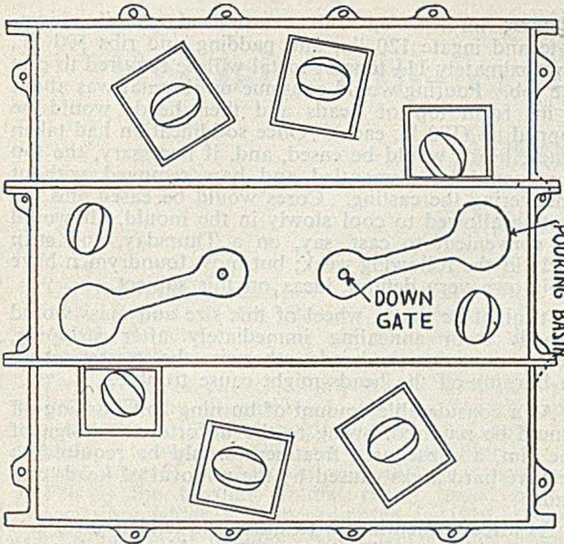

FIG. 6.—AN ADDITIONAL SMALLER BOX IS PLACED OVER THE MIDDLE OF THE TOP BOX TO TAKE TWO OF THE RISERS, THE POURING BASINS AND THE RUNNERS.

would be placed into the print in the dome of the blind riser and the cope would be placed into position. Two girders corresponding with those bedded in the

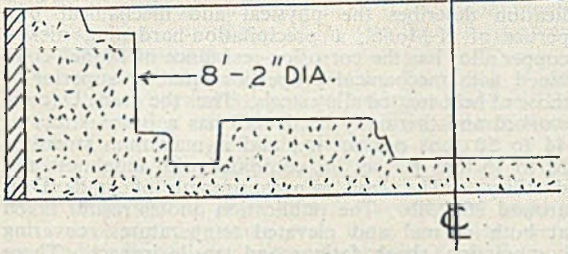

FIG. 7.—PROFILE B OF THE STRICKLE BOARD WOULD STRIKE OUT THIS SECTION OF THE MOULD.

pit would be laid over the top, and the rods through these would clamp the two boxes together—in addition to the bolting of 16 lugs. A sectional view of the mould ready for casting is shown in Fig. 8.

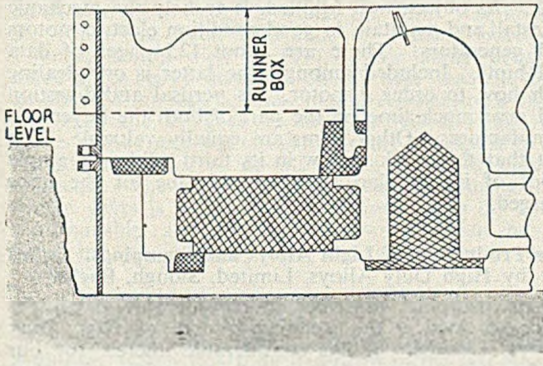

FIG. 8.—SECTIONAL VIEW OF THE MOULD READY FOR CASTING WITH BRONZE.

It will be noticed that the print portion of the centre core is made larger than the core diameter. There are two reasons for this; the core is not supported in any way at the top, and therefore a large size at the bottom helps to ensure its standing perpendicular. It also serves the dual purpose of withstanding the shock of the first metal to enter the mould. Naturally, vents would be taken through the bottom of the core.

The small portion of the core in the dome becomes superheated and penetrates through the crust, keeping the metal liquid. As it has a vent down the centre, it also allows the atmospheric pressure to feed the metal down into the boss. The job would be poured with two large ladles, and as the metal came up into the eight risers hot metal would be poured into these from four small crucibles.

MOULDING FOR STEEL

By H. G. Goyns

For steel, the single arm wheel with simple-cross spokes has been chosen. As only one off is required, existing tackle would require to be used as much as possible. Any foundry attempting a job of this size would probably have facilities for building up a suitable top part, though special bars would probably be required to suit heads on flange and hub.

Pattern tackle would be as shown in Fig. 9. Sketch 1 shows strickle boards with A and B profiles and with

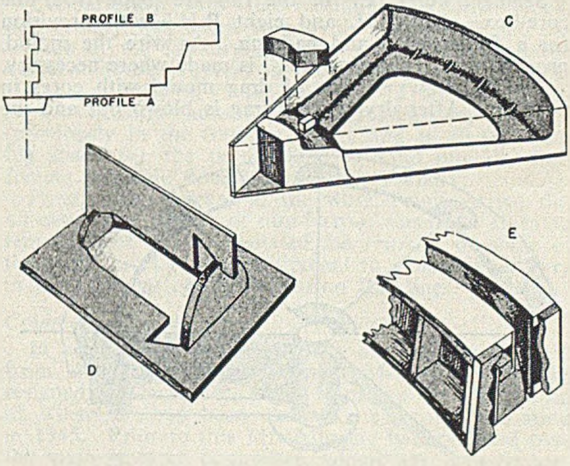

FIG. 9.—PATTERN TACKLE FOR THE CASTING OF THE SINGLE-ARM WHEEL IN STEEL.

full print for centre core. Sketch 2 shows a core frame for the segment cores (C1 and C2). Sixteen cores will be made from this box as follows:—Six off C1 plain; two off C1 with peg for ingate; six off C2 plain; and two off C2 without pad. Sketch 3 shows board and sweep for the centre core (D). Sketch 4 shows frame core-box for the rim segment (E). Sixteen cores will be made from this box as follows:—Eight off L.H.; and eight R.H.

Preparation

The mould bed would be prepared in a similar manner to those already described, but the downgate would be positioned and the ingate bedded in before building-up the sand to form the profile for the top strickle board. As the sand was built up, the downgate pipes would be added to give a location on the joint.

After strickling off the top joint, the mould would be marked off for eight rim risers (12-in. diam.) over the centre line of rim. Two kidney-shaped heads are re-

Casting of Large Gear Wheels

quired for the hub, and the downgate is 2½ in. diam. The top box, approximately 11 ft. by 10 ft., would be placed in position with heads and downgate, and rammed with adequate lifters. To facilitate easing, wooden easing blocks could be rammed up behind the heads. After the top box had been removed, the false parting would be taken away and the bottom profile strickled to shape, using a full boss for the centre core-print. Where necessary, cracking ribs would be cut and the relevant mould surfaces painted or sprayed with Zircon or other suitable mould paint, and then dried over and under a slow coke fire.

Cores

Meanwhile, eight segment cores (C1) would be made from the frame core-box—six off plain and two with a peg for an ingate. The top frame is removed, the boss altered, and eight more cores (C2) are made—six plain and two with head pad removed. These cores would be hollowed out (*i.e.*, shell cores) to interfere as little as possible with contraction. In these cores, internal chills would be used where the increased mass at adjoining sections would cause shrinkage areas (*i.e.*, where the arm joins the hub and the outer rim). The centre core (D) is swept up, dried and jointed.

Segment cores (E) for the rim are made from the core-box—eight L.H. and eight R.H.—with provision for a feeder head and padding. As with the mould, provision for "cracking ribs" is made where necessary.

Fig. 10 shows section of drag mould with cores in position. After drying, the drag is blown out and the

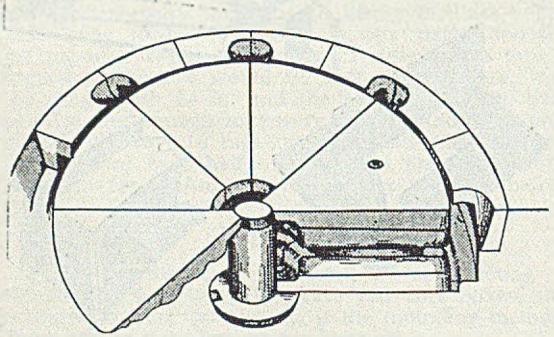

Fig. 10.—Section of Drag Mould with Cores in Position.

centre core is placed over the runner. Centre core (D) is now placed in mould, followed by the eight bottom-segment cores (C1), using templates and outside gauge sticks. Next come the top segment cores (C2). Cores (E) for the outside rim are now placed in the mould.

With this method, all cores are in the drag, and it will be possible to check the thickness and concentricity of the thin rim and the centre boss, as well as other sizes, before lowering the top part into position. Head boxes and runner boxes are now placed in position on the top part to bring rim heads to 27-in. high from the joint face. The mould is blown out, the top part is lowered over the drag for "touch" and, if all is well, the job is finally closed.

Casting and Stripping

If no pit- or anchor-bolts are available, the top part will require to be weighted down. As the wheel weighs 6¼ tons, rim heads 6,900 lb., centre head 3,200 lb., downgate and ingate 120 lb., and padding and ribs 500 lb., approximately 11½ tons of metal will be required to cast the job. Pouring would continue until metal was about 6 in. from top of heads and then heads would be topped up (180 lb. each). Once solidification had taken place, heads would be eased, and, if necessary, the top part could be dismantled and bars removed without uncovering the casting. Cores would be eased and the casting allowed to cool slowly in the mould. It would be convenient to cast, say, on a Thursday, and strip early in the following week; but most foundrymen have their own very definite ideas on this subject.

It might be that a wheel of this size and mass would benefit from annealing immediately after stripping, before removing the heads, otherwise the stresses set up in burning-off the heads might cause trouble.

As a considerable amount of burning and washing-off would be required, owing to the unfortunate design of the rim, a subsequent treatment would be required to remove hard areas caused by the removal of heads and pads.

As already mentioned, to offset the tendency for hot tearing which would be present, "cracking ribs" would require to be incorporated in core-boxes and cut in the mould.

Publications Received

K.-Monel. Issued by Henry Wiggin & Company, Limited, Wiggin Street, Birmingham, 16, this new publication describes the physical and mechanical properties of K-Monel, a precipitation-hardening nickel-copper alloy has the corrosion-resistance of Monel, combined with mechanical properties equal or superior to those of heat-treated alloy steels. Thus the grade D (cold-worked and thermally hardened) has a proof stress of 44 to 58 tons per sq. in., and a maximum stress of 62 to 75 tons per sq. in., combined with toughness and ductility. The Izod impact strength of grade D is around 26 ft.-lb. The publication quotes results taken at both normal and elevated temperatures, covering compression, shear, fatigue and tensile impact. There are brief but informative notes on available forms and on heat-treatment. Copies may be obtained free of charge, on application to the company.

Industrial Electric Motors. Issued by Higgs Motors, Limited, Witton, Birmingham. Price 1s. 6d.

Here is a pocket book which is of correct size and bulk. Its object, well fulfilled, is to help the mechanic to install and maintain in good condition electric motors and generators. There are about 125 pages of data and hints. Included amongst the latter is one dealing with how to order a motor. Its perusal and digestion will save much time on the part of both the buyer and manufacturer. Other items are equally valuable. The fact that this book is now in its third edition is ample proof of its popularity and good value for the price charged.

The Production of Light Alloys and Stampings. Issued by High Duty Alloys, Limited, Slough, Bucks.

This pamphlet describes in considerable detail the processes used at the Redditch Works of High Duty Alloys, Limited. It has considerable interest for our readers as it shows the sort of competition foundrymen have to meet, or more truthfully the fields just beyond their province.

British Non-ferrous Metals Research Association

Thirtieth Annual Report

The following paragraphs are abstracted from the Annual Report of the British Non-Ferrous Metals Research Association which was published at the end of last month:—

Two events of particular importance have occurred during 1949, the retirement of Sir John Greenly from the chairmanship after holding that office with distinction for twelve years, and the completion of the present stage of the Association's building programme.

This is the thirtieth annual report issued by the Association, which was incorporated in 1920. Those representatives of members who have seen the present laboratories, including the reconstructed Regnart Buildings and the foundry extension, will have realised that the Association has made much progress since the early days in Birmingham thirty years ago.

An extremely important change in procedure, instituted in January, 1949, and much welcomed by members, has been the issue of the *Bulletin Research Supplement*. The issue of these summaries, as would be expected, had some effect in lessening the demands for full reports, but on the other hand it has undoubtedly led to a wider appreciation of the significant facts about the research progress.

A second conference of members, covering those in the light-alloy industry, was held at Ashorne Hill in the beginning of June last. This was devoted to technical discussions of the research in progress of interest to the light-alloy industry and to the work which that industry thought the Association could usefully undertake in the future. As with the copper conference in the previous year, these discussions were extremely helpful to the Association's staff and appeared to be thoroughly appreciated by the members attending.

