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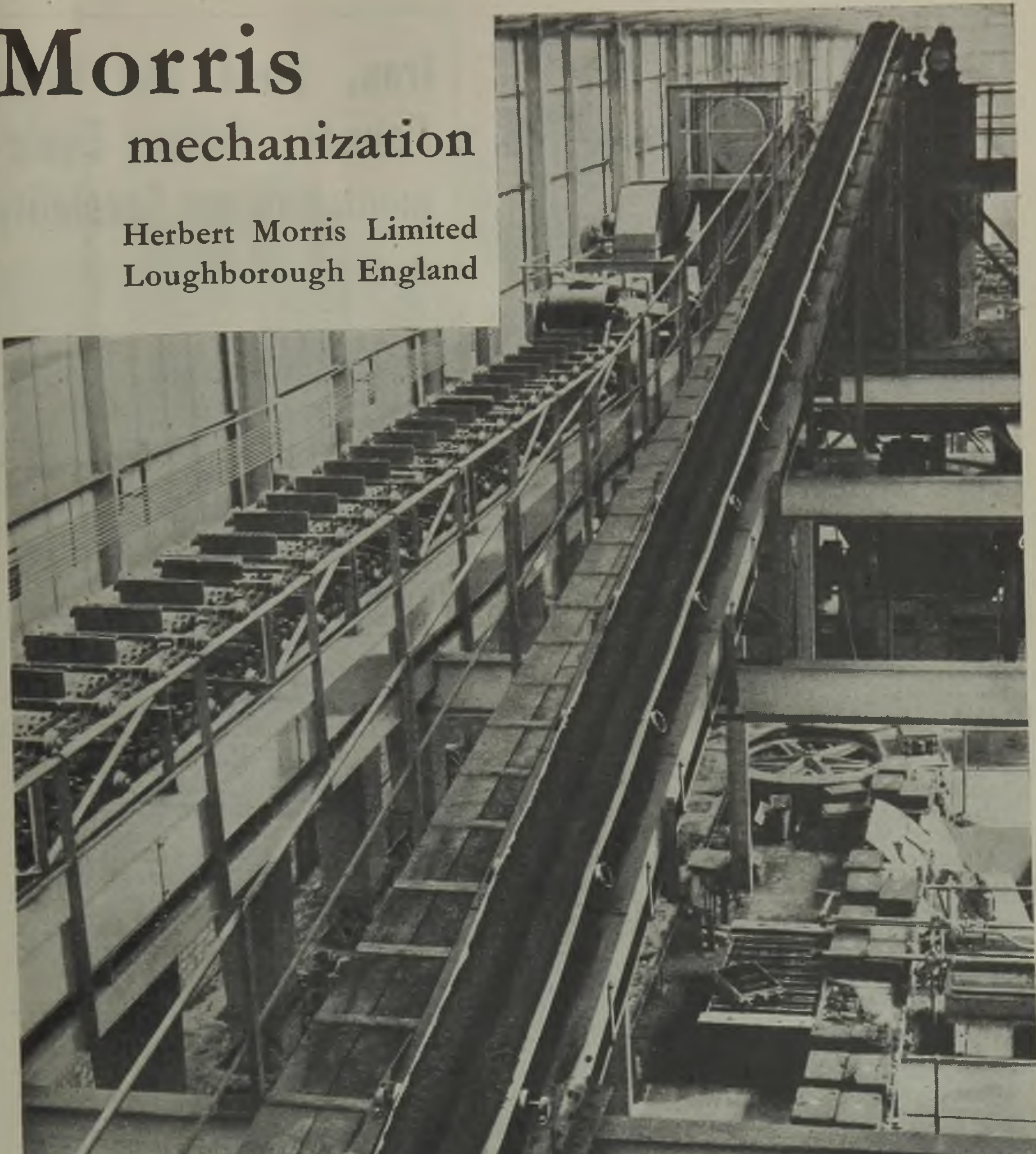

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The fact that goods made of raw materials in short supply owing to war conditions are advertised ... taken as an indication that they are necessarily available for export

FOUNDRY TRADE JOURNAL

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A Questionnaire on Maintenance

Members of the Steelfounders' Association of America have, no doubt, filled in as many questionnaires as their British confrères. Their minds must have been centreing around the poor bureaucrats whose job it is to add up a mass of figures, divide, and present the results to their chiefs. These poor devils have probably never seen the new materials or components to which the questionnaire relate. Thus the notion arose, why not examine and discuss our own questionnaires? Such a system has been organised to cover a limited field—the maintenance of certain types of foundry plant. Set questions on this subject produce answers of but limited value, but they are indicative and of distinct worth as a basis for further discussion—not merely academic analyses. A questionnaire was sent to the members asking for information as to the maintenance of diesels, jolters, shakeouts and sand reclamation systems. The difference between the official analysis and the subsequent discussion is most marked, the report of the latter being much more useful. So far as diesel engines are concerned, it was brought out that though maintenance costs may be higher, the running costs will take care of this as one can manage with one operator as against two for steam locomotives, and time is saved through the elimination of the initial lighting up process. For diesel shunting engines there was a general preference for the 65-ton over the 50-ton model.

When discussing jolters, reference was made to the detrimental effect they have on surrounding equipment and property. Some had mounted them on piles, presumably with good effect. General commendation was given to the use of Fabreeka, a proprietory material compounded of corded rubber. This is used as a cushion, and is installed between the machine and the foundations. Moreover, it is also used as bushings around the foundation bolts, and in connection with other foundry plant such as shakeouts and the like. The manufacturers of a popular American make of shakeout must have viewed the report of this discussion with mixed feelings as everybody was satisfied with the technical results but were severely critical of the brightness of the design and the heavy maintenance costs. We think the makers ought to be pleased as they could now market a 1945 model taking steps to eradicate the weaknesses disclosed. The elimination of dust around shakeouts is obviously still as much a problem in the United States as here. The freeing of cores from castings was also discussed, and favourable comment was accorded to the system of suspending the casting from the crane and attaching to it a pneumatic vibration. The system has no ill effect on the crane. Very large castings are dealt with by one firm by mounting them on springs on a wagon and striking the risers with a pile driver.

The last question to be discussed was the reclamation of sand by the Hydro-blast system and by a dry system. The latter consists of passing the sand through vibrating screens and then cascading over louvres through which regulated amounts of air are drawn to remove the silt. The reclaimed material is still black, and is not as good as new sand. The system being new, no reliable costs are so far available. There is just one factor which worries us about this discussion, and that is that it was held under the ægis of T and O group, Division 7. To our mind, to be thoroughly effective, every person who has had the fag of filling up the questionnaire should have the right to participate in the discussion. We well remember hearing of a committee discussion on an enquiry sent out as to the amount of patching used in cupola practice per ton of throughput. We are reasonably sure that if the most extravagant and economical of the reporting firms had been present both might have modified their practice, as excessive economy in one direction often leads to extravagance in another.

Contents

SCIENTIFIC TEACHING AND RESEARCH

SCHEME ANNOUNCED BY I.C.I.

The directors of Imperial Chemical Industries, Limited, have offered to provide at nine universities in Great Britain Fellowships to be held by senior workers in certain sciences. The scheme is announced to operate for an initial period of seven years. The Fellowships will be of the average value of £600 per annum, though the universities will have power to determine the emoluments for each particular appointment. The directors of I.C.I. have described on broad lines the subjects in which the Fellowships are to be held, and the administration of the scheme rests wholly with the universities, which will select and appoint the Fellows, subject only to such conditions as to duties and tenure as the universities themselves impose.

The purpose of the directors in instituting this scheme is to strengthen the general provision in the British universities for scientific teaching and research. The directors believe that academic and industrial research are interdependent and complementary, and that substantial advances in industry cannot be looked for without corresponding advances in academic science. In their view, it is important that the immediate objective should be the strengthening of university scientific departments in whatever way each university thinks to be best. No conditions whatever are attached by the directors to the tenure of these Fellowships. The Fellows will be members of the university staffs and will be concerned only with the duties laid upon them by the universities. Their primary work will lie in research. But they must also take some part in university teaching. It is intended not to relieve the universities from the cost of maintaining any part of their normal work, but to enable them to add to what they already do.

The universities to which this offer has been made comprise the larger metropolitan universities and those which have a close geographical relation to the main centres of the company's production. Twelve Fellowships have been offered to the universities of Oxford, Cambridge and London, eight to the universities of Glasgow, Edinburgh, Manchester, Birmingham and Liverpool, and four to the university of Durham. The directors believe that a rational policy of this character, together with a wise selection of men both as regards capabilities and tenure of office, will lead to the emergence of a body of men capable of taking high academic or industrial positions, thereby advancing academic and industrial research.

The American War Production Board is permitting the manufacture of 68,000 electric cookers for civilian use this year.

A Washington official has stated that, in order to keep the American foundry industry properly supplied with technical skill, the annual intake of apprentices must be of the order of 100,000 a year.

IRONFOUNDRY FUEL NEWS—XV

Flue arrangements in drying stoves in the ironfounding industry certainly range from the sublime to the ridiculous. Two examples of the latter variety are illustrated by the following extracts from reports by visiting members of the Regional Panels of the Ironfounding Industry Fuel Committee: "Moulds are dried in a primitive brick chamber . . . the moulds and a fire-basket are both shut up together inside the chamber . . . the flue outlet has a damper, access to which is from inside the stove!" "The stove is heated by a fire-basket at one end. The outlet flue is immediately over this fire-basket!"

Fortunately, these examples are not typical; but nevertheless numbers of cases have been met in which the flue arrangements have been far from satisfactory and where relatively slight alterations could render the stoves more efficient and therefore less wasteful of fuel. The purpose of flues is, of course, to convey the hot gases to, and away from, the stove, and their arrangement should therefore be such that there is the maximum circulation of the gases through the stove so that all the load can absorb some of their heat. The gases become cooled and laden with moisture on their passage through the load, and therefore become heavier than the fresh hot gases. The outlet flue should therefore be taken from the bottom of the stove, at the far end from the firebox, and not from the top, as is often found to be the case. Needless to say, an exhaust damper should be fitted, and used.

NOTES FROM THE BRANCHES

South Africa.—Two visitors from Capetown, Mr. G. F. Alexander and Mr. N. Watts, opened a discussion at the April meeting of the Branch on "Is Mass Production Possible in South Africa?" Mr. Alexander took the optimistic view and Mr. Watts the pessimistic attitude. Both presented good arguments, but until there is a better definition of mass production the subject will remain nebulus. Mr. Issels, of Bulawayo, Southern Rhodesia, was present and detailed the not inconsiderable progress made by the local founders in recent years. On May 18, some 60 members of the Branch visited the works of the Dunswart Iron & Steel Works, Limited.

NEW I.B.F. SECTION IN NATAL

At a well-attended meeting, held on May 2, at Durban, a Natal Section of the South African Branch of the Institute of British Foundrymen was inaugurated. Mr. T. H. C. Oram, who has been a member of the London Branch for the last 14 years, was elected chairman. He promised to address the new section from the chair on the occasion of the first regular monthly meeting.

STEEL MIXES AND INOCULANTS IN GREY CAST IRON*

Assumption that melting of steel in cupolas is a difficult practice is entirely false

By W. BARNES and C. W. HICKS

Much has been written about the inoculants and alloy additions in modern high-duty cast iron, and very little about effects of the various amounts of steel in the mix, but there is no doubt that the steel content of the charge is the greatest basic factor in the results obtained. There has been, and, for that matter, still is, too much misconception and doubt about the cupola melting of steel, and, because of this, many foundries are operating under high metal costs.

As production conditions are the acid test of any process, the following describes a series of experiments carried out on a cupola which is in daily use for normal production. Every care was taken to ensure that melting conditions for these experiments were as consistent as possible, and the metal charges involved were placed in the same charge sequence in every case. Control was established by means of a standard wedge bar, and only metal which gave the depth of chill established as a standard was used for the casting of test pieces; in other words, any sequence of charges which varied from the standards, however slightly, were discarded and were repeated the following day.

