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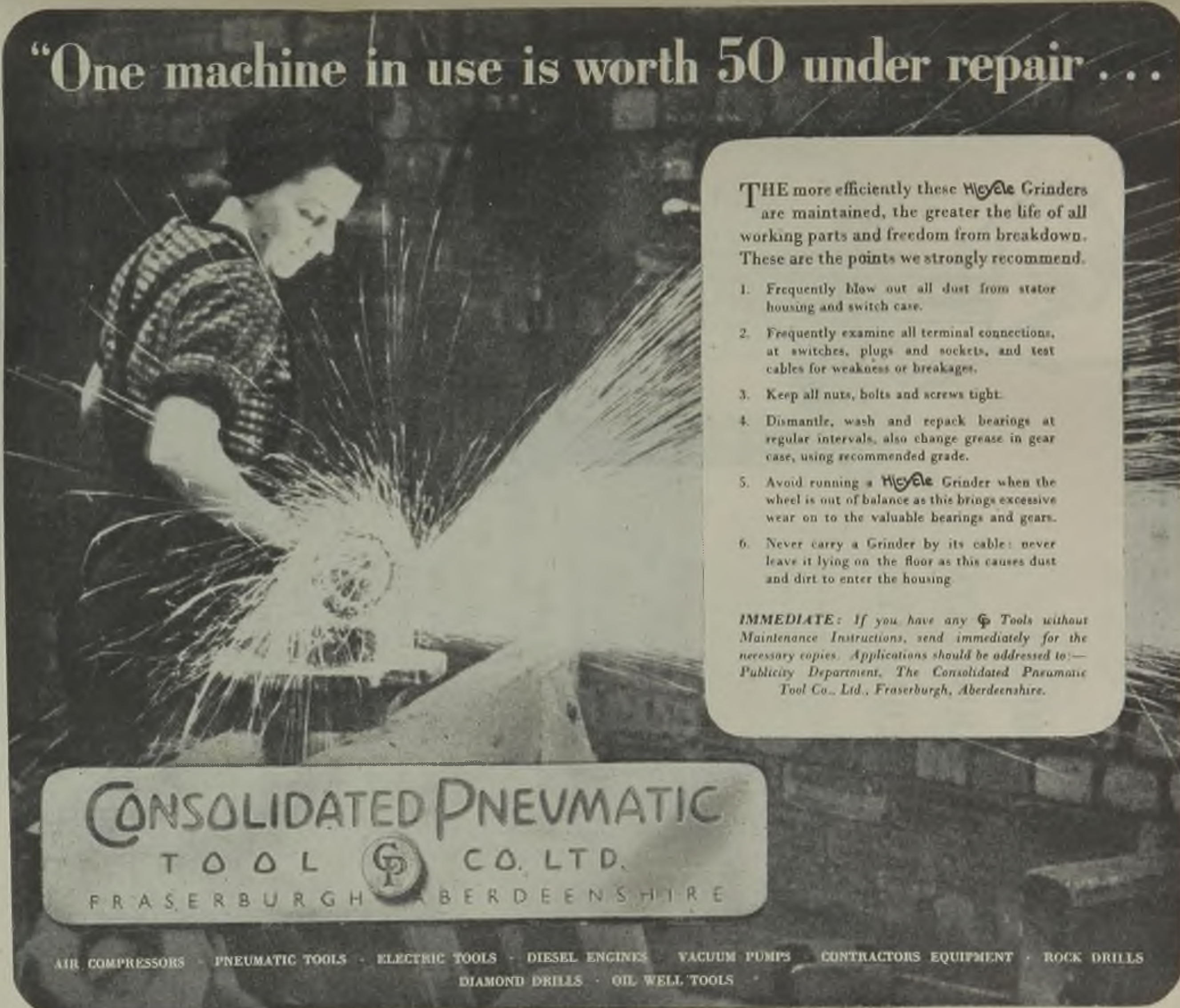
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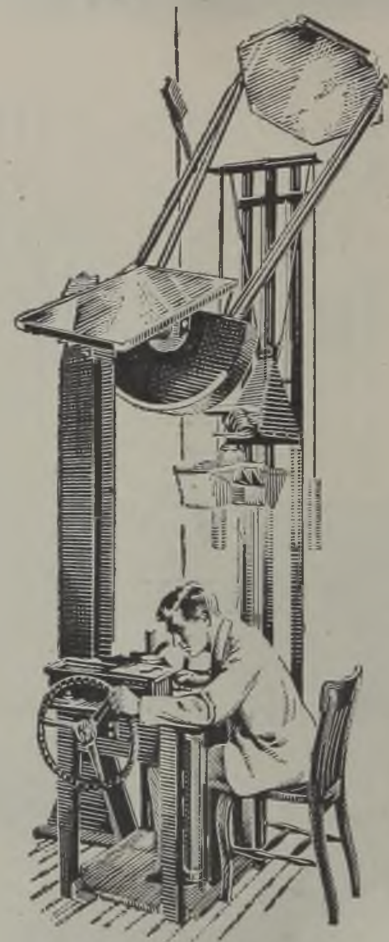

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Fuel Economy Campaign Surveyed

It is evident from the evidence which is available to us that there must be no relaxation in the striving after full fuel economy within the foundry industry in the immediate post-war era. In truth it should, and must, be a permanent feature in all industrial enterprises. We have since the inception of the fuel economy campaign been closely associated with its administration and conduct, and because of this we draw the following conclusions. There are registered very wide variations in the fuel consumption between concerns undertaking a similar class of business. These differences are due to a number of factors, of which the organisation of the work is not the least important. There are but few grumbles as to the quality of coke available for melting. Not all large foundries are particularly efficient from this angle, nor are the smaller concerns invariably extravagant. The majority of the foundries which have been inspected are appreciative of the help given by those acting on behalf of the Ministry of Fuel and Power. This gratitude is equally evident whether the inspection has been done by a foundryman or an engineer. It is apparent that, so far as fuel economy is concerned, the inspection by an expert foundry technician is by no means essential. Help given in some cases could not have been bettered by employing at a high fee the services of a consulting engineer—indeed, a percentage of the inspectors are of this profession.

Objections to being inspected, which are quite negligible, are usually due to the notion that a competitor may pick up more information than he gives. This is untenable, as the Foundry Industry Panels would never envisage sending a foundryman to inspect a competitive concern. The most fruitful source of waste is not to be associated with furnace operation, but the compressed air lines. We are convinced that normal maintenance is an insufficient guarantee against recurring leakages. There must be a fundamental search into the nature of the problems arising. Some will be traceable to the threads of the screwed-up parts. In many cases they must be of greater number and finer gauge. In short, there must be a thorough-going overhaul involving much redesign of components. Foundrymen are not noted for being skilled maintenance men, but at the same time they are not magicians, and they are a little tired of having to devote so much time to what ought to be made fool-proof. This inspection business will not last much longer, and in all sincerity we suggest to those foundries which have not been officially inspected to write to their local Panel for an early visit.

Lift the Ban

Quite a number of foundries, especially in the London area, are closed because of concentration, and are unable to derive any benefits consequent upon the fuel economy drive. There is a feeling abroad that the time has arrived, if not already overdue, when facilities should be given to these concerns to restart manufacturing, if they so wish. The sole consideration for their closure was to help the war effort, and unless it can be proved that conditions have not altered, the ban should be lifted forthwith. The conservation of manpower was, if we remember correctly, the main consideration for its imposition. We doubt if that argument could be substantiated to-day. Unquestionably, the employers' federations have this well in mind, as it was through their efforts that the concentration was limited to a few areas. But for that, Britain might now be in the same position as our American allies, where the shortage of manpower in the ironfoundries, not in the coal mines, has caused a bottle-neck in the supply of army vehicles and other munitions of war.

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THE INFLUENCE OF MELTING CONDITIONS ON THE PHYSICAL PROPERTIES OF STEEL CASTINGS

Mr. H. T. Protheroe, B.Sc., in Paper No. 11/1944 of the Steel Castings Research Committee (submitted by Prof. J. H. Andrew, D.Sc.) to the Iron and Steel Institute, has summarised his results in the following statement:—

This Paper gives a detailed report on the mechanical-test results obtained from a number of cast steels from various sources. A critical examination of the data recorded during manufacture has been made and used in conjunction with mechanical-test results in an attempt to trace the factor or factors having the most pronounced influence on the quality of cast steel. It appears that the combined phosphorus and sulphur percentage affects the mechanical properties to a much greater extent than do other factors, such as casting temperature, etc., and the property most affected is the impact value.

Unsoundness, as indicated by blow-holes or porosity, also has a pronounced effect, particularly on the ductility properties as measured by the reduction of area and elongation. Its effect on the tensile properties depends to a large extent on the actual location of the defect in the test-piece. There is an indication that the casting temperature, under controlled conditions, may have a slight effect on the mechanical properties. Its influence is so weak, however, that, unless the effect of other factors is completely eliminated, it is not noticed.

