FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 91 | Thursday, August 23, 1951 | No. 1825

PRINCIPAL CONTENTS

PUBLISHED WEEKLY: Single Copy, 9d. By Post 11d. Annual Subscription, Home 40s., Abroad 45s. (Prepaid).
49, Wellington Street, London, W.C.2. 'Phone: Temple Bar 3951 (Private Branch Exchange) Grams: "Zacatecas, Rand, London"

Added Interest

As an attraction for apprenticeship in foundry practice, thought might be given to the notion of encouraging the lads to make some small art castings. Not only will this inculcate the love of craftsmanship, but it would also lead to an appreciation of art. It may be objected that in the average foundry there is seldom anyone capable of giving the necessary instruction. There is, however, in most communities a local School of Art and in many of these there are on the staff enthusiasts who would welcome the opportunity of collaborating in any effort made. The equipment, if not already available, is not too expensive, whilst as a long-term project, the production of an art casting by a concern or one of its employees can attract considerable publicity. Or, again, in normal times, a market can be created for purely art castings, as for instance in Germany, where filigree plaques, suitable for hanging on plain walls, are regularly offered for sale. They are so much better than "Lovers' Quarrel" or "Kittens at Play," such as are often encountered in cottage homes, and with a shiny black finish are certainly decorative.

Even if there be no scope for truly artistic castings, attention can be given to the making of vitreous-enamelled cast-iron ash-trays, fine examples of which were shown on the exhibition train organised by Allied Ironfounders, Limited. Booth & Brookes, Limited, of Mildmay Ironworks, Burnham-on-Crouch, periodically produce plaques of well-known people, a good means of publicity. The travel bureaux of to-day nearly all carry stylised model aeroplanes as advertisements for the various airlines. These are made by the investment process and are fine examples of the modern use of castings for publicity.

Once a person gets really interested in art casting, he finds it an absorbing hobby. Mr. John Longden, of Tullis & Company, Limited, Clydebank, has done some really beautiful work—one of which, "The Runner," is now a permanent exhibit at the Glasgow Art Gallery. Mr. W. G. Mochrie, the popular honorary secretary of the London branch of the Institute of British Foundrymen, is also a craftsman of no mean order. These two art casters, of course, do their own modelling. There may be many potential artists amongst the foundry youth of to-day and it is good business for firms to do everything possible to create facilities for their development. These efforts in certain utilitarian directions are encouraged by the Royal Society of Arts, and it can be assumed that, should the system grow, other bodies would lend their support by the provision of prizes for competition. The benefits to be derived from the teaching of art moulding to apprentices are:—(1) added interest in craftsmanship; (2) when success is achieved, *kudos* is gained by the firm, and (3) by co-operation with the design and sales department of the larger concerns, media for publicity may be forthcoming.

Borough Polytechnic Foundry Classes

Classes for craft training in foundry practice for young trainees and apprentices in the industry are provided at the Borough Polytechnic, Borough Road, London, S.E.1, on the days and times set out below. Trainees taking this course will, if they so desire, be able to sit for the Intermediate and Final Examinations of the City and Guilds of London Institute in Foundry Practice. The work carried out in these courses is essentially craft and practical with the object of assisting firms in their training of the young members of their staff.

Part-time Day Classes

FIRST YEAR—
Foundry Practice I }
Drawing and Calculations I } Tuesdays or Wednesdays, 9 to 4.30.

SECOND YEAR—
Foundry Practice II }
Drawing and Calculations II } Thursdays, 9 to 4.30.

Students may take the City and Guilds intermediate examination in Foundry Practice on completion of the second year of the above course.

THIRD YEAR—
Foundry Practice III }
Metallurgy } Fridays, 9 to 4.30.

FOURTH YEAR—
Foundry Practice IV }
Foundry Technology } Mondays, 9 to 4.30.

Students may take the City and Guilds final examination in Foundry Practice on completion of the fourth year of the above course.

Evening Courses

FIRST YEAR—
Foundry Practice I — Wednesdays, 6.30 to 9;
Drawing and Calculation I — Fridays, 6.30 to 9.

SECOND YEAR—
Foundry Practice II — Thursdays, 6.30 to 9;
Drawing and Calculations II — Mondays, 6.30 to 9.

Students may take the City and Guilds intermediate examination in Foundry Practice on completion of the second year of the above course.

THIRD YEAR—
Foundry Practice III — Tuesdays, 6.30 to 9;
Metallurgy — Thursdays, 6.30 to 9.

FOURTH YEAR—
Foundry Practice IV — Tuesdays, 6.30 to 9;
Foundry Technology — Mondays, 6.30 to 9.

Students may take the City and Guilds final examination in Foundry Practice on completion of the fourth year of the above course.

Enrolment

The Polytechnic will be open from 5.30 to 8 p.m. on the evenings of September 17 and 18 for the enrolment of old students, and on the evenings of September 19 and 20 for the enrolment of new students for part-time day and evening classes. The principal, heads of departments and members of the staff will be present on each evening to advise students on suitable courses of instruction. It is important that intending students should enrol on one of these evenings. Fees are payable on enrolment. Classes commence on September 17.

"MARKET RESEARCH OVERSEAS" is the title of a brochure produced by the British Export Trade Research Organisation covering the objects, methods, and the scope of its market research services, the lines on which special services are conducted, and the approximate fees charged. Copies are obtainable from the London office of B.E.T.R.O., Premier House, 48, Dover Street, W.1. Under a recent working agreement, B.E.T.R.O. acts as the "chosen instrument" of the Federation of British Industries in the field of market research and works in close collaboration with the F.B.I. at home and abroad.

I.B.F. Honorary Members

At a recent meeting of the Council of the Institute of British Foundrymen the following were unanimously elected Honorary Life Members of the Institute. Mr. D. Sharpe, of Glasgow, past-president of the Institute; Mr. Oliver Smalley, O.B.E., of New York, president of the Meehanite Corporation, and Dr. James T. McKenzie, of the American Cast Iron Pipe Company, Birmingham, Alabama.

Mr. Sharpe is a real pioneer of the foundry industry. He was responsible for bringing into this country the Sandslinger, the Eaton-Erb iron die-casting system, and the Meehanite process. He joined the Institute in 1920 and has also presided over the Scottish branch. He has served on the boards of directors of a number of both iron and steel foundries and is amongst the best known of Scottish foundrymen. He is very widely travelled and has visited the United States, India, South Africa, and Australia, his most recent trip being to the Southern Hemisphere, where at Melbourne he was officially welcomed by the Institute of Australian Foundrymen.

Mr. Oliver Smalley, O.B.E., was, before he left England for the United States in about 1926, chief metallurgist of Sir W. G. Armstrong-Whitworth & Company, Limited. Quite early in his career he wrote an article for the FOUNDRY TRADE JOURNAL on the "Influence of Elements on Cast Iron," which still remains a classical contribution to ferrous metallurgy. After a few years as a consultant, he took up the Meehanite process, which has now spread all over the world. Mr. Smalley has been honoured by the Gray Iron Founders' Association, who presented him with a gold plaque. For many years he acted as British Consul at Pittsburgh, and his work in connection with the Royal visit to Canada and the United States was recognised by the award of the O.B.E. Mr. Smalley, who is now an American citizen, visits this country each summer, to preside over the meetings of the Meehanite Research Institute.

Dr. James T. Mackenzie is technical director to the American Cast Iron Company. His major contributions to foundry practice which have received international approbation are the development of the sand-spun process for making cast-iron pipes and cupola practice. He has been the recipient of numerous academic distinctions by American universities. He has paid several visits to Europe and was commissioned to inspect the German foundry industry after the war. He is a very active chairman of the Gray Iron Committee of the American Foundrymen's Society, to the Proceedings of which he has made innumerable and very valuable contributions. To these three very worthy recipients, the FOUNDRY TRADE JOURNAL offers its warmest congratulations.

Nomenclature of Refractories

During the past few years, there has been some confusion between makers and users of refractories on the meaning of silica bricks, siliceous bricks, semi-siliceous bricks and firebricks. The Ministry of Supply was asked to ascertain whether agreement on nomenclature could be obtained between interested organisations, and has now reported as follows:—

Silica bricks are bricks containing at least 92 per cent. silica.

Siliceous bricks are bricks containing 85 to 92 per cent. silica.

Semi-siliceous bricks are bricks containing 78 to 85 per cent. silica.

Firebricks are bricks for which the silica content is below 78 per cent.

Basic Cupola Melting and its Possibilities*

By E. S. Renshaw

The use of a basic-lined cupola as part of a production unit is described and experienced gained in operating with basic slags is discussed. Slag conditions which favour desulphurisation to low limits also give high carbon pick-up in low-carbon charges and the possibility of taking advantage of these factors is discussed with particular reference to nodular iron production. Additional refractory cost may prove to be justified if subsequent processing cost is lowered by reducing the quantity of alloy required for ladle treatment. Reference is made to water-cooling as a means of reducing refractory erosion and offering the possibility of operating with slags of higher basicity.

THE IMPORTANCE of the cupola furnace to the foundry industry cannot be overstressed and the economic advantages of this type of furnace will ensure its continued use for many years to come. By virtue of its apparent simplicity it has, in general, fulfilled the requirements of the industry and being continuous in operation, has fitted into the pattern of moulding continuity. The main limiting feature of the cupola and the factor which distinguishes it from the bath-type furnace is that chemical reactions cannot be invoked at will within the furnace itself. Consequently the required metal composition is obtained by simple calculation of charged elements, allowances for inevitable losses and gains of these elements being made on the basis of previous performance under a given set of standardised conditions.

The established practice of acid cupola melting has resulted in little interest being taken in the effect of slag composition and the rôle of slags during the melting operation. Work carried out on the basic cupola, on the other hand, has revealed the importance of slag chemistry and the possibility of promoting desirable reactions not hitherto obtainable. Published reports have shown that sulphur reduction by basic slag operation is substantial and controllable. Indications of considerable carbon absorption, well in excess of that obtainable in the acid cupola, have been reported, but control of the extent of this pick-up has not been studied in detail. Dephosphorisation has been attempted but with limited success and much work remains to be done on this aspect before a commercial process could be developed.

It is the purpose of this Paper to give details of an example where the basic cupola has been successfully employed; to report observations as a result of production experience, assessing its value for future application and indicating the direction in which development might usefully proceed.

Production Cupola

The earlier work on basic melting conducted in the Author's foundry[1] resulted in the method being adopted for production and a basic cupola has been in constant daily use for several years. Details of the cupola lining are shown in Fig. 1. Stabilised dolomite bricks form the basic-lined portion which extends from the sole plate to 46½ in. above a single row of tuyeres. Circle shapes are used except for a section above the tuyeres, that is in the melting zone where crown shapes are substituted, giving additional support as erosion takes place. The tapping hole and continuous slag separating box are rammed with stabilised dolomite cement suitably prepared in ramming form by mixing with 6 per cent. water and 1 per cent. sodium silicate.

Expansion characteristics of stabilised dolomite are such that suitable allowance must be made in the construction of the lining, and this is provided for by placing a layer of asbestos steam pipe lagging, 1 in. thick, between the shell and basic refractory. Stabilised dolomite cement is used for daily repairs and this material when mixed with water has the patching consistency of ganister and is simple to apply. Further details of cupola dimensions are given in Table I.

TABLE I.—*Production Cupola Dimensions.*

Internal diameter, in.	42
Lining thickness, in.	9
Well depth from sand bed to tuyeres, in. ..	29
Tuyere level to charging door, ft.	$16\frac{1}{12}$
Number of tuyeres	6
Tuyere dimensions, in.	6 × 6

The cupola in question is operated in conjunction with an electric furnace as a duplexing unit[2] and desulphurisation being the only objective, basic melting has enabled the equipment layout to be such that the cupola metal is able to flow continuously from the tapping spout direct into the electric furnace in the shortest distance with a minimum delay. Ladle treatment with soda ash between the cupola and electric furnace would result in loss of time and metal temperature, the heat loss having to be recovered by current and electrode in the electric furnace. The unit operates on a continuous pouring basis, the metal required being a low-carbon alloy of the graphitic steel type with a carbon content of 1.20 to 1.45 per cent. The carbon in the cupola metal is held between 2.5 and 3.0 per cent. and the finished carbon is obtained by regular additions of steel scrap to the electric furnace bath. The total metal charged into the electric furnace consists of, approximately, 60 per cent. solid steel scrap and 40 per cent. molten cupola metal,

*The Author is chief metallurgist Ford Motor Company, Limited, Dagenham. Official Exchange Paper from the Institute of British Foundrymen to the American Foundrymen's Society.

Basic Cupola Melting and its Possibilities

shop returns, runners, risers, etc., being adequate to provide all the metal for the cupola charge, details of which are given in Table II.

TABLE II.—*Production Cupola Charge Details.*

Return scrap, lb. ..	1,200	Limestone	90
Ferro silicon (75 per cent, lb.	8	Fluorspar	10
		Coke	135

Melting rate 9,000 lb./hr.

	T.C.	Si	Mn	S	P
Charged composition, per cent.. .	1.40	2.40	0.50	0.050	0.050
Actual analysis, per cent. ..	2.60 to 2.90	1.90	0.40	0.040 to 0.070	0.050

As the sulphur content of the metal is not required to be below 0.06 per cent., the flux and coke charges have been standardised accordingly. The previous acid practice with this metallic charge and coke of the same quality gave a sulphur content of between 0.12 and 0.16 per cent. in the molten cupola metal.

Production experience has enabled some interesting observations to be made on composition control and afforded a theoretical and practical basis on which control can be established.

Sulphur Removal

The transfer of sulphur from molten metal to slag depends on the presence of sufficient base in the slag to convert the sulphides in the metal to basic sulphide, insoluble in the metal and soluble in the slag.

In the basic cupola, a larger quantity of base can be introduced than is possible in the acid-lined furnace, and the sulphur-carrying capacity of the slag produced is thereby increased. The transference of sulphur from metal to slag also depends on the ratio of CaO to FeO and the presence of the latter in the slag phase limits the desulphurising power thus:

$$CaS + 2\ FeO = CaO.FeO + FeS.$$

Therefore, the desired reaction is one in which carbon plays an essential part represented by the following:

$$FeS + CaO + C = Fe + CaS + CO$$

It has been shown that slag in the melting zone of the cupola is rich in iron oxide,[6] the proportion of which may be dependent on a number of well-known operating factors. On collecting in the well, however, this oxide is reduced by the incandescent coke, the extent depending on the time of contact, volume of slag and no doubt, temperature and slag viscosity, thus creating the correct slag condition suitable for desulphurisation.

Experience in operating with basic slag has shown this theory to apply in practice and the sulphur pick-up may be controlled accordingly. The first metal tapped from the cupola is likely to be high in sulphur and this may be accounted for by low initial operating temperature with insufficient slag volume in the well. Higher initial coke bed and limestone added to the coke bed itself will reduce this condition to a minimum. Any circumstance, giving rise during melting to oxidising conditions, such as low coke bed height, results in a noticeable increase of the iron-oxide content in the slag, accompanied by an increase in the sulphur content of the metal. As in cupola practice generally, the normal precautions are taken to ensure correct conditions of combustion, as over-blowing obviously results in excessive oxidation and increased sulphur pick-up.

If for any reason a loss of slag volume in the furnace well occurs, thus reducing the time of contact between the slag and coke, there is an immediate increase in the iron-oxide content of the slag and desulphurisation is reduced in consequence. In the continuous tapping system shown in Fig. 1, the slag volume in the well is determined by the metal level at its exit from the box and should this level be too low, the slag depth in the well is reduced. Enlargement of the cupola tapping hole through erosion also results in loss of slag height in the well, so that refractory practice at this location is of importance.

The nature and colour of a basic slag affords a useful and rapid check on its desulphurising pro-

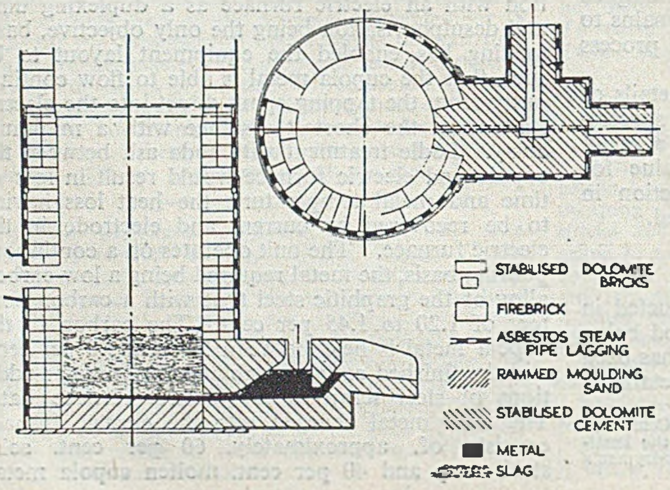


FIG. 1.—*Details of Basic Cupola Lining and Relative Dimensions.*

perties. The shade may vary from white, creamy white, pale brown, dark brown to black with chalky to vitreous fractures. Maximum desulphurisation is certain with white chalky slags and an increase in iron oxide content may be immediately observed by a change to the darker shades, vitreous fractures being evidence of shortage of base. For control purposes, samples of slag for visual examination are taken under standard conditions of cooling as the cooling rate effects the appearance and small oil-sand cores have been found suitable for sampling from the slag stream.

In the practice described above, the normal slag analysis is as follows:—

	Per cent.
CaO	42.0 to 45.0
MgO	9.0 to 11.0
FeO	Less than 1.50
MnO	Less than 1.50
Al_2O_3	8.00 to 10.0
SiO_2	30.0 to 35.0
S	Up to 1.0
CaF_2	2.0

Any slag within this range of composition will be white to pale brown in shade with a chalky fracture. An increase in iron oxide and manganese oxide above 1.50 per cent. will result in a progressive colour change from brown to black. This method of slag examination offers a much more positive guide to melting conditions than a similar examination of acid slags, as in the latter case changes in composition are not so readily discernible.

Silicon Loss

Whereas silicon loss in conventional acid practice is usually no greater than 5 to 10 per cent., allowance must be made in basic practice for a higher loss which in the above production cupola is 20 per cent. It has not been found possible to limit this silicon oxidation, the extent of which may be determined by the degree of slag basicity. Under conditions which exist in the cupola melting zone, silicon is first oxidised according to the following equation:—

$$Si + 2\,FeO = SiO_2 + 2\,Fe$$

The SiO_2 thus formed may be neutralised immediately by CaO as follows:—

$$SiO_2 + CaO = CaO \,.\, SiO_2$$

or, with an excess of FeO, a ferrous silicate may result according to the equation:

$$SiO_2 + FeO = FeO \,.\, SiO_2$$

followed by the CaO reaction:

$$FeO \,.\, SiO_2 + CaO = CaO \,.\, SiO_2 + FeO$$

It is not unlikely that in the absence of an excess of base, the silica formed by oxidation could be reduced by carbon and the silicon re-enter the metal, whereas with ample base, the more stable calcium silicate is formed. As these reactions are an inevitable part of the melting process, silicon control must be based on standardisation of melting conditions and charged materials with suitable allowance for loss.