The chief purpose of the investigation was to measure the effect on physical properties of increasing percentages of steel with and without a measured amount of various inoculants. The second purpose was to measure the effect of a fixed percentage of steel and varying amounts of inoculants. The third purpose was to ascertain the effect of increasing percentages of steel on the re-action of the resultant iron to low temperature treatment, and to oil quenching.

The following materials were used as inoculants:—(1) Calcium silicide; (2) ferro-silicon; (3) aluminium; (4) a mixture of aluminium and ferro-silicon, and (5) nickel shot.

Because enough has not been written about the melting of steel in the cupola, many founders are reluctant to develop it, on the entirely false assumption that it is very difficult practice. As a result, they compromise by purchasing refined irons, and as the price of these irons is considerably higher than standard pig-iron, there is a marked increase in the cost of metal at the spout, whereas the purchase of steel scrap and its direct inclusion in the charge would not only show the same improvement in physical properties, but the spout cost of the metal would be considerably reduced.

For example, in the foundry with which the Authors are connected, a metal mixture for certain castings containing 65 per cent. refined iron and 1 per cent. nickel addition gave a tensile strength of 13 to 14 tons, with a Brinell hardness of 217. This mix was replaced by one containing 20 per cent. steel, with a standard pig-iron and no nickel, with which a tensile strength of 15 tons was obtained at the same Brinell hardness, while the cost of the mix was reduced by 60s. per ton. Another important point in these times of fuel conservation is that the direct use of steel eliminates the fuel required to convert it to refined iron.

In some foundries small additions of nickel are added as a cure for almost every metal trouble, and various forms of nickel or nickel-copper additions are marketed as metal improvers or regenerators. When such alloys are added in reasonable amounts to produce such irons as the martensitic or austenitic grades their use is justified, but the addition of 0.5 to 1.0 per cent. is neither necessary nor justifiable, and appears to serve no purpose (other than to increase the metal cost per ton) that cannot be achieved by sound melting technique, and the correct selection of raw materials. Such practices may make a good iron slightly better, but they do not make a bad iron good.

Melting Practice

The cupola used was one employed on the daily melting of iron for normal production, with the following dimensions:

Shell diameter	60 in.
Internal diameter	30 in.
Bed plate to bottom tuyeres	28 in.
Bed plate to top tuyeres	33 in.
Windbelt	48 in. × 10 in.
Blast main	14 in. dia.
Tuyeres (1st row), 7 at	3 in. dia.
Tuyeres (2nd row), 7 at	2 in. dia.
Total tuyere area	71 sq. in.

Standard Preparation.—The slag is chipped off properly to ensure a good foundation for patching and a thin clay wash is applied. The patching ganister is milled and allowed to temper overnight, and is used as dry as possible, with only sufficient moisture to make it adhere. Where deeper pockets are encountered, bricks are embedded to make the patching firm, and prevent cracking. The lining is formed to follow a slight natural burn-out, giving a diameter of 32 in. just above the tuyeres, for which a gauge stick is used.

All obstructions are removed from windbelt and tuyeres, the bottom doors closed and propped, and the sand bottom is then rammed in. The sand is a normal

* Paper read at the Forty-first Annual Meeting of the Institute of British Foundrymen. The authors are, respectively, Foundry Manager and Metallurgist, Humber, Limited.

Steel Mixes and Inoculants

green moulding sand, and is rammed firmly to slope from the back and sides down to the taphole. The spout is lined to flow smoothly down from the taphole to prevent undue turbulence of the metal, and all patching is then dried thoroughly.

Preparing the Bed.—The taphole is protected by selected pieces of coke, then flat pieces of wood (not too thick) are placed over the sand bottom to protect it, and the rest of the wood to be used is built in an inverted cone, with the free ends resting against the tuyeres. The centre of the cone is then filled with coke, averaging 5 to 7 in., from which all green ends are discarded, and just less than one-half of the bed coke is put on. This is allowed to burn with a natural draft through the breast opening, until a bright red at the lining. The same amount of coke is then added, and when this is burnt to a dull red, the bed is poked thoroughly up and down through the tuyeres, and down from the charging door to ensure that any cavities left by the burnt wood are removed, so that the bed is firm and cannot collapse under the cupola burden. The height is then made up to the established depth except for the last 8 in., which are put on just before charging, when the bed height is fixed at 42 in. above the top tuyeres.

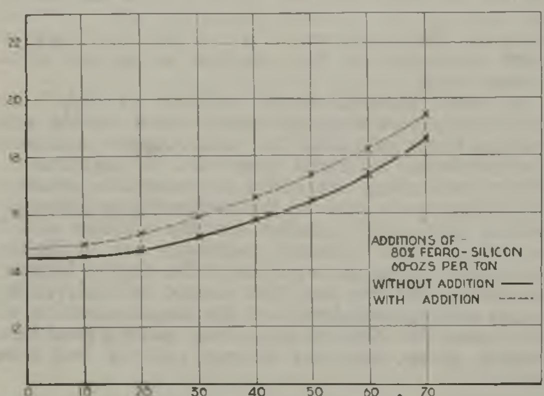


FIG. 1.—INFLUENCE OF FERRO-SILICON AS AN INOCULANT.

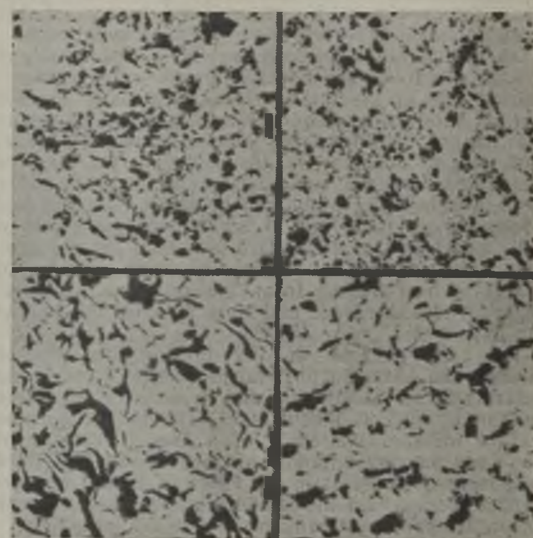
Raw Materials and Method of Charging.

The maximum length of materials is 10 in., width 8 in.; this reduces the risk of scaffolding to a minimum.

Charging sequence is controlled as follows:—Pig-iron, iron scrap, and steel scrap. The pig-iron and heavier scrap is charged to the outside, and the lighter materials to the centre to bring about as even melting conditions as possible, because of the greater depth of incandescence at the lining caused by blast deflection. When ferro-alloys are charged these are put in the centre prior to the steel scrap being charged.

TABLE I.—*Composition of Raw Materials.*

Metal grade.	Si	S	P	Mn
	Per cent.	Per cent.	Per cent.	Per cent.
Steel	0.20	0.05	0.05	0.60
Pig-iron No. 1 ..	3.10	0.04	0.36	1.1
Pig-iron No. 2 ..	4.50	0.06	0.37	1.5
Pig-iron No. 3 ..	0.18	0.014	0.032	0.35
C.I. scrap No. 1 ..	1.70	0.06	0.25	0.80
C.I. scrap No. 2 ..	2.50	0.09	0.35	0.75
C.I. scrap No. 3 ..	2.00	0.07	0.30	0.70
Ferro-silicon ..	14.4	—	—	—



FIGS. 2-5.—ADDITIONS OF FERRO-SILICON. 60 OZS. PER TON. TOP LEFT: 0% STEEL; NO ADDITION. TOP RIGHT: 70% STEEL; NO ADDITION. BOTTOM LEFT: 0% STEEL; WITH ADDITION. BOTTOM RIGHT: 70% STEEL; WITH ADDITION.

Five cwt. metal charges are used, and 12½ to 15 per cent. coke, according to the percentage of steel, 3 to 4 per cent. of limestone being charged on the coke, but confined to the centre zones to minimise scouring of the lining. The cupola is charged to the level of the charging door, but not above it, and holds eleven charges, this level being maintained until the last charge is put on. The compositions of the raw materials, and of the charges used, are shown in Tables I and II.

Cupola Operation.—Air is supplied at the rate of 1,700-cub. ft. a minute at a pressure of 14 in. W.G., and the metal is tapped to the clock, and not left to the operator's discretion. Tuyeres are kept under constant surveillance to ensure that heavy "slag curtains"

TABLE II.—*Metal Mixtures Used.*
(Percentages of raw materials.)

Metal grade.	%	%	%	%	%	%	%	%
Steel.	0	10	20	30	40	50	60	70
Pig-iron No. 1 ..	30	30	40	30	—	—	—	10
Pig-iron No. 2 ..	—	—	—	10	20	35	20	10
Pig-iron No. 3 ..	35	25	—	—	—	—	—	—
C.I. scrap No. 1 ..	35	35	40	30	—	—	—	—
C.I. scrap No. 2 ..	—	—	—	—	30	15	15	—
C.I. scrap No. 3 ..	—	—	—	—	10	—	—	—
Ferro-silicon ..	—	—	—	—	—	—	5	10

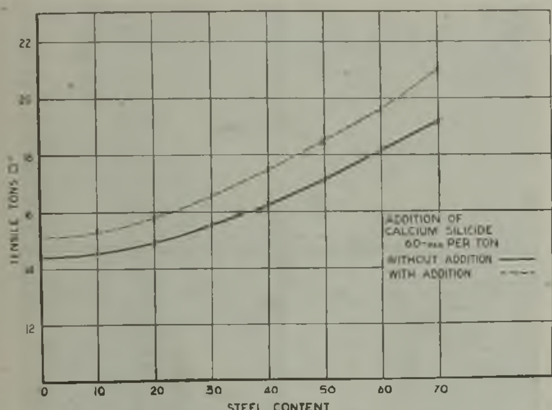


FIG. 6.—INFLUENCE OF CALCIUM SILICIDE ON STEEL MIX IRONS.

are not allowed to form and interfere with blast distribution, and only in exceptional circumstances (such as unexpected breakdowns) is the blast supply interfered with. When the last charges are melting the volume of blast is reduced to prevent erosion of the lining. A control board, showing the sequence and time of each tap, is made up before tapping commences, in order to prevent any misunderstanding in the foundry, which might cause a hold-up in melting.

Pointers in Good Cupola Practice.

(1). Make sure that the bed is firm and evenly burned.

(2). Establish a bed height that gives hot metal at the first tap.

(3). When melting starts the first drops of iron should be seen to pass the tuyeres not sooner than two minutes nor longer than five minutes. Should the metal appear too soon it indicates a low bed, and should it appear late the bed is either too high or has not been sufficiently burnt before charging.

(4). Keeping the cupola fully charged gives consistency of blast distribution, and uniform preheating.

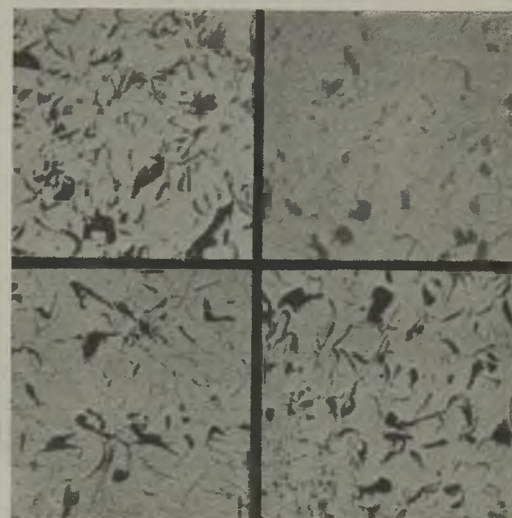
(5). Keep the tuyeres as clean and free from slag as possible.

(6). Use well-graded coke for the bed, free from "fines."

(7). Inferior coke may show a paper saving in cost, but the inferior metal which often results is a luxury which few foundries can afford.

(8). Charging should be under close supervision, and proper distribution insisted upon.