Sir John Greenly

The resignation of Sir John Greenly from the chairmanship of council has been reported previously The council took the opportunity of expressing their appreciations and thanks at a luncheon on January 24, 1950, to which Sir John was invited. Sir John had been chairman of council since Mr. Thomas Bolton died in 1937. His many activities made such heavy demands on his time that the large amount of interest he took in the Association's affairs and the time he gave to them provided ample evidence of his real enthusiasm for the Association and his determination to do all in his power to make it a success. The growth of the Association during these twelve years is in no small measure due to Sir John's chairmanship and to the hard work which he has done in this capacity for the non-ferrous metals industry.

Laboratory Accommodation

During the year the reconstruction of Regnart Buildings, which was fully described in the last Annual Report, was completed, although the block was not ready for occupation for a few weeks afterwards. Various other occasions have been taken to describe the re-arrangement of accommodation and the new equipment that it has been possible to install in these reconstructed laboratories. It can now be said that the completion of this work provides laboratory and office accommodation suitable for the present scale of the Association's operations and capable of housing the present staff conveniently and efficiently. Admittedly the layout of the buildings is somewhat confusing to the occasional visitor, but familiarity soon overcomes that difficulty. An important consequence is the space released in other parts of the premises by the transfer of administration and general metallurgy to Regnart Buildings. Some departments have obviously been overcrowded and only now are they housed adequately.

Concurrently with the rebuilding of this block, opportunity was taken to provide a much needed extension of the foundry into the workshop behind the adjacent house property in Euston Street. This workshop is a building 75 ft. long and 12 ft. wide which is conveniently housing the high-frequency furnace (previously in the foundry itself), and is also providing space for the preparation of sand moulds, thus freeing valuable floor space in the foundry.

Finally, an increase in the work being carried out on creep and fatigue of non-ferrous metals at elevated temperatures has necessitated the transfer of some of the mechanical testing equipment to a new laboratory in the basment of 18-20, Euston Buildings.

Council and Committees

In addition to the resignation of Sir John Greenly from the chair of the council, Mr. A. J. Murphy resigned in December, 1949, from the research board of which he had been chairman since its formation in 1945. Prior to this Mr. Murphy had presided over the main research committee, which was then responsible for our research programme, for some five years. His membership of council and finance committee were also surrendered at the same time as a result of his appointment to the chair of Industrial Metallurgy in Birmingham. These resignations instituted a considerable change in the officers of the Association.

At a meeting of council on January 24, 1950, Lt.-Col. The Hon. R. M. Preston, D.S.O., who was previously deputy chairman and hon. treasurer, was unanimously elected chairman of council. During the year, the council had felt the need for increasing substantially the number of vice-chairmen, and in April last unanimously elected Dr. Horace Clarke, Sir William Griffiths, Sir Paul Gueterbock, Mr. A. J. Murphy and Sir Arthur Smout as vice-chairmen of council. Mr. Preston's election to the chair involved his resignation from the post of hon. treasurer, and Mr. F. C. Braby was elected hon. treasurer and a vice-chairman. To succeed Mr. A. J. Murphy as chairman of the research board, Dr. Maurice Cook was elected to that post, which necessitated his resignation from the chairmanship of the Aluminium, Magnesium Industry Committee. In this he was suc-

B.N.F.M.R.A. Annual Report

ceeded by Dr. C. J. Smithells. The vacancy on the finance and general-purposes committee caused by the resignation of Mr. A. J. Murphy has been filled by Mr. T. M. Herbert, who has also accepted an invitation to serve on the research board.

During the year, the council welcomed a new member, Mr. D. P. C. Neave, who was elected some time ago to fill a vacancy caused by the death of Sir Clifford Paterson. Another vacancy on the council has later arisen from the resignation of Mr. D. W. Aldridge, who has served on the council since 1943 but finds it impossible to continue owing to the length of time he spends abroad.

Co-opted membership of the council decreased by the withdrawal of Sir Ben Lockspeiser on his appointment as secretary of the Department of Scientific and Industrial Research, but this was off-set by the co-option to the council of Dr. U. R. Evans, who has for many years been closely interested in the technical work of the Association. Fortunately, Professor Murphy's interest in our work has been retained by his co-option by the council at their meeting in January, 1950.

There has only been one change in the membership of the industry committees, Mr. W. T. Butcher having accepted an invitation to serve on the Lead. Tin Committee. Finally, in noting these changes in the council and our senior committees, one cannot but remember the tragic death during the year, in an air disaster in Canada, of Mr. A. D. Storke, who served on the council from 1940 to 1945 and who was such a useful member and good friend of the Association.

Staff

This year there has been a slight reduction in the total number of staff. This is due to a fall in the numbers of several grades, without any concentration in a particular department.

Information Department and Library

Since January, 1949, the Association's new monthly publication, the *B.N.F. Research Supplement,* has been appearing. The research summaries printed in it are provided by the liaison and research departments, the editorial and publication side being undertaken in the information department.

The library has continued to operate at full capacity. In 1949, loans to members, government departments and others numbered 8,655, as compared with just under 8,000 in 1948. Of the 494 member companies, 238 (48 per cent.) made use of the loan service. While this evidence of the extensive use of the library service is very gratifying, there are obviously numerous members who still do not make use of this service and who could do so with advantage. Internal loans, from the library to members of the staff, numbered 6,568. Additions to the library stock during the year were 118 books and 1,134 other items.

Liaison and Technical Service Department

The liaison and technical service department was formed in 1933 under the name of "development department" with the object of bridging the gap between the production of a research result and its application in industry. This is still the ultimate aim of the department, and the activities which it undertakes are those which have been found by experience to be helpful in achieving this object. In recent years, there has been increased emphasis on the importance of the Association's liaison activities, and it is thought therefore that members may be interested to have a fuller report than usual of the work of this department during the past year.

The methods used by the liaison department staff vary widely. In general, they can be summarised as the development of a research result into an industrial operation, the presentation to members of the information so gained, and the provision of assistance to the industry in the use of the information. The following description of the specific activities of the liaison department shows the steps that are taken.

Development Reports

Some research reports are of such a nature that the practical application of the research findings is obvious and no further steps are necessary to bring them to the notice of members' representatives. On the other hand, some researches, particularly those that have been in progress for a long time and the results of which are scattered through a number of reports, require the collection and clarification of the findings. In some cases, also, the work has been done on a small scale or in some way remote from practice; if so, the liaison department's first duty is to investigate either in the laboratory or in members' works the extent to which the findings are directly applicable. Where this involves trials on an industrial scale the co-operation of members is essential and is generally given, but in some cases further laboratory work to clear up particular points is required and is undertaken by the liaison department. The immediate objective is the production of a development report summarising the findings of the work and describing how the results can be used.

Development report No. 52, "The Production of Bronze Sand Castings," issued to members this year, did not involve any laboratory work by the liaison staff but included the results of practical trials of the Association's recommendations carried out by members under the supervision of B.N.F. staff. Another development report on similar lines, D.53, "The Melting and Casting of Aluminium-Magnesium Alloys," has also been issued to members.

Technical Enquiries

Members are invited to ask the Association for information on any problem concerning the manufacture or use of non-ferrous metals, particularly on any problem arising in their production operations. This service is called on to a large extent and is encouraged by the staff because of the opportunities it offers for the introduction of improved methods or materials. During the year, 994 technical enquiries were received and 51 per cent. of the membership used this service. The number of enquiries received during 1948 was 821.

All these enquiries are matters needing consideration, discussion with the member and in many cases some experimental work in examining, for instance, a component which has failed, or in testing the suggested remedy. Simple questions that can be answered immediately from common knowledge are not included in the above figures. The liaison staff are responsible for answering technical enquiries, but considerable calls are made on the research staff where their specialist knowledge will be helpful. This applies to all the work of the liaison department but particularly to the technical enquiry service.

Technical enquiries are strictly confidential, although in a few cases, where a number of enquiries is received on the same subject, members are asked whether we may refer the matter to one of the association's research committees. In other cases, where it is thought that a solution which has been found to a particular problem would be helpful to other members, the original enquirer is asked whether he has any objection to the disclosure of the information that has been given to him.

Review of Research Progress

A review which followed of the progress made during the past year was classified under headings corresponding to the four industry committees with a separate section for those researches which were of more general interest and which were the immediate responsibility of the research board. We extract those of direct interest to the foundry industry.

Casting of Copper/Nickel Alloys

The effect of metal/mould reaction on the soundness and strength of the inadequately-fed parts of ribbed-plate leaded gunmetal castings was reported to members in the early part of 1949. The research was terminated at a committee meeting held on April 11, 1949, since it was considered that sufficient work had been done to enable mould reaction to be controlled and used in industrial practice.

The Association's recommendations have been tried out in a foundry making about 3,000 valve castings per week, mainly in 85/5/5/5 leaded gunmetal. As a result, the number of castings rejected has been reduced by about 2 per cent. of the total production—a most valuable saving when time and money have to be spent in machining each casting before the final pressure testing.

A development report, "The Production of Bronze Sand Castings," based on the Association's work, has now been prepared for the guidance of members.

New Researches

The Industry Committee has decided to include in its programme new research on the subject "Grain Refinement of Cast Copper-Base Alloys." It is hoped to apply the principles which have emerged from the successful study of grain refinement of light alloys.

Aluminium, Magnesium and Their Alloys

Experiments on the identification of solidification nuclei in fine-grained aluminium alloys have been continued; carbide particles have been identified in alloys containing tantalum, and additional work on boron-containing alloys has confirmed the earlier indications that aluminium-boride crystals act as nuclei in these alloys. The effect of simultaneous additions of titanium and boron in refining the grain of cast aluminium alloys has been investigated. These additions are often stated to be more effective together than alone. Attention has been given to the possible formation of titanium-boride particles or titanium boride/aluminium boride mixed crystals which could act as nuclei, and to the practical advantages of the process such as the possibility of using high casting temperatures without producing the usual grain coarsening.

The marked influence of grain size on the tensile properties of high-strength aluminium casting alloys has been investigated, including the effects of variations in superheating and casting temperatures, pouring rate and methods of introducing the titanium. In connection with the latter, attempts have been made to prepare aluminium/titanium alloys with higher titanium carbide contents, so that the grain-refining additions can be made more effective; these experiments are continuing.

As a result of this work, two Papers have been published, one on the mechanism of grain refinement and the other on the influence of grain size on tensile properties.

Using the results obtained with aluminium alloys, preliminary experiments have been carried out on the grain refinement of cast copper-base alloys, and a few experiments have also been made with cast lead-base alloys.

When it was proposed to terminate the research on metal/mould reaction in light alloys, the research committee raised strong objections. The industry committee therefore arranged for foundry trials to be made to see just how far the Association's recommended methods of inhibition were successful in castings of large section. Test castings prepared by several members of the research committee have been examined by the staff. The addition of 2 per cent. boric acid to the sand and 0.025 per cent. beryllium to the alloys inhibits the reaction in castings up to 3 in. diam., but not in larger castings. The committee feels very strongly that a better understanding of the reaction is needed, and provision has been made for further work on the more theoretical aspects, including the effect upon the reaction of water-vapour concentration in the environment and beryllium content of the alloy.

Vitreous Enamels for Aluminium

During 1949, three new vitreous enamels were received for testing, and at the end of the year a report, summarising recent developments in this field, was made available to members. The problems inherent in producing a durable vitreous coating suitable for application to light alloys have not yet been entirely solved, but a useful beginning has been made and two enamels have now reached the stage of commercial production. One of these is a lead-bearing enamel and the other leadless, and in both cases the range of suitable application is restricted.

In addition to the *ad hoc* testing of enamels, work is also in hand, in conjunction with the Aluminium Development Association and the manufacturers of enamel, with a view to finding improved methods of application to cast and wrought materials. The influence of alloying constituents upon the nature of the bond between the metal and enamel is also being examined.

Thermal Gradients in Castings

Work described in the previous annual report on (*a*) the mechanism of solidification of various alloys, and (*b*) the rate of heat extraction at the corners, re-entrant corners and curved surfaces of dry sand moulds, has now been completed and the results of this work have been released to members.

A study of the solidification of plate castings of various thicknesses made in pure aluminium, a magnesium/10 per cent. aluminium alloy, aluminium bronze and tin bronze, is being made with the objects of correlating the mechanical properties of the plates with the solidification characteristics of the alloys and with their solidification rates when cast in different thicknesses. The plates are similar to those used in earlier work with an aluminium/4 per cent. copper alloy. Preliminary results have shown that the mode of freezing of plates made in skin-forming materials such as pure aluminium and aluminium bronze is quite different from that of plates made in alloys such as the aluminium/4 per cent. copper and the magnesium/10 per cent. aluminium, which solidify in a pasty manner.

Visit to Vickers Armstrongs

On Wednesday of last week, a party of about 60 members of the London branch of the Institute of British Foundrymen visited the Crayford, Kent, works of Vickers-Armstrongs, Limited. This works, completely devoted to armament production during the war, has now changed over to production of an unusually wide range of domestic machinery. Plant is made for a number of industries ranging from machines for preparing choc-ices to petrol pumps; intermediate are paint-grinding machines, wire-stitching machines, kneading machines, cardboad-box making and book-binding machines.