In the production cupola, no attempt is made to dephosphorise and under the operating conditions which favour desulphurisation, no loss of phosphorus is obtained or anticipated. Manganese loss is calculated at 20 per cent.

Carbon Control

The question of carbon pickup will be dealt with in detail later. At this point it is sufficient to state that slag basicity and quantity of coke are the two main factors which determine the extent of the pick-up so that an increase in the proportion of basic flux and higher coke quantity in a given charge will tend to increase the carbon absorption.

In the unit described above, high carbon pick-up is not desired. The carbon content of the cupola metal is preferably held below 3.0 per cent. so that the balance of steel scrap to be added to the electric furnace bath, to give a final figure of 1.40 per cent. is within the melting capacity of the unit. In this practice, therefore, the coke quantity is standardised at 11 to 12 per cent. and the combined fluxes, limestone and fluorspar at 8 to 9 per cent., giving an average figure of 2.8 per cent. carbon at the cupola spout. This represents a pick-up in carbon of 1.4 per cent. from the charged carbon of 1.30 to 1.40 per cent.

It has been established in basic melting that carbon pick-up bears a distinct relationship to sulphur reduction. In other words, conditions which favour carbon absorption intensify the desulphurisation reaction as clearly shown in Fig. 2. The figures

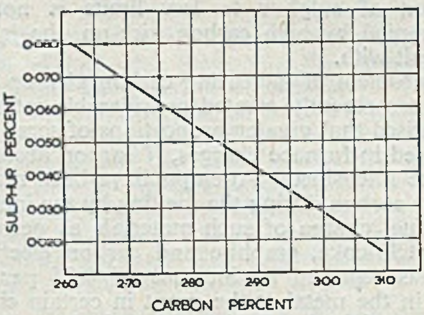


FIG. 2.—*Graph showing the Relation between the Desulphurisation Reaction and Carbon Content.*

plotted on this graph are averages taken from a large number of production melts under the standardised conditions described above. The coke quality without doubt has an important bearing on carbon pick-up and, for reference purposes, the properties of the coke used for this work are given in Table III.

TABLE III.—*Coke Properties.*

	Per cent.
Fixed carbon	87.5
Ash	11.0
Sulphur	1.0
Volatile	0.5
Shatter test	82 per cent. on 2-in. screen 90 per cent. on 1½-in. screen.

Possibilities of Further Application

It will be realised that the use of a basic cupola on the specialised unit described, represents the application of basic melting in, perhaps, its simplest form with a single main metallic constituent in the charge. It is of interest to examine whether advantage can be taken of the effect of melting metals under the influence of basic slags and with conditions which are present in the cupola-type furnace.

Basic Cupola Melting and its Possibilities

For example, in the manufacture of nodular cast iron, low sulphur is critically important in the development of the nodular structure. In the production of these irons by magnesium treatment, sufficient magnesium alloy must be added to reduce the sulphur to about 0.015 per cent. before the requisite amount of magnesium is available for solution in the iron to produce the desired effect.

Carter[3] has pointed out the advantage of having low initial sulphur content prior to the magnesium treatment in order to avoid the use of excessive amounts of expensive alloy and an unpredictable recovery of the essential element. Loss of metal temperature which accompanies excessive ladle treatment seriously affects the casting properties of metal and in good practice should be reduced to a minimum. It is correct to assume, therefore, that the nodular treatment would be facilitated if the initial sulphur content of the metal at the cupola spout could be held at, say, 0.030 per cent. and with basic melting, under certain conditions, this is quite possible. The effect of such conditions on the control of other elements must, however, be considered, in particular carbon, the absorption of which is intensified by basic conditions. Since the reduction of sulphur to low limits is normally accompanied by high carbon pick-up, the latter is now dealt with.

The problem of increasing carbon pick-up in the cupola has recently created considerable interest as it is realised that greater proportions of scrap could be utilised in furnace charges, if carbon absorption could be intensified. Attempts have been made to raise the carbon during the melting by the inclusion in the fuel charge of such materials as petroleum coke, pitch coke, graphite and carbon electrodes. Levi[4] has reported an increase of 0.25 per cent. carbon in the metal at the spout in certain charges by the use of these materials either singly or in combination. The availability of these products is limited and their use is consequently restricted. Coke quality undoubtedly has some bearing on the rate at which carbon can be absorbed and the pick-up is reduced with coke of higher ash content.

Higher melting zone temperature has the effect of raising the carbon content and consideration must be given to the use of hot blast for this purpose. In the Author's experience, operating with a blast temperature of 650 deg. F. (340 deg. C.) and using the Griffin system for this purpose, it has been found possible to raise the carbon by 0.07 per cent. in a cylinder iron mixture, thus enabling the replacement of pig-iron by steel scrap in the charge to the extent of 4 per cent.

The effect of slag composition and of the nature of the slag on carbon pick-up has not been thoroughly investigated, possibly because in acid practice little opportunity is offered for the modification of slag properties. Fluorspar is frequently used for increasing the fluidity of acid slags and the Author has found that in producing more active and fluid slags in the acid-lined cupola, carbon pick-up is increased. For example, the carbon content of a cylinder iron has been raised 0.10 per cent. by replacing 10 per cent. of the limestone charge with fluorspar, thus enabling pig-iron to be replaced with steel scrap to the extent of 6 per cent.

Work carried out in Germany and first reported by Heiken[5] revealed the remarkable effect of basic slag operation in accelerating carbon pick-up when melting cupola charges consisting of 40 to 60 per cent. hematite pig-iron and 60 to 40 per cent. steel scrap. In a cupola lined with dolomite, carbon contents in the region of 3.80 to 4.30 per cent. were obtained, whereas in the acid cupola similar mixtures gave 2.85 per cent. carbon. Confirmation of this has since been reported by the Institute of British Foundrymen. In the latter work, a stabilised dolomite lining was used and all-steel melts gave carbon figures of 3.0 to 3.5 per cent., being up to 1.0 per cent. higher than in the acid-lined cupola. The same effect was noted by the Author when, during the war, a basic-lined cupola was used on a cupola/converter plant for steel casting production and Table IV gives details of the charges used with typical analysis obtained.

TABLE IV.—*Data on Basic Cupola used in Cupola/Converter Practice.*

	Lb.		Lb.
Pig-iron	800	Coke	270
Steel scrap	1,200	Spar	10
Ferro silicon (45 per cent)	25	Limestone	130

Average daily analysis.					Calculated.	
T.C.	Si	S	Mn	P	T.C.	Si
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
3.44 ..	1.24	0.038	0.50	0.050	1.78	1.50
3.33 ..	1.0	0.039	—	—	—	—
3.15 ..	1.10	0.042	—	—	—	—
3.35 ..	1.13	0.040	—	—	—	—
3.52 ..	1.18	0.033	—	—	—	—
3.34 ..	1.00	0.042	—	—	—	—

In acid practice, it is recognised that low-carbon charges will absorb a greater amount of carbon than high-carbon charges, depending to a certain extent on the silicon and phosphorus present and the nearness to the eutectic composition. High-carbon charges tend to lose carbon in melting.

A similar effect is observed in melting under basic conditions but the gain in carbon in low-carbon charges is greater by a considerable degree. Table V

TABLE V.—*Experimental Melts to Show the Effect of Basic Melting on Carbon Pick-up.*

	Metal Charge, lb.					Flux, lb.		Charged Analysis, per cent.					Actual Analysis, per cent.					Carbon, per cent.	
Melt.	Pig Iron.	Steel Scrap.	Iron Scrap.	Ferro Silicon (75 per cent.)	Coke lb.	Lime-stone.	Fluor-spar.	T.C.	Si	S	Mn	P	T.C.	Si	S	Mn	P	Loss.	Pick up.
A ..	1,200	—	—	—	170	110	20	3.75	3.50	0.04	1.00	0.040	3.50	2.75	0.023	0.90	0.040	0.025	—
B ..	—	—	1,200	8	135	120	10	3.35	2.30	0.12	0.70	0.130	3.56	2.08	0.046	0.62	0.125	—	0.21
C ..	—	750	250	30	180	120	10	1.02	3.00	0.07	0.70	0.075	3.61	2.17	0.030	0.56	0.075	—	2.59
D ..	—	1,000	—	40	180	120	20	0.25	3.00	0.05	0.60	0.050	3.10	2.35	0.033	0.50	0.040	—	2.85

gives the results obtained in a series of experimental melts made in the basic cupola in order to observe the effect of melting metal charges of varying charged carbon content. Melt (A) consisting of an all-pig-iron charge showed a carbon loss from 3.75 per cent. to 3.50 per cent with a sulphur reduction from 0.044 per cent. to 0.023 per cent. Melt (B), an all-cast-iron scrap charge approximating eutectic composition, showed a slight gain in carbon from 3.35 per cent. to 3.56 per cent. and a sulphur reduction from 0.120 per cent. to 0.046 per cent. Melt (C) consisting of 75 per cent. steel scrap and 25 per cent. cast-iron scrap gave a gain in carbon from 1.0 per cent. to an average of 3.61 per cent., the sulphur being reduced from 0.070 per cent. charged to 0.030 per cent. Melt (D), an all-steel scrap charge with silicon added to approximate the previous charges, showed a carbon pick-up from 0.25 per cent. charged to 3.10 per cent., the average sulphur being 0.033 per cent. In melts (C) and (D) the coke percentage was increased to allow for the carbon absorption and, no doubt, facilitated both carbon pick-up and desulphurisation by producing the necessary reducing conditions. The limestone charge was also increased in order to raise the slag basicity and the fluorspar to assist the slag fluidity.

It may be inferred from these results that when operating the basic cupola with high flux charges capable of reducing sulphur to a low level, cognizance must be taken of the high carbon pick-up, particularly in low-carbon charges. Metal of normal grey-iron composition can be produced from high-steel charges and, at the same time, the sulphur content can be reduced to a low figure. The question of control of the reactions which produce the carburisation, desulphurisation and silicon oxidation must be considered, realising that such reactions are not likely to proceed to equilibrium in the cupola furnace. For this reason greater fluctuations in carbon and silicon than normal could be anticipated, particularly in high-steel charges with the silicon concentrated in a small proportion of the charge and a receiving unit of adequate capacity would be required to smooth out variations.

Alternatively when it is not required to take fullest advantage of the carburising reaction, it would appear necessary to use charged materials with a composition near to eutectic value, in which case, silicon control would be simplified, this element being distributed more evenly throughout the components of the charge. When the price of steel scrap is favourable, high steel charges would be a more attractive proposition, particularly for large scale production and when the phosphorus needs to be considered.

Such results cannot be obtained in the acid-lined cupola and it is evident from the foregoing that cupola charges may be computed for basic melting which would produce a low-sulphur iron of a base composition suitable for the nodular treatment.

Refactory Technique

Good refractory technique is essential in any type of melting furnace and the loss of refractory in cupola melting is undoubtedly high. This loss, occurring mainly in the melting zone, is due to the high temperature prevailing in this region and to attack by slag rich in iron oxide. Basic refractories, in general, have a higher fusion point that the acid refractories normally used for cupola linings but the presence of high-iron-oxide slag must be considered.

The most economical basic material available is calcined dolomite which may be prepared in ramming form by mixing with dehydrated tar. The time available for daily cupola repair is normally limited and would seldom allow the re-ramming and sintering of dolomite to be thoroughly carried out. While the fusion point of this material is high, it is subject to attack by iron-oxide slags, and Heiken reporting on its use, found it necessary to re-ram the cupola after each melt of 40 tons of metal. Carter[3], has reported the use of magnesite bricks for the initial lining construction and a ramming mixture of 90 per cent magnesite and 10 per cent bentonite for patching purposes. Lining erosion in this case was stated to be less than would be expected from acid refractory, the indication being that the magnesite lining could be operated two to three times as long as an acid lining. The resistance of magnesite to slags rich in iron oxide is known to be high and this may account for the improved results.

Stabilised dolomite consists essentially of tricalcium silicate and magnesia, the manufacture of which has been described elsewhere.[7] The thermal shock resistance of this material in brick form is less than magnesite, as also in its resistance to iron oxide slag attack, and for these reasons its performance could not be expected to equal that of magnesite. However, it has been used consistently by the Author because of its availability in England as a home-produced material. The consumption of refractory on the production unit is as follows:—

Patching material—42 lb. per short ton of metal melted.
Basic brick —13.6 lb. per short ton of metal melted.

This consumption is comparable to that of acid refractory with a similar metallic charge and for a cupola of 42 in. diameter, but it should be noted that the coke percentage on this unit is 11 to 12 per cent. and the melting rate is within the rated capacity. When melting with higher coke quantities, lining life could be expected to be shorter and consumption of refractory greater than that normally obtained in acid practice.

As cost of basic refractories is several times greater than acid refractories, their use can only be justified when the additional cost is offset in other directions, as in the production unit described above. In contemplating the use of a basic lining for the manufacture of nodular iron, therefore, the higher refractory cost must be balanced against the cost of the alloy required to desulphurise to the necessary low limit of sulphur. The evidence is that a case is presented where the use of a basic lining is worth consideration and in reducing ladle processing to a minimum, the final alloy treatment will be under a greater degree of control.

Basic Cupola Melting and its Possibilities

Water Cooling

The heavy erosion of cupola linings, whether acid or basic, presents a constant problem in cupola melting and recent work on the water cooling of critical portions of the lining appears to offer a solution. It has been shown that replacing refractories in the melting zone by water jackets and lining the cupola well only with basic refractory, it is possible to operate with a basic slag.[8] The erosion products from a refractory wall constitute an appreciable proportion of the slag bulk formed in the cupola and when erosion is prevented by water cooling, larger quantities of basic flux can be used to increase the slag basicity to the extent of that obtained in the basic-lined furnace.

An interesting application of this idea is evidenced in the so-called "metallurgical blast cupola" developed and described by Doat.[9] Although not described as such, this furnace is essentially a water-cooled, hot-blast cupola. Whereas the development of the hot-blast cupola has had for its main intention economy in fuel, the "metallurgical blast cupola" is operated with normal or higher than normal coke quantities, producing a top gas richer in CO and of higher calorific value, so that only a portion (35 per cent.) of this gas is required for preheating the incoming air. The remainder of the gas, it is stated, is available for heating purposes external to the furnace, as in blast furnace practice.

Recuperation is such that the blast temperature is in the region of 1,000 deg. F. (535 deg. C.) and by employing water-cooled tuyeres, protruding some distance into the furnace, combustion appears to be centralised. In this manner the melting zone itself is restricted in area and is reduced in height. This effect, combined with water cooling of the refractory for some distance above the tuyeres, reduces the lining erosion to negligible proportions and the slag suffers no dilution from this source.

Under these conditions, it would be expected that any basic flux in excess of that required to absorb the coke ash and oxidation products, would be available to increase the slag basicity, the effect on metal composition being similar to that obtained in the basic-lined cupola. The results quoted by Doat appear to confirm this as it claimed that in melting a charge of 100 per cent. steel scrap, carbon can be absorbed up to 4.0 per cent. and sulphur reduced to 0.050 per cent. One may speculate as to how much the increased carbon pick-up and sulphur reduction may be attributed to the higher temperature blast but as yet, there is no evidence that this factor alone is capable of producing such results and the inference is that slag reactions play a most important part.

Up to the time of preparing this Paper, no intimate details of operation of this type of furnace have been published but the principles are undoubtedly sound and it is in this direction that further work could usefully proceed.

Summary and Further Comments

It will be appreciated that the basic cupola should be considered as a special-purpose furnace. In normal grey-iron production sulphur does not present a problem when coke of reasonable sulphur content is available. When high-steel scrap charges are to be melted in the acid cupola, sulphur pick-up is prone to be high and normally the soda ash ladle treatment will suffice for desulphurisation. The use of a basic-lined cupola is not necessarily economically competitive with the soda ash treatment but the latter has certain disadvantages and this Paper gives an example where the basic cupola has been used to advantage.

Because of current interest in the subject, particular reference has been made to the possible use of the basic cupola in the manufacture of nodular iron. Operating factors which determine desulphurisation to the low limits required for nodular treatment have been discussed and it is clear that desulphurising slags can be worked in the cupola, such slags being sufficiently basic and low in iron-oxide content. The phenomenon of high carbon pick-up obtained under these operating conditions confirms previous observations and is a factor which must be taken into account, particularly where low sulphur metal is the objective. Providing that irons melted in this manner prove to be consistently responsive to the nodulising treatment, it is suggested that the added cost of basic melting will be offset by economy in the amount of alloy required for the treatment.

Development in the technique of melting in the cupola furnace has been relatively slow, much of the published literature being devoted to the theory and practice of combustion and principles of routine control. As is frequently the case, technical development is created by necessity and in recent years, with changes in the raw material situation and the introduction of new irons, it has been clearly shown that some advantage would be gained if the versatility of the cupola could be increased. Recent work on basic melting, water cooling and the use of high temperature hot blast has indicated a new approach to cupola development, and there is ample evidence available that their possibilities should be thoroughly explored.

Acknowledgment

The Author acknowledges his indebtedness to the Ford Motor Company, Limited, Dagenham, for permission to publish this work and to his foundry colleagues for their invaluable support.

REFERENCES.