The microstructures of the cast steels do not differ appreciably, and give no indication of the mechanical properties to be expected. The differences in macrostructures, however, are quite distinctive, and an explanation for the variations is put forward. The macrostructure itself does not indicate what mechanical properties are to be expected from the steel. The influence of other factors, such as the nature and distribution of inclusions, grain size and the method of manufacture, etc., has also been considered, but cannot be definitely correlated with the mechanical properties.

BOOK REVIEW

Commodity Control. Second (Cumulative Supplement). By J. Bray Freeman. Published by Butterworth & Company (Publishers), Limited, 11 and 12, Bell Yard, Temple Bar, London, W.C.2. (Price 4s. 10d., post free.)

The book to which this is the second supplement was reviewed in our issue of April 15, 1943. To maintain its recognised value, it is important to possess this addendum, as the Orders are frequently changed and the new Supplement is up to date to June 1 of this year.

SAVE WASTE PAPER

NOTES FROM THE BRANCHES

London Branch (East Anglian Section).—At a meeting of the Foundry Technical Educational Advisory Committee held recently, the Principal of the Ipswich School of Technology presented the results of the examination held on May 1 and 2. He stated that five students had been entered, and there were no failures, actually three 1st class and two 2nd class passes being obtained. The Secretary intimated that one of the students who had gained a 1st class pass, Mr. J. M. Goymour, assistant metallurgist at Reavell & Company, Limited, had received notification from the Acting General Secretary of the I.B.F. that he had been awarded the Buchanan Silver Medal for the high total of marks he had achieved in this examination. A copy of the letter was read, and on the chairman's suggestion it was agreed that further copies should be circulated to all the Advisory Committee members. The chairman, Mr. Shepherd, further suggested that the Secretary should undertake to convey by letter to Mr. Goymour the hearty congratulations of the committee on his success. This was agreed to.

The chairman then speaking on behalf of all the members, offered hearty congratulations to Mr. Sumner on the success he, as instructor, had attained with the class, and warm thanks and appreciation for the effort he had put in a sincere endeavour to help the students to achieve these results. The Committee's thanks had already been expressed by the chairman in a letter to Mr. R. F. Coates, who had acted as instructor during the first three months of the course. There was every prospect of recruiting nine new students, with possible additions.

INSTITUTE OF METALS

The thirty-sixth annual autumn meeting of the Institute of Metals was held at the James Watt Memorial Institute, Gt. Charles Street, Birmingham, yesterday (Wednesday).

After formal business, the following Papers, which all deal with the melting and casting of bronze, were presented and discussed:—"Development of a Flux-Degassing Process for Chill-Cast Tin Bronzes," by W. T. Pell-Walpole; "The Effect of Some Variations in Casting Procedure on the Properties of Degassed Chill-Cast 10 Per Cent. Tin Bronze," by W. T. Pell-Walpole and V. Kondic; "The Removal of Gases from Molten Bronzes," by W. A. Baker and F. C. Child; "The Effect of Shrinkage and Gas Porosity on the Pressure Tightness and Mechanical Properties of Bronze Sand Castings," by W. A. Baker, F. C. Child and W. H. Glaisher; "The Use of Leaded Gunmetal for the Production of Castings to Withstand Pressure," by F. Hudson.

Members of the Institute of British Foundrymen were invited to attend the meeting and to participate in the discussions.

DR. J. E. HURST has been elected President of the Staffordshire Iron and Steel Institute.

STEEL MIXES AND INOCULANTS IN GREY CAST IRON

By W. BARNES and C. W. HICKS

Discussion on a Paper presented at the Annual Conference of the Institute of British Foundrymen. The President, Mr. J. W. Gardom, occupied the chair. The Paper was printed in our issues of August 10, 17 *and* 24.

MR. JAMES BELL (Associate Member), after congratulating the Authors, said it was an excellent Paper for two reasons:—(1) It embraced a vast amount of original work; and (2) it would occasion quite an amount of controversy, which was all to the good. The information given regarding results obtained from various inoculants and increasing quantities of inoculants, was particularly interesting and helpful. In the past there had been a tendency to wrap up in "Celophane" certain alloy and inoculated irons and say these were not cast iron—nothing so common—they are such and such a material or metal. The Authors' frankness in giving a series of results, and introducing an inoculant that was new to some was, to say the least of it, commendable. In considering tensile tests it must be remembered that the Authors were inoculating what normally would have been grey irons—they stressed the results of inoculated white irons were outside the scope of the Paper.

The use of Jominy tests in assessing hardenability was a sign of the progressive outlook of the Authors. Such tests were in current use in American steel practice, but it was the first time he had seen them mentioned in British cast-iron practice.

Refined Iron Making

The Authors' point that refined iron was "simply steel mixtures melted down in some other cupola quite probably no different in design from the one in which the refined iron is charged" was misleading, and certainly far from correct. Rotary air furnaces incorporating the finest control in melting conditions and producing a pig-iron of a composition and structure unobtainable from a cupola were used in a number of cases. He would go so far as to say that there were few refiners who had not modified melting plants specially designed for their particular purpose. For very high alloy irons the conservation of high priced alloys was obtained by electric furnace manufacture.

The Authors were certainly correct in stating that most cupolas in ironfoundries were capable of melting high steel mixtures. The salient point, however, was not what they would melt—it was the final quality of the metal that was produced. Take the case of the Authors' 70 per cent. steel mix, the final analysis of which was shown in Table III. Those who have melted in the cupola a charge incorporating more than 50 per cent. steel with ferro-silicon, knew that such charges could prove extremely capricious and did not lend themselves to a product either of uniform analysis or structure. The following charge, 30 per cent. refined iron, 30 per cent. returned high duty scrap (gates, risers, etc.), 20 per cent. steel scrap, and 20 per cent. low-phosphorus pig-iron, melted under correct cupola conditions, would give a similar composition, *i.e.*: T.C., 3.1 to 3.2 per cent.; Si, 1.8 to 1.9 per cent.; Mn, 0.5 to 7 per cent.; P, 0.25 to 0.30 per cent.; S, 0.08 per cent.

As the materials forming this charge were not so diverse in composition they lent themselves to the manufacture of a much more uniform product.

The Authors' pointers on good cupola practice were certainly on the right lines. Point 7, that good coke should be used as inferior coke eventually proves more expensive in the long run, was certainly correct. The same parallel applied to pig-iron. As to the conservation of raw materials, he believed he was correct in assuming that the use of refined iron had been encouraged and expanded by the Iron and Steel Control. Refined iron had replaced pig-irons that could only be otherwise manufactured by bringing low-phosphorus ores from very far afield.

In the second paragraph of the Paper it would be noted that only metal which gave the depth of chill established as a standard was used for casting test-pieces. Mixtures had to be repeated the following day when the required chill depth was not obtained. Such lack of uniformity was reduced by the use of refined pig-iron. It was generally agreed that refined pig-iron gave a control of composition unobtainable with other pig-irons or mixtures. A point worth noting was that general experience indicated that cupola linings were very adversely affected by high steel mixtures.

Another point of interest was that when the Authors used mixtures of 70 and 60 per cent. steel scrap they obtained metals with 3.2 and 3.11 per cent. total carbon respectively. They were certainly working on the right lines in regard to final composition, as for general high duty iron a total carbon of 3.1 and 3.2 per cent. gave an iron that met most specifications, but did not present too many problems in the foundry. However, nine foundries out of ten, if they used mixtures incorporating 60 or 70 per cent. of steel, would end up with a total carbon well below 3 per cent., and run into general foundry troubles such as sluggish iron, necessity for large feeder heads, etc.

Uniformity of Composition

The impression given by the Authors was that the use of refined pig-iron precluded the use of steel. This was far from the case. There were hundreds of foundries each melting many thousands of tons,

Steel Mixes and Inoculants

incorporating both steel scrap and refined pig-iron. The use of refined pig-iron and steel ensured uniformity of composition at a commercial price.

The Authors hardly conveyed a truly representative picture when they stated that they were only obtaining 13 to 14 tons tensile from a mixture incorporating 65 per cent. refined iron and 1 per cent. nickel. A tensile of 18 to 20 tons could readily be obtained from such a mixture, providing the correct specification of refined iron was called for. A number of foundries were using refined iron, some with steel scrap and others without, and were obtaining tensiles of 20 to 22 tons without either alloys or inoculants.

Regarding the concluding paragraphs of the Paper, it should be pointed out that internal soundness is a feature of irons with total carbon around the 3.1 per cent. mark and properly balanced silicon content. Low phosphorus, of course, assists. Such soundness was not peculiar to high steel mixtures. It could readily be obtained by other methods.

As to the difference in price of £3 per ton between a refined iron mix and a high steel mix, a refined pig-iron should be used to the most economical advantage.