Foundry

The visitors were, naturally, very interested in the foundry, which is essentially of the jobbing variety, making castings up to about 3 tons individual weight mainly in iron, but also a fair quantity of aluminium and copper-base alloys. The total tonnage is of the order of 130 per month, and green-sand moulding is practised. There are several moulding machines, these being engaged on the few repetition lines; all the work is for internal consumption, and the range is remarkably varied. Local sand from the Erith seam is used. The foundry and raw materials are kept neatly and orderly, the shops are lofty and there are elaborate heating and ventilating ducts, described as very efficient in operation. In the patternshop, where all the company's requirements are made, there was a well-integrated layout, with benches towards the centre and machinery, which included a "Wadkin" pattern-miller and several lathes, to one side. In this shop the plant comprises a mixture of line-shaft and individual-drive machines. Both wooden and metal patterns are produced, though the latter are seldom called for.

During the visit to the pattern stores, where there are said to be over 100,000 patterns, the works' "paper" system for production and stores control was outlined. Its importance can be gauged from the vast number of intricate parts and operational schedules in use, and it was pleasing to find the executives unanimous in their opinions as to its efficacy.

A visit was made to the washing and changing centre specially built for foundry employees. Locker rooms as well as all the facilities were in spotless condition, and it was reported that a very high percentage of the workers take advantage of these amenities. It may be helpful to other foundries to record, briefly, the firm's experience with this section of amenities provision for foundry workers. Some years ago, a separate amenities block was erected and equipped, but this was so shockingly misused and wantonly damaged that management and dependable workmen alike were scandalised. As a result of a joint meeting, it was agreed that when the equipment and buildings had been repaired, *any person* found wilfully causing damage should be instantly dismissed, and this proviso was rigidly enforced and supervision was provided. This arrangement was respected, the facilities provided were well looked after and kept clean. Finally, upon seeing the success of the joint responsibility, the firm rebuilt and re-equipped the whole section on a more lavish scale, and that third installation was the one inspected by the London visitors.

Apprentices and Amenities

The system in the works for the intake and training of apprentices is commendably well organised. "Shop boys" are taken direct from school and attached to various departments. Suitable entrants, at the age of 16, commence a six-months' training course under a qualified instrucutor. During this time they are taught the purpose and method of operation of all manner of metal-working tools—lathes, bandsaws, millers, etc. All these machines are nicely laid out in a separate shop, and good use is made of colour, for machines, services and walls. Adjacent to the shop is a class-room where the boys go for lectures by qualified works' staff on two afternoons per week. Additionally, they are released for part-time studies at the local technical school. The visitors were very impressed by the general standards of neatness and cleanliness shown everywhere, and much admired the beautiful sets of engineering and founders' small tools which the boys make during their 6 months' course for their own subsequent use. All the operations in making the tool kit are laid out as blue-print operations embodying exercises in the use of the various hand and machine tools available.

Out of a total of 1,500 employees there are currently about 80 apprentices. The foundry personnel of 130 includes about 50 skilled moulders, 12 core-makers, five apprentices and two "shop boys." No difficulty is experienced in getting foundry apprentices, for the conditions are excellent and wages are attractive.

After completing the tour of inspection by visiting a large number of machine and assembly shops, during which period individual finished machines were demonstrated, the partly assembled for tea in one of the canteens, and thanks were suitably expressed by Mr. F. Arnold Wilson, branch president, to the management, to Mr. D. Morris, foundry manager, and to the guides. Mr. Kelly, works manager, responded for the firm.

Exhibition of Photomicrographs

Metallographers desirous of submitting photomicrographs for an international exhibition, with the possibility of medals and cash awards, will be interested in the forthcoming National Metal Congress and Exposition in Chicago, October 23 to 27, 1950. The Congress is under the auspices of the American Society for Metals. Photographic prints should be mounted on stiff cardboard, each on a separate mount, carrying a label giving:—Name of metallographer, classification of entry, material, etchant, magnification and any special information as desired. The mode of classification of micros is as follows:—(1) Cast irons and cast steels; (2) tool steels (except carbides); (3) irons and alloy steels (excluding stainless) in wrought condition; (4) stainless and heat-resisting steels and alloys; (5) light metals and alloys; (6) heavy non-ferrous metals and alloys; (7) powder metals (and carbides) and compacts; (8) weld structures (including brazed and similar joints); (9) series of micros showing transitions or changes during processing; (10) surface phenomena and macrographs of metallurgical objects or operations (2 to 10 dia.), and (11) results by non-optical or other unconventional techniques. A first prize (a medal and blue ribbon) will be awarded to the best in each classification. A Grand Prize, in the form of an engrossed certificate, and a money award of $100 will be awarded the exhibitor whose work is adjudged "best in the show." British entrants will do well to send their micrographs by first-class letter mail endorsed "May be opened for customs inspection before delivery to addressee." Exhibits must be delivered between October 1 and 20, either by prepaid express, registered parcel post or first-class letter mail. Address: Metallographic Exhibit, c/o W. H. Eisenman, National Metal Congress and Exposition, International Amphitheater, Chicago, Ill., U.S.A.

Notes from the Branches

London Branch

At the Annual General Meeting of the London Branch of the Institute of British Foundrymen held at the Waldorf Hotel on April 26, the following office bearers were elected for the 1950-51 session, commencing officially on July 1. As *president*, Mr. F. Tibbenham; as *senior vice-president*, Mr. L. G. Beresford, B.Sc., F.I.M.; as *junior vice-president*, Mr. D. Graham Bisset; as *honorary secretary and treasurer*, Mr. W. G. Mochrie (re-elected) and as *honorary auditors*, Mr. V. Delport (re-elected) and Mr. Barrington Hooper, C.B.E. (in place of Mr. C. Cleaver, who retired after about 25 years' service in that capacity). As *members of council*, Mr. J. P. Ellis, Mr. E. S. Renshaw and Mr. W. Wilson were elected to serve for three years and Mr. M. Glenny to serve for two years. As *branch representatives to general council*, Mr. C. H. Kain, F.I.M., Mr. V. Delport, and Mr. E. M. Currie, F.I.M., were re-elected and Mr. F. Arnold Wilson (the retiring president) was elected. Mr. F. Hudson was re-elected as *branch representative to technical council;* Mr. George Pierce was re-elected and Mr. A. R. Wizard, Mr. S. Pipes and Mr. A. Whiles additionally were elected as *stewards* and Mr. J. P. Ellis (re-elected) as *projectionist*.

Following the business meeting, a Paper, " Modernising an Iron Foundry," was given by Mr. L. W. Bolton and Mr. D. W. Ford. This described the installation of mechanical aids into a foundry where previously hand moulding operations had been carried out. Particular emphasis was given to the means for the removal of dust at the knock-out and in the fettling shop as well as experiences in heating, lighting and the application of colour in the foundry.

New Catalogue

Moulding Machines. The publication of a new catalogue by British Moulding Machine Company, Limited, of Faversham, Kent, gives a complete answer to the criticism that foundry equipment houses do not pay sufficient attention to the question of spare parts. In this catalogue no fewer than 472 bits and pieces are illustrated, described and given a code number. Moreover, the exact location of each component in the construction of the machine is clearly shown. The detailed description of its construction, installation and operation is excellent, so much so that a non-mechanically-minded person like the reviewer can readily follow the text. Incidentally those of our readers overseas who have from time to time to undertake translation will find this well-illustrated brochure of the greatest use. It is easy to find the equivalent in one's own language when every component is pictured and named. So far as foundry equipment is concerned, the brochure breaks new ground and the reviewer is convinced that it will be appreciated by castings manufacturers. It is well produced, and carries a pale-grey cover with the well-known B.M.M. device in red. Coil spring binding has been used and it is interesting to note it has been printed in the company's own offices, mainly for distribution in America and Canada, but a modified edition is being prepared for distribution in this country.

TENDERS ARE INVITED for equipping heavy metallurgical and foundry laboratories comprising an extension to the Municipal College of Technology, Manchester. Details are to be found in the advertisement pages of this issue.

House Organs

" 600 "—Vol. 24, No. 110. Published by George Cohen, Sons & Company, Limited, Cunard Works, Chase Road, London, N.W.10.

The reviewer confesses that he often purloins the " funny stories " appearing in " 600 " for retailing in smoking rooms without acknowledgement, so, for the following item of news, indebtedness to " 600 " is readily accorded. K. & L. Steelfounders & Engineers, Limited, Letchworth, have installed a new Twintable Tablast machine in their steel-foundry dressing shop. This machine, which is the first of its type to be installed in this country, makes for quicker and cheaper shot-blasting. There are many other items of news about this foundry, the provision of the radiographic service for the steel-foundry personnel being outstanding. The other foundry belonging to the " 600 " group—the Metalclad Foundry of Morriston—is also in the news, as its capacity has been extended. As for the rest, well, it is just " 600 "—well-written articles, good cartoons and funny stories.

F.B.I. Review, Vol. 1, No. 1. Published by the Federation of British Industries, 21, Tothill Street, London, S.W.1.

This new magazine is designed to serve the interests of the members of this organisation, by dealing with efficient production and the methods of increasing overseas trade. The former in this issue is covered by an article on Production—Problems and Prospects, by Mr. B. White. It shows up the appalling difference between cost of plant replacement to-day as compared with 1939. For the second there is an article on Dollar Sales—the Need for Follow Through. Nine precepts are listed, mainly concerned with the choice of a distributor. The magazine is well laid out and adequately illustrated.

Carron Cupola, Vol. 1, No. 2. Issued by The Carron Company of Falkirk.

Why do Scottish editors of house organs so often start their notes by meteorological observations? The weather is quite a good opening gambit for an interesting conversation, but it can be overdone. It is perhaps a little mean of the reviewer to criticise what is only the second issue of this magazine, and it would have been more appropriate to have made this observation about some of the more mature publications. For the rest of the magazine there is nothing but praise, as the contents will, it is reasonable to assert, well satisfy the staff.

B.C.U.R.A. Quarterly Gazette, No. 8. Published by the British Coal Utilisation Research Association, Leatherhead.

This bulletin is designed to interest the staffs of concerns manufacturing apparatus designed to use solid fuel, and amongst these, of course, are numerous foundrymen. The description of a new type of central heating boiler used in Sweden is a case in point. This issue is important as it contains the text of a speech by Sir Charles Ellis, F.R.S., made as president on the occasion of the annual meeting. The bulletin does not carry the address of the publishers as it should.

Rubber Developments, March, 1950. Issued by the British Rubber Development Board, Market Buildings, Mark Lane, London, E.C.3.

Though of but incidental interest to foundrymen, this well-produced house organ invariably carries articles of a helpful character. One, for instance, covers the use of rubber stamps for engineers' drawing offices. A second deals with the rubber impregnation of boots.

"Quickdraw"

A New Sketching Device

The drawing of plans and sketches is normally the province of the drawing office, but in many cases it is necessary for quick, but reasonably accurate, drawings to be prepared for submission to clients or even for the discussion of small points at the end of a letter. Again, the patternmaker or moulder may desire to indicate to the draughtsman some alteration in a pattern.

A new device sold by the Quickdraw Company, of 127, Gunnersbury Avenue, London, W.3, has just been brought to our notice, and is illustrated in Fig. 1.

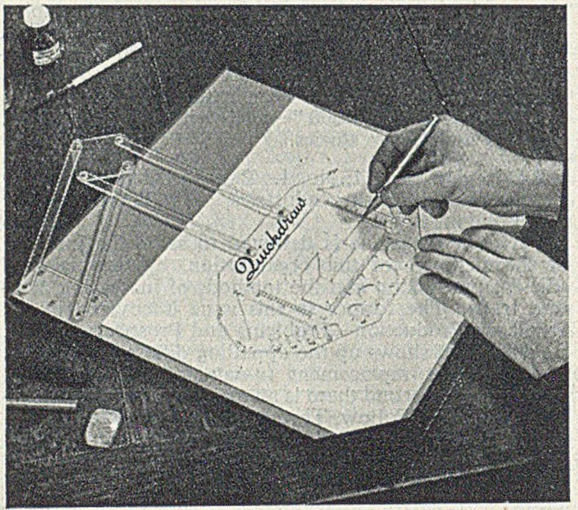

FIG. 1.—"QUICKDRAW" RAPID SKETCHING APPARATUS.

It enables a person with little previous experience of drawing to make sketches, plans, or other outlines rapidly and accurately to scale.