1 Renshaw, E. S. "Basic Cupola Process for Desulphurisation FOUNDRY TRADE JOURNAL, vol. LXX, June 24/43.

2 Renshaw, E. S. and Foley, T. "Duplexing Low Carbon Alloys" *The Iron Age* May 22/47.

3 Carter, S. F., "Basic-Lined Cupola for Iron Melting" A.F.S. *Transactions*, vol. 58, pp. 376-392 (1950).

4 Levi, W., "Operation of the Cupola," A.F.S. *Transactions* vol. 58, pp. 1-19 (1950).

5 Heiken, "Production Results with a Basic-Lined Cupola" FOUNDRY TRADE JOURNAL, vol. 72 Mar. 2/44.

6 Second Report on the Basic Cupola Proc. Inst. of British Foundrymen 1945-46.

7 Swinden, T., and Chesters, J. H., "Dolomite Bricks for use in Steel Works" Proc. Iron and Steel Inst. (1941).

8 Renshaw, E. S. and Sargood, S. J., "Some Modification in Cupola Design" FOUNDRY TRADE JOURNAL Oct. 13/49.

9 Doat, R., "The Metallurgical Blast Cupola," FOUNDRY TRADE JOURNAL, vol. 89, No. 1774, Aug. 31/50.

Evaluation of Soundness in Cast Iron*

Report and Recommendations of Sub-committee T.S.20 of the I.B.F. Technical Council

Constitution of Sub-committee T.S.20

A. Tipper, M.SC.(ENG.), F.I.M. (chairman), H. Forrest, J. Johnson, B.SC., A.INST.P., H. M. McLean, A.R.I.C., E. Morgan, M.SC., G. W. Nicholls, Dr. H. O'Neill, A. E. Peace, G. Swinyard, B.SC., A.I.M. (Gardom student), T. R. Twigger, A.M.MECH.E., F.I.M., K. E. Walker, G. Lambert (secretary to the Committee). In October, 1947, Dr. O'Neill was appointed Professor of Metallurgy at Swansea University and resigned from the Sub-committee. His place was filled by Mr. E. D. Knights, B.SC., F.I.M., L.M.S. Research Laboratories. The Sub-committee was also able to call on the services of Mr. A. C. Rankin, L.I.M., A.M.I.E.I., of Hughes, Limited, manufacturers of ultrasonic testing equipment and Mr. S. Spray, F.I.M., of the Stanton Ironworks Company, Limited, as Mr. Morgan's deputy.

Terms of Reference

THE SUB-COMMITTEE of the Technical Council of the Institute of British Foundrymen dealing with the evaluation of soundness in cast iron was appointed in March, 1947, following the earlier work and recommendations of the exploratory Sub-committee T.S.7. The new sub-committee had the following terms of reference:—

"To examine and recommend methods of evaluating soundness in cast iron with a view to the use of such methods in subsequent investigations on the effect of mould materials on grey and malleable iron castings."

Constitution

Three members were originally appointed by the Technical Council in March, 1947, with power to co-opt suitable individuals having the necessary knowledge and facilities for carrying out the work envisaged (particularly in regard to radiographic, ultrasonic and electrical methods of examination). The final constitution was as shown at the head of the Report.

Introduction

It should first be made clear that the work of the Sub-committee was not concerned with the *causes* of unsoundness in castings, but with the *means* of locating or detecting the unsoundness and determining its nature and extent. No limit was placed on the methods to be examined, but in the preliminary discussions of the Sub-committee the following conclusions were recorded:—

(*a*) Unsoundness is to be interpreted as including all forms of internal porosity, inclusions and gas holes.

(*b*) The use of different testing methods for assessing different forms of unsoundness in various shapes and sizes of casting may be advisable.

Various destructive tests to assess the soundness and strength of castings are well known and in common use. These can be either simple crushing tests on actual castings, or tests on specimens cut from castings with measurement of their resistance to tensile, transverse, compression, impact, or indentation loads. Alternatively, castings can be sectioned and examined visually or after suitable preparation, by contact printing, macro etching and photographing or under the microscope.

The results of such tests can be either qualitative or have quantitative values, which by comparison with the maximum value for a sound specimen of similar material, may be taken as a measure of the degree of unsoundness of the casting. These tests have definite limitations in assessing unsoundness, since they often only reveal the weakest spot in the casting or specimen rather than the total unsoundness, and may be quite unsuitable as a means of measuring the influence of mould materials.

Non-destructive tests if successful have obvious advantages in production and the Sub-committee has therefore focused its attention primarily on such methods of examination. In particular, radiographic and ultrasonic methods were selected as the most likely to provide reliable information.

The work can be broadly classified under three headings as follows:—

(*a*) Investigations into the limitations of the radiographic and ultrasonic methods of revealing unsoundness when applied to cast iron.

(*b*) The correlation of results obtained by both destructive and non-destructive testing methods.

(*c*) The investigation of a number of other possible means of detecting unsoundness in cast iron which might give a qualitative or quantitative result by comparison with some selected standard.

Table I indicates the test specimens prepared and examined.

RADIOGRAPHY

Introduction

Radiography is a well-known method of detecting unsoundness in metal sections and is very widely

* Presented at the Newcastle-upon-Tyne Conference of the Institute of British Foundrymen by Mr. A. Tipper, with Mr. E. Longden, M.I.Mech.E., in the chair.

TABLE I.—*Test Specimens Prepared and Examined.*

Code No.	No. of specimens	Identification marks	Size in in.	Material	Maker	Apparatus used
A1	4	PU1 A and B PU2 A and B	$6 \times 1\frac{1}{8} \times \frac{7}{8}$	White iron	Ley's Malleable Castings Co.	Philips 150 kv.
A1	4	PS1 A and B PS2 A and B	do.	Annealed white iron	do.	do.
A2	6	WU1 A and B WU2 A and B WS 1 and 2	do.	Grey iron	English Electric Co.	do.
B1	3	1, 2, 3	$6 \times 6 \times 6$	Grey iron	Modern Foundries, Ltd.	1,000 kv.
B2	6	A, B, C, D, E, F	$1 \times 1 \times 1\frac{3}{8}$ machined from 6 in. cubes	Grey iron (6 in. cubes)	Modern Foundries, Ltd.	Newton Victor, 200 kv.
C	4	TS20/17	$1\frac{1}{8}$ dia. $\times$ 6 2 dia. $\times$ 6 3 dia. $\times$ 6 $4\frac{1}{8}$ dia. $\times$ 6	Grey iron	British Piston Ring Co., Ltd.	—
D1	4	S. SS. MS. GS.	$6 \times 2\frac{1}{2} \times 1$	White iron	Ley's Malleable Castings Co.	Philips 150 kv.
D2	7	0-6 1st series	$6 \times 2\frac{1}{2} \times 1$	Grey iron	English Electric Co.	do.
D2	4	1-4 2nd series	do.	Grey iron	do.	do.
E1	5	0-4	$6 \times 2 \times 2$	Grey iron	do.	Philips 250 kv.
E2	5	0-4	$6 \times 2 \times 2$	Meehanite	do.	do.
G	5	0, 2, 2A, 3, 5	$6 \times 2\frac{1}{2} \times 1$	White iron	Ley's Malleable Castings Co.	Philips 150 kv.
H	3	1, 2, 3	—	Centrifugal grey cast iron	Stanton Iron Works Co., Ltd.	—
I	2	4, 5	—	Grey iron	do.	—
J	—	—	—	Loco cylinder and general iron	British Railways (L.M. Region)	—
K	8	1 to 8	6 dia. $\times 1\frac{1}{2}$ and 1 thick	—	Stanton Iron Works Co., Ltd.	—
L	6	0 to 14	6 dia. $\times 1\frac{1}{2}$ and 1 thick	—	do.	—
M	4	1 to 4	$\frac{5}{8}$ dia. $\times$ 6 1 dia. $\times$ 5 2 dia. $\times 1\frac{1}{2}$ 3 dia. $\times \frac{3}{4}$	Grey iron	British Piston Ring Co., Ltd.	—

made use of, *e.g.*, examination of welded joints, castings (particularly light alloys) and other components where absolute soundness is of major importance.

In investigating the possible application of radiography to cast iron, use has been made throughout of standard commercial X-ray equipment. In considering the conclusions, however, it should be understood that these are equally applicable to the application of gamma-rays. Artificially produced radio-isotopes, now readily available, have added materially to the scope of application of gamma-ray sources which provide radiation of the same nature as X-rays, though usually of much lower intensity and shorter wavelengths. By suitable choice of source and technique, sensitivities can be obtained with gamma rays comparable to the best radiological standards. Provided, therefore, that the inherent differences between the two techniques are appreciated, either source of radiation may be considered for work of this character.

General

In interpreting the results of examination of any solid body by means of X-rays the following points must be appreciated:—

(*a*) The radiographic image is essentially a two-dimensional record of all that can affect the intensity of the beam in passing through a solid body. Differences in film density result from the integration of the opacity of the section immediately below any selected spot. Thus many small defects can have the same cumulative effect as a single large cavity. Where a specimen exhibits fine porosity or open-grain structure evenly distributed over the whole cross section, it will not be revealed as unsoundness by the radiograph.

(*b*) The simple geometrical conception of the passage of X-rays through the matter is affected by scatter effects, particularly in thick sections. Thus defects nearer to the film are sharper in outline and result in greater visual contrast than those further away. The sensitivity is similarly affected and where defects occur on the tube side of a heavy section the sensitivity may fall far short of the 1 per cent. possible under ideal conditions.

(*c*) Precise location of gross defects and the distribution of minor defects demand the employment of a two-shot technique, *i.e.* two radiographs at 90 deg. to each other.

(*d*) Quantitative estimation of unsoundness is extremely difficult and is dealt with in Appendix I.

(*e*) It is reasonable to suppose, and experimental results confirm, that on specimens of appreciable thickness the graphite in grey irons has no effect, other than a general darkening over the whole area.

Method and Experimental Results

In all cases normal radiographic procedure was adopted. Most of the work was done using a Philips 150 k.v. macro set at 107 k.v. and 15 m.a. The tube film distance was maintained at 40 cms. and, using high definition tungstate screens with " S " type film, the exposure was of the order of two minutes. In all other cases, lead intensifying screens were used with copper or lead filters and " D " type film. The actual time of exposure naturally varied with the thickness of the test bars and the apparatus used. In the case of the 6 in. cubes, a lead tunnel was made to serve as a screen

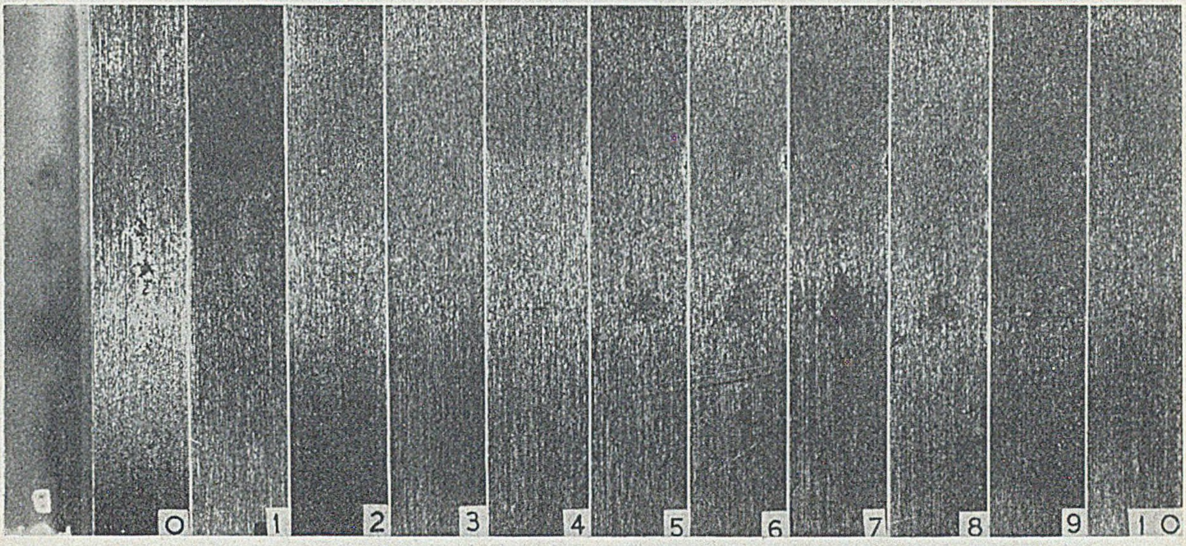


FIG. 1.—*Test-bar PU.1.B (annealed); successive $\frac{1}{16}$ in. Layers have been machined from the Bottom Surface at "O" which had previously just been cleaned up; thickness of Specimen $\frac{7}{8}$ in. The Photograph should be compared with the Radiograph (on the left) of PU.1B.*

to protect the film from stray radiations, with lead sheet masks or lead shot for the thinner specimens. The penetrameter sensitivity (see Appendix I) with the cubes and 6 in. × 2 in. × 2in. bars was between 1 and 2 per cent., whilst with the thinner bars less than 1 per cent. was obtainable. This implies that in the majority of cases defects not shown on the film are less than 1 per cent. of the total thickness of the specimen. The radiographs in this report are reproduced as fascimile prints, *i.e.* defects, etc. which are shown as dark regions on the radiograph are dark on the reproduction. Some graininess from the original film is unavoidable.

Consideration of Results

(*a*) *First series* (*Code A*1 *and A*2)

Radiographs of the first set of test pieces supplied in both white iron and grey iron showed that while defects could easily be detected, it was not an easy matter to produce samples with known degrees of unsoundness. Even nominally sound bars contained small defects.

The difficulty of locating and determining the nature and exact position of defects in a test bar was illustrated by successive sectioning of two of the bars. Layers $\frac{1}{16}$ in. thick were successively

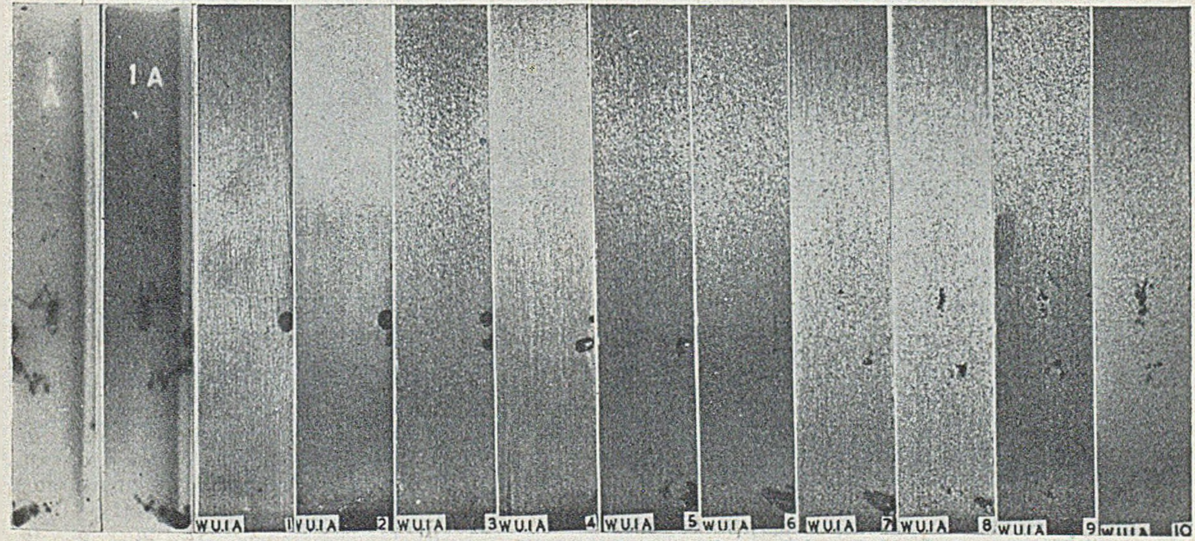


FIG. 2.—*Test-bar WU.1A; successive $\frac{1}{16}$ in. Layers have been machined from the Top Surface starting at No. 1, $\frac{1}{16}$ in. below the surface; thickness of Specimen $\frac{7}{8}$ in. This Photograph should be compared with the corresponding Radiographs (shown on the left) which are at 180 deg. to each other.*

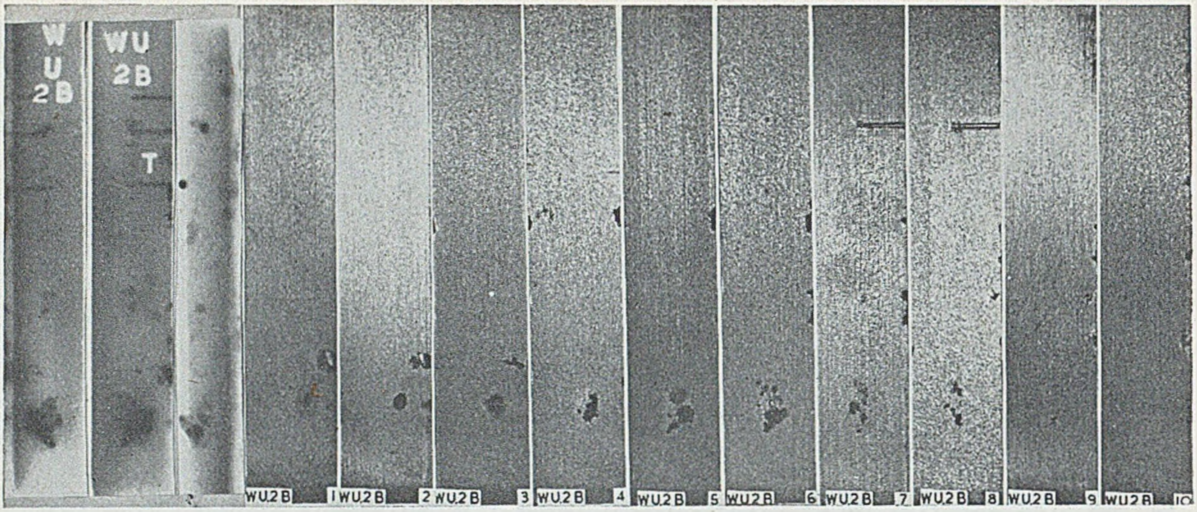


Fig. 3.—*Test-bar WU.2B; successive $\frac{1}{16}$ in. Layers have been machined from the Top Surface starting at No.* 1, *$\frac{1}{16}$ in. below the surface; thickness of Specimen $\frac{1}{8}$ in. This Photograph should be compared with the corresponding Radiographs (on the left), the second of which is at* 180 *deg. and the third at* 90 *deg. to the first.*

removed from test bars PU1B, WU1A and WU2B and the surface photographed. The appropriate radiographs and photographed sections are shown in Figs. 1 to 3. These illustrate the sharpness of defects near the film (*vide* 3 holes drilled in WU2B) and also the major defect at one end, which is much more clearly depicted when the specimen was radiographed after turning through 180 deg. By comparison it can be seen that integrated local porosity appears on the radiograph very much like cavities or voids except that the outline is more diffuse. The radiograph of WU2B taken normal to the previous position shows the defect to be near the top surface and proves that defects can be accurately located so long as two radiographs at 90 deg. to each other are taken.