Assuming the cost of raw materials at the foundry to be as follows: Refined pig-iron, at 174s. per ton; blast-furnace low-phosphorus pig-iron, at 140s. 6d. per ton; steel scrap, at 75s. per ton; cast-iron scrap, at 80s. per ton; ferro-silicon (14 to 16 per cent. Si), at 340s. per ton, the cost of the 70 per cent. steel mix as shown in Table II, would work out at £5 14s. 6d. per ton. The corresponding refined iron mix mentioned above would be 4s. 9d. higher, at £5 19s. 3d. It must be borne in mind that this metal was of a high duty nature usually commanding a fair price, and any foundry official who had used both mixtures would gladly pay the extra 3d. per cwt. to obtain less cupola wear and tear, less metallic melting loss, a more uniform product, and fewer sleepless nights.

Mr. J. K. Smithson (Member) congratulated the Authors on their Paper from the metallurgical point of view. But, he said, evidently they wished to stress both the metallurgical and the economic aspects of the subject, and he considered it unfortunate that their experiments were based upon the composition of raw materials as set out in Table I, and particularly the nature of the scrap. Supplies of scrap, and particularly scrap guaranteed to be of the composition set out, would not be available in sufficient quantities to sustain any large-scale production by a number of foundries in any area. He would be very interested to know whether one could obtain those excellent qualities of low-phosphorus cast-iron scrap in quantities sufficient to render their use a market proposition.

He was very glad that Mr. Bell had stated the case for refined iron. All that one needed to point out was that a substantial part of the 4s. 9d. per ton by which Mr. Bell's refined iron mix was more expensive than the Authors' 70 per cent. steel mix was probably saved in respect of cupola fettling alone.

Cupola Design

Mr. G. O. Stanley (Associate Member) congratulated the Authors on the preparation and operation of their cupolas. Their observation regarding the flame above the burden, he said, was quite sound; the flame gave a reliable indication as to whether the coke charge was correct and the air/coke ratio satisfactory. Referring to the Authors' statement that the cupola used for their experiments had a tuyere area of only one-tenth of the cross-sectional area of the cupola, he asked whether there was a special reason for that, and whether they recommended a tuyere area of one-tenth the cross-sectional area for high steel mixtures.

Expressing disagreement with their conclusion that the use of refined iron was both expensive and unnecessary, Mr. Stanley pointed out that the Authors had had the benefit of 61 small melts, selected scrap and hand charging. He asked if they would adopt the same practice for larger melts, of, say, 8 or 9 tons per hr. of high steel mixture from a mechanically charged cupola. He added that many castings were made by small founders who had not a metallurgist on their staff. He was quite sure that the use of refined iron had enabled them to change over from common iron to high-duty casting and to turn out a first-class product. Finally, referring to Table III, which quoted a total carbon content of 3.20 per cent. for a 70 per cent. steel mix, he asked whether they had adopted a special method of recarburising, for he would have expected the total carbon content to be about 2.5 to 2.7 per cent.

Mr. A. E. McRae Smith, M.A. (Member), complimented the Authors on the tremendous amount of work they had put into the Paper, and agreed with their general statement that it was not difficult to melt high percentages of steel scrap in any normal cupola; but he joined issue with Mr. Barnes in regard to his suggestion that most foundrymen thought there was difficulty in so doing. He estimated that 90 per cent. of the ironfounders in the country knew they could melt up to 50 per cent. steel scrap in any good cupola without difficulty. Whilst agreeing thoroughly with the Authors' cupola practice, Mr. McRae Smith asked whether they made any hard-and-fast rule concerning the thickness of the steel scrap which they selected, because difficulties might be encountered in melting large quantities of very thin steel scrap. He noticed that the Authors had been successful in maintaining their carbon levels at more than 3 per cent. Table III showed that the final carbon figure for the 70 per cent. steel scrap was 3.20 per cent. He asked whether they adjusted the bed height of the cupola and/or the melting rate, in order to ensure that this high percentage steel mixture was carburised to the level of 3.20 per cent. carbon.

Perhaps the title of the Paper was a little misleading. Apart from his personal dislike of the term "inoculant," he suggested that the Authors might have qualified the reference to their cast irons by adopting the title "Steel Mixes and Inoculants in Low-Phosphorus Grey Cast Iron." Inasmuch as they were concerned with the making of motor-vehicle castings, they were fortunate, for they evidently had large quantities of low-phosphorus cast-iron scrap available. He would like to see whether they had carried out similar work on medium- and high-phosphorus types of cast iron, including mixtures containing steel scrap.

It had been well known for 30 years or so that, as one increased the amount of steel scrap in the cupola burden, higher tensile strengths were obtained, provided the material was correctly melted. But he still believed that the greater proportion of that increase of strength was due to the smaller graphite content of the cast iron in the mixture as the proportion of steel scrap increased; and he asked if the Authors could confirm that view. At the same time, it was appreciated that the shape and distribution of the graphite also had something to do with it, but probably not so much as the Authors had tried to show.

Further, in the section of the Paper headed "Low-Temperature Treatment," a brief reference was made to high steel content in the production of acicular cast irons, the Authors having quoted a statement by some other authority to the effect that the best results appeared to be obtained with a high steel content in the charge. Incidentally, one would like to know who that authority was. However, it should be pointed out that acicular cast irons, that was to say cast irons with an acicular matrix, were made by a certain process, but need not be cupola melted. They could be obtained from electric furnace, rotary furnace or even crucible-melted iron, as well as cupola-melted metal, and the use of steel scrap was not essential for the formation of this type of structure. Of course, it was agreed there was less graphite and better patterned graphite, and therefore higher strength, in acicular cast irons when made by the cupola process from high steel scrap mixtures.

Nickel Additions

Mr. McRae Smith, continuing, said he did not wish to enter into any discussion about nickel additions, but would like to point out that the simple addition of nickel to any cast iron had never been claimed to give increased strength. Nickel was essentially a graphitiser when used by itself as an alloying element in cast iron, and therefore silicon adjustment must be carried out at the same time as the nickel addition was made in order to get increased strength. Nickel, of course, had other beneficial effects on the matrix. Again reverting to Table III. the compositions were rather surprising. The mix which did not contain any steel had a total carbon content of 3.60 per cent., and a silicon content of 1.40 per cent. The silicon content of that mix, after silicon addition, was 1.58 per cent., while the silicon content of the 70 per cent. steel mix, after silicon addition, was 1.87 per cent. Presumably the amount of silicon added was the same throughout the whole series of mixes. He asked whether that increase of final silicon content from 1.58 to 1.87 per cent. was an intentional increment or whether it was accidental. It seemed surprising that the 70 per cent. steel mix originally contained as much as 1.83 per cent. silicon. Could the Authors give any additional information on this point. Again, the curves shown in the Paper were beautifully smooth, smoother than he had ever seen during his foundry experience. He asked whether they were the results of individual tests or whether they were averages.

Mr. Barnes said they were the results of individual tests.

Mr. McRae Smith went on to congratulate the Authors on their use of the Jominy test for assessing the hardenability of cast iron. Although of great theoretical interest, he could scarcely see the practical reason for introducing this work, because, in his opinion, one could only heat-treat cast iron by quenching and tempering methods in the case of comparatively simple castings, such as liners, gear blanks, and so on. He presumed the Authors would not consider heat-treating cylinder blocks, etc., by quenching and tempering methods.

Mr. Barnes agreed that they would not, but many high-duty irons were heat-treated for certain applications, and the matter might be of interest.

"High Value of the Paper"

Mr. H. J. Young (Member) said that this Paper was unique. Without emphasising any point, the Authors stated all they did and all they found—thus following out the witness's oath. Their presentation of the results was uncoloured by their opinions or those of others. Finally, they refrained from the use of terms undeterminable by scientific measurement, such as "random." In contributing to the discussion, he desired to make clear one point, namely, the high value of the Paper as an example of unbiassed research.

The addition of 1 per cent. of nickel would better have been 0.1 per cent., as used in the case of other inoculants. He himself had not found that 1 per cent. of nickel raised the tensile strength of a cast iron which without the nickel was all-pearlitic in the test-bar. He thought that the remarks about nickel and, also, about refined pig-iron, were foreign to the Paper.

He observed that the 30 per cent. steel mixture gave between 15.1 and 15.5 tons per sq. in. tensile and, after inoculation, its strength rose to between 15.9 and 17.6 tons. These appeared to him to be low figures. Would the Authors expect a similar improvement in a 30 per cent. steel mixture tuned up to give 17.6 tons before inoculation?

The 40 per cent. steel mixture as charged into the cupola had a total carbon content not exceeding 2.50 per cent., yet the cast iron made from it contains 3.30 per cent. Would the Authors agree that high carbon pick-ups have to be taken into account when considering both the uninoculated and the inoculated results?

A quarter of a century ago it was not uncommon to keep out of the cupola charge about 0.25 per cent. of the silicon and to put it in at the cupola spout as ferro-silicon. It was then believed one got from a quarter to a whole ton extra tensile by this

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procedure, which was looked upon as scavenging, refining, deoxidising, killing, and so one. Even after reading this Paper with close attention he (Mr. Young) used the term inoculation with some reserve. The Authors refer to an effect upon the pearlite and of semi-sorbitic structure, none of which fitted in with inoculation as he saw it.