(9). Observations should be made of the flame above the burden at the charging door. A roaring flame, with pale blue cones burning through the top of the charge means excessive air. The ideal flame is blue-pink, burning spasmodically some inches above the charge, clinging to the brickwork, and only occasionally running down to the charge for a short period.



FIGS. 7-10.—ADDITIONS OF CALCIUM SILICIDE. 60 OZS. PER TON. FIG. 7, TOP LEFT: 0% STEEL; NO ADDITION. FIG. 8, TOP RIGHT: 70% STEEL; NO ADDITION. FIG. 9, BOTTOM LEFT: 0% STEEL; WITH ADDITION. FIG. 10, BOTTOM RIGHT: 70% STEEL; WITH ADDITION.

Cupola Design

The cupola used for the tests in this Paper had a stack height which held eleven 5-cwt. charges, and as the melting rate was 3-tons an hour, this meant almost an hour's metal, thus ensuring a satisfactory pre-heat, but the Authors wish to emphasise that any normal cupola will melt steel mixes. A cupola which will not melt steel will not melt any mixture satisfactorily, even if it be composed entirely of pig irons. A satisfactory iron at the spout is one which is clean and hot, and no

Steel Mixes and Inoculants

metal properly melted should tap at less than 1,400 deg. C.

The Author's believe that there are optimum ratios of tuyere area to cupola cross-section, stack height to cross-section, windbelt to tuyere area, and blast main to windbelt, and the employment of these ratios wherever possible reduces any variable factors to a minimum, but variations in these ratios bear no comparison with the bad influence of slipshod cupola practice. With sound control and supervision, good metal can be obtained, and neither the addition of inoculants, small amounts of alloy, or a high percentage of refined irons will produce a good iron under bad practice. The use of refined irons is a most expensive method of attempting to neutralise a deficiency of melting control, particularly when it is realised that such irons are simply steel mixes melted down in some other cupola,

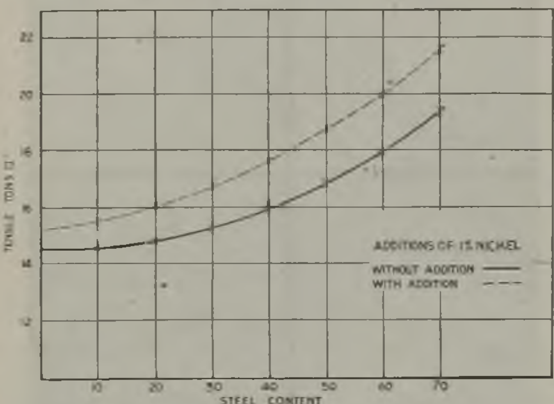


Fig. 11.—Influence of 1% Nickel on Tensile Strength.

quite probably no different in design from the one into which the refined iron is finally charged.

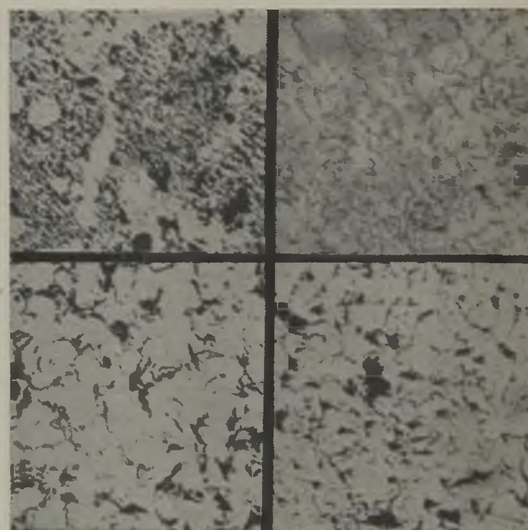
The statement that any normal cupola will melt steel has been substantiated in practice by the Authors. In the foundry where this research was carried out there was a second cupola with the following dimensions:—

Shell diameter..	42 in.
Internal diameter	30 in.
Bed plate to bottom tuyeres ..	28 in.
Bed plate to top tuyeres	45 in.
Windbelt	26 in. × 8 in.
Blast main	8 in. dia.
Tuyeres (1st row), 4 at	8 in. × 3 in.
Tuyeres (2nd row), 4 at	8 in. × 3 in.
Total tuyere area	192 sq. in.

It will be seen that the internal diameter was the same as the first cupola, with the same melting rate of 3 tons an hour. The stack in this cupola held only four 5-cwt. charges, 20-min. metal supply, which was considerably less than the pre-heat available on the other cupola. The recommended ratio of tuyere area to a 30-in. dia. cupola cross-section is in the vicinity of 1:5. This particular cupola had a ratio of 1:3.7, while the first cupola had a ratio of 1:10.

The contrast between the two furnaces was most marked, yet no difficulty was encountered in melting mixtures containing up to 85 per cent. of steel in this second unit, and melting rate and tapping temperature were both satisfactory. Actually, this furnace was used for a period of many months on the daily melting of 60 per cent. steel mixtures.

About five years ago, one of the Authors melted 75 per cent. steel satisfactorily in a standard dwarf cupola with a melting rate of 1 ton an hour. This cupola



Figs. 12-15.—Fig. 12, Additions of 1% Nickel. Top Left: 0% Steel; no addition. Fig. 13, Top Right: 70% Steel; no addition. Fig. 14, Bottom Left: 0% Steel; with addition. Fig. 15, Bottom Right: 70% Steel; with addition.

had no windbelt, and only two tuyeres running direct from the blast pipe. Again, in this instance the metal was clean with a high tapping temperature. These instances may appear to indicate an opposite view to the opinions expressed at the beginning of this chapter, but that is not so. Cupola design is important, and a correctly designed unit will give the greatest fuel efficiency, even melting, minimum of charge dilution, and the least oxidation, but these are factors which affect the melting of any cast iron.

Control of Test-bars

To obtain as consistent a melting condition as possible the metal charges to be used for test were placed on the cupola in the same sequence during each melt.

The third to the twelfth charges or, in other words, ten consecutive 5-cwt. charges were made up with the percentage of steel to be examined, and the metal tap corresponding to the two centre charges, the seventh and eighth, was used for casting the test-bars. The four clear charges on either side of these two gave a reasonable assurance that the metal in the ladle gave true reflection of the constituent steel in the charge.

A hand ladle to hold 10 lbs. of iron was placed under the spout 10 secs. after the tap hole was opened, and immediately after this sample was obtained the inoculant was fed on to the metal stream on its way to the main ladle. To effect this the measured amount of inoculant was placed in a hopper fixed over the tapping spout, and immediately after the taking of the untreated sample the hopper slide was opened and the speed of addition regulated to distribute the inoculant throughout the tap.

When the 10-cwt. ladle was full, a hand ladle was used again to cast the test-bars, and the main ladle

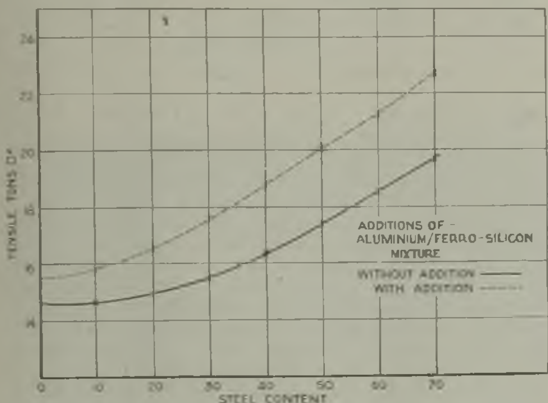


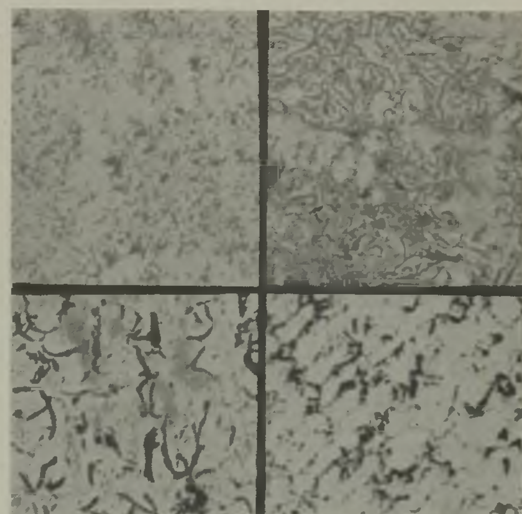
FIG. 16.—INFLUENCE OF ALUMINIUM/FERRO-SILICON ON TENSILE STRENGTH.

used for ordinary production. As it was essential that results should be truly comparative, a standard wedge test-bar was used as a metal control, and the chill depths were fixed at values of 6 and 4 for the untreated and treated iron respectively. These standards were observed for all the series of tests on increasing percentages of steel with a consistent addition of the various inoculants, and any metal with other than these chill values was discarded for the 10, 20, 30, 40, 50 and 60 per cent. steel mixes. The 0 per cent. steel irons had wedge values of 4 and 3, and the 70 per cent. steel mixes had values of 7 and 5. In the series of tests on standard percentages of steel with increasing amounts of inoculants, the chill depths naturally decreased as the inoculant increased.

Increasing Steel

The first series of tests were to show the effect on tensile strength of increasing the steel content of the charge from 0 to 70 per cent. by 10 per cent. stages, and to show the effect of a fixed amount of inoculant on the metal with each increase of steel.

Ferro-Silicon.—As the inoculant, 80 per cent. ferro-silicon powder was used for the tests shown in Fig. 1. It will be observed that there is a steady increase in strength from 14.5 tons with 0 per cent. steel to 18.6 tons with 70 per cent. steel, and the intermediate figures were in true relationship with the curve shown. With a fixed 60 ozs. of inoculant per ton of metal, there is an increase in strength of 0.3 ton to 0.8 ton as the steel content rises. In the photomicrographs, from which intermediate steel percentages are omitted, Figs. 2 and 3 indicate that in the two untreated irons



FIGS. 17-20.—ADDITIONS OF ALUMINIUM/FERRO-SILICON MIXTURE. 60 OZS. PER TON. FIG. 17, TOP LEFT: 0% STEEL; NO ADDITION. FIG. 18, TOP RIGHT: 70% STEEL; NO ADDITION. FIG. 19, BOTTOM LEFT: 0% STEEL; WITH ADDITION. FIG. 20, BOTTOM RIGHT: 70% STEEL; WITH ADDITION.

the intergraphitic areas increase and the graphite becomes more isolated, although the quantity of graphite does not appreciably diminish, which is confirmed in Table III.

Taking the formula $T.C + \frac{Si + P}{3}$ = carbon equivalent, it will be seen that, apart from the 0 per cent. steel mix, there is little variation in actual carbon values. The increase in silicon content is shown in the right-hand column.

Figs. 4 and 5, showing the same two irons after the ferro-silicon addition indicate a slight refining of the graphite.

Calcium Silicide.—The series of casts from 0 per cent. steel to 70 per cent. steel show an increase in

Steel Mixes and Inoculants

tensile strength from 14.3 tons to 18.5 tons per sq. in., and again the intermediate figures bear a true relationship, as illustrated in Fig. 6. With a fixed addition of 60 ozs. of silicide per ton of metal, the strength increases by 0.8 ton to 1.8 tons with increasing steel. The photomicrographs, Figs. 7 and 8, representing the untreated irons, are similar to the group, Figs. 2 and 3, and Figs. 9 and 10 indicate a marked refinement of the graphite.

TABLE III.—*Percentage Compositional Changes with Increasing Steel Additions.*

Steel content.	T.C.	Si.	P.	Si. (After addition).
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
0	3.60	1.40	0.45	1.58
20	3.38	1.50	0.35	1.56
40	3.30	1.57	0.30	1.72
70	3.20	1.83	0.25	1.87

Nickel.—An addition of 1.0 per cent. nickel by means of nickel "F" shot was adopted for this series, and the tensile values without the alloy addition can be seen in Fig. 11 to rise from 14.6 to 19.4 tons per sq. in., with a standard addition of 1.0 per cent. nickel there is an increase of 0.7 ton with 0 per cent. steel, going to 2.1 tons with 70 per cent. steel. Figs. 12 to 15, representing the graphite before and after alloy additions, once again show that the addition of the alloy at the spout produces a refining of the graphite.