(*b*) *Second series* (*Codes B*1 *and B*2)

These cubes, prepared with the intention of providing samples of varying graphite flake size, were radiographed because of anomalies in the ultrasonic test results. The radiographs were taken with 1,000 k.v. radiation by A.I.D. Test House, Harefield, and the penetrameter sensitivity was 2 per cent.

The results provided evidence of unsoundness not indicated on the surface, but suspected on ultrasonic examination. A correlation was obtained later with macro sections. Fig. 5A illustrates this work. An attempt at correlation was made later with macro sections and radiographs taken from 1 in. × 1 in. × $1\frac{3}{8}$ in. ultrasonic specimens (Code B2). Fig. 5B illustrates the general porosity as shown on one unetched side of each block. Even close examination of the radiographs (not reproduced) did not suggest any segregation. It is evident that graphite flake size, the distribution thereof, and the dispersion of fine porosity evenly throughout the specimen, cannot be detected by radiography. The cumulative effect of the graphite size and evenly dispersed fine porosity only produces a general increase in film density compared with that obtained from a steel specimen of similar dimensions.

(*c*) *Third series* (*Codes D, E and G*)

These bars were prepared to provide a gradation of unsoundness in grey iron, malleable iron and Meehanite. Although the intended order of unsoundness was not substantiated by radiography, the specimens did in fact provide a series of variable soundness and the results are reproduced in the comparator charts (Figs. 6 and 7). These show a

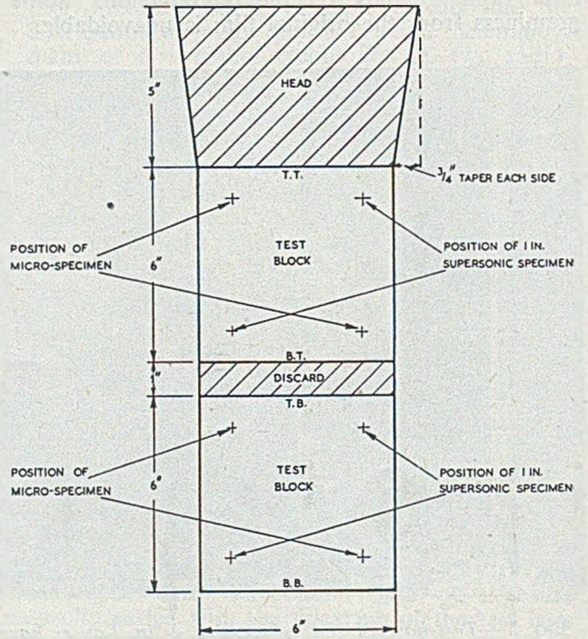
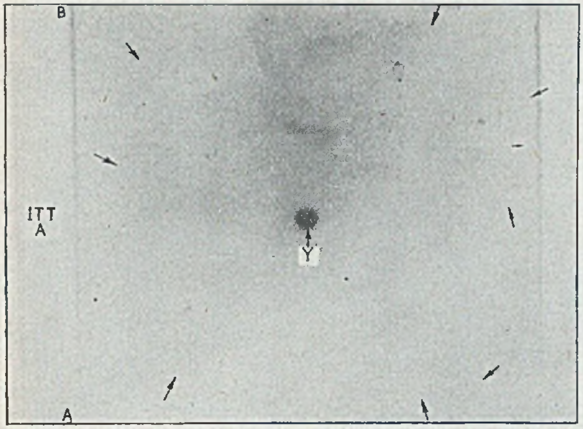
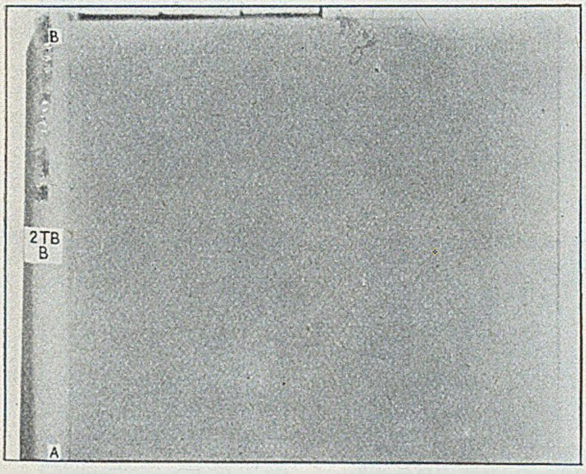


Fig. 4.—*Method of Producing the* 6-*in. Cube* (*Code B*).

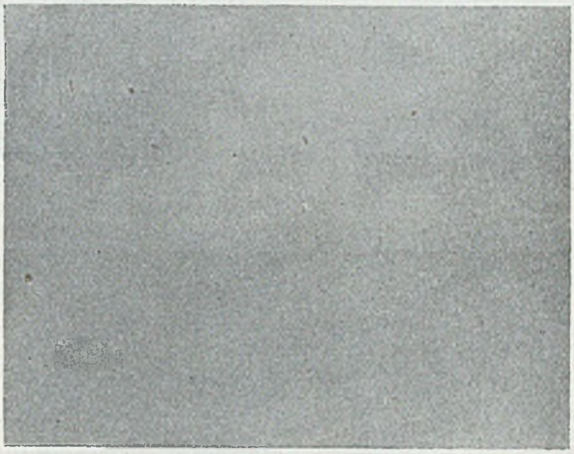


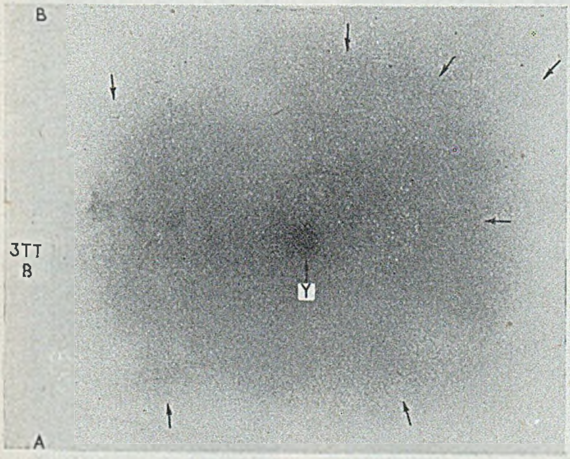
1 TT radiograph.


1 TT cross-section.



2 TB radiograph.

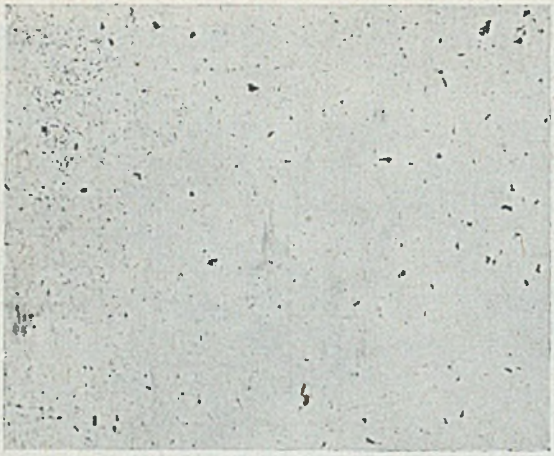

2 TB cross-section.



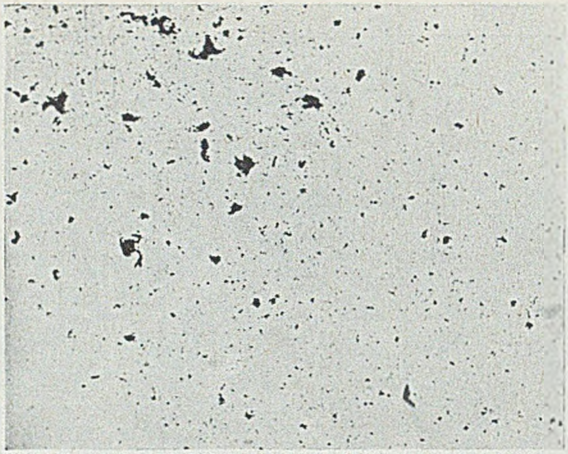
3 TT radiograph.


3 TT cross-section.

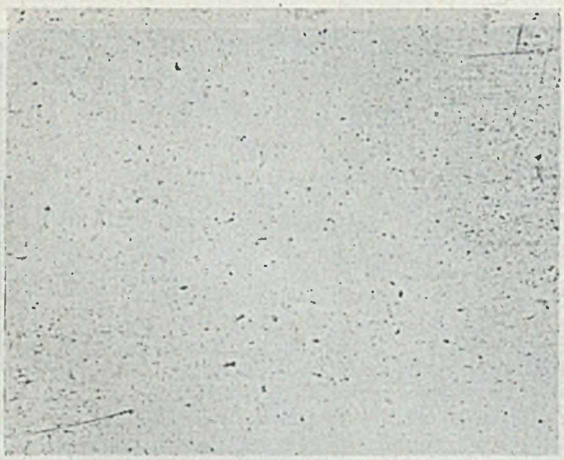
FIG. 5A.—*Radiographs and Cross-sections of* 6 *in. Cubes* (*Code* B1).



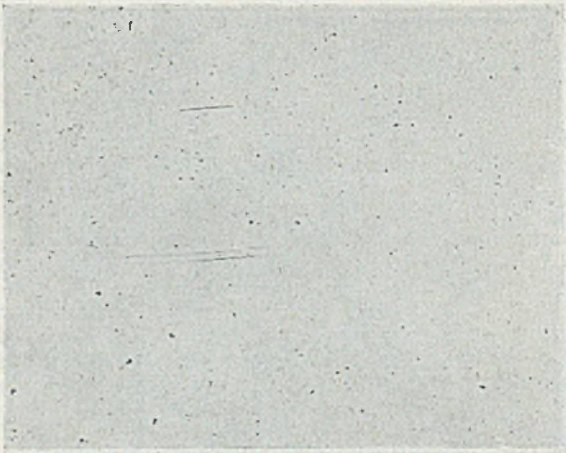
1 TT (Bottom specimen).



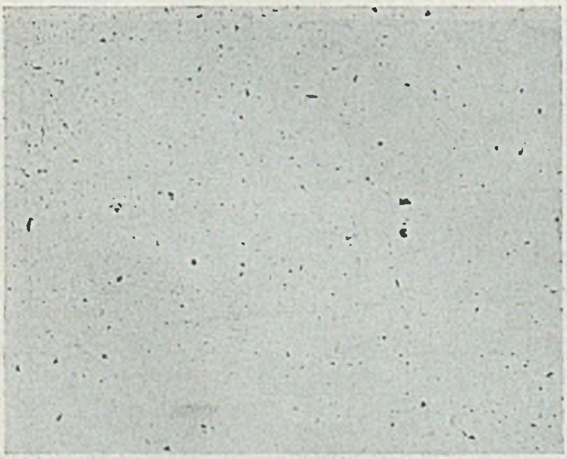
1 TT (Top specimen).



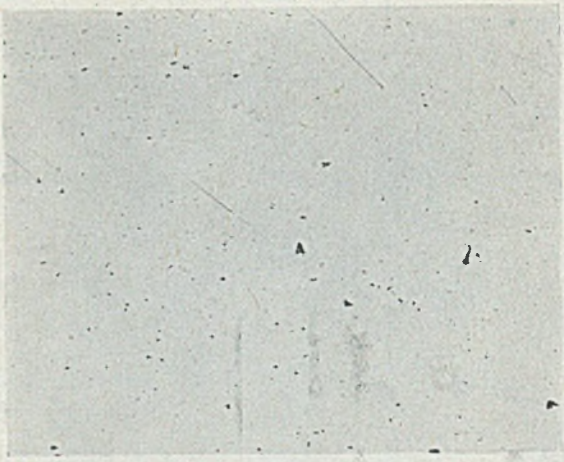
2 TB (Bottom specimen).



2 TB (Top specimen).



3 TT (Bottom specimen).



3 TT (Top specimen).

FIG. 5B.—*Macrophotographs from Grey-iron Cubes (Code B.2), showing Graphite Distribution. Magnification* ×6.

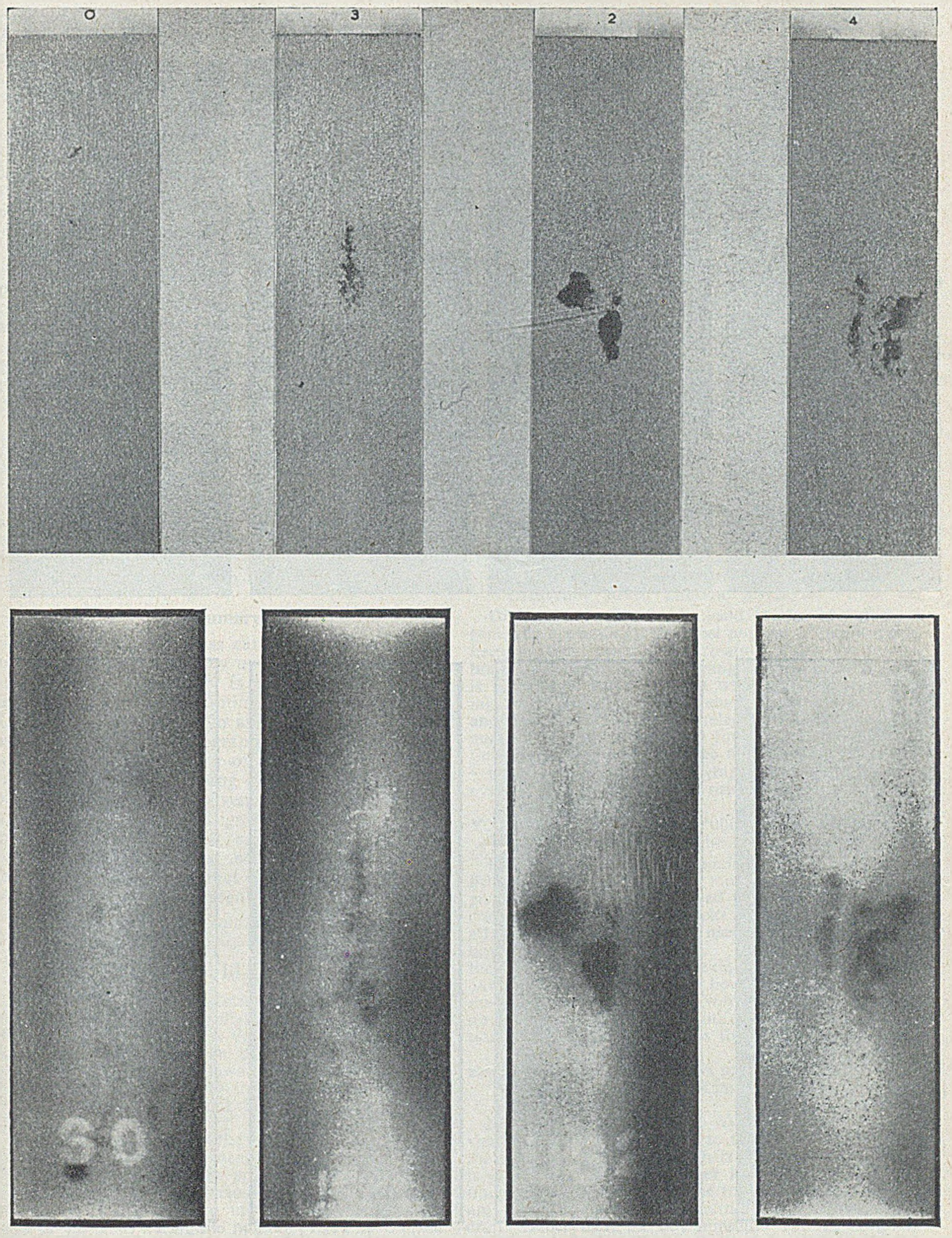


Fig. 6.—*Comparator Charts of 6 by 2 by 2 in. Grey-iron Bars. The Macrophotographs (top) show the Bars after Removing Half the Section; the Lower Series are Radiographs.*

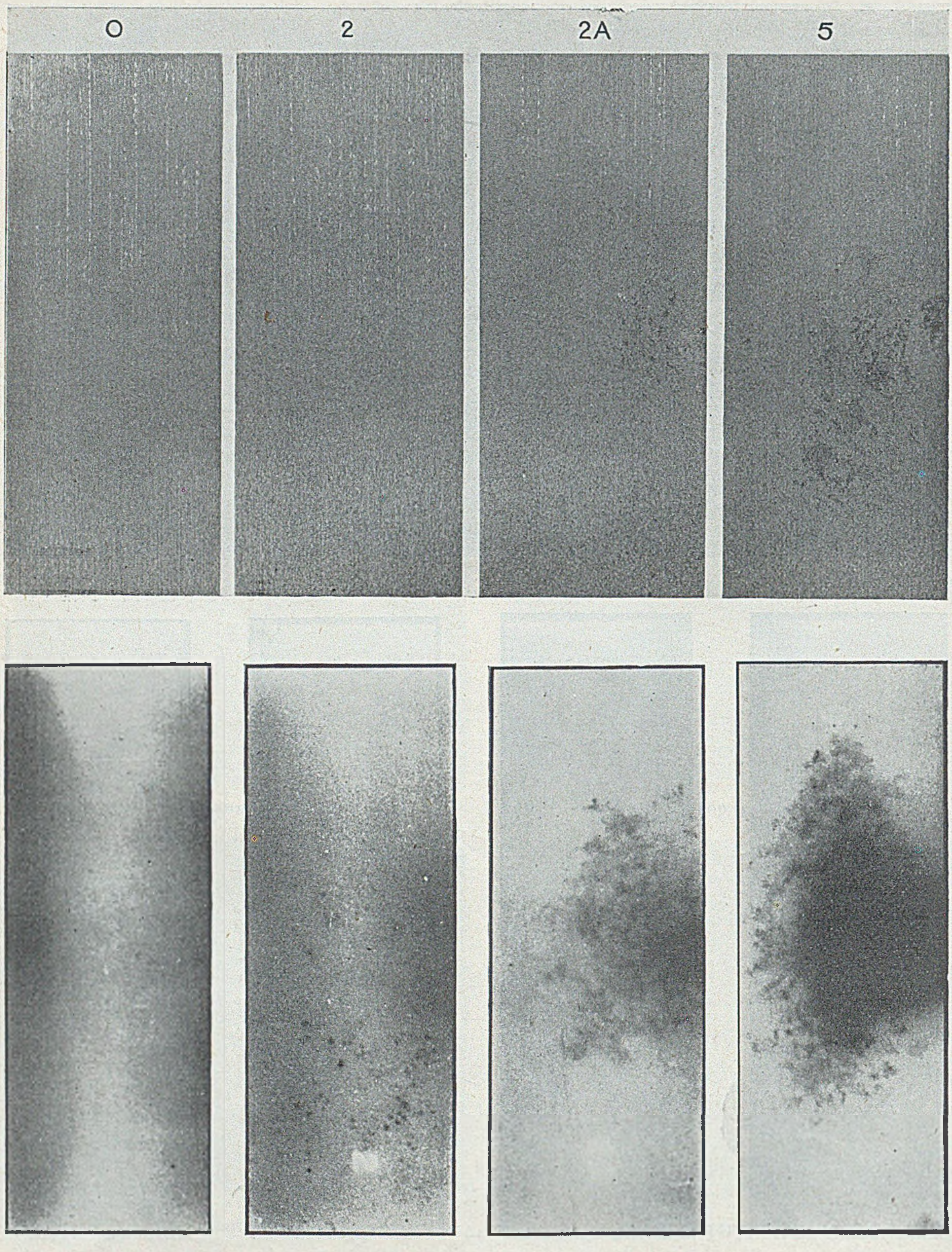


FIG. 7.—*Comparator Charts of 6 by 2 by 2 in. Bars of Annealed White Iron. As in Fig. 6, the Photographs (top) show the Bars after Removing Half the Section and the Lower Series are Radiographs.*

measure of the relationship between the radiographic evidence and unsoundness as revealed by sectioning.