It might possibly not be known to the Authors that one could produce with certainty day in and day out a grey cast iron containing no nickel, no steel, no scrap with nickel or steel in it, and no inoculant, the pearlite of which is so fine that it cannot be resolved at 400 diameters but requires 1,500 diameters, at which magnification it gives a characteristic "smoky" appearance. The first photo-micrograph of this iron appeared in a Paper read by him in 1935 before the Institute of Automobile Engineers.

He drew attention to the fact that in 1928 the Meehanite Corporation's British specification treated molten grey iron with silicide, and stated that it "acts to precipitate additional carbon in spite of which the tensile and transverse strength will be materially increased." Sixteen years later could one alter the words "in spite of" to "because of"? Could one prove that the increase of graphite was sufficient to alter the tensile either way? Were foundrymen sure that "refinement" of the graphite was the reason for whatever physical improvement they observed? There was one thing of which he was certain, namely, that the Meehanite Corporation's 1928 specification took all originality out of what to-day is called inoculation.

Table II showed eight mixtures, the first five containing 30 to 40 per cent. of scrap iron, the next two only 15 per cent., and the last none. Further, pig-iron No. 3 (Table I) was unusual, and occurred in only two of the eight mixtures. He (Mr. Young) thought that either all or no remelted iron should have been used, and he wondered whether the Authors knew how sensitive cast iron was to the "make-up" of the mixture.

For example, suppose the stockyard contained only common light scrap iron and a common pig-iron, both of the same composition. It was a certainty that a cast iron made from all pig-iron would be different from a one made from all scrap iron; equally one made from one-quarter scrap plus three-quarters pig, and *vice versa.* Further, if a cast iron was remelted alone, with merely additions of ferro-silicon and ferro-manganese to the cupola to keep the main composition the same, the resultant iron would be different. It was probably beyond the wit of man to make two things so alike that no test would detect a difference, and very surely two cast irons were dissimilar when made from different mixtures; they might seem to be identical until some test or other proved otherwise.

He (Mr. Young) did not remember who published the fact that treatment between 400 and 450 deg. C. tended to raise the tensile of cast iron, but before the introduction of Lanz Perlit iron about 1920 this procedure was used by him for all the more important parts of large Diesel engines. Tumbling in a rumbling barrel brought about somewhat the same effect. Neither treatment produced any change which had been detected through the miscroscope, but a bar of grey iron treated by either method very slightly elongated and increased its strength.

As a conclusion to their Paper the Authors believed they showed that the solidity of cast iron improved as the steel content increased, and they used sulphur-printing to illustrate it. He (Mr. Young) did not find the evidence convincing, and asked the Authors if they had tried the effects of various total-carbon contents upon iron of one steel content; also if they had considered the method of Emmel and how it would have affected their irons and results.

He wished they had not introduced cupola practice into this Paper. For thirty years he had had the almost constant task of having to read how somebody or other believed a cupola should be worked or constructed or both. When a consultant it was his task to make function any cupola in any foundry and to do it without undue expenditure of money, time or words. Long ago in a weak moment he wrote out precisely how he did this and it took but a few lines—the article was returned to him as containing no information.

The above remarks were but a modest contribution to a brave research. What it must have taken to accomplish only those knew who had their own work to do as well as trying something like this. It was upon such individual effort that our national greatness was established in the past; may this Paper create an urge for post-war research by individuals, Mr. Young concluded.

Sulphur Content

Mr. J. Roxburgh, A.M.I.Mech.E. (Member), commented that the sulphur content had been omitted from all the analyses quoted by the Authors. Whether or not they had omitted it purposely he did not know; it would probably have given rise to a great deal of discussion, but, after all, the sulphur content was very important. Again, the combined carbon content, which was always a very important factor in cast iron, was not quoted.

Naturally, he continued, those who had to operate foundries had had a great deal of experience of adding steel, and undoubtedly when it was first introduced the improvement in the physical properties was due to the lowering of the total carbon, silicon and phosphorus contents. Later it was found that by adding silicon to a material which was reasonably free from graphite—a white iron—one could get a very much more refined graphite when it was precipitated.

Coming to some rather domestic questions, Mr. Roxburgh asked how many mixtures the Authors actually melted in their foundry, or whether they were making just one mixture. They had quoted all sorts of percentages of steel, and it was very important to know which particular mixtures were in fact used. Another important consideration was the section of the castings produced. Were the Authors dealing with a standard sort of casting, or was there a great variation of section?

Finally, he emphasised the point raised by Mr. McRae Smith concerning the effect of the rate of melting on the total carbon content.

MR. E. HUNTER (Member) said he thoroughly agreed with the Authors as to the value of high steel mixtures; it was the only way to make really sound pressure-tight castings. He was melting regularly mixtures containing up to 70 per cent. of steel, which did not destroy the cupola lining any more than did ordinary grey iron, if one's melting practice were good; he melted grey iron and high steel mixtures parallel. He was rather concerned that the Authors had not mentioned blast velocity, because from his experience of high steel mixtures, if that were too high, trouble would be encountered.

Commenting on the rather low tensile results quoted by the Authors, Mr. Hunter said he would have expected, in the 70 per cent. steel mix, a tensile strength of 25 to 27 tons per sq. in. in the as-cast condition, rather than the 18 tons per sq. in. quoted by the Authors. However, that might be a matter of test-bar technique.

Having had the privilege of visiting the Authors during the course of the work described in the Paper, he could testify to its thoroughness. Furthermore, it would be a good thing if all who were interested in the work could see the Authors' original sulphur prints, for those prints gave a much better idea than the reprints of how the Authors had set about the measurement of soundness.

Regarding Mr. McRae Smith's statement that inoculating from a white iron had gone out-of-date six or seven years ago, he asked Mr. McRae Smith if that was what he meant to convey.

MR. MCRAE SMITH said that the period stated was a conservative estimate.

MR. HUNTER commented that surely the inoculation from an iron which would normally cast white was the most classical way of controlling carbon, and he believed it was still the very best method. Certainly it was the method that he used.

Authors' Reply

MR. BARNES replied to the discussion on behalf of himself and his colleague. Dealing first with Mr. Bell's statement that a refined iron mix, corresponding to the Authors' 70 per cent. steel mix, would cost only 4s. 9d. per ton more, he said the information given in the Paper was based entirely on the experience of the Humber Company, including their experience in the purchase of iron, and the figures given were entirely correct. The original mixture for their cylinder iron, which had given a tensile strength of 13 to 14 tons per sq. in., had contained 65 per cent. of pig-iron and 1 per cent. of nickel. Taking the scrap cost at mixture cost, in accordance with the Institute's recommendations, the difference in price resulting from the changeover to the mixture containing 20 per cent. steel was 60s. per ton. A danger about the use of refined iron was that founders might be inclined to pile it into the cupola, in the hope of obtaining a marvellous metal.

It was true, as Mr. Young had said, that the addition of an inoculant to a grey iron was not new. All that the Authors had tried to do in the Paper with regard to it was to prove that it had to be controlled. If one merely loaded it into a ladle, in the hope that a bad iron would be satisfactory, that bad iron would deteriorate seriously. He agreed with Mr. Bell that the addition of alloys in a concentrated form in the ladle was a very dangerous and expensive practice. Even distribution was of great advantage.

As to the suggestion that a foundry using a high steel mixture would experience uneven melting, he said that that was not his experience. He was melting a 60 per cent. steel mixture for eight hours per day, and it was poured into green-sand moulds, being used for the casting of flywheels 2 in. thick. There was no feeder, the metal being poured through small central runners; and the flywheel had to balance to within close limits.

With regard to the chill depth and the discarding of samples which were not of the chill depth required, he said the chills did not vary greatly. They had a range of chills for each grade of iron, and the only reason for discarding a slight variation of chill in these tests was to make comparisons as academically accurate as possible.

In melting with high carbon, his practice was to work with a bed of 42 in., and for the 60 per cent. steel mix he used a 14 per cent. charge. For the 20 per cent. steel mix he used the same bed, and the charge was 12 per cent. The tapping temperature for the high steel mixes was about 1,500 deg. C. It went to the track in ½-ton ladles, and was cast into green-sand moulds.

Whilst he had not at hand the figures for blast velocity, he said he liked to put in 600 cub. ft. of air per min. for each ton per hr. of metal required from the cupola.

With regard to low-tensile strength of some refined iron mixes, Mr. Barnes said that a large number of foundries in the Midlands were using 50 to 65 per cent. of fairly expensive pig-irons in the charge. It was costly, and the iron produced was not particularly good, when the cost of the mixture was considered. Incidentally, the wear resistance of cylinder bores had improved greatly when the Humber Company had changed over to the 20 per cent. steel mix. Blocks were taken out on test, and the wear resistance in the bores was more than twice that afforded by the iron previously used.