The pantograph, to which the template is necessarily attached, ensures that the principal lines are vertical or horizontal, whatever the position of the template. The shaped edges of the template enable lines to be drawn at any of the principal angles, including those for isometric "perspective" sketches. Circles of various sizes may be drawn quickly and accurately, and small perforations in the instrument enable a number of equally-spaced horizontal lines to be drawn at intervals of $\frac{1}{8}$ or even $\frac{1}{16}$ in. The scales are in fractions of an inch and in millimetres. The template and pantograph are made of plastic and are mounted on a light board contained in a portfolio. One drawing-pin only is required to secure the paper in position. The largest size of drawing possible is 13 by 10 in., but, of course, smaller reproductions are easily effected. This instrument seems to have potentialities for quick mechanical visuals, and suggests many uses whereby draughtsmen could produce a quick "one-off" sketch. Members of our drawing-office staff are enthusiastic as to its capabilities and uses.

MR. B. L. PAGE has been appointed a director of John Dale, Limited, New Southgate, London, N.11. Mr. Page is the general manager of the company's foundry section.

Australia's Motor-car Industry

The ten thousandth Australian-built Holden car has come off the assembly line at General Motors-Holden's works at Fishermen's Bend, Melbourne.* Although Australians have been making motor vehicles for more than 50 years, conditions favourable to the large-scale production of cars in the country have only arisen since the recent war. To-day, the first mass-produced Australian car, the Holden, is being produced at the rate of 20,000 a year. In many of the Australian States new projects are being planned which will eventually bring low-priced locally-made cars within the reach of most Australians, and provide a surplus for export.

During the war, the late Mr. John Curtin, Prime Minister at the time, called on manufacturers to submit plans for the large-scale production of an all-Australian car. Of the hundred detailed proposals received, the first major plans came from General Motors-Holden's Limited. These were approved by the Government. The company invested £8,500,000 in the project, which aimed at the production of a 6-cylinder 21-horsepower car suited to Australian conditions. General Motors agreed that imported parts and components should not exceed 10 per cent. of the list price for the car, or 5 per cent. of its weight.

With its relatively low fuel consumption and swift acceleration the Holden has proved that Australian technicians and workmen are capable of first-class precision engineering and skilled assembly. The flow of parts to General Motors plants from hundreds of Australian component manufacturers proves also that the motor industry can be established on a firm footing.

Within the last few years, a number of overseas and local manufacturers have prepared projects for large-scale car production in Australia. The Ford Motor Company, for example, has announced plans to increase the Australian-made content of its V8 model marketed in Australia.

Among English manufacturing companies, the Nuffield Organisation officially launched its Australian project on March 1. Viscount Nuffield, head of the firm, attended the ceremony. A local enterprise recently formed to develop the motor industry within Australia is the L.J. Hartnett Company. The Hartnett project envisages a "people's car"—a 4-seater aluminium sedan, priced in the region of £430. The prototype, based on designs prepared by the French *Société des Brevets J. A. Gregoire*, is now in Sydney.

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* Foundry described in our issue of March 30, 1950.

House Magazines on Show

An exhibition of current house magazines, arranged by the British Association of Industrial Editors in conjunction with the Federation of British Industries, was held at the F.B.I. Council Room, Tothill Street, London, S.W.1, on May 4. The exhibits could be broadly classified into those intended to provide information and news for the issuing company's own employees, or to keep member firms of a group in touch with each other, and those which were intended for "external" use, for the benefit of agents and customers, especially in overseas countries. The magazines themselves ranged from the expensively produced "prestige" journal to the "news-sheet" type of information bulletin. Most of the house organs on show were those of the larger firms and combines, and although a small exhibition such as this must necessarily be selective, the foundry industry, with its many excellent publications, could well have been more fully represented.

Iron Ore in Venezuela

Existence of large deposits of iron ore of high grade in Venezuela has been known many years and the Bethlehem Steel Corporation, the largest independent concern in the United States, acquired interests there at El Pao some ten years ago. More recently, the threatened depletion of the higher-grade Mesabi iron-ore reserves has led the United States Steel Corporation to undertake intensive exploratory work resulting in the discovery of the Cerro Bolivar and other large deposits of high-grade iron ore.

The Cerro Bolivar deposit is of outstanding importance, there being tremendous masses of solid iron ore of very high purity. Drillings here have proved the existence of vast reserves. The explored area is about 600 yds. by 400 yds., the average depth of ore being nearly 150 ft. Regarding the deposits at La Irulla which is some 30 miles south of the Orinoco River and 90 miles east of Ciudad Bolivar, the ore bodies there, although high grade, are relatively small and extend over a wide area. The reserves, however, do not appear to exceed about 10 million tons and are relatively unimportant compared with the discovery at Cerro Bolivar.

Transport of course presents a problem since much work is involved in providing facilities to bring the ore some 200 miles to the coast before being shipped well over 2,500 miles to Sparrows Point adjacent to Baltimore, Philadelphia, and a short haul away from Pittsburgh. The preliminary work in this connection is said to involve an expenditure of many millions of dollars. In addition the Corporation has in view a large steel plant at Trenton just above Philadelphia on the Delaware River. This would receive ore direct from the large ocean ore carriers.

South of the Orinoco River and to the west of the Caroni River, the Corporation has a number of concessions containing reserves of the highest grades of iron ore, said to exceed 1,000 million tons. It also has half-a-dozen concessions including La Irulla east of the Caroni River and south of the Orinoco. Although not comparable with Cerro Bolivar these deposits are of some importance. Regarding the problem of getting the ore to the coast from Cerro Bolivar, a railway survey has been made across country to a point on the north coast near Barcelona.

Grinding of Metals

The Minister of Labour and National Service has made Regulations under the Factories Acts amending the Grinding of Metals (Miscellaneous Industries) Regulations, 1925. The new Regulations,* which come into force on June 1, are entitled the Grinding of Metals (Miscellaneous Industries) (Amendment) Special Regulations, 1950. They were first issued in draft form in April, 1949, and a modified draft was published in February of this year.

The main effect of the new Regulations is that the application to a particular room of some of the exemptions in the 1925 Regulations will in future depend upon how long certain work is carried on in that room, and not (as hitherto) upon how long *a particular individual* is employed on that work in the room. In addition to other minor amendments the new Regulations also specify which of the provisions of the 1925 Regulations are intended to be in addition to, and which in substitution for, certain provisions of the Factories Act, 1937.

* S.I. 1950, No. 688. Obtainable from H.M. Stationery Office, York House, Kingsway, London, W.C.2, or local offices or through any bookseller, price 2d., post free 5d.

New Continuous Bar Mill

A new 11-in. continuous bar mill to be constructed on a large area of land adjoining the works of the Park Gate Iron & Steel Company, Limited, at Rotherham will, it is claimed, equal, if not improve upon, any at present in existence. Another major development to be undertaken by the company is the reconstruction of charging and casting facilities at the blast-furnace plant. Authorisations for the erection of the mill have been obtained, and work on the site has begun. It is hoped that the mill, which will have an output of 3,000 tons a week, will start production at the beginning of 1953.

The company's extensive programme of modernisation and development is being undertaken at a cost of £2,000,000. The directors' borrowing powers, formerly limited to £1,000,000, have been amended and now stand at £2,500,000. The scheme will be financed through the Finance Corporation for Industry, Limited.

The design of the new mill has been agreed upon in collaboration with the Brightside Foundry & Engineering Company, Limited, Attercliffe, Sheffield, 9, who are to build the mill, and special visits have been made to the Continent and to the United States to study the latest developments in bar mills.

The installation of the new continuous bar mill has been decided upon because of trade developments. The mill will, when in operation, enable the company to increase its bar trade, and will absorb nearly half the company's ingot output.

A complete system of mechanical charging has been installed in the blast-furnace plant. Wagons are unloaded by tippler, and after being conveyed to bunkers the materials are fed into skips by means of a scale car, the skips being hoisted to the furnace top and emptied on to the bell. This equipment has been completed for one blast furnace, which was blown in during January, and is now being extended to the second, which will be ready in July.

The blast-furnace scheme includes a pig-casting machine, and improved finish of its product will enhance the sale of any surplus pig-iron.

Arrangements for preparing and charging materials for the open-hearth furnaces are being revised. In 1948 these furnaces were converted to the use of oil fuel instead of producer-gas, the conversion being undertaken at the Government's request at a time of acute coal shortage. Slightly higher working cost has been more than offset by increased steel output and better control of the furnaces. The use of oil fuel and the adoption of the continuous working week at the steel furnaces have effected a marked increase in output which is now not infrequently 7,000 tons a week.

Further revisions are taking place in the cogging mills where alterations have already been made, and the new arrangements here will enable the company to deal with the larger outputs of steel ingots and maintain the balance of production.

Crofts Canadian Subsidiary

Crofts (Engineers), Limited, of Thornbury, Bradford, have established a company in Canada—Crofts Canada, Limited—and a selling organisation known as Britenco, Limited, will put on the Canadian market, straight from stock held in Canada, the products of British engineering firms. Crofts have been responsible for the promotion of the selling company, and have invited other British firms to join in the venture. Goods from Crofts will be on show at the Canadian International Trade Fair at Toronto this year.

Personal

MR. JOHN LANG, new chairman of the Scottish T.U.C. General Council, is Scottish secretary of the Iron and Steel Trades Confederation.

MR. DAVID BROWN, managing director of David Brown & Sons (Huddersfield), Limited, engineers and foundrymen, has been elected to the committee of the British Motor Racing Research Trust.

MR. S. N. GARNER, a member of the head office staff of Hall & Pickles, Limited, Port Street, Manchester, 1, has retired after completing nearly 51 years' continuous service with the company.

MR. B. G. CREWE, assistant controller of the Board of Trade Patent Office, retired at the end of April after nearly 50 years' continuous service. Mr. Crewe is an international authority on copyright and on industrial property.

MR. JAMES WEIR, a director of G. & J. Weir, Limited, Glasgow, has been elected president of the Helicopter Association of Great Britain. Weir's, who built aircraft during the first world war, spent over £60,000 on helicopter experiments between the two wars.

MR. F. M. G. WHEELER has been appointed head of the railway sales division of British Timken, Limited, manufacturers of tapered roller bearings, of Northampton. He was previously a deputy chief mechanical engineer in the Indian State Railway Service.

MR. W. SCOTT, managing director of Jarrow Metal Industries, Limited, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Gateshead, and Armstrong, Whitworth & Company (Pneumatic Tools), Limited, is to resign from Jarrow Town Council owing to pressure of business.

MR. R. THOMAS, of John Harper & Company, Limited, has succeeded MISS J. BOOTH as secretary of the Joint Committee for the Foundry Trades in Willenhall and Wednesfield. Miss Booth was thanked by the Committee for her services and wished success in her new post as careers advice officer at the Ministry of Labour regional office in Birmingham.

MR. J. D. WOLFF, who has been chairman of the London Metal Exchange for 21 years and a member of the Committee for 26 years, has retired from the Committee. The position of chairman is to be filled by MR. W. K. DAVEY. MR. FRANK L. BAER, the vice-chairman, has also retired from the Committee and his place will be filled by MR. F. C. CHISNELL, who took over from Mr. Wolff last January as Government broker for tin.

Board Changes

HENRY HOPE & SONS, LIMITED, metal window manufacturers, of Smethwick—Admiral J. H. Godfrey has resigned from the board.

EDMUNDS, WALKER & COMPANY, LIMITED, steel balls and bearings manufacturers, of Hendon, London, N.W.9—Mr. James Thomson McNeil has been appointed to the board.

ALBION MOTORS, LIMITED, Glasgow—Mr. William M'Farlane, who has been secretary for 35 years, has resigned, but retains his seat on the board. Mr. J. E. Campbell, accountant for the company, has been appointed in his place.

NORTH BRITISH LOCOMOTIVE COMPANY, LIMITED, Glasgow—Mr. J. B. Mavor has been appointed chairman in place of the late Sir Frederick Stewart. Mr. Mavor, who joined the board of the company in 1944, is chairman of Mavor & Coulson, Limited, Glasgow. He is a member of the South-West Scotland Electricity Board and a governor of the Royal Technical College, Glasgow.

Steel Industry's Future

Confidence in the British iron and steel industry's ability to expand in the face of increasing world competition, and in its capacity to run its own affairs without State interference was expressed by Mr. E. W. Senior, commercial director of the British Iron and Steel Federation, at the recent annual dinner of the Lincolnshire Iron and Steel Institute, held at Scunthorpe.

To-day some 320,000 people were engaged in the iron and steel industry, an increase of 5 per cent. over 1947, and production had increased by no less than 25 per cent., he said. The achievement was due to the work of all in the industry. "But," he declared, "by their efforts alone such production as we have seen lately could never have been achieved. I think the work of management and of technical management has been a major factor."