Comparator Charts

The difficulties of obtaining a quantitative measurement of unsoundness from radiographic negatives are explained in Appendix I. The Sub-committee has therefore in mind the desirability of producing some form of comparator chart to enable a value or order of merit to be established for a range of castings on a purely arbitrary basis.

As a first effort to establish a working basis the two charts, Figs. 6 and 7, have been produced of graded unsoundness as shown on a series of radiographs of similar size bars of grey and annealed white iron. These illustrate one particular type of unsoundness, *i.e.* shrinkage, in stages:—1, Radiographically sound; 2, slightly unsound; 3, moderately unsound and 4, grossly unsound (reading from left to right).

No attempt has been made at this stage to illustrate other types of unsoundness commonly found in iron castings. To do so would entail much more work, and it is felt that study of the present charts will prove whether the preparation of a full series is justified. The degree of unsoundness illustrated has not been related to the mechanical properties of the casting since the relationship will vary from casting to casting.

Summary

Segregated unsoundness can be readily detected and on suitable specimens up to 2 in. thickness a high degree of sensitivity is possible. On heavier sections the limitations outlined under the heading "General (*b*)" apply. In spite of a sound rating by other methods, radiography revealed some unsoundness in the majority of cases. Whilst disadvantages arise in attempting quantitative estimation of the unsoundness in a given sample, there appears to be no difficulty in assigning an order of merit to series of specimens or castings. Radiographic detail, whilst capable of some misinterpretation, provides a generally correct overall record and no serious anomalies have been found.

(*To be continued*)

Reduced Sheffield Steel Output

Insufficient supplies of steel scrap and imported iron ore resulted in Sheffield steelmakers producing 5,000 tons a week less in July than they did in July last year. Production dropped to an average of 36,300 tons a week, the lowest figure since December, 1949. Compared with June the fall was 4,000 tons a week, partly due to annual holidays at the end of July.

Some improvement in the position now appears to be evident and at the steel-melting plant of Steel, Peech & Tozer it has been practicable to restart one of the five melting furnaces closed down when shortages of melting materials were most acute. Accumulations of materials during the holiday period have made this possible. There are now 13 furnaces in production at the plant, compared with a normal 16 at any one time.

Publications Received

Cornish Engineers, by Bernard Hollowood. Published for private circulation by Samson Clark & Company, Limited, for Holman Brothers, Limited, Camborne.

Only too often does one read, as the Author sets out in his introductory note, "unfortunately, very few of the early records . . . have been preserved." This is greatly to be regretted as the histories of such firms as Holman Brothers mirror more truthfully than the historians, the changing over of Britain from an agricultural country to the mixed economy of industry and farming. The founder of this great enterprise was Nicholas Holman, a blacksmith, who had as a contemporary, Trevethwick, and from his account books something has beent learned of this early workshop. In those days, machinery, like castings, was sold by the ton. Nicholas started up in a period of prosperity, and the manufacturing of plant for the local mines was a substantial business. In 1860, when Nicholas' son John inherited the business a slump had set in, and it was due to his initiative in tackling the export market that placed the business on a sound foundation. The book tells of the continuous growth under the direction of five generations of Holmans. Interest is well maintained throughout its 50 pages. The illustrations have been well chosen and in the case of the coloured ones excellently reproduced. Recipients of this publication can indeed count themselves fortunate.

Aluminium Development Association—Directory of Members. Published by the Association from 33, Grosvenor Street, London, S.W.1.

Directories, guide books, and works of reference generally are amongst the most popular of publications, because they contain information which the human brain is incapable of retaining. This little booklet is of extreme value to those who have business dealings with the aluminium industry. Products, names and addresses, postal and telegraphic and telephone numbers, are all listed. The functions of the Association—briefly, to give service to the industries they serve—is set out in a short paragraph. The publication is available to our readers on writing to Grosvenor Street.

Your British Railways. Published by the Railway Executive and sold on the bookstalls, price 2s.

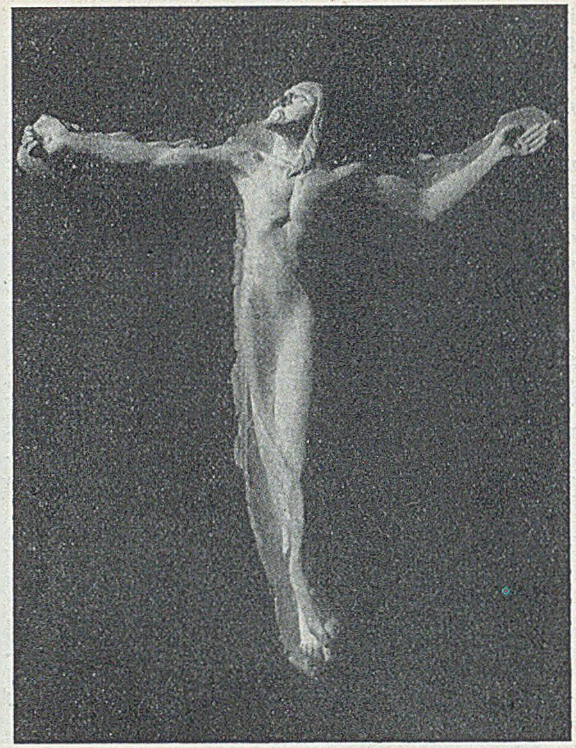
Before transport was nationalised, the railways published from time to time modest booklets, mainly giving statistics. They entered into the same class as cricket and football year books and were cherished by all railway fans. This new magazine-type of publication gives but few statistics. Nowadays, of course, there is neither "Coronation Scot" nor "Silver Jubilee" to embellish the book. However much austerity there is with railways nowadays, there is no evidence of it in this beautifully illustrated publication, which is quite cheap as things are to-day.

Engineering Training for Boys and Apprentices. Issued by Ransome & Rapier, Limited, Waterside Works, Ipswich.

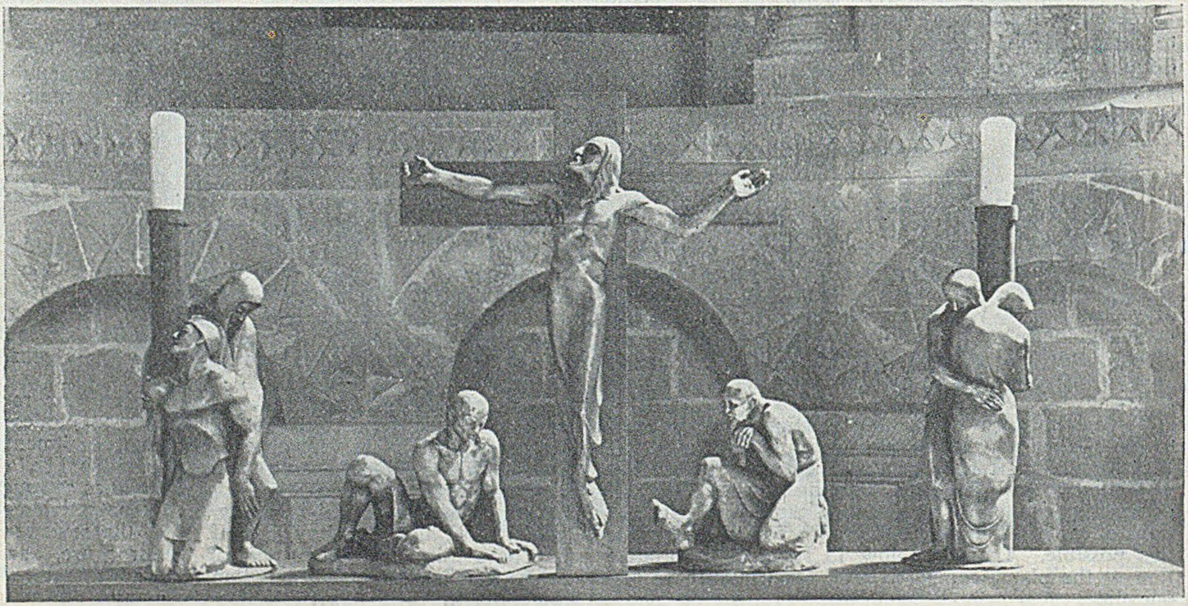
Neither the format nor the layout appeals to the reviewer as being appropriate to the end sought, unless the state of affairs in Ipswich is such that recruitment is easy. The four-page leaflet looks too much like a trade catalogue and, whilst the training facilities set out are excellent, the appeal is rather to the potential recruit's father than the boy himself. Yet the reviewer may have mistaken the purport of the brochure, and maybe it is just to let entrants know the advantages of apprenticeship with Rapiers, which are many.

Australian Master Craftsman

Hundreds of our readers have reason to be grateful to Mr. W. O. Adams, a past-president of the Institute of Australian Foundrymen for it was he who was the main organiser of the scheme for the despatch of food parcels to members of the Institute of British Foundrymen. Mr. Adams who has been in this country for a prolonged and well-deserved holiday is a partner in the brassfounding concern of W. O. & B. Adams of 142, Pelham Street, Carlton, Melbourne. He is accompanied by Mrs. Adams. Because of the holiday period, it was only found possible to entertain the visitors informally. However, Mr. T. Makemson, M.B.E., secretary of the Institute, organised a small party at the Café Royal, with Mr. and Mrs. Sheehan and Mr. and Mrs. V. C. Faulkner to join in the welcome.



During dinner, it was learnt that a group of Australians had presented to the Anselm Chapel of Canterbury Cathedral a set of altar ornaments. This chapel, it will be remembered, is dedicated to artists and craftsmen. The ornaments were designed by Mr. A. Mésáros, an Australian of Hungarian origin. They were carried out in a 60 per cent. silver alloy and carry a matt finish. Though Mr. Adams has a staff of 40 people in his foundry, he could not find a craftsman having the necessary skill, so, using some French sand which had been on the premises for 20 years, he carried through the job personally. There were innumerable drawbacks and cores to be used, but the final result is very creditable. The writer has visited the Cathedral, and he agrees with Mrs. Adams, that a blue and silver altar cloth would be more appropriate than the present one, and she is making an effort amongst her friends to raise the necessary money. Perhaps it was a transient phase of the light, but there seemed to be a slight tarnish appearing on two of the figures. The centre-piece is about 18 in. high; it is seen above during the course of manufacture. The right-hand figure below depicts the two Mary's, whilst on the left is St. John and the Centurion, the recumbent figures being, it is presumed, two Roman soldiers. Foundrymen visiting Canterbury cathedral should certainly make a point of visiting this altar. The writer is indebted to Miss Margaret Babington, O.B.E., the honorary secretary of "The Friends of the Cathedral," for supplying the two illustrations.



Castings for the Corliss Steam Engine*

By D. Redfern

(*Continued from page* 164.)

In the first section of this Paper the Author described the making of the flywheel and the trunk-guide soleplate for the engine. In what follows details are given of the production of the cylinder for the same engine and illustrations are included of the completed machinery.

Cylinder

In the Author's opinion, the production of a steam cylinder casting is the perfect example of the art of moulding and to produce such a casting involves the full co-operation between the moulder and the metallurgist. It is essential that the metal is of a correct composition and is ready to pour at the optimum temperature as soon as required.

Runners and downgates must be placed to flood the mould as quickly as possible, yet they must be placed in such a manner that they do not directly impinge on either the mould face or the main core, as the slightest scab or penetration of the metal will be fatal. The main bore must be free from blemish.

All cylinders of this type are loam-moulded in the foundry with which the Author is connected. Past experience has shown that this practice has been the best method. The pattern in this case is a full block pattern, and in most cases only the facings and valve ends are supplied in wood. The main body of the cylinder pattern is built in loam and all facings are attached when the loam is sufficiently hardened. While there is no doubt that time and money is saved in the patternshop and on timber, extra work is entailed in the foundry, and the risk of having the various facings and fittings forced out of position is far greater.

The methods used on this cylinder were to sweep up a print to the dimensions of the pattern and also strike up a flat joint over the surface of the plate. After drying, the pattern is placed in position and the ingates are set at the four sections. Each ingate is so placed to cause the metal to swirl round the main core, and a downgate is connected to each ingate. Fig. 23 shows the pattern ready for lowering into the core print. On the left of the pattern is the steam inlet pipe, and above and below the facings for the inlet steam valves. On the opposite side of the pattern are the facings for the exhaust valves, top and bottom. In the centre can be seen the stop valve boss and facing. A bed of loam is then spread over the joint and on this the cope plate is bedded down, being now ready for the first stage of building. A 12 in. wall is built round the pattern, bricks are kept 1½ in. away from the body of the pattern and building rings are incorporated at various levels. At various stages, holes are left in the building to allow the securing of the cores and also for free venting. (Fig. 24.)

Building is continued until the halfway line is reached when a joint is made. On all joints, pins of the dowel and socket type are used for location. After making the joint, a plate similar to the cope is again bedded on loam, and building continues until the top of the pattern is reached.

A dirt head is used on this cylinder, and this is formed by building a dummy head in loam the full diameter of the outside flange and about 6 in. wide. A grating is then made to carry the extra section of building required, a similar grating is also made for the centre of the pattern, six downgates are then equally spaced round the top, and the building is carried on until the top of the dirt head is reached. A moulding box is used for the top part, and a 12 in. tube is carried through the top box to give sufficient vent to the main core. After the gratings are toggled to the bars of the moulding box, the top is lifted off and finished, the pattern is withdrawn, the mould split in half. Then the bottom cope is removed, the whole is dressed, blackwashed and placed in the stove to dry.

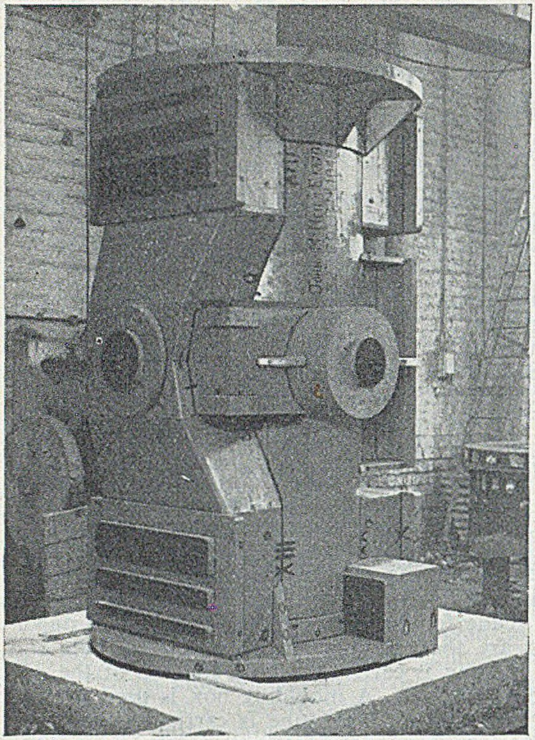
The main core is also made in loam. This is built up on a plate with strickle board and is treated in a similar manner as the mould. As soon as the mould is dry and ready for closing, the lower half is set in a pit and the port and lightening cores are secured in position (Fig. 25). The mid part is cleaned out and the top port core set in position (Fig. 26), and placed on the cope. All the remaining port cores, lightening cores and sundries are then set in position, and bolted through the wall of the mould. As an additional security, chaplets are inserted at the side of the cores. The mould is now ready for the main core (Fig. 27).

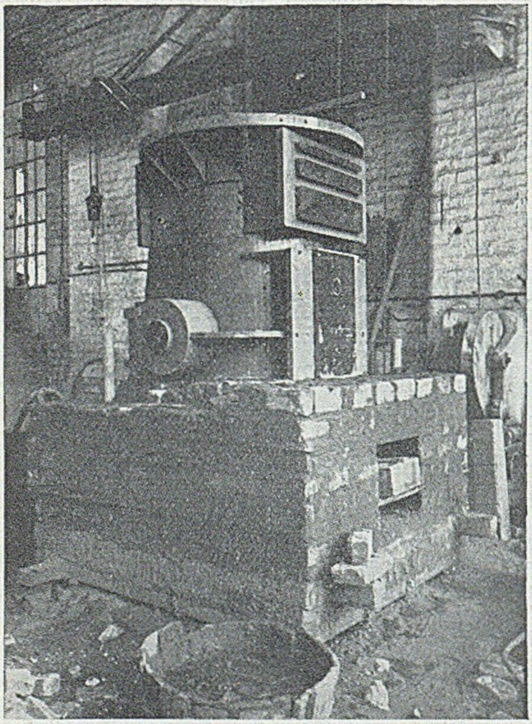
The main core is then brought over the mould and set ready to be lowered in place (Fig. 28). It may be necessary to try this core in many times before it is centred correctly; unevenness on the bottom of the core or in the core print are the main causes for the core being off centre. A thickness stick is made to reach to the bottom of the mould and this stick is tried all round the main core before it is finally left in place (Fig. 29).