Replying to Mr. Smithson's question as to the source of the low-sulphur and low-phosphorus scrap, Mr. Barnes said it was not bought scrap, but was his own mixture returns. Some of it was flywheel scrap with a 60 per cent. steel base, so that it was already a low-phosphorus iron when melting was commenced.

There was nothing special about the cupola melting. The ideal tuyere ratio for a 30-in. internal diameter cupola was about 1:5½ or 1:6, although the recommended ratio given in the Paper was 1:5. The ratios in the cupolas mentioned in the Paper were respectively 1:10 and 1:37. They both melted the 60 per cent. steel mix, with high carbon. As to larger

Steel Mixes and Inoculants

melts in steel mixtures, he did not see that that mattered. On certain days his foundry melted well over 25 tons of the 60 per cent. steel mixture; and he believed it was no more difficult over a long period than a short period.

Selection of Steel Scrap

Replying to Mr. McRae Smith's question concerning the selection of steel scrap, he said he specified that its length should not be more than one-third the diameter of the cupola, and not more than 5 in. wide at that maximum length. Apart from those limitations, he accepted anything; the composition of the steel did not matter a lot. Flashings from drop forgings were used very satisfactorily. There was no re-carburising at all in order to achieve the required total carbon figure; it was a natural phenomenon. He used 14 per cent. coke, and there was no difficulty in achieving the 3.1 per cent. carbon. He had not experimented with the phosphoric irons, and did not think that he would. At no time had the melting been done experimentally in small amounts in a crucible.

The increase of tensile strength was not due essentially to the decreasing graphite content of the irons; he felt that it was due rather to the increased amount of combined carbon in the pearlite.

It was true, as Mr. McRae Smith had said, that nickel was a graphitiser. But why add nickel to graphitise when that could be done much more cheaply? By adding a small amount of inoculant one could achieve the same result in the ordinary engineering grey iron. Some firms added 1 per cent. of nickel because they believed it was a good thing to do. There was no doubt that it was a good thing, but it was very expensive, unnecessarily so when one could buy a cheap "pill" in the form of an inoculant.

Although he could melt 100 per cent. steel, he did not want to do so; he did not know how he would introduce all the silicon necessary to produce metal suitable for the section of casting that he was making. He had at one time melted a mix containing nearly 95 per cent. of steel. for the duplexing of short-anneal malleable iron, and with very little trouble.

Replying to Mr. Roxburgh, Mr. Barnes said there was not a wide variation of sulphur content; the variation was between 0.08 and 0.09 per cent.

Determination of Sulphur Content

Mr. Roxburgh asked how the sulphur content was determined, for the figures seemed to be very low.

Mr. Barnes said that the gravimetric method was used, and the melts were fairly consistent in respect of sulphur content.

Replying to the question concerning the mixtures used in his foundry, Mr. Barnes said that a steel-free mixture was used for very light parts, from $\frac{1}{8}$ in. up to $\frac{1}{4}$ in. or $\frac{3}{8}$ in. The 60 per cent. steel mixture was used for flywheels and for pulleys, and the 20 per cent. steel mixture for cylinders.

Mr. Roxburgh asked if it were the practice to correlate depth of chill with section.

Mr. Barnes replied that it was, but he erred very much on the soft side. If he were making flywheels only he would want a chill of about 12, as against the 4, 5 or 6 that he was using. But he had to run other parts in the flywheel iron, where the thinnest machined section was $\frac{3}{8}$ in., and machinability was still required. It was a very soft iron, and it had still a high tensile. This also answered Mr. Hunter, who was quite right in expecting a higher strength with 70 per cent. steel, as long as the chill test was correlated closely to the casting section.

Finally, with regard to test-bar technique, he said that a shaped bar of 0.75 in. was made and was machined down to 0.564 in.

Mr. J. Arnott, F.I.C. (Member) wrote that the Authors had covered a wide scope, but in the writer's opinion, many features detracted from the value of the work done.

(1) The effect of increasing steel additions was deduced from a set of charges of very varying nature. The use of six different raw materials was rather puzzling, and it was surprising to find charges containing pigs of 3.1 and 0.18 per cent. silicon respectively.

(2) The phosphorus contents of the final mixes in Table III were much higher than those calculated from the charges in Table II. The phosphorus content of the mix without steel was higher than that of any of the raw materials used.

(3) The total carbon content of the raw materials was not given, hence it is not possible to see the effectiveness of the steel additions.

(4) Although the Authors mention modern high-duty irons at the beginning of their Paper, the strengths obtained only touched the lower range of what might be called high-strength iron.

As would be expected from the total carbon figures, the maximum was of the order of 20 tons per sq. in. No indication was given of how higher requirements, say a minimum of 20 tons per sq. in., were to be assured.

(5) In their comments on the use of refined pig-iron and of nickel, the Authors did not credit their foundry brethren with much business acumen. The example given on page 1 of the Paper simply indicated a misuse of good material.

Mr. Barnes, in reply to Mr. Arnott, wrote that the use of pig-irons of varying nature was essential to produce charges giving the same constant chill depth with varying amounts of steel. All the materials used were commercial blast-furnace pig-irons.

Mr. Arnott pointed out a discrepancy in the phosphorus content of the raw materials and finished iron which he could not explain. This did not, however, affect the physical results obtained. The tensile figures were low because of low chill depth. If, as was the best practice in the production of high-duty iron, the composition had been adjusted to give a chill in proper ratio to section thickness, the tensiles would have been much higher. The Authors had repeatedly produced cast iron of 25 tons tensile when making isolated castings.

The procedure in the Paper, however, was based on every-day practice which, as continuous casting was in vogue, involving difficulties in the grouping of castings to very close limits, and, therefore, a chill depth suitable for lighter sections was sought.

As regards the use of refined pig-iron and nickel, he neither credited nor discredited the acumen of our brethren, but he would go so far as to say that many foundries were misusing good material, not because of lack of business acumen, but through lack of advancement.

Authors' Experience with Refined Pig-irons

MR. J. L. FRANCIS, A.M.I.Mech.E. (Member), wrote: The Authors must have been exceptionally unfortunate in their experience with respect to the use of refined pig-irons. A charge comprising 65 per cent. of refined iron with a 1 per cent. nickel addition should yield a cast iron of much greater tensile strength than the 13 to 14 tons per sq. in. quoted. A good refined pig-iron would, of itself, record a better figure than this.

The addition of small percentages of nickel, up to 2 per cent., with or without copper, was fully justified in the writer's view, not so much because of the added tensile strength imparted, but because of the beneficial effect on soundness under hydraulic test, and for the reduced tendency to chill and improved machinability. It is with castings of varying section that small ladle additions of nickel and copper showed a maximum advantage, as they produced a more uniform grain size which was not so sensitive to the effects of cooling rate.

The main purpose of any alloy addition was not to make a bad iron good. Indeed, they should not be employed at all, except with carefully adjusted base iron charges where their power to impart specialised properties could be fully developed. In connection with the taking of the metal sample for the casting of test-bars, it is noted that this was obtained from the 7th and 8th charges already in the well of the cupola at the time the first 10 lbs. of iron were caught.

Referring to Fig. 58, the tensile strength of 11 tons per sq. in. shown on the curve for the 30 per cent. steel cast iron was remarkably low for a material containing this amount of steel. Details given of the aluminium ferro-silicon inoculant developed by the Authors were of particular interest to the writer. In view of the difference in specific gravity between the ferro-silicon and the aluminium swarf, had difficulty arisen from any tendency of these two materials to separate during handling? If any such separation did occur, it was obvious that the proportions of each material entering the metal at different times would not be constant.

Another point on which information would be of value was the effect of holding time on the tendency for the inoculation treatment to revert to normal, that is to say, how long could an inoculated ladle of metal be held without danger of reversion using a given inoculating material, and how was this period affected in the case of different inoculating materials? Further, in respect of this matter, it would be valuable if the Authors could provide some data on the influence of melting and pouring temperatures on the effectiveness of inoculation.

In reply, MR. BARNES wrote that no difficulty had arisen from any tendency for the silicon and aluminium swarf to separate during handling. No check had been taken on how long a ladle could stand without danger of reversion, as, after all, the taps were not large ones and the ladle went straight from the cupola spout to the pouring station, and, after the ladle was skimmed off it was disposed of within 10 min. The Authors had found no evidence that variations in pouring time caused any variation in effectiveness of inoculation, but there was undoubtedly an adverse effect if tapping temperature should be above 1,400 deg. C.

MR. L. W. SANDERS (Associate Member) wrote that at the present time, when hematite pig-iron was in short supply, many foundries had turned over to high-steel compositions inoculated at the spout by some form of graphitiser. Instead of these foundries using the information which had been published during recent years, they preferred, at great expense, to go through the usual teething period to arrive at the same position as former investigators.