Referring to the record output during March, Mr. Senior said that of that notable achievement, North Lincolnshire produced just under 10 per cent. "With ores that are among the leanest in the world I wonder what North Lincolnshire would have done if it had the Mesabi range to get at."

Of nationalisation Mr. Senior said he did not agree with those people who alleged that the achievements of the industry were the results of fears of the threat of nationalisation. Even before the war when free products were admitted to this country while other countries overseas had fenced themselves in with tariffs the British industry were pioneers jointly with the employees and the trade unions in setting a high standard. Between the wars, development was going on in the industry in Corby, Ebbw Vale, Shotton, and, above all, in North Lincolnshire, where output was increasing more rapidly than in any other part of the country.

An appeal for wider membership in the Lincolnshire Institute was made by the president, Mr. H. M. Henderson, general sales manager of the United Steel Companies, Limited.

Aluminium from Canada

The Ministry of Supply has contracted to buy 96,000 metric tons of virgin aluminium from Aluminium, Limited, of Canada during 1950. Total imports of virgin aluminium from Canada during 1950 are expected to reach about 136,000 tons, comprising 96,000 tons from the new contract and about 40,000 tons under the 1949 contract.

In 1949, when 161,000 tons were imported from Canada, stocks rose above the level considered necessary. During 1950 stocks will be reduced to the required level. These imports from Canada, together with aluminium from European and home production, will provide an adequate supply for the UK fabricating industry, which in 1949 used 181,500 tons.

Britain's aluminium imports from Canada are paid for by Marshall aid dollars; since the beginning of Marshall aid 300,000 tons of Canadian aluminium have been paid for in this way.

THE LEIPZIG FAIR OFFICE has now issued a final report on the results of the 1950 Spring Fair. The report states, *inter alia*, that the demands, particularly of foreign customers were much more exacting than they were a year ago. Prices were sometimes considered too high, more so those of consumer than capital goods. Foreign customers mainly complained about prices of furniture, textiles and clothing, toys, leather goods, precision tools and instruments, optical goods, and industrial requisites. Only 25 per cent. of all exhibitors were fully satisfied with export business at the Fair, despite the considerable turnover.

Obituary

Mr. Arthur Nield Winder, a director of Cammell Laird & Company, Limited, died on April 29.

Mr. Robert W. Cuthill, foundry manager with Douglas Fraser & Sons, Limited, Arbroath (Ayrshire), died last Friday. He was 58.

Mr. William Wilkinson, formerly a director of Judson & Hudson, Limited, engineers and millwrights, of Keighley (Yorks), died on April 13. He was 77.

Mr. Benjamin Bott, who retired in 1948 after having been with C. & W. Walker, Limited, gasworks engineers and ironfounders, of Donnington, near Wellington (Salop), for 66 years, has died at the age of 81.

Mr. C. T. Monseur, the well-known Belgian pig-iron agent, died at his Liège home on April 29, at the age of 60. He had never fully recovered from the effects of a very severe motor-car accident 15 months ago.

Mr. Frederick Roddis, cashier at Kayser, Ellison & Company, Limited, steel manufacturers, of Carlisle Street, Sheffield, died recently. Mr. Roddis, who was 74, was within five months of completing 60 years' service with the company.

Mr. Robert Peter Bethell, a former president of the Staffordshire Iron and Steel Institute, and works manager of G. & R. Thomas, Limited, pig-iron manufacturers, of Bloxwich (Staffs), has died at the age of 78. Mr. Bethell had previously been works manager of Bradley & Foster, Limited, manufacturers of refined iron, etc., of Darlaston (Staffs).

Mr. Stanley Alexander Jackson, a director and general manager of Samuel Fox & Company, Limited, steel manufacturers, of Stocksbridge, near Sheffield, died on April 30. He joined the company in 1933, being appointed to the board two years later. Mr. Jackson had been general manager since 1943, before which he was general works manager.

Wills

Falk, Gustav, a director and formerly chairman of Falk, Stadelmann & Company, Limited, manufacturers of heating and cooking appliances, etc., of Farringdon Road, London, E.C.1	£87,244
Newsum, Major H. E. (retired), chairman of Shipley & Company, Limited, iron, steel, and metal stockholders, of Lincoln, a director of Robey & Company, Limited, engineers and boilermakers, of Lincoln, and Rotherham Forge & Rolling Mills Company, Limited	£38,753
Wright, Lt.-Col. S. C., managing director of C. & C. Wright (Boston), Limited, iron and steel merchants, of Boston (Lincs)	£29,198
Hall, Lees, ironfounder, of Gronant Road, Prestatyn, N. Wales	£26,218
Dickinson, Henry, chairman of Butterworth & Dickinson, Limited, ironfounders	£45,730
Challingsworth, W. H., a director and late managing director of W. H. Challingsworth, Limited, ironfounders, etc., of Heath Street, Birmingham, 18	£15,782

Rhodesian Metallurgical Plant

A new metallurgical plant to be constructed in Southern Rhodesia is to be operated by Rhodesian Alloys, Limited, a new company sponsored by John Brown & Company, Limited, Clydebank.

The authorised share capital of Rhodesian Alloys is £1,000,000, which when issued will be taken up by a combination of John Brown & Company, and a small number of other shareholders. The new plant will be established in Gwelo, and will take electric power from the Electricity Supply Commission of Southern Rhodesia. Construction work is expected to take about two-and-a-half years and John Miles & Partners (London), Limited, will act as consulting engineers.

The first production will be of ferro-chrome, utilising the local ores.

News in Brief

A contract from India for Diesel engines woth £1,000,000 has been secured by F. Perkins, Limitd, Peterborough.

The telephone number of Aluminium Unio, Limited, The Adelphi, Strand, London, W.C.2, hs been changed to Trafalgar 7878.

Mr. W. F. S. Woodford has been appointed actig secretary of the Institution of Production Enginees following the resignation of Major C. B. Thorne, M.:.

Grangemouth Iron Company, Limited, are to cary out additions and internal alterations to their offices t Grange Iron Works, Falkirk, at an estimated cost f £3,650.

Falkirk Iron Company, Limited, are to erect showr baths for the use of trainee apprentices and foundy workers at Castlelaurie Works, at an estimated cost f £2,000.

Power Jacks, Limited, have appointed Normai Stanley & Company, 56, Marshall Drive, St. Alban, Herts, as their London main distributors for the Nevton Hydratruck.

A small oil tanker, which has been purchased n Norway by the British Iron & Steel Corporation, s to be towed for breaking up by Metal Industrie, Limited, at Rosyth.

Free film shows are given at lunchtime each Wednesday to employees of the Stanton Ironworks Compan:, Limited, near Nottingham. Lunch-hour gramophore record recitals are also proving popular.

On Tuesday of last week Mr. N. P. Newman, J.P, and Mr. K. Marshall, M.A., left Southampton in the Queen Mary *en route* for the United States, where the/ are visiting the A.F.S. Convention at Cleveland.

Damages of £200 were awarded at Walsall Count' Court to a 16-year-old girl, Betty Hollyhead, who hai to have her right-hand index finger amputated as i result of an accident when cutting iron bars on a machine at the works of Job Wheway & Son, Limited, malleable-iron founders, of Walsall.

"Materials Handling" will be the subject of a one day conference to be held in Bristol by the Westerr Section of the Institution of Production Engineers. I' will take place at the Victoria Rooms on May 13, anc the lectures and films comprising the programme have been chosen to give thorough coverage of many of the problems arising in handling materials.

Mr. W. F. Prentice, a member of the British Iron anc Steel Federation, speaking at Whitby (Yorks) on May 1, said that many members of the Federation believec that the industry would not be nationalised, althougt vesting day had been fixed for January 1 next. Many people who at one time advocated the nationalisatior of the industry were not so keen about it to-day.

Head Wrightson Processes, Limited, Thornaby-on-Tees, have secured a contract to supply a pair of gates for the entrance to the King George V Dock, London. The gates, 57 ft. wide and weighing 227 tons each, will be welded at Thornaby and towed to the Port of London. The company have also been commissioned to build a carbon-black factory at Avonmouth for Philblack, Limited.

Prototypes of a considerable range of new farm machinery were exhibited on April 25 at a demonstration arranged by the Agricultural Equipment Sub-committee of the Scottish Council at Monktonhall, Musselburgh. Machines seen in action were a revolving spike-tooth harrow, from a Norwegian design, and a combined spring-tooth harrow and Cambridge roller, designed in Canada. Both were produced by Cruickshank & Company, Limited, ironfounders, Denny.

Imports and Exports of Iron and Steel

Board of Trade Returns for March

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in March. Figures for the same month in 1949 are given for purposes of comparison, and totals for the first quarter of this year are also included.

Total Imports of Iron and Steel

From	Month ended March 31.		Three months ended March 31.
	1949.	1950.	1950.
	Tons.	Tons.	Tons.
Australia	126	—	9
Canada	5,887	3,584	9,842
Other Commonwealth countries and Irish Republic	67	9,100	23,532
Sweden	2,045	1,125	3,251
Norway	2,411	3,776	10,860
Germany	263	10,260	22,310
Netherlands	5,366	8,325	17,428
Belgium	40,810	12,599	23,147
Luxemburg	20,495	4,812	8,340
France	17,166	13,776	52,688
Austria	4,499	961	961
USA	14,160	8,598	20,070
Other foreign countries ..	334	446	1,833
TOTAL	113,629	77,362	194,271
Iron ore and concentrates—			
Manganiferous	—	4,500	10,900
Other sorts	652,898	800,247	2,148,974
Iron and steel scrap and waste, fit only for the recovery of metal..	65,052	242,930	597,809