Aluminium/Ferro-Silicon.—This inoculant is one which has been developed by the authors, and consists of seven parts of 80 per cent. ferro-silicon and three parts of aluminium swarf, mixed and ground to pass a B.S.S. 16-mesh sieve. The aluminium and silicon are not alloyed. Fig. 16 again confirms the steady increase in tensile strength with increasing steel shown in the previous graphs. With a fixed addition of 60 ozs. of the specified mixture per ton of metal, there is an increase of 1.0 ton on the 0 per cent. steel iron to 3.0 tons on the 70 per cent. steel iron. Again, there is a definite refinement of the graphite, as evidenced in Figs. 17 to 20.

Matrix Structures.—For the purpose of comparing the matrix of the treated and untreated irons, the inoculant aluminium silicon was chosen, and comparative photomicrographs in each 10 per cent. of steel from 0 to 70 per cent. were taken, as shown in Figs. 21 and 22. Taking the photomicrographs under the heading, "0 per cent. steel," there is no obvious difference in the structure, and this applies equally to each group. When, however, the photomicrographs representing the increasing steel contents without additions are examined, it becomes apparent that the changes in the pearlite formation are the true basis of the improved physical properties, and that the use of inoculants is simply a final refinement in the conditioning of the molten iron. This is dealt with in the next section.

The gradual transformation of the pearlite is clearly illustrated in the photomicrographs, which need little comment. The pearlite in the 0 per cent. steel iron is coarser and more lamellar than in the other groups, the 30 per cent. steel mix shows finer lamination of the pearlite, not so continuous as the 0 per cent. steel iron, and the 60 per cent. steel shows the continuity of the laminæ broken up, and in some cases a semi-sorbitic structure can be seen, this increasing molecular cohesion, improving resistance to rupture.

Cost of Ladle Addition per ton of Metal

	s.	d.
60 ozs. of 80 per cent. ferro-silicon ...	1	10½
60 ozs. of calcium silicide	3	9
1 per cent. of nickel	33	0
60 ozs. of aluminium-silicon	1	9

(*To be continued.*)

INDUSTRIAL USES OF LITHIUM AND ITS COMPOUNDS

According to the "South African Mining and Engineering Journal" lepidolite and sometimes other lithium minerals are required in considerable quantities for glass manufacture, glazing and enamelling. Their chief field is in the manufacture of opal and white glasses, where the principal advantages resulting from their use are lowering of the coefficient of expansion, thereby decreasing breakages due to sudden heating and cooling; increase of toughness and hence resistance to shock; increase of refraction and hence brilliancy; and production of a harder surface on the glass. Other advantages are lessened corrosion of tanks, less scumming of the melt and devitrification of the resultant glass. Increasing quantities of lepidolite are also being used in the production of bulbs for the electrical industry.

Another important development is the replacement of felspar by lepidolite in the manufacture of high-grade special porcelains of extreme whiteness and notable resistance to thermal shocks. A mixture of 25 per cent. spodumene and 75 per cent. felspar has proved such a useful vitrifying agent in ceramic work that it is now being commercially produced. In the manufacture of enamels spodumene, a powerful fluxing agent, lowers the maturing temperature and so reduces wear and tear on refractories. Small quantities of lithium chloride and lithium fluoride used in welding rod coatings are said to give an exceptionally fine finish to the weld.

Increasing applications are also being found for lithium alloys. For instance, the use of lithium as a 50-50 Ca-Li alloy for the deoxidation of high conductivity copper castings more than doubled in 1941, as compared with 1940, and its use is extending to a number of other non-ferrous alloys.

AN OUTLINE OF GRAVITY DIE-CASTING*

A general survey of development in its application

By M. R. HINCHCLIFFE

(*Continued from page* 273.)

Bottom Running

The ideal way to achieve metal flow free from turbulence is to direct the metal to the bottom of the die through a properly designed runner, it being as essential to avoid turbulence in the running system as in the die cavity proper, and gate into the lowest point in the mould. Filling is thus effected by displacement, the metal rising in a tranquil manner. With this gating principle it is preferable to employ a large number of small ingates to a small number of large ingates, as the latter is conducive to spurting or "fountaining." Fig. 8 shows examples of bottom gated aluminium alloy castings. In certain cases, particularly when it is desired that a runner should also act as a source of "feed," it is practicable to use a continuous ring runner round the periphery of the casting.

FIG. 8.—TYPICAL BOTTOM GATED ALUMINIUM ALLOY GRAVITY DIE-CASTINGS.

Vertical Strip Runner

A type of running arrangement which combined the advantage of a bottom runner and top pouring is the vertical strip or flash gate, which extends from the bottom to the top of a casting. By this means, progressive filling and therefore, progressive solidification from the bottom to the top of the casting is promoted. Castings lending themselves to this method of running are those of a long thin cylindrical nature and thin plate-like castings made in the vertical position wherein the metal would be subject to premature freezing if bottom poured. A number of castings with runners and risers attached designed according to the strip gate principle are shown in Fig. 9.

Swan Neck Choke

Irrespective of the type of running system used, the die designer is always keen to adopt methods which make the production of satisfactory castings less dependent on the human element. On the question of running systems scope is to be found in the desire to control the rate of pour. One way of achieving this is to use a swan neck runner, *i.e.*, a runner formed with an "S" bend in it, part of which constitutes a choke by a reduction in the cross-section, thus regulating the rate of entry of the metal.

Venting

Prior to metal entering a die, the mould cavity is occupied by air which has to be displaced by the ingoing metal. Unlike a sand mould, a die is completely impermeable, resulting in the tendency for air to be confined and pocketed between the advancing metal surface and any irregularities and corners in the die cavity, thus tending to produce castings having bad

FIG. 9.—TYPICAL STRIP GATED ALUMINIUM ALLOY GRAVITY DIE-CASTINGS.

definition of line. To avoid this, artificial means have to be provided for the air to escape through the die walls to the atmosphere. Venting is usually effected by forming a joint in the die in the necessary region and cutting fine vent grooves, about 0.020 in. to 0.030 in. deep, along the joint faces from the die face to the atmosphere, the grooves being sufficiently deep to allow free exit for the air, at the same time prohibiting entry of the molten metal.

The usual method of venting a boss, for instance, is to continue the boss through to the back of the die and insert a plug in the bored hole, cutting a number of fine grooves or flats round the periphery of the plug, as shown in Fig. 10 (1). A further application of this principle is sited in Fig. 10 (2), where it is desired to prevent a misrun in a thin section due to trapped air. Again, a deep recess in a die forming a web of a casting may be very effectively vented by

Gravity Die-Casting

splitting the die along the centre line of the web and cutting grooves in the joint faces, illustrated in Fig. 10 (3).

Cases frequently arise when venting by the above methods is inadequate to deal with the volume of air trapped. This condition can be obviated by placing a small riser, which may be either open or blind, over the effected region of the casting, as shown in Fig. 10 (4). A die adequately and properly vented is very essential for the production of sound castings, as it eliminates the very bad practice of forcing the metal into the die to ensure good definition of the casting.

Feeding Heads—Solidification Stage

During the passage of the metal through a die it is continually losing heat to the mould walls, and shortly after the movement of the metal relative to the die has ceased, or in certain cases before, the temperature

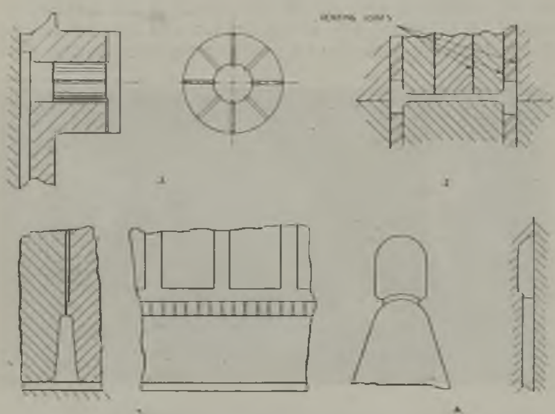


Fig. 10.—Venting Arrangements for Gravity Dies (Diagrammatic).

of the metal in certain parts of the die has been lowered to that at which solidification takes place; followed by solidification of the remainder of the metal. The mode of solidification of the casting is determined by the thermal conditions existing on completion of filling, that is to say, by the division of temperature and heat throughout the mass.

Solidification in metals and alloys is a process of crystallisation, and is almost invariably accompanied by a reduction in volume of the alloy, and unless this shrinkage is replaced by additional liquid metal, empty voids will appear in the final casting. Obviously those parts of the casting solidifying first will obtain " feed " metal at the expense of the sections still liquid, which results in the concentration of shrinkage in those parts of the casting last to solidify. Therefore, to ensure castings free from shrinkage, feeding heads must be applied, designed and situated to remain liquid until the casting proper has solidified, their purpose being to act as a reservoir of liquid metal to replace volume contraction within the casting.

A casting may be made to solidify according to two

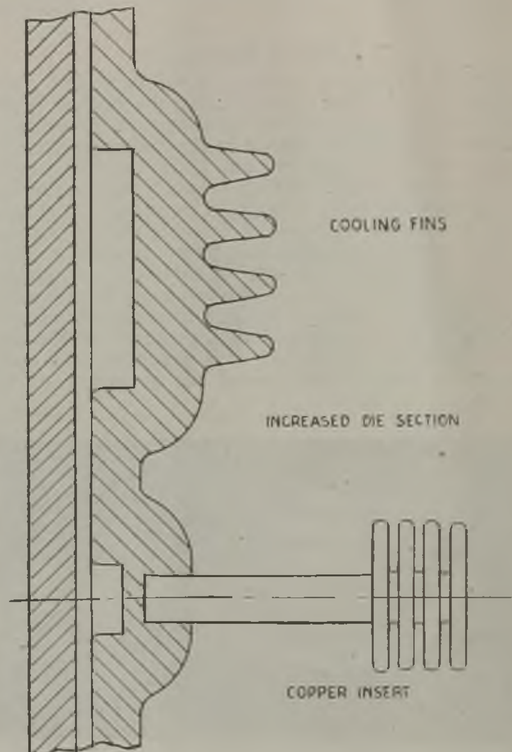


Fig. 11.—Means by which Gravity Die-castings may be Chilled (Diagrammatic).

principles:—(1) Equalisation of the rate of cooling throughout the entire casting, and (2) solidification in parallel layers either horizontally or vertically—the theory of controlled directional solidification. Satisfaction of either of these resulting in the absence of shrinkage cavities.

Equalised Rate of Cooling

Balancing the rate of cooling between thick and thin sections is accomplished in the die by the conventional manner of chilling the heavy section. It may sound paradoxical to say that certain sections of a die-casting can be chilled when it has already been stated that a die is virtually one complete chill. It must be remembered, however, that chilling is a relative term, and merely denotes a relative increase in the rate of cooling.

A localised increase in the rate of cooling of a die-casting may be simply achieved up to a certain extent by removing the thin layer of refractory coating from the die surface. When this is done the rate of extraction of heat from the casting in that particular region is the function of the sectional thickness of the die and the area of the radiating surface of the die wall exposed to the atmosphere. Should a more severe chill be required, it may be obtained by increasing the die section or increasing the radiating surface by the introduction of cooling fins, or both. An even greater rate of cooling may be attained by inserting a pure copper plug into the die wall, finned on the

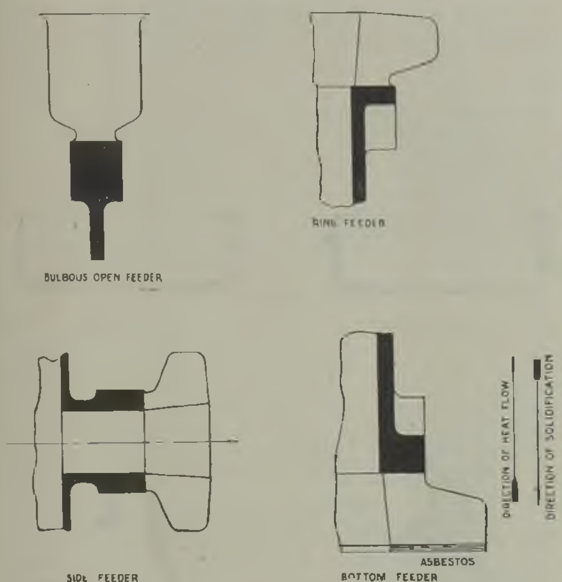


FIG. 12.—DIFFERENT TYPES OF FEEDING HEADS USED ON ALUMINIUM ALLOY GRAVITY DIE-CASTINGS (DIAGRAMMATIC).

outside. Examples of each case are illustrated diagrammatically in Fig. 11.