It was commendable that the Authors had given much attention to the preparation of the bed, a point so often overlooked, and yet so essential for the production of good iron in the early stages of the blow. The bed height of 42 in. appeared to be rather excessive even for charges containing 70 per cent. steel, and in conjunction with the soft blast pressure of 6 to 7 ozs. and the generous coke charges of 7.7 to 1, the melting rate would obviously be affected. Generous coke charges were, of course, necessary when long blows of high-steel charges were being run.

Charging Sequence

He did not agree with the charging sequence which was entirely reversed to that of the majority of users of high-steel charges. Usually the steel was charged first, as steel melts as steel, and not as a highly carburised metal of a much lower melting point, and for this reason should be allowed to melt nearest to the zone of maximum temperature.

Dealing with the inoculation experiments, (*a*) *with constant additions*, it was remarkable that a sharper increase in strength was not attained in the lower regions of 25 to 40 per cent. steel, and that, when using 70 per cent. steel with the 60 ozs., or 1 lb. per charge, the strength should have fallen due to the iron being either mottled or white; and (*b*) *fixed steel with varying inoculant*, it was quite probable that the reason for the falling away of tensile strength was due to the iron being saturated with graphite and compensating adjustment of the physical charge should be made.

(*Continued overleaf, column* 2.)

INFRA-RED LAMP HEATING UNITS FOR MOULD DRYING

Although paint drying is the most widely used application of infra-red heating, it is not by any means the only successful use to which the process has been applied. On the other hand, it must not be thought that the infra-red system can be applied to all heating and drying problems; it would not, for example, be suitable for the uniform heating of a poor thermal conductor, or for a process requiring a low temperature for a long time, but, fortunately, other heating methods are rapidly being developed to meet the needs of processes outside the scope of infra-red lamps.

G.E.C. infra-red lamp installations consist essentially of the lamps and reflectors and the structure on which they are mounted. Lamps and reflectors are standardised, but the structure, and hence the numbers of lamps and reflectors, vary both in shape and size with the shape and size of the components to be treated.

The infra-red process is not confined to paint drying, and Fig. 1 shows part of an installation used for skin-drying foundry moulds. Usually this is done by means of a gas torch, but this method is not entirely satisfactory, since success is dependent upon the skill and care of the operator and, with inexperienced or careless operators, the percentage of rejected castings may be high. Automatic drying equipment such as lamp heating may be used for some moulds, but it will be appreciated that uniform drying can only be achieved if the surface of the mould is free from relatively deep cavities which are in shadow.

The foundry illustrated employs 38 infra-red lamp units, each of which incorporates six trough reflectors with six lamps per trough. The total number of lamps employed is 1,368, and the aggregate load is 342 kw. These units are mounted over conveyors, which carry moulds of various types through the infra-red channels thus created. Satisfactory drying of some types of mould is accomplished to a depth of $\frac{1}{16}$ in. in about 5 min.; in other moulds the time may be as long as 30 to 45 min., according to the shape of the mould, the depth of the drying required, and the type and moisture content of sand employed.

An American firm of frit manufacturers are stated in the Press to have developed a one coat porcelain enamel. It is a white opaque finish, with all the characteristics of the finest white cover coat and the adherence qualities of a good ground coat. It is said to require no special bond or pickling equipment, nor does it need special handling. It can be fired at 815 deg. C.

STEEL MIXES AND INOCULANTS IN GREY CAST IRON

(*Continued from previous page.*)

Personal experience of inoculated cast iron, that was 50 per cent. steel charges, led him to believe that the maximum properties were attained when 50 per cent. of the total silicon of the iron was added as an

Fig. 1.—G.E.C. Infra-Red Lamp Heating Units Installed in a Foundry. Thirty-Eight Units are Used for Drying Various Types of Mould.

inoculant; thus Fe-Si up to 35 to 40 lbs. per ton was necessary and strengths of 20 to 23 tons were produced.

It would appear from the work carried out by the Authors that the theory of inoculation was imperfectly understood. The basis of the original work in this field was to work with low-carbon, low-silicon irons which would normally solidify white, but to inoculate and provide nuclei for the precipitation of graphite in order to produce improved properties. Unfortunately, the Authors' rather tentative endeavours had not attained any decisive findings and were rather reminiscent of the earliest attempts of previous investigators.

Mr. Barnes wrote that Mr. Sanders appeared to be basing his remarks on the inoculation of an iron which would be white without the addition. He would imagine that an addition of 35 to 40 lbs. of ferro-silicon per ton would tend to make the iron in the ladle very sluggish.

FIRST REPORT ON THE BASIC CUPOLA BY THE MELTING FURNACES SUB-COMMITTEE

Examination of results obtained in practice with basic-lined cupolas

(*Continued from page* 28.)

Basic Brick Linings

Chrome Magnesite Bricks.—In one instance a basic cupola has been lined with chrome magnesite bricks from the top of the well upwards to a height of 4 ft. 6 in. above the tuyeres. The lining in the well was of stabilised dolomite monolith. Two courses of bricks were used making a lining thickness of 9 in. This lining gave excellent results in service and patching consumption using stabilised dolomite patching was of the same order as that with a stabilised dolomite monolithic lining. Details of total life are not available, but after daily use for four months the backing layer of bricks was still in good condition.

Stabilised Dolomite Bricks.—A complete lining of these bricks, the properties of which are detailed in Table I, has been used, including the well and extending to a height of 4 ft. 6 in. above the tuyeres. An expansion allowance was made between the shell and the first course of bricks, asbestos steam pipe lagging being used to a thickness of ½ in. This lining showed an appreciable improvement over rammed stabilised dolomite. Initial erosion was small, being indicated by a 30 per cent. reduction of patching material required for the first week's run. By the end of the third week of operation, however, the normal amount of patching material was necessary for repairs and averaged about 63 lbs. per ton of metal melted.

There is no evidence to show that the spalling tendency of basic bricks has any detrimental effect on the performance of the lining, although cracks immediately develop after the furnace is dropped each day.

Cupola Melting of Ferro-manganese

In the manufacture of manganese steel by the converter process it is usual to melt the ferro-manganese in a small cupola or cupolette. The erosion of an acid lining is severe, and even when using firebricks containing 40-42 per cent. alumina the wear is such that the lining in the combustion zone requires renewal after a melt of eight hrs. A monolithic stabilised dolomite lining was installed in the well and combustion zone of a cupolette engaged in this service to ascertain whether an improved life would be obtained and also the effect on manganese loss during melting which in an acid-lined furnace averages 6.5 per cent.

The cupolette used was of standard type, having a shell diameter of 2 ft. 9 in., lined to 23 in. internal diameter. The rammed basic lining was continued to a height of 3 ft. 6 in. above the tuyeres, from this level to the top of the shell being finished with firebricks. With this practice there is no danger of the coke and metal charges damaging the friable and unfritted surface of the rammed lining.

The lining was given two days air drying, followed by a further two days' forced drying by gas to bring the temperature up to approximately 700 deg. C. The drop bottom was made up with stabilised dolomite material, but it was not possible in this instance to utilise this material for making up the breast. This was made up with ganister to a thickness of about 8 in. The cupolette was then used for a full eight hr. melt. For the first hour's run the rate of melting was lower than with an acid lining, the amount of ferro-manganese obtained per tap being only 3½ to 4 cwt., as against 5½ to 6 cwt. in the same period from an acid lining. Three pounds of fine sandstone, walnut size, were introduced per charge as a flux, and after a further two hours' run a sufficient quantity of metal was being melted. The use of sandstone was therefore discontinued after two hrs.

After one day's use, an even wear in the well and melting zone of some 1½ in. had taken place, against 3 to 4 in. in a firebrick lined shell. The lining was repaired, using stabilised dolomite cement. The furnace was then used again for two days' full production, without dropping the bottom. No fluxes were used at any time during this period. The following are the manganese and phosphorus contents of the metal at hourly periods on the second day's run:—

Time.	Mn per cent.	P per cent.
8.30 a.m.	77.3	0.19
9.30 a.m.	78.6	0.18
10.30 a.m.	74.6	0.18
11.30 a.m.	77.5	0.20
1.30 p.m.	78.6	0.21
2.30 p.m.	76.9	0.20
3.30 p.m.	78.7	0.18
4.30 p.m.	78.5	0.18

The above results seem to indicate that no appreciable loss of either manganese or phosphorus has occurred, and they are exactly similar with those obtained in daily practice, using a firebrick-lined furnace.

The wear after two days' run was only slightly in excess of that found in a brick lined shell after one day's run. The only serious wear was in the well, and this was attributed to the action of the liquid ferro-manganese upon the ganister in the breast. The acid slag resulting from this action would be raised and lowered in the well as metal was collected and tapped.

Melting Furnaces Sub-Committee

It seems improbable that with the quantities of manganese and carbon present in ferro-manganese, any dephosphorisation can be obtained and the results at present available show no appreciable difference in manganese loss between acid and basic melting. The possible advantage of a basic-lined cupolette for ferro-manganese melting appears to be in the field of a reduced refractory cost, with savings in repair time and labour. Labour costs for lining a shell with firebricks, and for ramming a shell with the basic material are about the same.