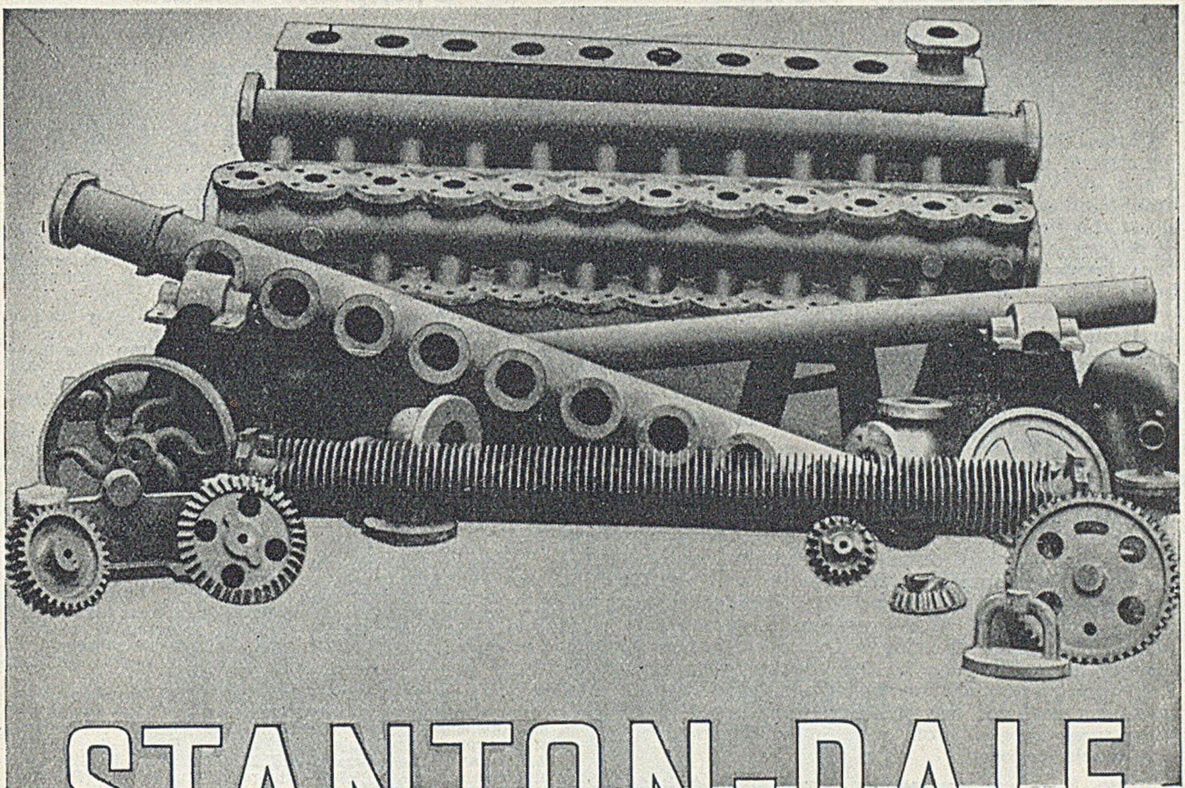
Exports of Iron and Steel by Products

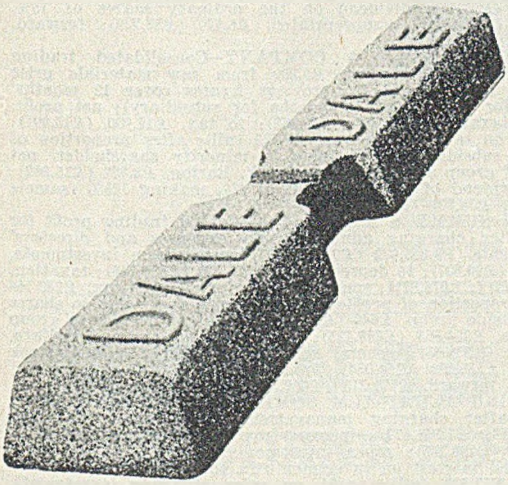
Product.	Month ended March 31.		Three months ended March 31.
	1949.	1950.	1950.
	Tons.	Tons.	Tons.
Pig-iron	187	2,565	6,630
Ferro-alloys, etc.—			
Ferro-tungsten	71	76	264
Spiegeleisen, ferro-manganese ..	208	152	716
All other descriptions ..	120	70	511
Ingots, blooms, billets, and slabs	70	199	621
Iron bars and rods	834	480	1,342
Sheet and tinplate bars, wire rods	197	504	946
Bright steel bars	2,473	3,619	10,467
Other steel bars and rods ..	12,876	16,963	62,720
Special steel	1,202	1,434	3,852
Angles, shapes, and sections ..	12,251	14,659	37,636
Castings and forgings	724	872	2,414
Girders, beams, joists, and pillars	2,669	5,825	14,338
Hoop and strip	3,540	9,812	21,368
Iron plate	437	78	715
Tinplates	16,398	23,462	60,123
Tinned sheets	337	374	746
Terneplates, decor. tinplates ..	—	23	83
Other steel plate (min. ⅛ in. thick)	19,340	30,081	72,541
Galvanised sheets	8,837	10,859	29,154
Black sheets	12,762	11,241	30,765
Other coated plates	412	1,085	2,965
Cast-iron pipes, up to 6-in. dia. ..	7,421	6,316	18,375
Do., over 6-in. dia. ..	7,301	7,908	21,217
Wrought-iron tubes	31,184	32,990	81,490
Railway material	15,974	22,190	64,659
Wire	4,510	6,523	16,900
Cable and rope	2,603	3,398	8,961
Netting, fencing, and mesh ..	1,557	1,448	4,921
Other wire manufactures	1,175	1,870	5,268
Nails, tacks, etc.	594	503	1,283
Rivets and washers	839	682	1,997
Wood screws	330	278	838
Bolts, nuts, and metal screws ..	2,397	2,950	8,066
Stoves, grates, etc. (excl. gas) ..	931	847	2,781
Do., gas	276	296	658
Baths	752	1,041	3,464
Anchors, etc.	975	864	2,461
Chains, etc.	915	817	2,430
Springs	710	921	2,381
Hollow-ware	6,196	8,353	25,575
All other manufactures	21,556	21,245	62,693
TOTAL	204,141	255,882	705,175

Total Exports of Iron and Steel

Destination.	Month ended March 31.		Three months ended March 31.
	1949.	1950.	1950.
	Tons.	Tons.	Tons.
Channel Islands	811	744	2,311
Gibraltar	100	167	452
Malta and Gozo	475	377	1,362
Cyprus	270	689	2,054
British West Africa	6,859	5,852	24,476
Union of South Africa	14,725	16,283	36,596
Northern Rhodesia	2,288	3,354	7,464
Southern Rhodesia	4,448	6,823	19,177
British East Africa	6,960	9,705	25,206
Mauritius	568	851	2,573
Bahrein, Koweit, Qatar, and Trucial Oman	3,675	606	1,825
India	5,425	7,188	20,228
Pakistan	2,199	7,277	15,697
Malaya	5,145	5,805	19,572
Ceylon	1,294	3,666	9,552
North Borneo	396	296	2,212
Sarawak	91	130	625
Hongkong	3,396	5,457	13,789
Australia	9,946	24,369	80,216
New Zealand	8,760	13,133	44,032
Canada	7,213	8,663	19,887
British West Indies	6,048	4,694	17,093
British Guiana	264	978	2,043
Anglo-Egyptian Sudan	2,165	2,076	4,824
Other Commonwealth countries ..	836	1,644	3,551
Irish Republic	6,173	9,609	21,695
Russia	609	45	250
Finland	4,999	6,450	17,277
Sweden	4,994	7,938	21,186
Norway	7,726	8,195	18,742
Iceland	651	219	1,356
Denmark	10,390	15,876	40,284
Poland	64	259	502
Germany	33	31	131
Netherlands	10,556	9,064	20,733
Belgium	856	1,048	4,167
Luxemburg	—	—	253
France	1,182	4,214	6,749
Switzerland	1,149	1,260	3,872
Portugal	2,460	1,743	4,359
Spain	560	1,386	2,987
Italy	212	843	2,212
Hungary	—	63	199
Greece	175	555	1,612
Turkey	728	424	2,916
Indonesia*	4,526	915	4,112
Netherlands Antilles	309	1,075	3,117
Belgian Congo	145	131	381
Angola	145	284	1,040
Portuguese East Africa ..	621	311	1,131
Canary Islands	312	248	645
Syria	358	146	219
Lebanon	5,676	1,041	2,623
Israel	1,644	1,517	4,756
Egypt	6,866	8,516	19,546
Morocco	28	16	214
Saudi Arabia	151	502	890
Iraq	2,375	8,282	14,382
Iran	12,543	9,891	33,872
Burma	1,443	858	2,612
Thailand (Siam)	391	356	2,130
China	477	161	571
Philippine Islands	528	2,243	4 581
USA	445	1,626	3,079
Cuba..	15	149	406
Colombia	483	961	1,569
Venezuela	7,443	1,859	10,157
Ecuador	443	394	907
Peru	285	1,350	2,563
Chile	546	1,071	3,494
Brazil	2,024	3,401	8,856
Uruguay	807	459	2,113
Argentine	3,695	5,152	19,148
Other foreign countries ..	1,543	1,688	7,762
TOTAL	204,141	255,882	705,175

* Includes Netherlands New Guinea in 1949.

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Company News

The information under this heading has been extracted from statements circulated to shareholders, speeches made at annual meetings, and other announcements.

Clarke, Chapman & Company, Limited, manufacturing marine engineers, of Gateshead:—The chairman, MR. J. B. WOODESON, told the annual meeting that the order-book at the moment was very satisfactory, and stood at a figure of over £11,000,000. A fair proportion of this was export work, some for the dollar areas. All departments over the past year had been extremely busy.

The marine department had constructed some very large and powerful equipment. Output of electric deck machinery had also remained very satisfactory. The pump department also had had an excellent year for output, and continued to have a very full order-book. The boiler department was busier and its order-book bigger than ever before.

Newton Chambers & Company, Limited:—In the heavy construction division, capital expenditure on machinery and equipment, together with the great improvement in the supply of iron and steel, combined to bring about increased output which resulted in a most successful year, surpassing the turnover and profit of 1948 and establishing new records. The light-castings department has met with considerable success in replacing the output lost owing to the reduced demand for castings in connection with the housing programmes. The mechanised plant on which considerable capital had been expended was well occupied throughout the year: turnover and profit were in consequence both very much improved.

Brush Electrical Engineering Company, Limited:—The group's order-book by the end of 1949 had decreased by 20 per cent. as compared with the end of 1948, but the chairman, SIR RONALD W. MATTHEWS, says that the board does not consider that this is unsatisfactory having regard to the changed conditions in world trade. Customers overseas are now not prepared to accept the long deliveries which were common at the end of the war, and it is this factor, he says, which has caused the shrinkage in the total order-book. There is, however, evidence that as the group is able to shorten deliveries, further orders are forthcoming at a steady rate. Steps have been taken to strengthen the company's world-wide sales organisation.

National Gas & Oil Engine Company, Limited:—The directors would have liked to increase the ordinary dividend, but in view of the scheme for expansion of output, obscurity of the future trend of events in foreign markets, and heavy demands made by taxation at its present onerous level, they decided it was necessary to place a maximum sum to reserve to ensure future stability of the company, says LORD CUNLIFFE, the chairman. Extensive plans have been made to achieve a still further increase in production during the current year. Whereas output in 1948 was 14 per cent. greater than in 1947, production in 1949 was 20 per cent. greater than in 1948.

British Rollmakers Corporation, Limited:—The chairman (MR. OWEN F. GRAZEBROOK) says that the total volume of sales and the total of rolls manufactured during 1949 were greater than in the previous year, but the advance in price of every item in costs has continued and is continuing. Much progress has been made in the erection of the new plant at Crewe, and it is anticipated that by March, 1951, the company will be producing rolls on the site.

Company Results

(Figures for previous year in brackets.)

LIGHTALLOYS—Interim dividend of 5% (same).

LANCASHIRE STEEL CORPORATION—Dividend of 8% (same).

COCHRAN & COMPANY, ANNAN—Interim dividend of 1½%, tax free (same).

FOLLSAIN-WYCLIFFE FOUNDRIES—Final dividend of 18%, making 24%. The company completed its reorganisation in June, 1948.

THARSIS SULPHUR & COPPER COMPANY—Trading profit for 1949, £211,092 (£305,981); net profit, after directors' remuneration, etc., £80,234 (£99,520); to plant replacement reserve, £50,000 (nil); dividend of 7½% (same); forward, £174,987 (£196,316).

PROJECTILE & ENGINEERING COMPANY—Net trading profit for 1949, before tax, £71,407 (£49,262); to taxation Schedule A and profits tax, £16,070 (£6,129); provisions taxation not required, £2,705 (£13,500); deferred repairs, nil (£15,000); to general reserve, £30,000 (£48,700); additional to pension fund, £1,000 (same); dividend of 12½% (same); forward, £51,745 (£45,328).

ENFIELD ROLLING MILLS—Consolidated trading profits and rents for 1949, £629,770 (£503,716); net profit, after depreciation, taxation, etc., £225,058 (£163,380); to pension fund, £15,000 (£5,000); general reserve, £100,000 (same); plant replacement reserve, £50,000 (nil); dividend of 5% and bonus of 2½% (same); forward, parent company £80,210 (£68,016), subsidiaries £44,705 (£29,841).

PARKINSON & COWAN—Consolidated trading profit for 1949, £302,066 (£292,141); net profit, after depreciation, etc., £173,034 (£171,313); profit on sale of sundry assets, £100 (£673); income not relative to year's trading, £3,294 (£7,099); reserve accounts transferred, nil (£639); to income tax, £63,427 (£59,041); profits tax, £32,694 (£26,497); reduction of goodwill and patents, £25,000 (£34,353); equity of outside shareholders, £1,463 (£753); dividend of 7% (same); forward, £137,242 (£129,975).

WILLIAM DIXON—Consolidated profit and loss account for the year to February 28 shows trading profit, less proportion of management expenses, £32,638 (£63,141); investment income, interim income from Ministry of Fuel and Power, etc., £11,999 (£26,289); available balance, £137,277 (£180,433); to directors' emoluments, £7,284 (£7,389); depreciation, £5,800 (£12,679); tax, £17,687 (£37,033); preference stock—proportion of dividend on stock repaid, nil (£1,146 net); ordinary dividend of 7½% (10%), £18,040 (£24,053); forward, £82,966 (£92,633).

BRITISH ROLLMAKERS CORPORATION—Trading profit of group for 1949, £294,730 (£325,264); depreciation, £43,795 (£41,385); net profit, £224,730 (£256,203); profit tax, £39,150 (£38,000); income tax, £83,141 (£98,502); loss on sale of assets, £3,068 (profit £4,564); retained in subsidiaries' reserves, nil (£2,015); net income of holding company, £99,371 (£122,250); to general reserve, £40,000 (same); preference dividends, £11,064 (£9,414); dividend on the ordinary shares of 15%, £42,128 (£35,107); unappropriated, £6,179 (£37,729); forward, £69,864 (£63,685).

QUIRK, BARTON & COMPANY—Consolidated trading profit for 1949, including £3,000 from raw materials price reserve, £27,800 (£38,578, previous figures cover 12 months' period for parent and 18 months for subsidiary); net profit, before taxation, £19,354 (£29,868); to tax, £12,900 (£13,991); surplus on sale of property, £2,422 (nil); after proportion of loss of subsidiary attributable to minority shareholder, net profit of group attributable to Quirk, Barton, £8,882 (£15,862); final dividend of 6% and bonus of 4%, making 12½% (same); forward, £36,701 (£35,614).