Progressive Solidification

In general, it is easier to effect progressive solidification than it is to equalise the rate of cooling throughout, merely because, unless the rate of cooling in a section of a casting is very low, there will always exist during cooling a temperature gradient from the mould face to centre of the section, this being the first essential for progressive solidification. As a result of this most dies are designed to give thermal conditions which promote progressive solidification from the bottom to the top of the casting.

Consider again the classical example of a round stick or billet die. It was stated under the principles of running that it was imperative that this be top poured. If a bottom runner were used the tendency would be for the coldest metal to be at the top and the hottest metal at the bottom, which would result in castings having internal shrinkage cavities along the centre line. On the other hand, top pouring would result in ideal thermal conditions as a distinct temperature gradient would exist from the bottom to the top, depending on the height of the mould and the rate of pouring. Theoretically, the ideal rate of pour would be that which gave a rate of filling corresponding to the rate of directional solidification. Under these conditions shrinkage would be directed into the feeding head. A feeling head, therefore, besides acting as a supply of liquid metal may also direct solidification. The correct shape for a feeding head is shown in Fig. 12. It will be observed that it is bulbous in form, with the mass as near the casting as possible.

Progressive solidification may be promoted to a certain extent in bottom poured castings by connect-

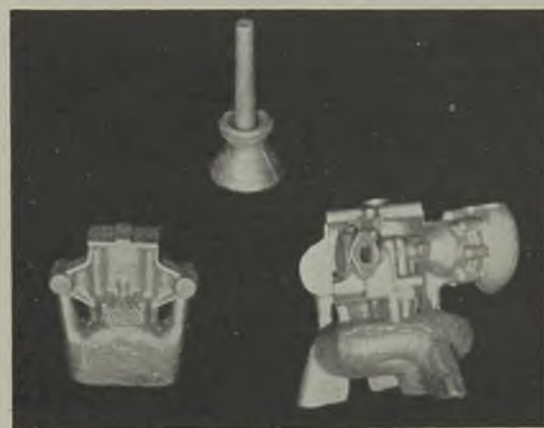


FIG. 13.—TYPICAL ALUMINIUM ALLOY GRAVITY DIE-CASTINGS GATED TO PROMOTE PROGRESSIVE SOLIDIFICATION.

ing the down runner to the casting in a number of places, and also to the feeding head so that comparatively hot metal is supplied to the metal in the metal as it rises. A type of feeder used on the side of a casting is shown in Fig. 12.

The nature of a casting may be such that heavy sections requiring feed exist in the bottom of the mould. As it would be impossible to feed the heavy section through the thin section above it, it is the practice to place a reservoir of metal below the thick section insulated with asbestos on the bottom surface. As crystallisation always proceeds in a direction opposite to the heat flow, the casting is thus made to solidify vertically downwards, illustrated diagrammatically in Fig. 12. When designing for alloys such as DTD. 133 B and similar alloys, it is the practice completely to surround the top of the casting with a

Gravity Die-Casting

splitting the die along the centre line of the web and cutting grooves in the joint faces, illustrated in Fig. 10 (3).

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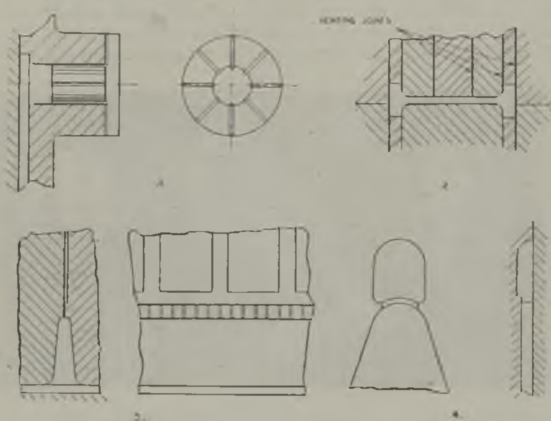

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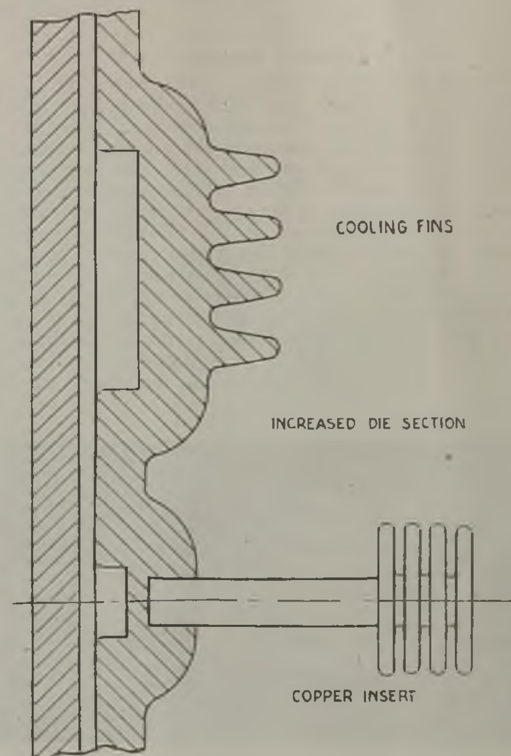

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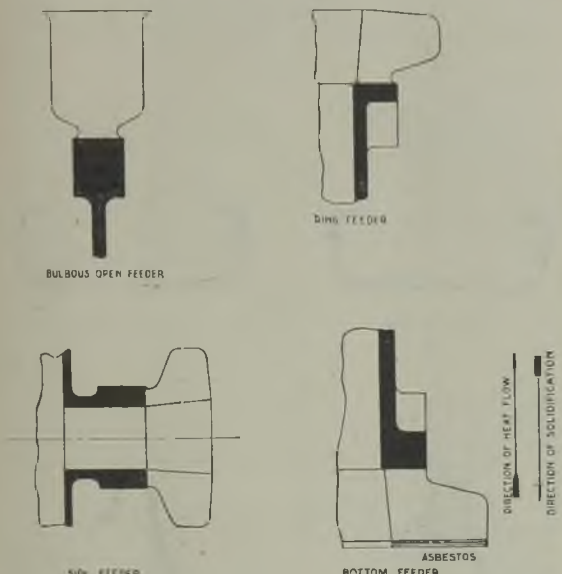

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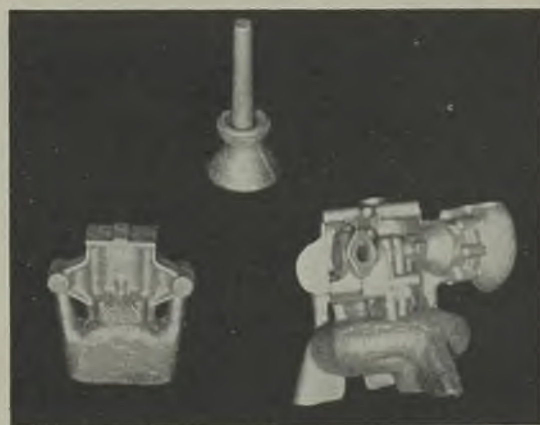

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Gravity Die-Casting

ring riser of the type shown in Fig. 12. A number of castings, complete with runners and risers designed to promote progressive solidification, are illustrated in Fig. 13.

(3) Die Construction

The first essential in designing a die is that the die must draw away readily from the solidified casting or alternatively the casting must withdraw from the die cavity freely. Thus, a die is constructed in a number of separate mould sections, the size and form of each depending on the design of the casting and the gating and feeding system employed. Generally speaking, the outside of the casting is formed in die blocks, arranged to slide backwards and forwards in a horizontal plane on a suitable base. The die blocks, when moved into position, are located relative to each other by means of dowels and then clamped together before casting. The inside of a casting is formed by means of cores locating in the die blocks which are withdrawn from the casting by means of pinch bars applied beneath wrench heads on the cores prior to opening the die.

This method of removal can only be employed when the cores are in a position accessible to the operator. The design of a casting may necessitate cores withdrawing in a vertically downwards direction, through the die base, in which case a core withdrawing mechanism, such as rack and pinion, eccentric and rollers or a suitable air cylinder is used. Owing to the fact that a casting contracts towards the centre during cooling it is necessary to have a small amount of taper or "draw" on all cores to enable them to be withdrawn easily after overcoming the initial grip of the casting. A draw of half a degree per side is the minimum advisable.

The position of the joint lines of the die relative to the casting, although dependent on the method of moulding decided, is always preferable when coinciding with faces or machined parts of the casting as this renders the removal of unsightly flash lines, reproduced from the die joints, less difficult. Generally speaking, it is arranged for the casting to remain in a certain part of the die when opened, by incorporating the most intricate or deepest part of the impression in this section, thus causing the casting to bind on to the die.

To avoid fracture of the casting during extraction from the particular die member it is advisable to use an ejector mechanism rather than manual effort. This is usually constructed in the form of a number of pins passing through the walls of the die from an ejector thrust plate to which they are connected and actuated by a suitable lever mechanism. Forward movement of the ejector plate results in the pins pushing on the appropriate face of the casting, thus forcing the casting, with uniform pressure all over, away from the die cavity.

A simple one piece core is only applicable when the walls of the casting are parallel to the direction in which the core is pulled out, the same condition applying to the external die blocks. In cases where the casting is undercut relative to the line of draw, a more advanced stage of die design is reached by the introduction of collapsible cores and loose pieces.

Collapsible Cores

A collapsible core is a core made in a number of sections fitting together in such a manner that removal of a key piece enables the remaining sections to collapse inwardly, individually, into the space previously occupied by the key piece and thus extracted from the casting.

Loose Pieces

A loose piece is that section of a die or core which remains in position on the casting after the main die members have been withdrawn, to be picked-off the casting afterwards by hand. Both these methods are illustrated diagrammatically in Fig. 14.

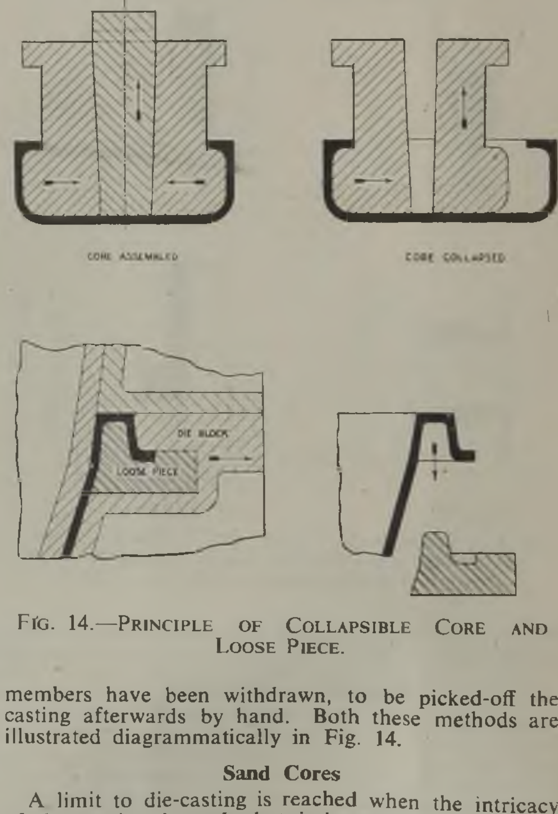

FIG. 14.—PRINCIPLE OF COLLAPSIBLE CORE AND LOOSE PIECE.