TABLE II.—*Composition of Slags from Basic Cupola.*

	(Pale brown).	(Dark brown).
SiO_2	30.80	29.80
FeO	0.52	1.47
CaO	44.04	45.15
MgO	14.00	12.90
Al_2O_3	8.74	6.46
S	1.08	1.00
MnO	0.83	1.43

Desulphurisation

In the conventional acid cupola it is not possible to increase the basicity of the slag to a point where appreciable desulphurisation can be obtained because of the erosive action of such a slag on the lining. Using a basic stabilised dolomite lining, Renshaw[2] has shown how sulphur can be removed during cupola melting by the use of a basic slag. The cupola, which is fitted with a continuous tapping spout, allows the maintenance of a considerable volume of slag in the well. The drops of molten metal must, of course, pass through this slag before leaving the cupola.

To test the effectiveness of the desulphurisation a variety of different mixtures was melted ranging from 100 per cent. grey iron to charges composed entirely of steel scrap and ferro-silicon. In all cases the average sulphur content of the molten metal was less than 50 per cent. of that normally expected when melting similar mixtures in an acid furnace. In the melt when all steel charges were used the average sulphur content of the molten metal was 0.049 per cent. The limestone charges used in this melt were 7 per cent. by weight of the metal charges and 1 per cent. of fluorspar was charged with the limestone. Charge coke consumption was 14.3 per cent.

TABLE III.—*Pig-iron Melt. Ex. D.P.*1.

Time.	T.C.	Si	S	Mn	P	Details of Cupola Charge.						
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.			T.C.	Si	Mn	S	P
a.m.							Per Lb.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
10.45	3.85	0.29	0.064	0.38	0.42							
11.00	—	0.24	0.070	0.35	0.40	Pig-iron ..	500	4.0	0.77	0.87	0.062	0.74
11.15	3.86	0.29	0.074	0.35	0.44	Limestone ..	15	—	—	—	—	—
11.30	3.80	0.19	0.076	0.29	0.40	Spar ..	5	—	—	—	—	—
11.45	3.82	0.14	0.080	-0.37	0.45	Ore	5	—	—	—	—	—
p.m.						Coke ..	70	—	—	—	—	—
12.00	3.88	0.05	0.084	0.30	0.36	Coke bed ..	—	42 in.	—	—	—	—
12.15	3.90	0.45	0.060	0.40	0.62	Melting rate	—	3,400	lb. per	hour.		
12.30	3.66	0.24	0.056	0.40	0.55							
12.45	3.91	0.24	0.064	0.46	0.50							

Phosphorus reduction : Maximum, 51 per cent. Minimum, 16 per cent.

TABLE IV.—*Pig-iron Melt. Ex. D.P.*2.

Time.	T.C.	Si	S	Mn.	P	Details of Cupola Charge.		
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.			
a.m.							Lbs.	
9.30	3.99	0.19	0.080	0.43	0.58			
10.00	4.08	0.34	0.074	0.38	0.54	Pig-iron ..	500	(Analysis same as Ex. D.P.1.)
10.15	4.12	0.34	0.066	0.59	0.64	Limestone	20	
10.30	4.14	0.35	0.070	0.62	0.61	Spar ..	10	
10.45	4.07	29	0.070	0.55	0.58	Ore	10	
11.00	4.09	0.49	0.080	0.48	0.70	Coke ..	70	
11.15	3.97	0.53	0.084	0.50	0.66	Coke bed ..	—	42 in.
11.30	4.0	0.34	0.084	0.53	0.65	Melting rate	—	3,860 lb. per hour.
11.45	4.12	0.34	0.064	0.44	0.68			

Phosphorus reduction : Maximum, 27 per cent. Minimum, 5 per cent.

NOTE.—The analyses in these tables are from samples taken from the metal as it was melted and they are not representative of any particular quantity of metal.

Using charges of 100 per cent. cast-iron scrap having a sulphur content of 0.120 per cent. the average sulphur content of the molten metal produced from the basic cupola was 0.056 per cent., *i.e.*, a sulphur reduction of 53 per cent. In each melt the first metal tapped from the cupola had a higher sulphur content than succeeding taps, due to the fact that at this stage only a small volume of slag was available in the well and temperatures were below normal. A reduction in the volume of slag present in the well later in the melt was found to lead to an increase in the sulphur content of the metal.

The slag produced under conditions of maximum desulphurisation had, when cold, a light brown chalky appearance. By overblowing the cupola, thus creating an oxidising condition, it was found that the sulphur in the metal rose from 0.050 per cent. to 0.075 per cent., with a change in the colour of the slag to dark brown. The analyses of typical pale brown and dark brown slags are given in Table II.

This process has been put into commercial production, and metal is being regularly produced with a sulphur content 50 per cent. lower than was obtained from an acid furnace. When required, final figures between 0.03 and 0.05 per cent. sulphur can be obtained. Under these particular conditions of operation there is no outstanding effect on the elements carbon, silicon and phosphorus such as were reported by Heiken.

Experiments in Dephosphorisation

In metallurgical processes concerned with the removal of phosphorus, certain fundamental reactions occur, comprising the oxidation of the phosphorus constituent to iron phosphate, followed by its ultimate removal in the slag as calcium phosphate. The phosphorus is retained in the slag only when the latter is

TABLE V.—*Slag Analysis—Pig-iron Melts.*

	Ex. D.P.1.	Ex. D.P.2.
	Per cent.	Per cent.
SiO_2	28.80	27.40
Al_2O_3	10.37	11.54
CaO	44.00	45.20
MgO	11.40	13.86
FeO	1.14	1.00
MnO	1.44	1.65

TABLE VI.—*Dephosphorisation with Minimum Silicon in Charge. Phosphorus Increased Progressively in each Melt by the Use of Wrought Iron.*

Melt No.	Metal Charge.		Charge Comp.		Average Final Analysis.					Phosphorus Reduction.	Remarks.
	Steel Scrap.	Wrought Iron.	Si	P	Si	P	Mn	S	T.C.		
	Lb.	Lb.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
Ex. D.P. 7	1,300	—	0.30	0.060	0.20	0.022	0.15	0.120	2.50	63.3	
Ex. D.P. 8	1,300	—	0.30	0.060	0.34	0.029	0.21	0.130	2.70	52.0	
Ex. D.P. 9	900	400	0.20	0.133	0.062	0.028	0.16	0.110	2.60	79.0	Wrought iron, 0.30 p.c. P. Steel scrap, 0.060.
Ex. D.P. 5	975	325	0.23	0.200	0.20	0.053	0.17	0.110	3.06	73.5	Wrought iron, 0.60 p.c. P. Steel scrap, 0.060.
Ex. D.P. 6	720	580	0.20	0.300	0.16	0.065	0.13	0.100	2.85	78.0	Wrought iron, 0.60 p.c. P. Steel scrap, 0.060.
Ex. D.P. 12	—	1,300	0.050	0.60	Tr.	0.12	Tr.	0.130	2.70	80.0	Wrought iron, 0.60 p.c. P

TABLE VII.—*Dephosphorisation with Silicon Present.*

Melt No.	Metal Charge.			Charge Comp.		Average Final Analysis.					Phosphorus Reduction.	Remarks.
	Steel Scrap.	Wrought Iron.	Ferro-Silicon (78 per cent. Si).	Si	P	Si	P	Mn	S	T.C.		
	Lb.	Lb.	Lb.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
Ex. D.P.13	1,300	—	10	0.90	0.060	0.33	0.035	0.27	0.110	2.70	41.0	
Ex. D.P.14	1,300	—	16	1.26	0.060	0.70	0.036	0.25	0.090	2.54	40.0	
Ex. D.P.15	1,300	—	30	1.80	0.060	0.97	0.039	0.29	0.090	2.70	35.0	
Ex. D.P.17	1,100	200	20	1.37	0.110	1.06	0.061	0.28	0.069	2.70	45.0	Wrought iron, 0.40 p.c. P Steel scrap, 0.06 per cent.
Ex. D.P.16	1,100	200	35	2.15	0.110	1.50	0.059	0.27	0.082	2.86	46.4	Wrought iron, 0.40 p.c. P Steel scrap, 0.06 per cent.

Melting Furnaces Sub-Committee

strongly basic, and to a certain extent oxidising. The retarding effect of silicon is very pronounced, and its removal is considered necessary before the phosphorus can be effectively eliminated. Preliminary work carried out in the basic cupola in an attempt to reproduce the above reactions in this type of furnace, is reported herewith.

Preliminary Melts with Pig-iron

Tables III and IV give the results of two of the first melts using an all pig-iron charge, the cupola used having an internal diameter of 24 in., and being fitted with a continuous tapping arrangement. It will be seen from these results that the amount of dephosphorisation varied between 5 per cent. and 50 per cent., but was in no way consistent, being almost dependent on the extent of the silicon removal. In general, samples which showed the maximum silicon loss also gave the maximum amount of dephosphorisation; as in Table III, when the silicon had been reduced from 0.77 per cent. to 0.05 per cent., 50 per cent. dephosphorisation was obtained. Table V gives the analyses of typical samples of slag produced on these two melts.