JOHN SUMMERS & SONS—Consolidated trading profit for 1949, after charging administration expenses and directors' emoluments, £2,863,972 (£2,379,217); income from investments, £60,152 (£96,827); to depreciation, £510,970 (£537,744); taxation, £1,185,987 (£1,076,871); special reserve for deferred tax, £238,164 (nil); proportion of profits of subsidiaries applicable to shares held outside group, £640 (£3,306); surplus applicable to group holdings, £988,363 (£858,123); to special pensions and welfare, £100,000 (£33,063); general reserve, £350,488 (£350,580); stock reserve, £156,720 (£59,054); final dividend of 6%, making 8½% (same); forward, £971,313 (£967,346).

BRITISH ALUMINIUM COMPANY—Consolidated trading profit, after charging management remuneration for 1949, £1,538,359 (£1,845,677); income from allied companies, etc., £35,564 (£100,143); other investments, £1,348 (£2,888); dividend and interest on investments in subsidiaries not consolidated, £17,522 (nil); profit on sales of trade investments, £143,288 (£140,265); profit on exchange, £67,574 (nil); balance, after depreciation, taxation, etc., £551,203 (£498,450); profits attributable to outside shareholders, £2,643 (£2,369); net profit attributable to the British Aluminium Company, £548,560 (£496,081); to general reserves, £125,000 (£204,000); income-tax equalisation reserves, £145,000 (nil); final dividend of 6%, making 10% (same); credited to contingencies reserves, £30,860 (£35,522); forward, £733,543 (£700,343).

Raw Material Markets

Iron and Steel

The steel industry is to bear the whole of the increased costs arising from the higher rail charges which come into operation next Monday. It thus falls to the lot of an industry still under private enterprise to offer the first effective resistance to the spiral of inflationary price increases.

The blast furnaces are receiving ample supplies of ore, coke, and limestone, and from the units in production are obtaining satisfactory outputs. But supplies of pig-iron available for distribution are scarcely adequate for current needs and bigger tonnages of most grades could be readily absorbed. Engineers experience difficulty in obtaining delivery of their full allocations of low- and medium-phosphorus iron, and refined iron is possibly the only grade which can be said to be plentiful.

Owing to the keen competition of Belgian makers of re-rolled bars and sections, export orders are scarce. There is, however, a fairly steady demand for prime billets, and the phenomenal demand for sheets, both black and galvanised, ensures the ready disposal of the full output of sheet bars and slabs from British steel plants.

The curtailment of steel imports is, of course, a reflection of the shrinkage in the demand for re-rolled products.

The plate and heavy-section mills are assured of a steady run until the end of the current period. Substantial export orders have been booked for joists and sections, and plate-mill capacity is taxed to its utmost limits to keep pace with the steady flow of specifications. Colliery requisitions for arches, roofing bars, and pitprops are fairly constant, and there is no sign of any slackening in the home and export demand for heavy steel rails, chairs, points, and crossings. Strip and wire mills are also heavily booked for several months ahead.

Non-ferrous Metals

Although the tin market was rather erratic last week and values did not show a lot of change either way on balance, the general tone of non-ferrous metals was decidedly firm. This strength, of course, was in the first place manifested in the United States where commodity markets generally are showing a firm front. Both lead and zinc moved up, and as a result of appreciation in the New York price the Ministry of Supply increased lead by £2 to £90 and zinc by £4 to £99 10s. Yesterday (Wednesday) the Ministry's zinc price was raised by £4 per ton to £103 10s. following a further upward movement in America.

No change has been made in copper, which remains at 19½ cents for electro, but on the Commodity Exchange futures were raised to 17.10 cents. Throughout last week, however, and, indeed, since the advance to 19½ cents, there has been persistent talk of another rise in the copper quotation, and it does seem very likely that this will eventuate.

Metal Exchange tin quotations were as follow:—

Cash—Thursday, £590 to £590 5s.; Friday, £591 to £592; Monday, £588 15s. to £589; Tuesday, £592 5s. to £592 15s.; Wednesday, £594 to £594 5s.

Three Months—Thursday, £591 to £592; Friday, £591 to £592; Monday, £590 to £590 10s.; Tuesday, £593 to £593 10s.; Wednesday, £595 to £595 5s.

The tone of the scrap market has been firm and holders of both brass and copper material make no disguise of their intention to await a higher level before selling. Some business was done, but only when buyers, for one reason and another, made up their minds to face the increased charge. The merchants maintain that they are having no little difficulty in replacing material at the present time, and in order to protect their position they are obliged to advance prices for brass and copper offered to consumers.

The usual monthly figures have been issued by the British Bureau of Non-ferrous Metal Statistics, and from the details given below it will be seen that March was a period of much activity. Consumption of copper amounted to 46,446 tons, some 29,200 tons of which were in the form of virgin metal and 17,246 tons secondary or scrap. These figures compare with 40,080 tons total in February, of which 25,006 tons were virgin and 14,574 tons scrap. It is evident, therefore, that the improvement in March was divided between old and new metal. Stocks fell from 119,317 tons at February 28 to 115,882 tons at the end of March. Thus the Government's intention of drawing on stocks is being implemented, and in zinc, too, there was a fall of about 3,000 tons during March. Consumption of zinc increased to 30,276 tons. Virtually no change occurred in lead stocks, but consumption improved.

On the whole, the figures are undoubtedly favourable, the copper picture being particularly bright.

Generating Plant Expenditure

BEAMA CHAIRMAN ON "SERIOUS SITUATION"

Speaking at the recent annual general meeting of the British Electrical and Allied Manufacturers' Association, Mr. H. W. Bosworth, chairman of the Council, said that the question of the provision of generating plant throughout the country had been a major issue.

The Association claimed, he said, that the industry could satisfy all home and export demands made on it for such plant. "I feel, however, that I must emphasise the serious situation which is being created by the curtailment of capital expenditure on generation stations," said Mr. Bosworth. During the year the generating plant completed by manufacturers was 1,900 MW, but it was only found possible to put into commission during the year about 825 MW.

In 1949 the export of British electrical goods amounted to £140,000,000, compared with £23,000,000 in 1938. This represented exports in volume of well over double the pre-war figure.

Mr. G. Leslie Wates, chairman and joint managing director of Johnson & Phillips, Limited, Charlton, London, S.E.17, was elected chairman of the Association for 1950-51. He is also chairman of British National Electrics, Limited, and other companies. In 1946-47 he served as chairman of the Cable Makers' Association.

The new vice-chairman is Mr. I. R. Cox, managing director of Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester, 17, who is also deputy chairman of Metropolitan-Vickers Electrical Export Company, Limited, chairman of the Edison Swan Electric Company, Limited, and of Metro-Cutanit, Limited, and a director of Associated Electrical Industries, Limited, British Thomson-Houston Company, Limited, Metropolitan-Vickers-GRS, Limited, and Sunvic Controls, Limited.

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

May 10, 1950

PIG-IRON

Foundry Iron.—No. 3 Iron, Class 2 :—Middlesbrough, £10 4s. ; Birmingham, £10 0s. 6d.

Low-phosphorus Iron.—Over 0 10 to 0.75 per cent. P, £11 15s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si)—North Zone, £12 2s. 6d. ; South Zone, £12 5s.

Scotch Iron.—No. 3 foundry, £11 18s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £12 14s. 6d. ; South Zone, £12 17s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £13 4s. 6d. ; South Zone, £13 7s.

Cold Blast.—South Staffs, £15 16s. 6d.

Hematite.—Si up to 2½ per cent., S & P over 0.03 to 0.05 per cent. ; N.-E. Coast and N.-W. Coast of England, £11 16s. 6d. ; Scotland, £12 3s. ; Sheffield, £12 9s. ; Birmingham, £12 15s. ; Wales (Welsh iron), £11 16s. 6d.

Spiegeleisen.—20 per cent. Mn, £17 8s.

Basic Pig-iron.—£10 5s. 6d., all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, basis 2-ton lots, d/d Sheffield works.)

Ferro-silicon (6-ton lots).—45 per cent., £33 15s. ; 75 per cent., £49.

Ferro-vanadium.—35/60 per cent., 15s. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 8s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £109 per ton.

Ferro-tungsten.—80/85 per cent., 7s. 3d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 8s. 3d. per lb. of W.

Ferro-chrome.—4/8 per cent. C, £60 ; max. 2 per cent. C, 1s. 5½d. lb. ; max. 1 per cent. C, 1s. 6d. lb. ; max. 0.15 per cent. C, 1s. 6¾d. lb. ; max. 0·10 per cent. C, 1s. 7d. lb.

Cobalt.—98/99 per cent., 13s. 6d. per lb.

Metallic Chromium.—98/99 per cent., 5s. 3d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £25 14s. 8d.

Metallic Manganese.—96/98 per cent., carbon-free, 1s. 7d. per lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—Basic : Soft, u.t., £16 16s. 6d. ; tested, up to 0.25 per cent. C (100-ton lots), £17 1s. 6d. ; hard (0.42 to 0.60 per cent. C), £18 16s. 6d. ; silico-manganese, £23 19s. ; free-cutting, £20 1s. 6d. Siemens Martin Acid : Up to 0.25 per cent. C, £22 4s. ; case-hardening, £23 1s. 6d. ; silico-manganese, £26 6s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £19 16s. 6d. ; basic, hard, over 0.41 up to 0.60 per cent. C, £21 1s. 6d. ; acid, up to 0.25 per cent. C, £23 1s. 6d.

Sheet and Tinplate Bars.—£16 16s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Plates, ship (N.-E. Coast), £20 14s. 6d. ; boiler plates (N.-E. Coast), £22 2s. ; chequer plates (N.-E. Coast), £22 19s. 6d. ; heavy joists, sections, and bars (angle basis), N.-E. Coast, £19 13s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £22 6s. ; flats, 5 in. wide and under, £22 6s. ; rails, heavy, f.o.t., £19 2s. 6d. ; hoop and strip, £23 1s. ; black sheets, 17/20 g., £28 16s.

Alloy Steel Bars.—1-in. dia. and up : Nickel, £36 8s. ; nickel-chrome, £52 16s. 6d. ; nickel-chrome-molybdenum, £59 9s. 6d.

Tinplates.—I.C. cokes, 20 × 14, per box, 41s. 9d.. f.o.t. makers' works.

NON-FERROUS METALS

Copper.—Electrolytic, £162 ; high-grade fire-refined, £161 10s. ; fire-refined of not less than 99.7 per cent., £161 ; ditto, 99.2 per cent., £160 10s. ; black hot-rolled wire rods, £171 12s. 6d.

Tin.—Cash, £594 to £594 5s. ; three months, £595 to £595 5s. ; settlement, £594.

Zinc.—G.O.B. (foreign) (duty paid), £103 10s. ; ditto (domestic), £103 10s.; "Prime Western," £103 10s.; electrolytic, £104 5s. ; not less than 99.99 per cent., £105 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £90 ; ditto (Empire and domestic), £90 ; "English," £91 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, all English destinations, £119 10s. ; rolled zinc (boiler plates), all English destinations, £117 10s. ; zinc oxide (Red Seal), d/d buyers' premises, £98.

Other Metals.—Aluminium, ingots, £112 ; antimony, English, 99 per cent., £160 ; quicksilver, ex warehouse, £17 7s. 6d. to £17 10s. ; nickel, £321 10s.

Brass.—Solid-drawn tubes, 16¾d. per lb. ; rods, drawn, 23⅛d. ; sheets to 10 w.g., 21d. ; wire, 21½d. ; rolled metal, 19¾d.

Copper Tubes, etc.—Solid-drawn tubes, 18¾d. per lb. ; wire, 182s. 6d. per cwt. basis ; 20 s.w.g., 209s. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £101 to £115 ; BS. 1400—L.G.3—1 (86/7/5/2), £110 to £122 ; BS. 1400—GI—1 (88/10/2), £158 to £200 ; Admiralty GM. (88/10/2), virgin quality, £185 to £200, per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £162-£216 ; L.P.Bl, £120-£128 per ton.

Phosphor Bronze.—Strip, 28¾d. per lb. ; sheets to 10 w.g., 30⅝d. ; wire, 30¾d. ; rods, 28¼d. ; tubes, 33½d. ; chill cast bars : solids, 28½d., cored, 29½d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 1s. 10½d. per lb. (7%) to 2s. 8½d. (30%) ; rolled metal, 3 in. to 9 in. wide × .056, 2s. 4½d. (7%) to 3s. 2½d. (30%) ; to 12 in. wide, × .056, 2s. 4¾d. to 3s. 2¾d. ; to 25 in. wide × .056, 2s. 6¾d. to 3s. 4¾d. Spoon and fork metal, unsheared, 2s. 3d. to 3s. 1d. Wire, 10g., in coils, 2s. 9¾d. (10%) to 3s. 8d.; (30%). Special quality turning rod, 10% 2s. 8¾d. ; 15%, 3s. 1¼d. ; 18%, 3s. 5½d.