Sand Cores

A limit to die-casting is reached when the intricacy of the casting is such that it becomes impossible to design a die capable of being dismantled from around the solidified casting even with the use of collapsible cores and loose pieces. The use of sand cores, however, which are employed only once, being knocked out of the casting after removal from the die, enables castings to be made which would otherwise present insurmountable difficulties for the above reasons.

In designing a semi-die, *i.e.*, a·die containing sand cores, the same conditions apply as in sand casting in that provision has to be made for: (*a*) adequate location and support for the core when placed in the mould; and (*b*) means for venting the core to remove the core gases generated at the moment of casting.

Die Wall Thickness

The thickness of the mould wall in contact with the casting is important as it is a factor determining the thermal conditions in the mould. There is no general formula for calculating this dimension as the most suitable one varies with different alloys. An average figure would be from ½ to 1 in. In arriving at a satisfactory dimension experience plays a large part, and the structural requirements of the die must not be ignored, otherwise distortion during operation at higb temperatures will result. Should a very thin die section be necessary in order to maintain a high working temperature the rigidity of the die may be increased by webbing, but this would contradict the original intention by exposing a much greater radiating surface to the atmosphere. This problem is best overcome by keeping the die section sufficiently heavy to provide adequate strength and insulating the back of the die with asbestos lagging.

Die Foundry Plant

A conventional commercial die casting foundry for general work using a variety of casting alloys has for its major items of plant, melting furnaces and die heating equipment. Other minor plant items such as tilting tables, on which small dies are operated, and core quenching tanks, etc., are also included. A supply of high pressure air for operating pneumatic apparatus and blowing out dies is, of course, an essential.

Melting Furnaces

In a die-casting foundry owing to the high speed of production it is necessary to have a continuous supply of molten metal at the correct temperature. This is attained by using the bale-out type crucible furnace having a capacity of 200 to 300 lbs. molten aluminium and designed to stand approximately 2 ft. 6 in. above floor level so as to be easily accessible to the casters. The purpose of this furnace is to receive and maintain at a fixed temperature metal previously melted in a primary melting unit, which may be either a crucible tilting furnace or a reverberatory furnace, one of, say, half a ton capacity. A plentiful supply of metal is thus provided with a low fuel consumption.

In some foundries the bale out type furnace is also used for melting in which case the furnaces are arranged in tandem, one melting whilst the other is maintaining and being drawn from. The furnaces are spaced uniformly about the shop floor, the dies being situated in a convenient position close to the furnaces to enable the casters to draw the requisite amount of metal for their particular die by means of pressed steel hand ladles. Through the stimulus of war circumstances many foundries doing specialised work have been built. The result has been a profound modernisation of die foundry plant and layout. Conveyor systems have been layed down to remove castings from the casting shop and transport them through all the various fettling, finishing and inspection stages, and advanced metal melting and treatment equipment has been introduced. Detailed treatment of recent developments along these lines is, however, outwith the scope of this Paper.

Conclusion

This Paper was written with a view to presenting a general elementary picture of gravity die-casting, its scope, principles and practices, to foundrymen with only a bare knowledge of the subject. For reasons of simplicity and national security the highest achievements in die-casting have not been included, but it is hoped that the material dealt with will serve as an introduction to more detailed and specialised works. Although much more progress had been made in the size and complexity of castings which can be die cast, there is still room for development. This may take the form of work on die design on the lines of semi or complete automatic operation of dies. A good deal depends on what the demands for castings are like.

Here, users can assist by endeavouring to design castings with a view to die-casting by avoiding undercuts and making other slight modification which probably would not effect the technical qualities of the castings but would greatly reduce the cost of a die and increase the rate of production, again, by standardisation of different castings meant for the same purpose advantage could be taken of die-casting.

The Author is indebted to Mr. J. Vickers, foundry manager, Rolls-Royce, Limited, for the illustrations and permission to use material relating to the company's practices; also to Mr. J. J. Mills for the illustrations of the Leyland castings and gearbox die.

NEW CATALOGUES

Shop Microscope.—Machine Shop Equipment, Limited, Allington House, 136-142, Victoria Street, London, S.W.1, has sent us a four-page well-illustrated leaflet which describes a shop microscope. This magnifies 40 diameters and can be used either with a battery or be plugged into the general lighting system.

Fans.—The fans described and illustrated in a new brochure (VI) just issued by Keith Blackman, Limited, of Mill Mead Road, Ferry Lane, Tottenham, London, N.17, are of especial interest to the foundry industry, as they are specially designed for ventilation, drying, fume and steam removal and other purposes. In designating this line of manufacture "streamline," the issuing house is not, for once in a way, resorting to hackneyed phraseology. The pamphlet in its 48 pages gives the fullest possible technical data and still recommends personal contact with its representatives to ensure that the problem is correctly tackled initially—surely a wise course to pursue.

SAFETY FIRST IN CUPOLA PRACTICE*

By A. P. SCATTERGOOD

For many years, and through numerous industrial changes, the cupola furnace has been regarded as the heart of the foundry. Yet, despite the fact that it controls the rhythm, or pulse, of the foundry, the cupola is often taken too much for granted, with the result that, even in some of the most up-to-date plants, it is not an uncommon occurrence to find iron escaping through some undesirable part of the cupola, and the day's work left uncast. Surely this state of affairs would not exist if the interior of the furnace were prepared in an efficient manner. So with the view that prevention is better than cure, it is the object of this Paper to consider preventive measures in cupola practice, which may be adopted, to eradicate these troubles.

The brickwork round the melting zone is not only exposed to the heat of the molten metal, but more especially to the hot gases of combustion. If the blast has not sufficient penetrative power, it will take the line of least resistance and rise up the sides of the furnace, thus burning away the lining. Tuyere design greatly influences this occurrence, for if their aggregate area is too large to give the blast that necessary initial pressure, then there will be an accompanying lack of penetration, with a corresponding increase in boshing out of the melting zone. The bricks must be stripped clean of slag, for, although the external surface may appear sound, it is often found to be honeycombed with holes underneath, thus presenting a potential weakness to the lining. Ganister should be used as dry as possible, and pin vented to facilitate evaporation. Broken firebricks rammed into the ganister round the melting zone will impart rigidity and increase the refractoriness of the lining.

Making the Bed

If the bottom doors are jammed or forced into position, they may expand and disturb the sand bed. So they must rest upon the prop (which incidentally is to be preferred to a cross band). The prop should be supported on a firm cast-iron base, for it is imperative that the bed should not be upset once it has been laid. It is advisable to drill the bottom doors to allow of free escape of moisture in the bed. All sand used in making the bed should be sieved, and it is a safe rule to make the mixture stronger than is actually required, then, by judicious experiment, the sand can be weakened until a suitable mixing has been found. Floor sweepings are excellent for this purpose. The rammed density of the bed is of primary importance. It should not be too hard, but evenly rammed over the whole area, with particular reference to the outer edge of the bed.

An important point in packing the breast hole is to see that the coke is pushed well inside the cupola. In this way the full thickness of the brickwork can be utilised, leaving an ample depth for packing. As an additional precaution, ganister is usually pressed well into the coke spaces and up against the sides of the bricks. If the ganister is scored with a trowel or wire, the sand will adhere more firmly and form a more homogeneous joint. It is good practice to allow the sand to project approximately half an inch proud of the casing, then additional pressure can be placed upon the sand when the breast band is tightened. On no account must the breast plate touch the casing, otherwise the pressure will not be distributed evenly and wholly upon the sand.

Hints on Tap-hole Practice

The weakest and most vulnerable part of the furnace is the tapping hole and the run immediately behind. All this region must be totally cleared of slag and iron; if any of the bricks are badly burnt, they should be replaced. It is best to use as little wet ganister as possible, and for this reason previously prepared bricks are to be preferred. There should be a clear space between the brick and the lining to allow of adequate packing. This work should be done as early as possible and a coal fire lit in the run in order that it may be thoroughly dry before tapping.

It is erroneous philosophy to ganister round the outside of the casing or breast plate in the hope of stemming metal which may cut through the brickwork, for, should this occur, the iron will merely run along behind the ganister until it does find an outlet. Furthermore, the melter has no warning of imminent danger, thus making it a very dangerous practice. It is advisable to drain the well of metal periodically during the blow, so that the slag will tend to seal up any cracks that have developed in the bed. Similarly, if the iron does cut its way through the bed, switch off the blower and drain the well, thus allowing slag to enter the crevice and seal the joint.

Although the lead safety discs in the windbelt are so important, they are often sadly neglected, and in many cases would never serve the purpose intended should the occasion arise. The tuyere nearest the melter may be constructed a little lower than the remaining tuyeres, thus giving ample warning of the proximity of the metal to the wind belt. There should be no lack of equipment near the cupola for dealing with any eventuality, in particular, hose pipes for run-outs and oxygen cylinders for hard holes. All furnacemen should be thoroughly drilled to act efficiently in an emergency, and, in conclusion, it may be added that the controlling virtues in cupola melting are confidence, cool-headedness and common sense. With these three assets the furnace is in safe hands and no trouble should be experienced.

* An entry for a Short Paper Competition organised by the East Midlands Branch of the Institute of British Foundrymen.

The March production of malleable-iron castings in America increased from 741,371 short tons in February to 80,886 tons, and compares with 781,143 tons for March, 1943. Order-books are still well filled.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

562,043-4 Whessoe Foundry & Engineering Company, Limited, Francombe, K. W., Puttick, A., and Putnam, W. E. Electrical dust-precipitators, for use with mobile producer-gas plants.

562,046 Mond Nickel Company, Limited. Production of nickel coatings on ferrous articles.

562,080 Mond Nickel Company, Limited. Drawing of metal into wires, bars, tubes and other shapes.

562,118 United Flexible Metallic Tubing Company, Limited, Bingley, H. W., and Jones, L. Manufacture of flexible metal tubes or ducts.

562,153 Canning & Company, Limited, W., and Pope, G. A. Electroplating plant.

562,157 Bethlehem Steel Company. Electro-deposition of zinc.

562,162 Electric Resistance Furnace Company, Limited, Millar, W. J., and Monks, J. A. Muffle furnaces.

562,189 Daniels, C. V., and Evans, H. E. (trading as Premier Steel Bin Company). Racks or stands for bars or like elongated articles.

562,218 British Insulated Cables, Limited, Wilkinson, C., and Northway, H. S. Manufacture of covered wires.

562,225 Express Lift Company, and Wells, L. E. W. Application of vitreous enamels.

562,320 Parkes, Jun., Limited, and Dainty, R. Manufacture of sand cores.

562,347 Shorter Process Company, Limited, and Shorter, A. E. Surface hardening of ferrous metal articles.

562,384 Foundry Equipment, Limited, and Beech, A. S. Rotary furnaces and methods of operating the same.

562,407 Alexander Furnaces, Limited, and Williams, W. Reverberatory melting furnaces.

562,428 Moller, G. A. Production of electrolytic coatings of aluminium and aluminium alloys on metals.

562,442 Hopkinsons, Limited, and Brown, R. L. Foundry moulding-machines.

562,462 Lazenby, T., Neelands, A. R., and Cementation, Company, Limited. Production of cutting tools.

562,469 Six, C. G., and Berk & Company, Limited, S. W. Process for the production of light metal powders.

562,545 Abbey, A. (Sandvikens Jernverks Aktiebolag). Method of and apparatus for forming tapered strips, sheets and rod-like material by rolling.

562,563 Appleby-Frodingham Steel Company, Limited, and Reeve, L. Magnetic means for the detection of the quality of steel.

562,586 Du Pont de Nemours & Company, E. I., Goebel, M. T. J., and Walker, I. F. Prevention of atmospheric corrosion of metal surfaces.