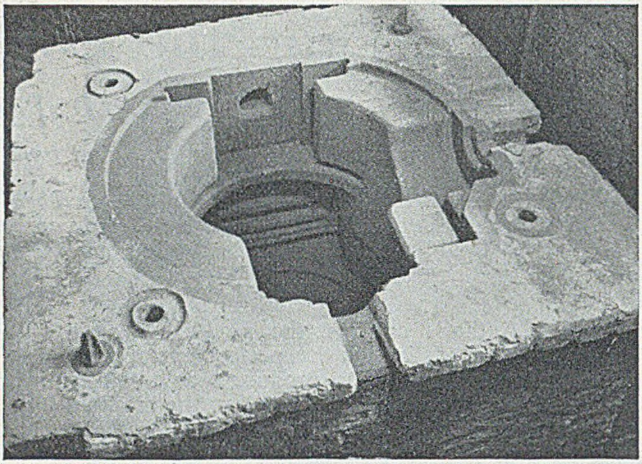
The top joint is cleaned off and the top part tried on; the joint is then stamped with oil and loam, the top is removed, stamping over the core is checked and dried, all waste removed, the mould cleaned out and top replaced (Fig. 30). The mould is then prepared to cast.

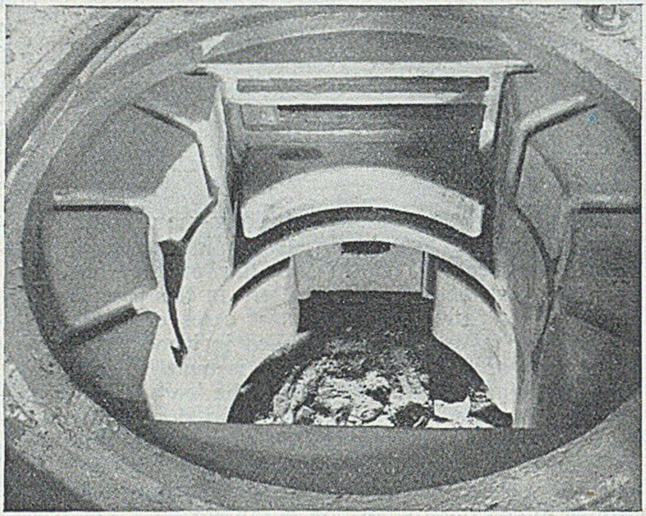
Fig. 31 shows a view of the finished casting. On this section can be seen the steam inlet pipe and

* Paper read before the Lancashire branch of the Institute of British Foundrymen, Mr. C. R. van der Ben presiding. The Author is general manager of G. M. Hay & Company, Limited.









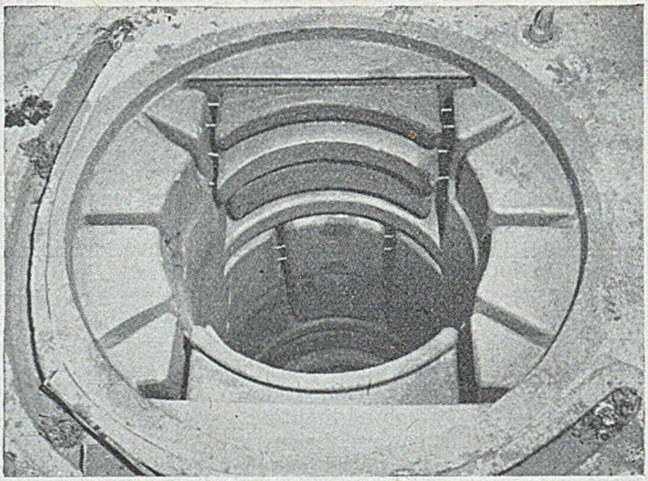


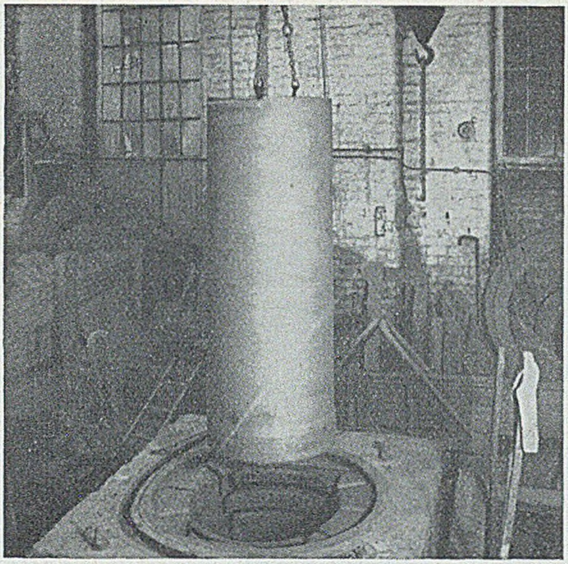
FIG. 23 (TOP).—*Block Pattern for Cylinder Set on the Prepared Bed prior to Moulding.*

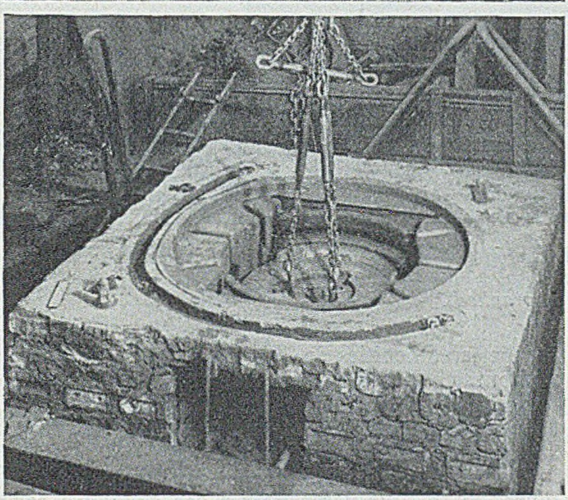
FIG. 24 (BOTTOM).—*12-in. Wall of Loam Bricks being built around the Pattern.*

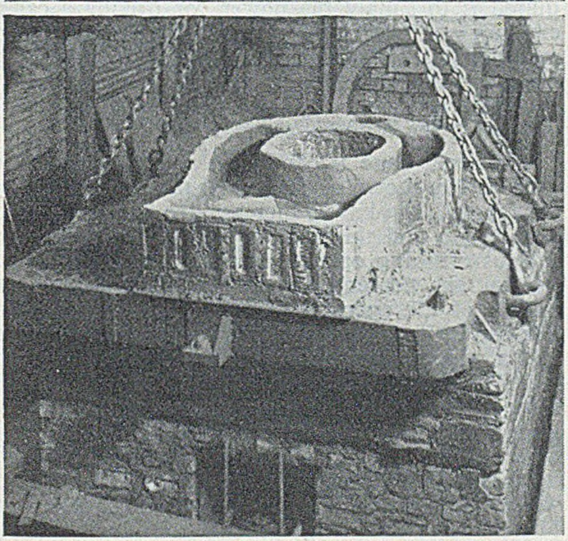
FIG. 25 (TOP).—*Lower Half of the Mould ready for Core-setting.*

FIG. 26 (CENTRE).—*Top Port Core set in Position in the Cope.*

FIG. 27 (BOTTOM).—*Mould Ready for Receiving the Main Core.*







the sealings for the inlet steam valves. Fig. 32 shows the distance piece for the stop valve, and also the seatings for the steam exhaust valves. Note the dirt head at the bottom of casting.

Percentage mixture:—Steel scrap, 10; cylinder returns, 60; hematite pig-iron, 10; foundry pig-iron, 20. *Percentage composition*:—TC, 3.05; CC, 0.65; Si, 1.8; Mn, 0.09; S, 0.06; P, 0.02.

Test Figures:—Tensile strength is 15 tons per sq. in., and transverse on 1.2 in., 18-in. centres, is 24 cwt.

Use of Finished Casting

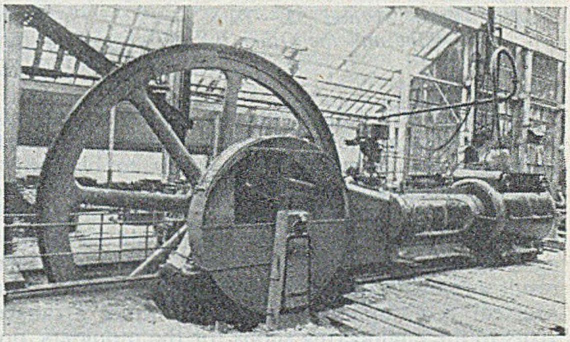
As far as the foundry is concerned the work is now finished, but it is thought that most foundrymen are keenly interested in the ultimate service that the casting is destined for, and it is proposed to carry this Paper further by entering into what is really the engineer's province.

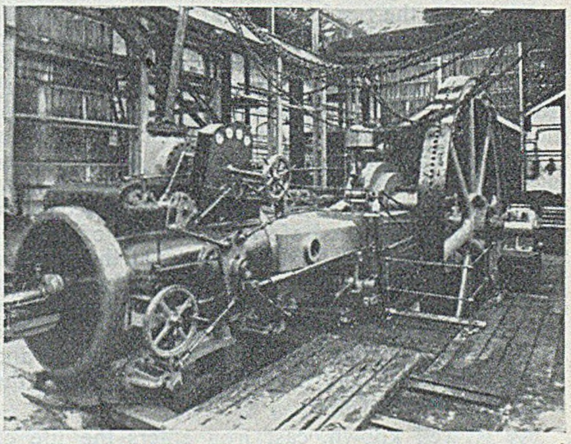
FIG. 28 (TOP).—*Setting the Main Core for the Cylinder.*

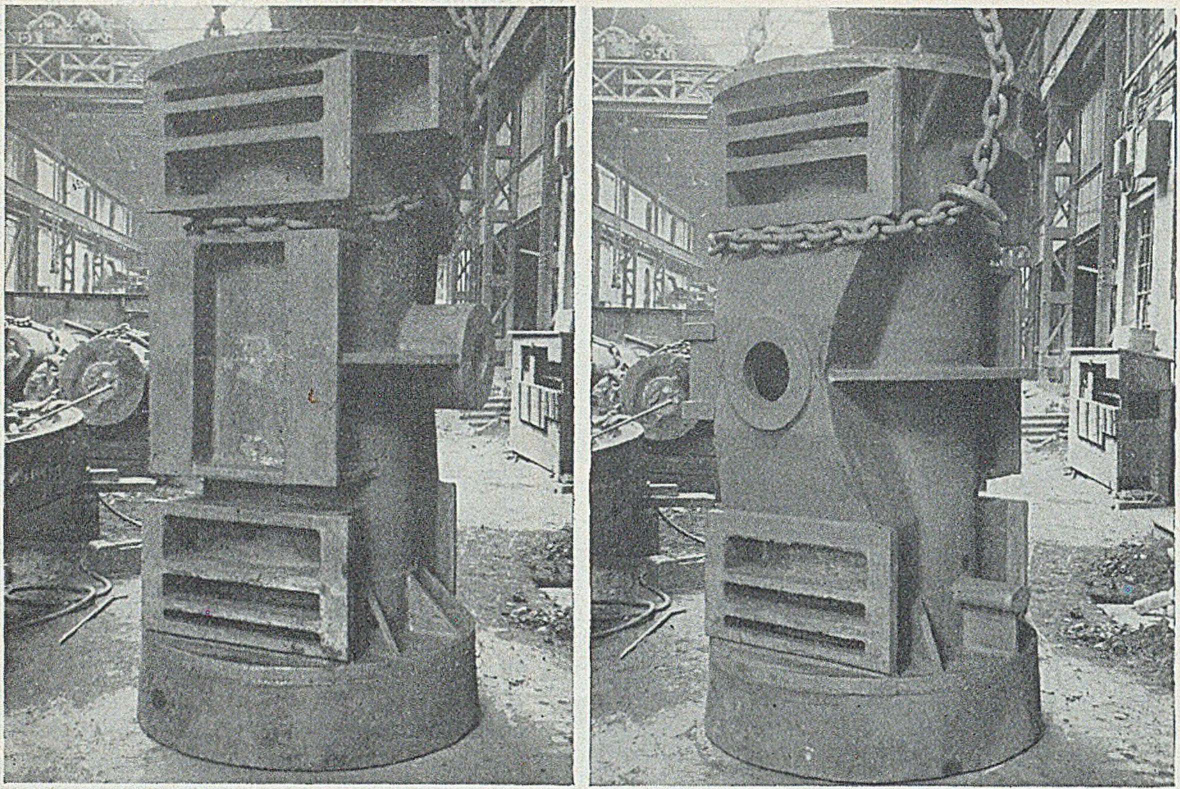
FIG. 29 (CENTRE).—*Cored-up Mould Ready for Closing.*

FIG. 30 (BOTTOM).—*Final Closing of the Mould.*

FIGS. 33 *and* 34 (BELOW).—*The Corliss Steam Engine on the Test Bed; Photographs taken from Opposite Ends.*







FIGS. 31 *and* 32.—*Two Views of the Finished Cylinder Casting, One showing the Steam Inlet Pipe and the Other the Distance Piece for the Stop Valve. Note the Dirt Head (at the Bottom as Photographed).*

Normally the foundryman is rarely called into the engineering shops to see the finished product. Perhaps they themselves are partly to blame for this, as most foundrymen are reluctant to leave the foundry to visit other departments, but the Author thinks that all foundry personnel should be encouraged to visit the machine shops to see the final result of their labour. The management of John McNeal & Company, Limited, at times arranged visits to the engineering shops for the moulders, not always with the results it would have liked. Quite a number of the employees did not make the visit; on the other hand, when visits to other foundries have been arranged the response has been very good. The Author expresses his sincere appreciation to the engineers for their courtesy and help in compiling this section of the Paper, and offers his thanks for the three photographs which will follow. Fig. 33 shows one of the engines being erected on the test bed. A good view is obtained of the flywheel and the trunk-guide soleplate; at the extreme end is the steam cylinder which is totally enclosed. The connecting rods and part of the crankshaft are also discernible in this view. Fig. 34 shows the reverse end; the engine is completely assembled and ready for testing and happily it came through the tests very successfully.

As is well known, cast iron enters the life of everybody and by its use the public is able to have far better amenities in life than they would have without it. These castings are made for the production of sugar. After the engine has passed its test, it will be dismantled and packed to be shipped abroad to a sugar-cane factory.

The plant for which the steam engines are required is to supply the power for driving a cane-crushing mill. Fig. 35 shows the mill assembled ready for test. This mill consists of a cane-crushing plant and a train of sugar-cane mills, consisting of two 40-in. by 84-in. mills and three 38-in. by 84-in. mills with the cane cutters in front.

The sugar cane is carried in a conveyor to the cane cutters shown at the top of the photograph at the far end, the knives then cut the cane to a suitable length and this cane is conveyed through the various crushing operations, each operation crushing out the contents in the cane. Only a brief outline of the operations of this particular operation can be given, but further treatment is continued and a wide variety of products are eventually obtained. Close inspection of Fig. 35 will reveal some of the rolls in various stages of machining, also in this view can be seen a section of the half flywheel and a trunk soleplate. All the rolls used on these mills were cast in the foundry. The total weight of iron castings in the steam engine was 51 tons and total weight of the rolls in the mills, 126 tons.

The Author wishes to thank the directors of G. M. Hay & Company, Limited, Strathclyde Foundry, for their kind permission in allowing the photographs to be published, and also the staff of the same company for their co-operation in assisting him to compile the Paper.

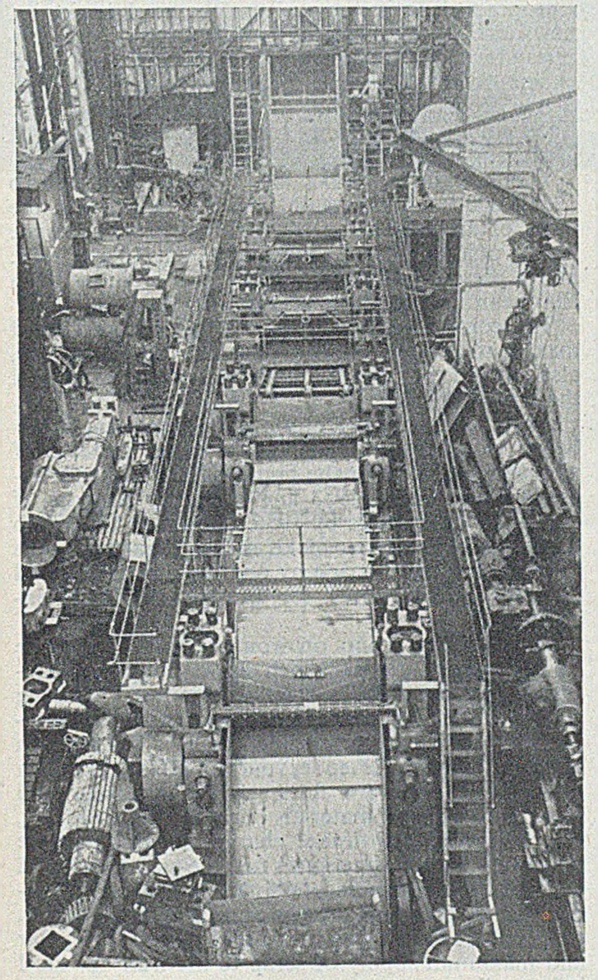


FIG. 35.—*Sugar Cane Mill in the Erecting Shop; this Plant is Driven by a Corliss Engine.*

British Association President

A general committee meeting of the British Association has elected Prof. A. V. Hill, F.R.S., the Royal Society's Foulerton Research Professor since 1926, to the office of president of the association next year, when the meeting will be held at Belfast in September. Chairman of the executive committee of the National Physical Laboratory from 1939 to 1945, he was a member of the War Cabinet Scientific Advisory Committee from 1940 to 1946, and the Advisory Council of the Department of Scientific and Industrial Research, 1940-45. From 1943 to 1944 Prof. Hill was Scientific Adviser to the Government of India and since 1940 he has been chairman of the Research Defence Society, while in 1946 he was appointed to a similar office in the Society for the Protection of Science and Learning. He was secretary of the Royal Society from 1935 to 1945.

Personal

MR. K. N. ECKHARD has been appointed a director and general sales manager of the Brush Bagnall Traction, Limited, Loughborough.

WHEN MR. H. F. CARPENTER retires from the position of secretary of the British Electricity Authority in the autumn, he will be succeeded by MR. ERNEST LONG.

MR. PETER WRIGHTSON, O.B.E., has been elected to a seat on the North Eastern District board of Martins Bank Limited. Mr. Wrightson is deputy managing director of Head, Wrightson & Company, Limited, Thornaby-on-Tees.

THE NEEPSEND DIVISION of Sheffield will be contested at the next general election on behalf of the Conservative and Liberal parties by MR. ALFRED STOBBS, a director of J. H. Mudford & Sons, Limited, rope manufacturers, of Sheffield.

SIR ROBERT JOHNSON, whose resignation, owing to overstrain, from the position of managing director of Cammell Laird & Company, Limited, Birkenhead, was announced recently, is reported to be seriously ill at his Birkenhead home. He was 79 on August 7. Sir Robert retains the chairmanship of the company.