New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

MECHANICAL HANDLING (LONDON), 38, King William Street, London, E.C.4—£5,000.

VACU-BLAST, 10, St. Swithins Lane, London, E.C.4—Engineers, founders, etc. £5,000. R. R. Wilson.

HENRY BROWN & COMPANY (IRVINE)—Metal founders, engineers, etc. £60,000. R. and McC. Brown.

A. HUDDLESTONE & SONS, The Slack, Ambleside—Sanitary engineers. £10,000. A. E., T., and J. A. Huddlestone.

L. PICKERING & SONS, Clinton Lane, Kenilworth (Warwickshire). General engineers. £10,000. L. M. and L. Pickering.

H. BROADBENT & SON, Park Street Foundry, Ashton-under-Lyne—Ironfounders, etc. £20,000. H. H. Broadbent and W. E. Gregory.

ROBERT CURRIE & SONS, 107, Riverford Road, Glasgow, S.3—Aluminium, iron, and steel founders, etc. £7,500. R., G. C., and H. Currie.

LEEPER MELLOR & WHITTLES—Steelmakers and ironfounders. £5,000. H. V. Young, Essex House, Essex Street, London, W.C.2, subscriber.

J. WASTENEY & COMPANY, Vulcan Foundry, Eckington, near Sheffield—Iron and brass founders, etc. £5,000. P. McGovern, A. Hall, and G. Conway.

LAND PYROMETERS—Temperature measurement instrument manufacturers. £10,000. F. W. Land, Prenton, Church Lane, Dore, Sheffield. T. and E. H. Land.

A. S. LADLEY & COMPANY, 30, Fleet Street, London, E.C.4—Instrument makers, ironfounders, and mechanical engineers. £5,000. A. S. and W. Ladley, and J. K. Moore.

R. E. GLANVILLE & SONS (BOVEY TRACEY), Station Works, Bovey Tracey (Devon)—Agricultural engineers and implement manufacturers. £16,000. E. O., V. M., and M. F. Glanville, and J. R. L'E. and D. E. Burges.

G. P. WILSON (ENGINEERS), 31, Oxford Street, Southampton—To take over business carried on at Northam Bridge Foundry, Southampton, by G. P. Wilson & Son, and to enter into an agreement between the above mentioned company and Marine Contractors. £5,000. J. O., J. M., and K. Ingram.

New Trade Marks

The following applications to register trade marks appear in the "Trade Marks Journal":—

"BROSKO"—Firebricks. S. SPENCER, LIMITED, 7, Park Square, Leeds, 1.

"STELLITE"—Welding rods. DELORO STELLITE, LIMITED, Highlands Road, Shirley, Birmingham.

"SOLANUM"—Machines. BOWMAN, ARLINGTON & FREE, LIMITED, 23, Haymarket, London, S.W.1.

"DURAGAS"—Gas ovens. TOM CHANDLER, LIMITED, 14, Egerton Road, Fallowfield, Manchester, 14.

"WUNDO"—Washing and wringing machines. BRADSTEDS, LIMITED, Ash Street, Bradley, Bilston (Staffs).

"ALMINTRODE"—Electrodes. WELDING SUPPLIES, LIMITED, Anchor and Hope Lane, Charlton, London, S.E.7.

"HOMA"—Casters and buffers. HOMA ENGINEERING COMPANY, Homa Works, Cambridge Road, Cosby (Leics).

"DISTAL"—Unwrought and partly wrought common metals. ALMIN, LIMITED, The Chalet, Farnham Royal (Bucks).

"GREE-CO"—Agricultural implements, hand tools, etc. J. & J. GREIG, LIMITED, Viaduct Works, Heaton Lane, Stockport (Ches.).

"POLYGRAM"—Moulding and casting machines. POLYGRAM FOUNDRIES, LIMITED, Power Road, Gunnersbury, London, W.4.

"FIBROGLIDE," "UNIGLIDE," and "THERMOGLIDE"—Pumps. HARLAND ENGINEERING COMPANY, LIMITED, B.E.P. Works, Alloa, Scotland.

"30 UP" (DEVICE)—Piston rings, etc. RAMSEY CORPORATION, c/o Stevens, Langner, Parry & Rollinson, 5 to 9, Quality Court, Chancery Lane, London, W.C.2.

"COFLEX"—Thermostatic bimetals. THE H. A. WILSON COMPANY, c/o Cruikshank & Fairweather, 29, Southampton Buildings, Chancery Lane, London, W.C.2.

RAM DEVICE—Machinery for making and handling foundry bonding material. FULLERS' EARTH UNION, LIMITED, Patteson Court, Nutfield Road, Redhill (Surrey).

"FULBOND"—Machinery for making and handling foundry bonding materials. FULLER'S EARTH UNION, LIMITED, Patteson Court, Nutfield Road, Redhill (Surrey).

"ENALON" AND "ENALEM"—Textile-machinery parts. ENGINEERING & ALLIED MANUFACTURING COMPANY, LIMITED, South Premier Works, Drayton Road, Tonbridge (Kent).

"DURAMOULD"—Machine-finished moulds of metal and die-cast moulds of light metal alloys. WHITWELL ENGINEERING COMPANY, LIMITED, High Street, Whitwell (Herts).

CLASSIFIED ADVERTISEMENTS

PREPAID RATES : Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Numbers 2s. extra (including postage of replies).

SITUATIONS WANTED

FOUNDRY Manager wants Partnership or Directorship small Foundry (Midlands); sound practical and commercial knowledge; can influence substantial business; would reorganise neglected or run down foundry; invest up to £2,000.—Box 470, FOUNDRY TRADE JOURNAL.

A KEEN Young Man (age 25), with a good practical knowledge of foundry work and metallography, desires a responsible position in a metallographic laboratory, or a non-ferrous and/or light alloy foundry; passed O.N.C.—Box 438, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN desires post, Midland Foundry; not afraid of hard work, long hours, etc.; control all departments tnd take responsibility; age 45; M.I.B.F.; commence immediately.—Box 468, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (37), M.I.B.F., desires change to light malleable foundry, where initiative and ability to obtain results is required; capable organiser; control all grades labour; sound practical experience; semi and fully mechanised plant, coreblowing, P.F. annealing, etc.—Box 458, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (age 44) open re-engagement owing termination of contract, life experience light castings, specialist economic repetition production, good commercial knowledge and contacts, able to obtain substantial business, can train labour and get results, would like join small Midland Foundry.—Box 466, FOUNDRY TRADE JOURNAL.

IRON Moulder (age 44) seeks position as FOUNDRY FOREMAN or UNDER-FOREMAN; 30 years' practical experience, estimating, piece work; able to handle labour; references.—Box 442, FOUNDRY TRADE JOURNAL.

IRONFOUNDRY FOREMAN (aged 42 years) requires similar position; experienced in hand, board and machine moulding, green and dry sand work of wide range, including high strength irons; price setting and estimating, and able to train labour; post preferred in south.—Box 452, FOUNDRY TRADE JOURNAL.

PRACTICAL FOUNDRY MANAGER desires change; 13 years' supervisory experience; general engineering, including textile, in general and mechanised foundries; age 45.—Box 450, FOUNDRY TRADE JOURNAL.

PATTERN CHECKER (aged 28 years), experienced in plate and loose patterns, wood and metal, seeks position, with prospects of advancement, in return for diligence and initiative; preferably Sheffield area.—Box 462, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

EXPERIENCED IRON MOULDER required for Jobbing Foundry in South London; good bonus paid; accommodation can be arranged for single man.—Box 436, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

APPRENTICE TRAINING.—A unique opportunity is offered to one interested in youth activities and experienced in the work of an Iron Foundry to instruct in a Foundry Apprentice Training Centre. He will be required to teach practical green and dry sand moulding and core making, together with elementary foundry calculations and science.—Applications in writing, giving age and present salary, details of practical, technical and youth work experience, should be addressed to the PERSONNEL OFFICER, Newton, Chambers & Co., Ltd., Thorncliffe, Sheffield. Previous applicants need not re-apply.

ASSISTANT FOUNDRY MANAGER required, to train youths and young labour; salary £520 per annum; Midlands, near Birmingham.—Please reply, stating age and experience, to Box 434, FOUNDRY TRADE JOURNAL.

EXPERIENCED FOUNDRY SUPERINTENDENT required, to control the Steel and Iron Foundry of The Union Steel Corporation (of South Africa), Ltd., at Vereeniging, Transvaal. Annual production 4,500 tons of steel and 2,500 tons of iron castings.

Applicants must have practical and technical knowledge of the manufacture of castings in plain carbon, alloy and manganese steels up to 20 tons in weight, be fully conversant with estimating from customers' drawings, and also job costing methods. Previous positions held should be stated, also age and marital state.

Commencing salary £1,000 per annum, on an initial 3 years' contract, plus "cost-of-living" allowance, at present £171 per annum for a married person. It is obligatory for the successful applicant to join the Corporation's pension, recreation and medical benefit funds.

Fare to South Africa for successful applicant and family will be paid by the Corporation.

Applications in writing should be forwarded to the LONDON REPRESENTATIVE, Union Steel Corporation (of South Africa), Ltd., 535-546, The Adelphi, London, W.C.2.

FOREMAN required, to supervise production in Grey Iron Foundry; age 30-40; sound knowledge of floor, machine and mechanised production essential; applicant must have proved himself in similar capacity, and must have experience of cupolas, metal and sand control.—Write, stating age, experience, and full history of employment, to JONES & ATTWOOD, LTD., Stourbridge, Worcs.

FOUNDRY METALLURGIST required for Works situated 20 miles west of London; good practical knowledge of non-ferrous melting and foundry work essential, and some experience of steel foundry work an advantage; state standard of education, experience, and salary required; all applications will be acknowledged.—Write Box L.714, WILLINGS, 362, Grays Inn Road, London, W.C.1.

MANAGER required for Light Castings Foundry in East Midlands doing substantial and profitable business; only men with executive ability and with approximately £5,000 capital need apply; present managing director intends gradually to retire owing to ill-health; applicant will be able to acquire controlling interest in business over an agreed period.—Reply to Box 428, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

APPLICATION SALES ENGINEERS wanted to introduce to the Foundry Industry equipment based on entirely new technique; applicants should have had practical foundry experience, including metallurgical or laboratory training; some knowledge of instrumentation an advantage.—Write, stating age, experience and salary required, to Box 476, FOUNDRY TRADE JOURNAL.

ENGINEER'S PATTERNMAKER required.—Apply C. F. DOYLE, LTD., Weston Works, Faversham.

FOUNDRY SUPERINTENDENT, C.I., M.I., and non-ferrous, required immediately for well-known Engineering firm in Leicestershire; wide practical experience in machine and floor moulding in up-to-date mechanised plants essential; only those who can handle a mixed labour force with understanding and efficiency need apply.—Write full details experience, age, and salary expected, to Box 418, FOUNDRY TRADE JOURNAL.

FOUNDRY TECHNICIAN required for Modern Progressive Foundry, situated near London; must have good experience in non-ferrous and foundry processes, including melting sand control, running and feeding practice; state standard of education, experience, and salary required.—Write Box M.715, WILLINGS, 362, Grays Inn Road, London, W.C.1.

GENERAL MANAGER to control, commercially and technically, 60-Ton Jobbing and Semi-repetition Grey Iron Foundry outside Manchester; light engineering, electrical and allied castings; first-class commercial and technical experience essential; aged 35/45; state fully qualifications and salary required.—Box 430, FOUNDRY TRADE JOURNAL.

PRODUCTION CONTROLLER required for Midlands Works, comprising Iron Foundry, Machine Shop, Vitreous Enamelling Plant and Assembly Shop; foundry and enamel shop experience essential; Commencing salary £750 per annum.—Apply Box 478, FOUNDRY TRADE JOURNAL.

RADIOLOGIST required for the Inspection of Castings by large Foundry in South-East London area; applicant, with experience of analysing and interpreting radiographs of castings, will be preferred.—Write, stating age, qualifications and experience, to Box 448, FOUNDRY TRADE JOURNAL.

SALES MANAGER required, to control Sales Organisation for an old-established Midland Group of Companies producing Castings, Forgings, and small Machine Tools, with a view to consolidating old and increasing the present business; the position offered is a responsible one, and the remuneration will be paid accordingly; full particulars of present and planned capacity available at interview.—Apply Box 446, FOUNDRY TRADE JOURNAL.

WANTED.—Young, energetic, METALLURGICAL AND GENERAL WORKS CHEMIST, B.Sc. for preference or equivalent experience; must have practical knowledge; living accommodation can be arranged.—Apply C. R. PURLEY, L.E.C. Factory, Bognor Regis, Sussex.