NEW TRADE MARKS

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

"Junction"—Stoves, etc. G. P. Chamberlain & Company, Limited, Carmichael Road, South Norwood, London, S.E.25.

"Tubular Q.B."—Domestic fittings and utensils. Tubular Hollow-ware Company, Limited, Quarry Bank, Brierley Hill, Staffs.

"Monitor"—Machines and parts. Pascall Engineering Company, Limited, 114, Lisson Grove, Marylebone, London, N.W.1.

"Cardox"—Cartridges for blasting purposes, and parts thereof. Cardox (Great Britain), Limited, 20, Copthall Avenue, London, E.C.2.

"Alcho-Re"—Solder and fluxes. Fry's Metal Foundries, Limited, Tandem Works, Christchurch Road, Merton Abbey, London, S.W.19.

"Karrena"—Furnace roofs, and shaped refractory linings for furnaces. A. B. Cleworth & Company, Limited, 381 to 399, London Wall, London, E.C.2.

"Suba"—Drilling and blowing machinery, pressure filter machines, automatic discharge hoppers, pumps, etc. William Freeman & Company, Limited, Wellington Street, Leeds, 1.

"Alpolain"—Refractory apparatus and appliances for metallurgy and metal-working, and for heat-treatment processes. Charles Vaughan Brindley, 5, Dalewood Road, Sheffield, 8.

"Cruickshanks"—Chemicals for use in electroplating, bronzing, and other processes used in metal industries. R. Cruickshank, Limited, 121 to 135, Camden Street, Birmingham, 1.

"Maniflex"—Bi-metallic strips consisting principally of an alloy of manganese, copper, and nickel. Mallory Metallurgical Products, Limited, 78, Hatton Garden, London, E.C.1.

B.C.I.R.A. ELECTS NEW MEMBERS

At a recent meeting of the Council, the following firms were elected as members, the names of the representatives being given in brackets:—Arbroath Foundry Company, Limited, Arbroath (Mr. D. R. Hunter); Richardson & Cruddas, Bombay (Mr. E. W. A. Richardson); Rudge Littley, Limited, West Bromwich (the Secretary); and E. R. & F. Turner, Limited, Ipswich (Mr. A. Leggett). The firm of H. W. Ward & Company, Limited, Birmingham (Mr. G. Thompson) was elected to "trade" membership.

According to the "Wall Street Journal," the Bethlehem Steel Corporation is putting the finishing touches to a refunding programme that will rank as one of the largest industrial company refinancing operations in many years. It contemplates the placing with investors of $60,000,000 in notes. The proceeds will be used with other funds to retire $73,800,000 worth of 3½ per cent. convertible debentures and $42,000,000 worth of serial debentures.

PERSONAL

Mr. W. M. Watson has been elected a director of Herbert Morris, Limited, of Loughborough.

Brigadier G. S. Harvie Watt, M.P., has been appointed a director of the Birmingham Small Arms Company, Limited.

Mr. Percy Holland and Mr. G. H. Sheldon have been appointed directors of Walmsleys (Bury), Limited, engineers and ironfounders.

Mr. D. C. F. Lowson has tendered his resignation as a director of Barton & Sons, Limited, owing to the pressure of public and other work.

Mr. H. A. Skelton has retired after 42 years' service with the British Aluminium Company, Limited, thirty of them as manager at Foyers, Inverness.

Major Simon Green has been appointed managing director of E. Green & Sons, Limited, Wakefield, in succession to Mr. Harold Livesey, who has recently retired.

Capt. G. Stuart Wood has been mentioned in despatches for distinguished services. He is son of Mr. George Wood, managing director of Thos. W. Ward, Limited, Sheffield.

Mr. A. L. Airey has been appointed Manchester and Liverpool area representative of Baldwins, Limited, following the death of Mr. S. E. Booth. Mr. Airey has for many years been a member of the company's sales staff.

Mr. T. N. Jennings, secretary of Radiation, Limited, Mr. F. A. Hooper, director of John Wright & Company, Limited, and Mr. W. D. King, director of Richmonds Gas Stove Company, Limited, have been elected to the board of Radiation, Limited.

Sir Frederick C. Stewart has been appointed deputy-chairman of the North British Locomotive Company, Limited. He is chairman and managing director of Thermotank, Limited; chairman of Kelvin Bottomley & Baird, Limited; and a director of the Clydesdale Bank.

Dr. E. W. Smith has resigned his position as technical director to the Woodall-Duckham Vertical Retort & Oven Construction Company (1920), Limited, and his other directorships in the Woodall-Duckham group of companies, with which he has been associated for over 24 years. It is understood that he proposes to devote himself to public work.

Mr. F. Samuel, branch manager of the Ipswich office of British Insulated Cables, Limited, has been transferred to their London office staff, and is succeeded by Mr. F. Driessen. Mr. J. Anderson, manager of the company's Manchester branch office, has taken up an appointment on their head office staff at Prescot, and is succeeded at Manchester by Mr. E. A. Sayers, formerly sales engineer attached to London office.

Mr. and Mrs. Benjamin Talbot, of Solberge Hall, Northallerton, were the recipients on Friday, July 21, of many congratulations upon the celebration of their diamond wedding. Mr. Talbot is still the active chairman of the South Durham Steel & Iron Company, Limited, and the Cargo Fleet Iron Company, Limited. He is a past-president of the Iron and Steel Institute and a Bessemer medallist.

Dr. Edwin Gregory, who has been assistant director of the metallic materials section of the Aeronautical Inspection Directorate since August last, has been appointed chief metallurgist to Edgar Allen & Company, Limited, Sheffield, in succession to the late Mr. S. J. Hewitt. Before taking up his appointment with the A.I.D., he was for six years chief metallurgist to the Park Gate Iron & Steel Company, Limited, and before that had been lecturer in metallurgy at Sheffield University and a member of the staff of Kayser, Ellison & Company, Limited. He is a Mappin Medallist, and in 1937 he was made the first freeman of Sheffield Tool Trades Technical Society, receiving the Ripper Medal for distinguished services.

NEWS IN BRIEF

A dinner was held at Rotherham on July 28 to celebrate the centenary of the Midland Iron Company, Limited. The chairman, Mr. George Wood, said that 12 employees had been with the firm from 50 to 62 years.

Five firms who will take part in the production of the Portal house were named in the House of Commons on Monday of last week. Briggs Motor Bodies, Limited, and the Pressed Steel Company, Limited, will provide the bulk of the carcasses and partitions. Among the main contractors for the fittings will be Fisher & Ludlow, Limited, Sankey-Sheldon, and Rubery Owen.

A plan for the recruitment and training of juveniles for industry was accepted as a basis for further discussion by the Amalgamated Engineering Union Youth Conference at Southport. It sets out the joint replies and conclusions of the Engineering Employers' Federation and the National Engineering Joint Trades Movement, and has been drawn up in consultation with the Ministry of Labour, the Board of Education, and the Scottish Education Department. It has not been finally approved. It is hoped to incorporate it into a national industrial agreement for apprentices.

Sir Miles Thomas, vice-chairman of the Nuffield Organisation, in an address to Wolverhampton Production Exchange recently, said that after the war we must make every endeavour to get a firm footing in export markets. The day had gone when an industry could be the sport of politicians, and he did not propose to enter into any argument as to the merits of free trade or protection. Yet he could not fail to be conscious of the fact that, while he knew the British motor industry as a fabricating instrument was efficiently organised, he was yet unconvinced that they were in a position to buy steel and other materials as cheaply, comparatively, as did their competitors in other markets. Sir Miles emphasised the wisdom of close industrial co-operation with Russia after the war as a contribution to the future peace of the world.

COMPANY RESULTS

(Figures for previous year in brackets)

Hadfields—Interim dividend of 7½% (same).

Bairds & Dalmellington—Interim dividend of 4% (same).

John Bolding & Sons—Interim dividend of 4% (same).

Shanks & Company—Interim dividend of 3% (same).

Consolidated Tin Smelters—Net revenue for year, £120,445.

Richardsons, Westgarth—Final dividend of 4%, making 8% (same).

Peter Brotherhood—Net profit, after tax, £44,534 (£48,873); final dividend of 12%, making 20% (same).

Fisher & Ludlow—Net profit for the year to March 31 last, £108,210 (£105,174); ordinary dividend of 15% (same).

Rippingilles—Profit to March 31 last, £21,229 (£19,108); taxation, £16,912 (£10,537); ordinary dividend of 7½% (same); forward, £5,258 (£7,341).

George Kent—Profit to March 31 last, £32,944; brought in, £40,132; to general reserve, £5,000; ordinary dividend of 10%, plus 2½% bonus, £14,258; forward, £37,569.

West's Gas Improvement Company—Profit for the year ended March 31, 1944, after making provision for taxation, £8,843; dividend of 10% on the ordinary shares; forward, £27,898 (£27,867).

Broken Hill Proprietary Company—Net trading profit for the year ended May 31, 1944, £480,638 (£559,879); income from investments, etc., £248,036 (£137,911); two dividends of 2½% each were paid for 1943-44 (same).

Metal Industries—Profit for the year to March 31 last, £262,055 (£263,194); taxation, £137,768 (£131,769); stock reserve, £10,000; building and plant reserve, £4,549; final dividend on the "A" and "B" ordinary stocks of 6% (5½%), less tax at 9s. 9d., making 8½%, less tax (8%); forward, £151,156 (£149,846).

OBITUARY

Mr. F. Bulmer, chief chemist for 23 years with the Consett Iron Company, Limited, died suddenly recently.

Mr. John Wilson Steven, of Steven & Struthers, Limited, brassfounders and engineers, Glasgow, died recently.

Sir Ralph Fowler, F.R.S., Plummer Professor of Applied Mathematics at Cambridge University since 1932, died recently, aged 55. In 1938, Sir Ralph was appointed director of the National Physical Laboratory, but a sudden illness made a change of post inadvisable.

Mr. John Cochrane, who founded in 1895 the Eclipse Ironworks, Carntyne, Glasgow, which he carried on until their transfer in 1937 to Mr. James N. Connell, Phœnix Ironworks, Coatbridge, died recently in Glasgow. A native of Ayrshire, Mr. Cochrane was 85 years of age.

SURPLUS TINPLATE CAPACITY

WELSH PLAN NOT APPROVED BY BOARD OF TRADE

It was reported to the annual meeting of the Welsh Tinplate Association in Swansea last week that Mr. Dalton, President of the Board of Trade, could not see his way clear to approve of the industry's scheme for the permanent elimination of the surplus productive capacity in the trade. A statement issued after the meeting said:—

"The industry had always held the view that the disposal of this problem was an essential preliminary to the very important issues involved in the reorganisation of its methods of manufacture, and a scheme had been unanimously adopted by the trade with this principle fully in mind. At recent interviews with the Minister, the Welsh parliamentary party elicited assurances that South Wales would not suffer the depression at the end of this war as it did after the last war. Among proposals to modernise the tinplate industry so as to meet any post-war demand was the expansion of the strip-mill process of manufacture, as carried out in the United States, that Richard Thomas & Company, Limited, at Ebbw Vale introduced into South Wales for the first time in recent years."

Mr. E. H. Lever, chairman of Richard Thomas & Company, Limited, was appointed chairman of the association and chairman of the Tinplate Conference.

FUTURE OF GOVERNMENT PLANT

Presiding at the annual meeting of the Glacier Metal Company, Limited, Mr. W. B. Duncan Brown (chairman and managing director) said that, like many other companies, they were using to-day a considerable amount of plant on rental from the Government. Its installation had displaced quite a large amount of older plant which had been sold or scrapped. In addition, there had been very considerable depreciation of much of their other plant due to unskilled usage by newcomers to industry, long hours of work, and other causes. These facts dictated that the directors should consider a plan to replace the plant which had been disposed of and that which was in poor condition, and it would be of the greatest value if the Government would forecast the terms upon which the company might be able to acquire the plant they now had on hire. Ignorance on this point made forward planning difficult.