MR. J. A. J. BLANCKENSEE AND MISS E. P. WOOD (joint general managers of the raw-materials division of George Cohen Sons & Company, Limited) have been elected to the boards of Pollock Brown & Company, Limited, Westbourne Park Coal & Iron Company, Limited, and Southall & Hayes Coal and Iron Company, Limited.

MR. H. B. STENT'S appointment as director of East African industrial research has been announced by the East Africa High Commission. Since 1946 Mr. Stent has acted as chairman of the East African Research Board, which the Governments of the three High Commission territories have agreed should be reconstituted as a scientific and advisory committee.

MR. W. R. HEROD has resigned from the board of Associated Electrical Industries, Limited, because he feels that as a co-ordinator of the North Atlantic defence programme it is inappropriate for him to have business contacts with companies with whom he may be in relation in his official capacity. Mr. Herod is president of the International General Electric Company of America.

MR. E. J. BATCHELOR, managing director of Brush Coachwork, Limited, has been appointed vice-chairman of the company. He is also managing director of A. C. Morrison (Engineers), Limited, Loughborough, and a director and general manager of Henry Meadows, Limited, which belong to the Brush group of companies. Before joining the present companies of the Brush group, he was connected with a number of well-known engineering companies.

EX-PROVOST J. K. SHANKS, M.B.E., D.L., J.P., and Mrs. Shanks, Beechfield, Denny, Stirlingshire, were quite overwhelmed with telegrams conveying good wishes and the messages and floral tributes they received on Monday, August 13, when they celebrated their golden wedding. Ex-Provost Shanks, who is 81 years of age, was until he retired last year, the managing director of Cruikshank & Company, Limited, Denny, general ironfounders and makers of Flintrite and Steelrite plough fittings. He was succeeded in the management of the business by his elder son, Captain Tom Shanks. From the family the golden-wedding gift was a television set and at a ceremony in the works the employees and staff presented the ex-Provost with a Westminster chiming clock. The civic career of ex-Provost Shanks started in 1908; he was elected to the civic chair in 1926, and was Provost of the burgh until 1932.

Silicon Removal from Molten Iron

It is interesting to learn from B.I.S.R.A. of some preliminary experiments undertaken by Brymbo Steelworks, Limited, with a view to lowering the silicon content of their blast-furnace iron with the oxygen lance. This firm have considerable experience in the use of the oxygen lance in the electric arc furnace. The trials so far performed have been carried out with oxygen taken from 2,000 cub. ft. capacity cylinders, and it is intended to pursue them with equipment of larger oxygen delivery capacity.

From the first it was considered that one of the most essential features of an operation of this sort would be to ensure an adequate degree of agitation and mixing during blowing, without an excessive mechanical loss of yield due to splashing. Before the blow commences, therefore, the bulk of the contents of the blast-furnace ladle, capacity 20 tons, is poured into a larger ladle of 30 tons capacity and near the end of this operation the ½-in. dia. lance is inserted into the metal in the larger ladle and blowing commences. The agitation is thus considerable, but the use of a larger capacity ladle sensibly reduces mechanical losses, and it is hoped by the use of a refractory-lined hood to control this even further. Blowing continues for some 10 to 15 min. at the rate of about 100 cub. ft. of oxygen per min.

In order to form a fluid and easily-removed slag on the surface of the iron, the following materials are charged into the bottom of the large ladle before pouring and blowing commences:—Limestone chippings 5 cwts., fluorspar ½ cwt., soda-ash blocks 30 lb.

Results of Treatment with Oxygen

Four blows performed as described above have been carried out with the following results:—Eighteen tons of iron were treated, with from 1,200 to 1,500 cub. ft. of oxygen. The accompanying Table gives the hot-metal analysis of the four melts. The slag formed on the surface of the metal after blowing assayed:—CaO, 32 per cent.; SiO_2, 34; Al_2O_3, 11; MnO, 9; Fe, 5; S, 1 per cent. It was estimated that a temperature increase of from 30 to 40 deg. C. took place during the lancing operation.

	Hot metal analyses, per cent.			
	Si.	S.	P.	Mn.
Before lancing	0.86	0.052	0.53	1.20
After lancing	0.48	0.040	0.47	1.00
Before lancing	1.03	0.067	0.59	1.30
After lancing	0.79	0.048	0.52	1.15
Before lancing	1.12	0.072	0.57	1.60
After lancing	0.88	0.044	0.60	1.35
Before lancing	1.24	0.056	0.62	1.60
After lancing	0.88	0.048	0.55	1.55

The use of the lance in these four trials removed an average of 0.305 per cent. Si and 0.16 per cent. Mn, which in theory require roughly 1,700 cub. ft. of oxygen. Disregarding the chemical action of limestone and soda ash, the oxygen (ex cylinders) was used at the rate of roughly 24 cub. ft. per 0.1 per cent. Si per ton iron.

The sulphur removal which took place during lancing is, of course, mainly due to the addition of soda ash. It is important to note, however, that this can be achieved simultaneously with the silicon reduction.

(*Concluded at foot of next column*)

Blast-furnace Requirements for Europe

General measures to reduce the pressure on iron-ore supplies and specific measures to increase the production of lean and rich iron ores at various European deposits, as well as the exploitation of new deposits which could be a source of ore supplies for Europe, were recommended by steel experts from 13 European countries and the United States, constituting the Steel Committee of the Economic Commission for Europe, meeting at Geneva.

The committee seeks by 1953 a 7,000,000 to 12,000,000-ton increase in iron-ore output (on the basis of an average of 40 per cent. iron content). This would involve a boost of about 10 per cent. above present estimated 1953 ore availabilities from European and overseas producers.

The committee, which, since 1947, has promoted maximum production of iron and steel in Europe, also studied the coke supply situation and examined the scrap situation.

An E.C.E. working group states that since they began work, Sweden had intimated an increase of about 15 per cent. in the figure of its planned iron-ore production for 1953 and a further increase of about that magnitude by 1956. However, the group states, its calculations make it clear that even this "substantial effort made by one large producer and exporter of iron ores for Europe would be inadequate."

The working group on iron ore therefore made its recommendations, which have now been approved by the E.C.E. Steel Committee. Among general measures to reduce the pressure on iron-ore supplies it is recommended that "All European countries should (1) endeavour to utilise, as much as possible, iron-ore fines, pyrites residues, and other iron-bearing materials such as flue-dust, slag, etc., in their blast-furnace charge: for this purpose whatever technical measures may be suitable should be taken, such as increased sintering capacity, beneficiation of ores and top pressure in blast furnaces, etc.; (2) take continuing measures to ensure a regular and maximum supply of scrap to the iron and steel industry."

Steps to Increase Production

To increase the production of lean ore in the Lorraine, western Germany, and the United Kingdom, and of rich ore in western France, Norway, Conakry, French Morocco, Tonkililli (Sierra Leone), Liberia. Mauretania, and other new deposits which could be a source of ore supplies for Europe, the committee has made specific recommendations to the countries concerned.

News in Brief

At the annual general meeting of the British Internal Combustion Engine Research Association held recently, the Rt. Hon. Viscount Falmouth, M.I.Mech.E., was re-elected president for 1951-52.

The directors of Breedon & Cloud Hill Lime Works, Limited, propose to increase the capital from £125,000 to £250,000 and to pay up in full 400,000 new ordinary shares to be distributed as bonus shares.

Work is progressing on the £100,000 extensions to the Grantham works of Aveling-Barford, Limited. More than half of the extensions is now completed and in operation. The extensions comprise altogether three bays, with a total floor space of 75,000 sq. ft.

The British Oxygen Company, Limited, include among their exhibits on Stand 7W. at Olympia new Cutogen hand-cutters, models 3 and 5. The former is a heavy-duty blowpipe for use on thick sections of cast iron and steel, and the latter a general-purpose tool.

The offer of 32s. per share made by the Brush Electrical Engineering Company, Limited, for the 226,950 £1 ordinary shares in the National Gas & Oil Engine Company, Limited, not already beneficially owned has been accepted by more than 90 per cent. of the shareholders concerned.

During July, 1,043 new companies, with a total nominal capital of £5,296,000, were registered in Britain. This compared with 1,025 having a nominal capital of £5,699,000, registered in July, 1950, and 1,129 new companies, with total nominal capital of £5,239,000, registered in June this year. Only two of the July registrations were public companies, with total nominal capital amounting to £15,000.

Serious damage was caused last Friday by an outbreak of fire at the premises of the Snydale Iron Foundry in Snydale Road, Normanton, which is a family concern built largely by the principals themselves two and a half years ago. The blaze apparently started among some wood patterns and destroyed the whole roof of the foundry's main building. Arrangements have been made to carry on the business as usual.

Considerable interest attaches to the decision of the Institution of Engineering Inspection to hold their Festival year convention in the Engineering Centre at Glasgow next month, in view of the wide divergence between the English and Scottish practices of inspection. Dr. Edwin Gregory, of Edgar Allen & Company, Limited, will present a Paper on "Formulation and Interpretation of Steel Castings Specifications," which will raise practical problems which are faced in every engineering shop.

Part of the largest railway workshops in the West of Scotland—the old Germiston Works, Petershill Road, Glasgow—may be acquired soon by a big American engineering firm. Our Scottish correspondent learned from an official of the Board of Trade that negotiations are now going on. If they succeed, it is expected that the Americans will move in during the early part of next year, probably in May. Official sources emphasise, however, that discussions are still at an early stage. It is not yet possible to give full details.

The board of directors of the Patent Shaft and Axletree Company, Limited, of Birmingham has been reconstituted and will consist of Sir Archibald Boyd, Mr. Cheesley and Mr. Edwards as part-time directors, Sir Archibald Boyd being the chairman. Mr. B. S. Prichard, managing director, will also continue as a member of the board, and Mr. R. L. Haskew, works manager, Mr. D. Cockburn, chief engineer and Mr. P. J. Davies, secretary and accountant, all of whom have rendered distinguished service, will be appointed.

British Cast Iron Research Association

A Conference on Heating, Ventilation, and Lighting is to be held by the British Cast Iron Research Association at Ashorne Hill from September 26 to 28. The provisional programme indicates that Dr. J. E. Hurst, J.P., President, B.C.I.R.A., will open the conference. Scheduled to give lectures are Mr. W. B. Lawrie on "Improvement of Working Conditions in Foundries; Survey of Problems Involved"; Mr. J. Hunter, on "Incorporation of Dust Control in Foundry Planning"; Mr. F. Jamieson, on "Electric Lamps" and "Industrial Lighting"; Mr. L. G. Davies, on "Natural Ventilation"; Mr. K. Nilsson, on "Ventilation Methods in Swedish Foundries"; Mr. R. H. Young, on "Fans: Their Characteristics, and Factors Governing Their Selection"; Mr. W. B. Lawrie, on (*a*) "Dust in Foundries" and (*b*) "Observation of Dust in Foundry Dressing Operations" (film); Mr. C. G. McKeown, on "Methods of Dust Conveying and Dust Collection"; Mr. L. W. Bolton, on "Fume and Dust Extraction at the Knock-out"; Mr. W. D. Bamford, on "Methods of Foundry Heating"; Mr. W. Russell, on "Core Removal and Cleaning of Castings by the Wet Process"; Mr. J. W. Gardom, on "Some Experiences in Dust Suppression and Suggestions for Future Work"; Mr. N. Charlton, on "Some Experiments in Dust Suppression in the Fettling Shop." The conference will be concluded with an open discussion, after which Mr. C. Gresty will summarise and state his conclusions. Details of the conference can be had by writing to the Association at Bordesley Hall, Alvechurch, Birmingham.

Catton's New Director

At the annual general meeting of Catton & Company, Limited, Yorkshire Steel Foundry, Leeds, held on August 10, Mr. S. L. Finch was appointed a director of the company. Mr. Finch commenced his career with the Leyland Motor Company, where his technical and practical training were completed. In 1943 he joined K. & L. Steel Founders & Engineers, Limited, Letchworth, as chief methods engineer and later in 1945 was made assistant foundry superintendent. In January, 1947, he joined Catton & Company, Limited, as foundry manager and was appointed works manager in 1949. Mr. Finch obtained a first-class certificate in metallurgy and in foundry practice and science in the City and Guilds of London Institutes Examinations. In the latter subject he gained the Buchanan Prize of the Institute of British Foundrymen for obtaining the leading position in the examination. He is a member of the Institute of British Foundrymen, to which he has presented several Papers on foundry practice; a member of the Iron and Steel Institute; and also an associate of the Institution of Metallurgists. At the present time, Mr. Finch is a member of several of the research and development committees of the British Steel Founders' Association.

In 1950 and in January of this year Mr. Finch studied Belgian and German steel foundry practice, and on August 30 he sails in the Queen Mary to America, where he will spend two months touring steel foundries, studying the modern methods of production, plant, equipment, welfare, and labour relations.

The English Electric Company, Limited, is raising the interim dividend on its ordinary capital to 5 per cent., less tax, compared with the 4 per cent. paid last year.

Raw Material Markets

Iron and Steel

Control over the distribution of the main forms of carbon steel will be introduced on December 3 next. The Government's decision to introduce this control was intimated by the Chancellor of the Exchequer on June 28, when he announced the introduction of the present interim arrangements involving the use of "D.O." (Defence Order) and "P.T." (Preferential Treatment) symbols. The present arrangements for controlling the distribution of sheet steel, tinplate, terneplate, and blackplate will remain unaltered. A further announcement will be made about control over the distribution of alloy steel.

The new arrangements will be similar to those in operation up to May, 1950. As from December 3, no person will be allowed to acquire carbon steel in the forms listed below, unless he has an "I.S. authorisation." These authorisations will be issued to firms to acquire specific quantities of steel for specific purposes. The authorisation will permit the firm to acquire the steel direct or allow the firm's sub-contractors to purchase steel to fulfil sub-contracts. These arrangements do not apply to building and civil-engineering firms, who will receive a notice from the Ministry of Works telling them how to apply for the steel they need. There will be other variations from the general procedure similar to those that existed before.

Firms which formerly received I.S. authorisations will shortly be asked by the appropriate department to send in applications for allocations of carbon steel. Ministry of Supply Regional Controllers will ask firms who formerly received I.S. authorisations from regional offices to apply to them.

Any steel-using firm, except a sub-contractor, which will be requiring carbon steel and has not had an authorisation before, should apply early in September as follows:—(1) If the firm requires more than 25 tons of steel a quarter, it should apply to the department which it normally contacts on matters of production; (2) if the firm uses 25 tons or less a quarter (including not more than 10 tons of sheet), it should apply to the Ministry of Supply Regional Controller. In cases of doubt application should be made to the Ministry of Supply, Iron and Steel Division, Shell Mex House, Strand, London, W.C.2.

I.S. authorisations will not be needed to buy small quantities of carbon steel (1 ton a quarter or less according to the form of steel). Full details of these exemptions for small quantities will be issued later. Iron and steel stockholders will again need licences to acquire controlled types of steel for resale. Stockholders who previously had licences will be told direct what action to take. Iron and steel stockholders established since May, 1950, should write for a licence to the Iron and Steel Division of the Ministry of Supply.

These arrangements apply to the following types of carbon steel:—Ingots; billet, bloom, slab; tinplate bar, sheet bar; plate; angle, channel, tee, joist, piling section, and other sectional material; round, rod, square, hexagon, flat, other section and shape (and whether black or bright); rail, sleeper, fishplate, soleplate); hoop, strip (and whether coated or uncoated, and whether hot or cold rolled); tube, pipe; tyre, axle, wheel; block for forging, block for pressing, forging, drop forging; colliery arch and accessories therefor, pitprop; any spring whether laminated, volute or coil, made either of round rod of not less than $\frac{5}{16}$-in. dia. or other steel material of a corresponding cross-sectional area; wire rod; coated or uncoated wire (whether plain or barbed); wire rope, wire strand.

Current pig-iron production is considerably below requirements, with little, or no, prospect of early improvement. All foundries have plenty of business on hand, much of it of an urgent character. The pig-iron shortage, far from being confined to any one particular quality, applies to hematite, medium-, low- and high-phosphorus descriptions. The makers of refined iron, too, are heavily committed ahead. There is thus urgent need to increase the number of blast furnaces in operation, but the main difficulty towards this end is to be found in coke supplies. There are furnaces now idle for this very reason.

There is no improvement in the situation governing supplies of billets and sheet bars. The re-rollers of bars and strip are compelled to operate below capacity. It is difficult to envisage any early improvement in supplies of semis from home makers, but it is likely that there will be a gradual improvement in the flow of imported semis. Meantime, the rollers of bars and strip, and sheets, too, are full up with orders for urgent home requirements and for important export consumers, a considerable quantity of the latter being against bilateral agreements. Steelworks have no difficulty in disposing of any defectives, crops, or, in fact, any form of steel which can be put to use at the re-rollers.

Non-ferrous Metals

It was reported from Washington last week that the President had authorised a sale of 25,000 short tons of copper from the strategic stockpile to meet defence needs during this period of extreme scarcity. The recent strike at the Garfield smelter cost the country some thousands of tons of copper and doubtless this has proved to be the last straw to compel the decision to draw upon national reserves. It was stated that some 10,000 tons out of the 25,000 tons had already been released. Apparently the aim is to replace this metal by June, 1952, but this plan will not be slavishly adhered to if it should prove that defence needs make it imperative to delay the repayment to the stockpile. It has been confirmed that for the present all deliveries of copper to the stockpile have been suspended.

In the United Kingdom stocks of copper at the end of the half-year were 116,907 tons, according to information released by the British Bureau of Non-ferrous Metal Statistics, and of this the Government held about 82,000 tons, of which about one-quarter was in the form of blister. Consumption of copper in June was 46,784 tons, about 19,000 tons of which was in the form of scrap. In May the corresponding figures were 45,319 tons and 15,700 tons. Stocks of virgin lead at June 30 were 25,963 tons, which registered a sharp fall on the May total of 27,335 tons. Consumption of virgin and secondary lead in June was about 29,900 tons. In zinc, usage was 23,312 tons and stocks on hand at the end of June were 34,221 tons.

The scrap situation shows little or no change, the amount of secondary metal coming forward for consumption being disappointingly small.