Capt. G. F. Davies, R.A., has been appointed a director of Hick, Hargreaves & Company, Limited, to fill the vacancy caused by the death of Mr. Charles Robson. Capt. Davies joined the company in 1934, and before the outbreak of war he was in charge of the rotary compressor department. He had previously visited South Africa on the company's behalf. Capt. Davies was wounded in Tunisia, but he has made an excellent recovery, and it is expected that he will shortly be able to resume active work with the company.

Raw Material Markets

IRON AND STEEL

The present condition of the pig-iron trade is somewhat analogous to peacetime experience at this period of the year, when mid-summer lassitude commonly afflicted the industry. Foundries, engineering shops and shipyards are "staggering" their holidays, but the peak period of this industrial interregnum is at hand, and requisitions, already on a reduced scale, are being further limited until operations are resumed. The contraction of demand is most noticeable in the case of high-phosphorus grades, the greater relative activity at engineering and speciality foundries ensuring a better demand both for low-phosphorus iron and refined qualities.

As from August 1, the price of foundry coke has been increased by 6s. a ton. In the case of blast-furnace coke, no decision has yet been taken, as prices are controlled by an agreement between coke producers and iron and steel manufacturers. Durham foundry coke is now 64s. 3d. f.o.t. ovens.

The scrap position is somewhat better than it was, but in some cases there is still difficulty in obtaining supplies. Cast-iron scrap and heavy machinery metal are in particularly strong demand.

Finished iron makers are reasonably well employed, but are not so busy as to be unable to entertain new business. A steady demand is maintained for best and common iron bars, strong support being forthcoming from the shipyards.

The re-rolling industry provides British steelmakers with an assured outlet for heavy outputs of steel semis in the form of billets, blooms, slabs and sheet bars, which is all the more welcome in view of the recent recession in the demand for certain finished products. While some branches of the steel trade are still awaiting a revival of business to ensure continuity of operations, the re-rolling mills have orders in hand for a wide variety of light material which will keep them fully occupied for some months to come. There appears to be no diminution in the Government's requirements for light sections, small bars, sheets, etc. At the moment, new orders for sheets are not being issued quite so freely, but are expected to mature, as soon as the substantial contracts in hand approach completion.

The completion of the heavy constructional programme is reflected in the reduced call for the larger sizes of joists, channels, etc., but the recent shrinkage in the call for steel plates is a much more surprising development. Mills are now able to accept specifications for delivery within a few weeks and the belief persists that the slackening of demand is no more than a temporary phase. At all events, there is no relaxation of the rules which canalise the whole of the capacity of the steelworks into war production. In the House of Commons recently, Mr. Dalton stated that the 10,000 tons of steel to be shipped to America monthly are to be sent in the form of ship plates. This arrangement is only to be of a temporary character, but it comes at a time when a lull in the scale of home orders has made it a welcome development to the plate mills.

NON-FERROUS METALS

At the moment it seems extremely uncertain what turn events in the copper market will take during the next few months. Although well below previous levels, current consumption is still high, but in certain directions there has been a sharp decline in the number of war orders, one reason, no doubt, being to limit the amount of surplus munitions on hand at the end of the fighting. The Control does not yet seem inclined to release metal for the execution of civilian orders and, unless there is a revival of war demand, many manufacturers will be forced to ease-off their production rate still further.

Supplies of tin are well maintained for current requirements, and there have been no developments in the immediate position. Interest continues to be centred on post-war problems. Unlike most of the other metals, tin is not likely to be faced with a very large surplus of secondary metal, as it seems will be the case with copper. On the other hand, production in the Far East will almost certainly take several years to get back into its stride. In any case, the amount of scrap on hand is unlikely to prove large enough seriously to disturb the balance of the post-war tin market.

SMALL ORDERS for non-ferrous castings have been freed from price control by the U.S. Office of Price Administration.

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(*Delivered, unless otherwise stated*)

Wednesday, August 9, 1944

PIG-IRON

Foundry Iron.—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.; Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(*No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.*)

Hematite.—Si up to 2.25 per cent., S & P 0.03 to 0.05 per cent.; Scotland, N.-E.Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

Scotch Iron.—No. 3 foundry, 124s. 9d.; No. 1 foundry, 127s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, 174s.; South Zone, 176s. 6d.

Refined Malleable.—North Zone, 184s.; South Zone, 186s. 6d.

Cold Blast.—South Staffs, 227s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than* 0.75 *per cent., are subject to a rebate of 5s. per ton.*)

FERRO-ALLOYS

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

Ferro-silicon (5-ton lots).—25 per cent., £21 5s.; 45/50 per cent., £27 10s.; 75/80 per cent., £43. Briquettes, £30 per ton.

Ferro-vanadium.—35/50 per cent., 15s. 6d. per lb. of V.

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

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 9s. 8d. lb.

Tungsten Metal Powder.—98/99 per cent., 9s. 9½d. lb.

Ferro-chrome.—4/6 per cent. C, £59; max. 2 per cent. C, 1s. 6d. lb.; max. 1 per cent. C, 1s. 6½d. lb.; max. 0.5 per cent. C, 1s. 6¾d. lb.

Cobalt.—98/99 per cent., 8s. 9d. lb.

Metallic Chromium.—96/98 per cent., 4s. 9d. lb.

Ferro-manganese.—78/98 per cent., £18 10s.

Metallic Manganese.—94/96 per cent., carb.-free, 1s. 9d. lb.

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Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s.; free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.42 to 0.60 per cent. C, £14 10s.; acid, up to 0.25 per cent. C, £16 5s.

Sheet and Tinplate Bars.—£12 2s. 6d., 6-ton lots.

FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

Plates and Sections.—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s.; joists, 3 in. × 3 in. and up, £15 8s.

Bars, Sheets, etc.—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ⅝ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8 g. plain, £26 17s. 6d.

Tinplates.—I.C. cokes, 20 × 14 per box, 29s. 9d. f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t., 28s. 6d., f.o.b.

NON-FERROUS METALS

Copper.—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 15s.

Tin.—99 to under 99.75 per cent., £300; 99.75 to under 99.9 per cent., £301 10s.; min. 99.9 per cent., £303 10s.

Spelter.—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £25; ditto (Empire and domestic), £25; English, £26 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

Other Metals.—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16s.; rods, drawn, 11⅜d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 11⅛d.; wire, 10⅞d.; rolled metal, 10⅛d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15¼d. per lb.; brazed tubes, 15¼d.; wire, 10d.

Phosphor Bronze.—Strip, 14¼d. per lb.; sheets to 10 w.g.; 15¼d.; wire, 16½d.; rods, 16½d.; tubes, 21½d.; castings, 20d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in. wide, 1s. 4¼d. to 1s. 10¼d.; to 15 in. wide, 1s. 4½d. to 1s. 10½d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5½d. to 1s. 11½d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6½d. Ingots rolled to spoon size 1s. 1d. to 1s. 9½d. Wire, round, to 10g., 1s. 7½d. to 2s. 2½d with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6½d. upwards.

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Controlled Maximum Prices.—Bright untinned copper wire, in crucible form or in hanks, £57 10s.; No. 1 copper wire, £57; No. 2 copper wire, £55 10s.; copper firebox plates, cut up, £57 10s.; clean untinned copper, cut up, £56 10s.; braziery copper, £53 10s.; Q.F. process and shell-case brass, 70/30 quality, free from primers, £49; clean fired 303 S.A. cartridge cases, £47; 70/30 turnings, clean and baled, £43; brass swarf, clean, free from iron and commercially dry, £34 10s.; new brass rod ends, 60/40 quality, £38 10s.; hot stampings and fuse metal, 60/40 quality, £38 10s.; Admiralty gunmetal, 88-10-2, containing not more than ½ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin, £77, all per ton, ex works.

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended Aug. 5, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

Brass.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £42 10s.; S.A.A. turnings (loose), £37; S.A.A. turnings (baled), £42 10s.; S.A.A. turnings (masticated), £42; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other 70/30 process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. Cu, £43 10s.; ditto, over 58 per cent. to 62 per cent. Cu, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

Cupro Nickel.—80/20 cupro-nickel webbing, £75 10s. 80/20 defective cups and envelopes before filling, £70 10s.

Nickel Silver.—Process and manufacturing scrap: 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

Copper.—Sheet cuttings and webbing, untinned, £54; shell-band plate scrap, £56 10s.; copper turnings, £48.

IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3¾ per cent. dealers' remuneration. 50 tons and upwards over three months, 2s. 6d. extra.*)

South Wales.—Short heavy steel, not ex. 24-in. lengths, 82s. to 84s. 6d.; heavy machinery cast iron, 87s.; ordinary heavy cast iron, 82s.; cast-iron railway chairs, 87s.; medium cast iron, 78s. 3d.; light cast iron, 73s. 6d.

Middlesbrough.—Short heavy steel, 79s. 9d. to 82s. 3d.; heavy machinery cast iron, 91s. 9d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 89s. 3d.; medium cast iron, 79s. 6d.; light cast iron, 74s. 6d.

Birmingham District.—Short heavy steel, 74s. 9d. to 77s. 3d.; heavy machinery cast iron, 92s. 3d.; ordinary heavy cast iron, 87s. 6d.; cast-iron railway chairs, 87s. 6d.; medium cast iron, 80s. 3d.; light cast iron, 75s. 3d.

Scotland.—Short heavy steel, 79s. 6d. to 82s.; heavy machinery cast iron, 94s. 3d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 94s. 3d.; medium cast iron, 77s. 3d.; light cast iron, 72s. 3d.

(Note.—*For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less*).

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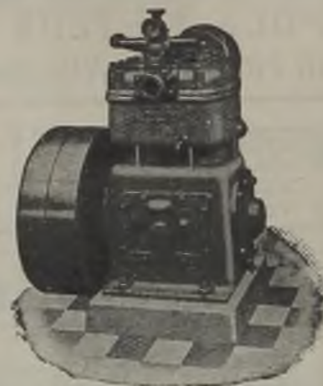

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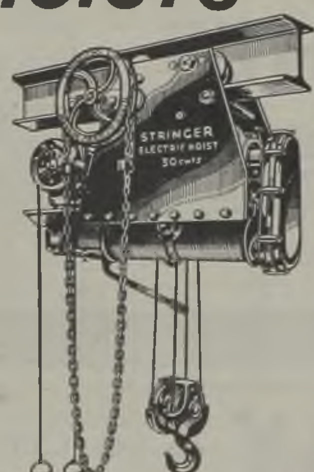

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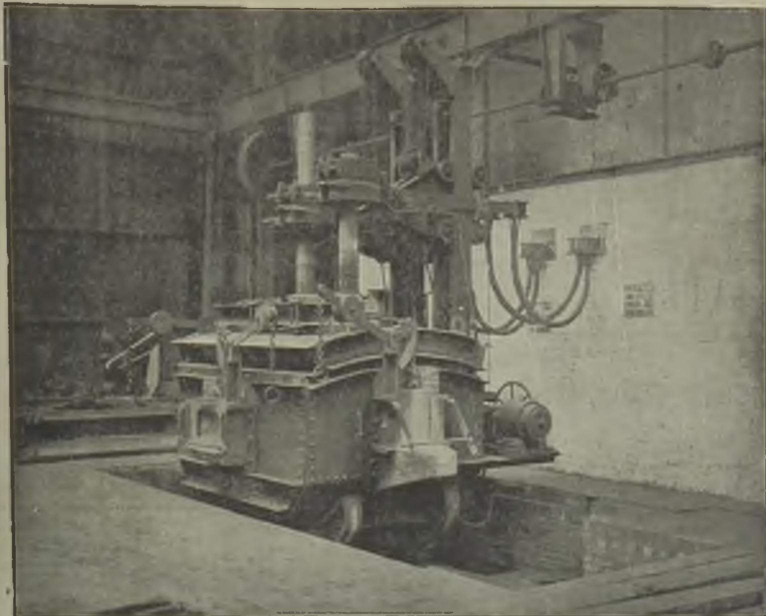

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