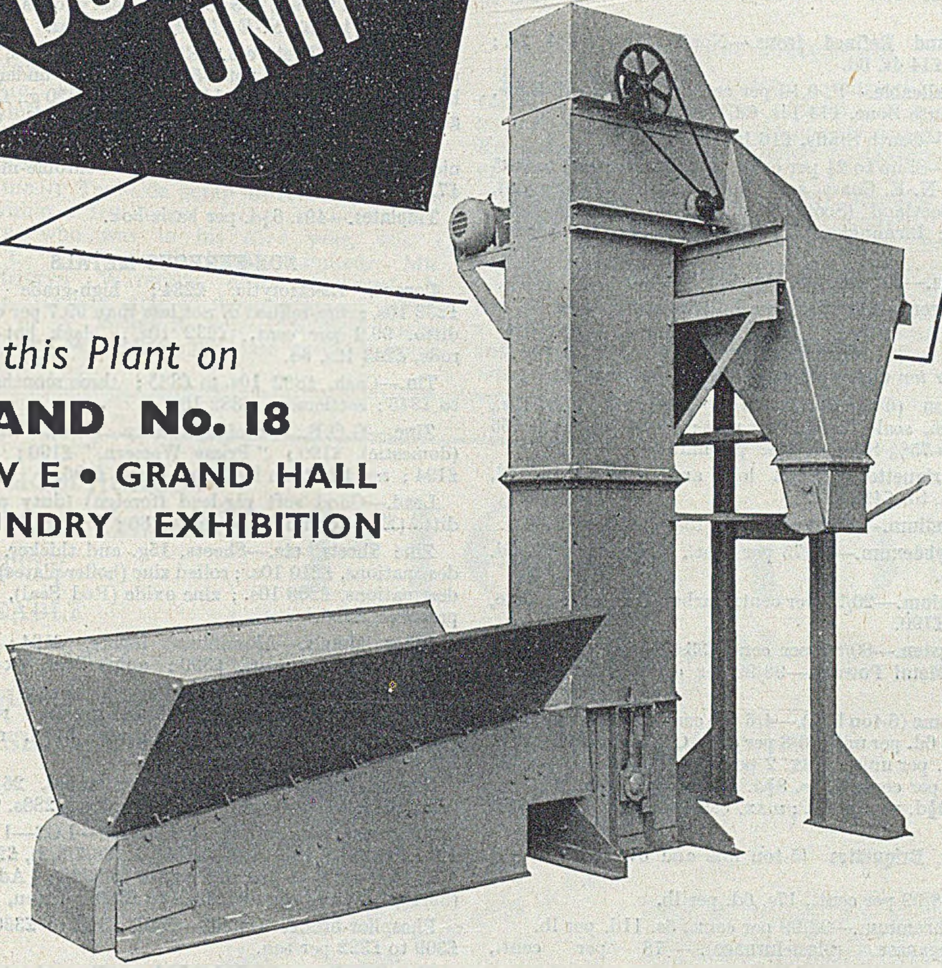
A total of 6,044 tons of aluminium castings was produced in the U.K. during June, bringing the total for the first half of the year up to 35,029 tons, comprising:—Sand castings, 9,815 tons; gravity castings, 19,575 tons; pressure castings, 5,639 tons.

London Metal Exchange official tin quotations were as follow:—

Cash—Thursday, £840 to £842 10s.; Friday, £850 to £855; Monday, £862 10s. to £867 10s.; Tuesday, £885 to £887 10s.; Wednesday, £882 10s. to £885.

Three Months—Thursday, £816 to £817 10s.; Friday, £822 10s. to £824; Monday, £837 10s. to £840; Tuesday, £842 10s. to £845; Wednesday, £842 10s. to £845.

POLFORD DUAL SAND UNIT



See this Plant on

STAND No. 18

ROW E • GRAND HALL

FOUNDRY EXHIBITION

THE HEATON FOUNDRY CO., LTD.

HEATON JUNCTION NEWCASTLE-ON-TYNE, 6

Telephone:—59011/2/3

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

(Delivered, unless otherwise stated)

August 22, 1951

PIG-IRON

Foundry Iron.—No. 3 Iron, Class 2:—Middlesbrough, £11 10s.; Birmingham, £11 4s. 6d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 0s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £13 12s. 3d.

Scotch Iron.—No. 3 foundry, £13 1s., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £14 2s.; South Zone, £14 4s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £14 12s.; South Zone, £14 14s. 6d.

Cold Blast.—South Staffs, £16 10s. 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, £12 17s.; Scotland (Scotch iron), £13 3s. 6d.; Sheffield, £13 13s. 6d.; Birmingham, £14 0s. 6d.; Wales (Welsh iron), £13 3s. 6d.

Spiegeleisen.—20 per cent. Mn, £18 15s. 9d.

Basic Pig-iron.—£11 15s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £40 15s., basis 45% Si, scale 15s. 6d. per unit; 70/84 per cent., £56 2s. 6d., basis 75% Si, scale 16s. per unit.

Silicon Briquettes (5-ton lots and over).—2lb. Si, £48 5s.; 1lb. Si, £49 5s.

Ferro-vanadium.—50/60 per cent., 15s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 9s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £175; ditto, copper-free, £190.

Ferro-tungsten.—80/85 per cent., 33s. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 35s. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent C, £74, basis 60% Cr, scale 24s. 6d. per unit; 6/8 per cent. C, £70, basis 60% Cr, scale 23s. 3d. per unit; max. 2 per cent. C, 1s. 8¼d. per lb. Cr; max. 1 per cent. C, 1s. 8¾d. per lb. Cr; max. 0.15 per cent. C, 1s. 9½d. per lb. Cr.; max. 0.10 per cent. C, 1s. 9¾d. per lb. Cr.

Chromium Briquettes (5-ton lots and over).—1 lb. Cr, £78 9s.

Cobalt.—98/99 per cent., 17s. 6d. per lb.

Metallic Chromium.—98/99 per cent., 5s. 11d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £39 9s. 4d.

Manganese Briquettes (5-ton lots and over).—2lb. Mn, £46 18s.

Metallic Manganese.—96/98 per cent., carbon-free, £215 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—Basic: Soft, u.t., £21 6s. 6d.; tested, 0·08 to 0.25 per cent. C (100-ton lots), £21 16s. 6d.; hard (0.42 to 0.60 per cent. C), £23 14s.; silico-manganese, £29 10s.; free-cutting, £24 10s. 6d. Siemens Martin Acid: Up to 0.25 per cent. C, £27 11s.; case-hardening, £27 19s.; silico-manganese, £30 11s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £25 10s.; basic, hard, over 0.41 up to 0.60 per cent. C, £26 10s.; acid, up to 0.25 per cent. C, £27 19s.

Sheet and Tinplate Bars.—£21 8s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £25 6s. 6d.; boiler plates (N.-E. Coast), £26 14s.; chequer plates (N.-E. Coast), £26 15s. 6d.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £23 15s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £27 11s.; flats, 5 in. wide and under, £27 11s.; hoop and strip, £28 6s.; black sheets, 17/20 g., £35 15s. 6d.; galvanised corrugated sheets, 17/20 g., £49 18s. 6d.

Alloy Steel Bars.—1-in. dia. and up: Nickel, £44 17s. 3d.; nickel-chrome, £65 2s. 9d.; nickel-chrome-molybdenum £72 10s. 3d.

Tinplates.—49s. 6½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £234; high-grade fire-refined, £233 10s.; fire-refined of not less than 99.7 per cent., £233; ditto, 99.2 per cent., £232 10s.; black hot-rolled wire rods, £243 12s. 6d.

Tin.—Cash, £882 10s. to £885; three months, £842 10s. to £845; settlement, £882 10s.

Zinc.—G.O.B. (foreign) (duty paid), £190; ditto (domestic), £190; "Prime Western," £190; electrolytic, £194; not less than 99.99 per cent., £196.

Lead.—Good soft pig-lead (foreign) (duty paid), £180; ditto (Empire and domestic), £180; "English," £181 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £210 10s.; rolled zinc (boiler plates), all English destinations, £208 10s.; zinc oxide (Red Seal), d/d buyers' premises, £205.

Other Metals.—Aluminium, ingots, £124; antimony, English, 99 per cent., £390; quicksilver, ex warehouse, £73 5s. to £74; nickel, £454.

Brass.—Solid-drawn tubes, 25½d. per lb.; rods, drawn, 28¼d.; sheets to 10 w.g., 30½d.; wire, 31¾d. rolled metal, 28⅞d.

Copper Tubes, etc.—Solid-drawn tubes, 26⅞d. per lb.; wire, 261s. 9d. per cwt. basis; 20 s.w.g., 288s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £277 to £281; BS. 1400—LG3—1 (86/7/5/2), £282 to £300; BS. 1400—G1—1 (88/10/2), £340 to £360; Admiralty GM (88/10/2), virgin quality, £340 to £350 per ton, delivered.

Phosphor-bronze Ingots.—P.B1, £348 to £390; L.P.B1, £309 to £322 per ton.

Phosphor Bronze.—Strip, 38d. per lb.; sheets to 10 w.g., 40½d.; wire, 42⅜d.; rods, 38d.; tubes, 36½d.; chill cast bars: solids 3s. 10d., cored, 3s. 11d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 2s. 7½d. per lb. (7%) to 3s. 7½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 1½d. (7%) to 4s. 1½d. (30%); to 12 in. wide × .056, 3s. 1¾d. to 4s. 1½d.; to 25 in. wide × .056, 3s. 3¾d. to 4s. 3¾d. Spoon and fork metal, unsheared, 2s. 10½d. to 3s. 10½d. Wire, 10g., in coils, 3s. 7½d. (10%) to 4s. 7d. (30%). Special quality turning rod, 10%, 3s. 6½d.; 15%, 3s. 11d.; 18%, 4s. 3½d. All prices are net.

Obituary

MR. JACK KILBRIDE, progress and planning manager of Samuel Fox & Company, Limited, steelmakers and rollers, of Stocksbridge, near Sheffield, died in Sheffield Royal Infirmary on August 11, at the age of 56.

THE DEATH is reported from Newcastle-upon-Tyne at the age of 78 of MR. WILLIAM SHEARER, who, until his retirement 14 years ago, was chief cashier and accountant with C. A. Parsons & Company, Limited. He was with the firm for 46 years.

MR. JOHN GJERS MILLS, who died recently, was the eldest son of Mr. Charles E. Mills, one of the founders of Gjers Mills & Company, Limited, pig-iron manufacturers, of Middlesbrough. He, too, was formerly a director of the company, but retired some years ago. He was 65 years of age.

MR. OWEN A. PRICE, who has died in a Bristol hospital, was for 30 years chief hydraulic engineer with Glenfield & Kennedy, Limited, Kilmarnock, although a native of Lincolnshire. He was a recognised authority on all matters pertaining to hydraulics and his contribution to research and development work in this field was outstanding. He retired in 1949.

TWO PROMINENT Tees-side scrap merchants died on August 13 within a few hours of one another. MR. JOHN FOSTER, who was in his 63rd year, was a director of E. Hind (South Bank), Limited. MR. WILLIAM MOSTYN WATSON'S death occurred in his 43rd year. He had attained the position of executive director of A. Wood & Sons (Middlesbrough), Limited, and, like Mr. Foster, was also active in sport and Freemasonry.

Nickel Bans Postponed

Following representations by industries affected by the Nickel (Prohibited Uses) Order, it has been decided that the date from which the nickel plating of articles listed in the second schedules to the Orders will be prohibited, shall be October 1, instead of August 22.

The Ministry of Supply and Board of Trade announce that it has also been decided that the disposal of articles containing controlled material or which are nickel plated shall be permitted without licence up to December 31 next. Under the present Orders disposal was prohibited after October 1 and August 22 respectively.

These changes are being made to allow manufacturers more time to turn over to alternative methods of production and to dispose of existing stocks. Amending Orders giving effect to these decisions were issued on Tuesday.

Qualcast Extension

Originally the works of John Lysaght, Limited, Swan Garden Works, Horseley Fields, Wolverhampton, have been purchased from the present occupiers, British Rollmakers Corporation, Limited, by Qualcast, Limited, of Derby.

Qualcast, Limited, have already premises in Horseley Fields, known as the Crane Foundry, and these will not be affected by the new purchase. British Rollmakers Corporation have sold the factory, as they are concentrating their business at Crewe. Accommodation at the Swan Garden Works includes an office block, a laboratory block, main foundry block, machine shop and stores. The site covers an area of 31,604 sq. yds. The price paid has not been made known.

CLASSIFIED ADVERTISEMENTS

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

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, 49, Wellington Street, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

C.I. DIECASTINGS. — Consultant wishes to contact Foundries interested in development for production of Light Grey Iron Repetition Castings.—Box 1176, FOUNDRY TRADE JOURNAL.

ASSISTANT FOUNDRY MANAGER (31), A.M.I.B.F., keen, energetic, desires change. Sound knowledge of patternmaking, mechanisation, rate fixing and estimating, also City and Guilds certificate holder. West Midlands, Salop or Potteries preferred.—Box 1175, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

FURNACEMAN required for Foundry in Home Counties producing grey iron castings up to one ton weight. House can be made available to satisfactory applicants.—Box 1171, FOUNDRY TRADE JOURNAL.

WORKING FOREMAN for Small Non-Ferrous Foundry in the Midlands. Living accommodation provided. Good working conditions, with prospect of advancement. Please state age, experience, and salary required.—Box 1146, FOUNDRY TRADE JOURNAL.

SKILLED MOULDERS, PLATERS, TURNERS, BORERS, etc., required by Distington Engineering Company, Limited, Workington, Cumberland. For further details apply to the LABOUR MANAGER.

FOUNDRY MANAGER. Must be fully experienced aluminium gravity die-castings, to lay down small foundry, and take complete control; able to design own dies, cost, and obtain results on own initiative. Good prospects. Interview Lancashire or London.—Box 1155, FOUNDRY TRADE JOURNAL.

METALLURGICAL ASSISTANT required for Engineering Works in North Midlands; graduate or associate preferred; age 20-25 years; previous experience in foundry or welding work desirable, but not essential; the post covers shop and laboratory work, and offers wide scope to a man with initiative.—Write, stating age, experience, and salary required, to Box 1170, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required to take over a small Iron Foundry. Development work is required on quality and output, and applicant must be fully conversant with jobbing and machine moulding. In addition, experience of Costing and a Metallurgical background is desirable. This position is one with a good future for a young executive who is capable of growing with the job. Write giving full particulars, age, and salary required. House available.—Box 1160, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

NON-FERROUS and CAST IRON MOULDERS required. Good rates. Canteen, etc.—Write Box 302, W.B.G., 39, Cheapside, London, E.C.2.

MACHINE tool manufacturers require FOUNDRY MANAGER to take complete charge of grey iron foundry in Yorks. West Riding. Applications in writing stating age, experience and salary to Box 1173, FOUNDRY TRADE JOURNAL.

METALLURGIST wanted, to start new department to control melt and sand in light repetition and jobbing Grey Iron Foundry. Main requirement is practical experience and lack of academic qualifications would be no bar.—Apply by letter to J. ALAN PRIOR, ESQ., Managing Director, Wilmer Lea Foundries, Ltd., 32/62, High Street, London, E.15.

STEEL FOUNDRY FOREMAN required, to take charge of a jobbing section producing 40 tons of general steel castings up to a maximum individual weight of 5 tons. Applicant must have drive and initiative to organise and develop on modern lines this section of the steel foundry. Write, giving details of experience to date, with age and salary required. Housing accommodation will be found after the applicant has served a satisfactory probationary period.—Box 1179, FOUNDRY TRADE JOURNAL.

YORKSHIRE Foundry, producing Engineering and Machine Tool Castings, invites applications for position full time WORKING DIRECTOR, with some investment. Must be fully experienced foundry management, able to take complete control. Amount invested secondary to experience and ability.—Fully detailed replies, stating salary required, etc., Box 1177, FOUNDRY TRADE JOURNAL.

ASSISTANT FOUNDRY SUPERINTENDENT required for Foundry situated in the Midlands producing Machine Tool and General Engineering Castings up to 5 tons. Knowledge of sand, metal, and cupola control, and of modern production methods on mechanised plant desirable. The position is progressive and offers good prospects to the right man. Age preferred 35-40. House available.—Apply, giving full particulars of experience, age and salary required, to Box 1178, FOUNDRY TRADE JOURNAL.

BUSINESS FOR SALE

FOR SALE AS A GOING CONCERN.—Iron Foundry in South of England. Premises 43,000 sq. ft. Mainly modern ferro concrete buildings, 17,500 sq. ft. Mechanised equipment with key personnel if required.—Box 1054, FOUNDRY TRADE JOURNAL.

FACTORY PREMISES WANTED

DISUSED FOUNDRY or Premises suitable for smelting required within 25 miles London, either Surrey or Sussex. Approx. 5-8,000 sq. ft.—Full details and price to Box 1106, FOUNDRY TRADE JOURNAL.

BUILDING REQUIRED

BUILDING required, approximately 6,000 sq. ft. or more, to be used as foundry. Good price paid.—Box 1172, FOUNDRY TRADE JOURNAL.

AGENCIES WANTED

LONDON AREA.—Engineers' Agents, with good offices in Westminster, require AGENCY for Malleable or Steel Castings. If principals have established connections amongst users in the area, remuneration required would be correspondingly moderate.—Box 1061, FOUNDRY TRADE JOURNAL.

REPRESENTATION. Long established and successful Agency with office in Glasgow, and good connection with light engineering trade throughout Scotland, wishes to undertake the representation of one additional manufacturer. Stock can be carried if desired.—Box 1174, FOUNDRY TRADE JOURNAL.

MACHINERY WANTED

SECONDHAND Belt Conveyor, type Tilghmans Wheelabrator, or similar. Good condition.—BARRACLOUGH'S, Stanningley, Leeds.

WANTED.—Pair of Modern Drop-Bottom Cupolas, not less than 6 ft. shell diameter. Complete with spark arrester, blowing fan, and skip hoist charger, etc.—Box 1147, FOUNDRY TRADE JOURNAL.

WANTED

1-TON Capacity Ladle, with enclosed gears. Must be in good condition. Price and particulars.—Box 1166, FOUNDRY TRADE JOURNAL.

OFFER YOUR SURPLUS PLANT TO
FRANK SALT & CO., LTD.,
Station Road, Blackheath, Birmingham.
BLA. 1635.

WANTED.—Oil - fired Reverberatory Furnace: melting capacity 400 lbs. Gunmetal. Fullest particulars and price to Box 1164, FOUNDRY TRADE JOURNAL.

WANTED.—One only (Foundry Equipment) Hand Roll-over Moulding Machine with hydraulic stripping. Particulars to: John Harper & Co., Ltd., Albion Works, Willenhall, Staffs.