Dephosphorisation of Steel Scrap, Wrought Iron and Pig-iron Charges

Tables VI, VII and VIII give the results obtained in a series of melts using steel scrap as the base material of the charge; the phosphorus was increased in the charge by the addition of wrought iron and, at the same time, the limiting effect of silicon on dephosphorisation was investigated.

The basic cupola used for these melts was of standard design, dimensional details of which are given in Table IX; this furnace being in regular production as part of a duplex cupola/electric furnace unit. Experimental melts followed the normal daily production with the exception of melts Ex. D.P.9 and Ex. D.P.12, which were conducted as entirely separate melts. The cupola is fitted with a continuous tapping arrangement previously described[2], and as the well of this furnace carries only a small weight of metal, with no intermediate ladle between cupola and electric furnace, frequent sampling at five minute intervals is necessary, the average of the samples giving a more representative analysis. The analytical results are therefore condensed in Tables VI, VII and VIII, and details of certain of the individual melts are given in Tables X, XI, XII and XIII.

(*Continued overleaf, column* 1.)

TABLE VIII.—*Dephosphorisation with Pig-iron and Steel Scrap Charges.*

	Charge.				Charge Composition.		Average Final Analysis.					Total Phos. Reduction.	Phos. Reduction in Pig-iron.*	Remarks.
	Steel Scrap.	Wrought Iron.	Pig-iron.	Mill Scale.	Si	P	Si	P	Mn	S	T.C.			T.C. Si P Mn S
	Lb.	Lb.	Lb.	Lb.								Per cent.	Per cent.	
Ex D.P.10	1,150	—	150	—	0.40	0.140	0.30	0.077	0.26	0.070	2.98	45	35	Pig-iron: 3.80, 2.30, 0.76, 0.90, 0.046 *Object.*—To use high phos. pig-iron to replace hematite iron in Tropenas Charge.
Ex D.P.11	1,040	—	260	—	0.40	0.30	0.15	0.21	0.31	0.103	3.10	30	22	Pig-iron: 3.80, 1.20, 1.25, 0.80, 0.060 *Object.*—To find the limiting effect of silicon when present in the phosphorus-rich portion of the charge.
Ex. D.P.18	900	—	400	—	0.37	0.257	0.35	0.19	0.45	0.083	2.82	26	20	Pig-iron: 4.0, 0.76, 0.70, 0.97, 0.107 *Object.*—As Ex. D.P. 11.
Ex. D.P.20	900	—	400	30	0.37	0.257	0.26	0.185	0.48	0.130	2.84	28	21	Pig-iron: As Ex. D.P. 18. *Object.*—To attempt oxidation of phosphorus with Mill Scale.
Ex. D.P.19	840	200	260	—	0.95	0.107	0.67	0.064	0.41	0.097	2.80	40	—	Pig iron: 3.80, 3.75, 0.053, 0.87, 0.097 *Object.*—To find the limiting effect of Silicon when the phosphorus is present in the low-silicon portion of the charge.

* Calculated on the assumption that the phosphorus in the steel scrap was reduced to 0.025 per cent. (*See* melts Ex. D.P. 7 and Ex. D.P. 8.)

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Another heat-consuming process which lends itself to the use of waste heat from other operations is the drying of incoming silica sand for cores. This sand should, of course, be stored under cover (*a*) for protection against the rain, (*b*) so that some of the moisture can evaporate to atmosphere, and (*c*) so that excessive moisture, due to the sand arriving in unsheeted wagons, can drain away by gravity. Any moisture remaining when the sand is required for use must be removed by the application of heat. One firm uses waste heat for this purpose by loading the sand into trays, which are then circulated through the continuous core stove after the day's core drying is finished, the residual heat in the stove being sufficient to dry the new sand. Another stores a supply of new sand in bins backing on to the drying stove, the drying being done by heat conducted through the wall. At a third firm a layer of new sand is spread over the floor of the mould drying stove for each firing.

There are doubtless numbers of other methods which can be used in individual cases. Cannot some of the heat which is necessarily wasted in your foundry be put to good use? If you already operate a scheme which might be of interest to other founders, details of it would be gratefully received by the Fuel Officer, Ironfounding Industry Fuel Committee, Alvechurch, Birmingham.

The joint conference on "Instruments for the Automatic Controlling and Recording of Chemical and Other Processes," organised by the Institution of Chemical Engineers, the Institute of Physics, and the Chemical Engineering Group of the Society of Chemical Industry, which was to have been held in London on September 22 and 23, has been postponed.

American malleable iron castings production for the first six months of the year, at 440,478 short tons, registered a moderate gain over the 1943 figure, which was 419,745 tons.

FIRST REPORT ON THE BASIC CUPOLA BY THE MELTING FURNACES SUB-COMMITTEE

(*Continued from previous page.*)

Table VI indicates the extent of dephosphorisation with a minimum percentage of silicon in the charge Table VII gives the results with varying amounts of silicon added to the charge in the form of ferro-silicon. In the series with no avoidable silicon present, some difficulty was experienced in operation, there being a tendency to bridging. The relatively small amount of silicon added in the second series appeared to off-set this effect, and there were no apparent melting difficulties. Experimental results with steel scrap and pig-iron charges are given in Table VIII, and indicate that a certain amount of dephosphorisation of pig-iron is possible when melted with a high percentage of steel scrap.

(*To be continued.*)

OPEN JOINTS IN PATTERNS

ALTERNATIVE TO STOPPING-OFF PIECE

By "CHECKER"

Instances arise when patternmakers have to joint two or more pieces of wood together, to get the required width for the pattern, and may be requested to forgo the ordinary glue joint, and use the open joint method. This in itself will present very little difficulty if the construction of the pattern is such that the separate pieces of wood can be secured together by means of ribs and bosses. With shell patterns that have no suitable parts either external or internal to strengthen the joint face, suitable means must be found to connect the pieces together and give them the necessary rigidity in the centre.

For this purpose a stopping-off piece could be positioned across the joint as shown in Fig. 1; but the following method may be preferred, which will produce a strong open joint without any of the disadvantages of a stopping-off piece.

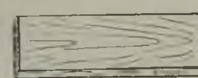


FIG 2

FIG 1

FIG 3

First prepare the boards to be jointed to the correct width, and then into the edge of one board at each joint, drive in round nails at suitable intervals, leaving them protruding so that sufficient will be projecting to act as a dowel after the heads have been clipped off, as shown in Fig. 2; care must, however, be taken to ensure that they are square with the edge. Then place the faces of the two boards making one joint, together on a straight faceplate or anything flat, and press them together; this will give the impression of the ends of the nails on the other board, which is the correct position for holes to be bored into the board. These holes must be of a smaller diameter than the nails to guarantee a good fit.

Then knock the boards together, which will force the nails into the holes in the opposite board. To keep the boards the right distance apart at the joint, insert pieces of wood the required thickness, as shown in Fig. 3, when assembling the boards together.

NEWS IN BRIEF

UNITED SILICA INDUSTRIES, LIMITED, Brynamman, is paying a first and final dividend of 13s. 0½d. in the £, payable on September 28, at the Official Receiver's Office, Government Buildings, 10, St. Mary's Square, Swansea.

REPORTS FROM EIRE state that the necessary refractory bricks to complete their two steel-melting furnaces at Haulbowline have now been obtained by Irish Steel, Limited, from the United States. In the interests of the Haulbowline works, export of scrap steel from Eire has been stopped for some time past.

MR. W. W. WATT will deliver his Presidential Address at a general meeting of the Institute of Welding, to be held at the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1, on September 27, at 6 p.m. The Sir William J. Larke Medal will be presented to the winner of the 1944 competition, Mr. H. W. Clark, M.Inst.C.E.

A MAJOR SHARE in the firm of Joseph Evans & Sons (Wolverhampton), Limited, of Culwell Works, Wolverhampton, has been acquired by Newman Industries, Limited, of Bristol. Joseph Evans & Sons are manufacturers of pumps and pumping machinery. Mr. J. Osmond Evans, formerly chairman and joint managing director, with his brother, Sir Walter Evans, Bt., will be directors of the firm, and Mr. Anthony A. Evans, Sir Walter's son, becomes a director.

ONE STEEL COMPANY in U.S.A. is so pleased with the use of colloidal fuel for open-hearth use that it may continue to use it after the present emergency is ended. Recently the company has been using a mixture of 13 per cent. powdered coal with fuel oil at a saving of 50,000 barrels of fuel oil per year, based on an annual consumption of 500,000 barrels. The equipment set up for preparing this fuel is working well, and is described in a recent issue of "Steel."

BRITAIN HAS AN excellent chance of making a better and quicker recovery from the war than any other country in the world to-day, Sir Miles Thomas, vice-chairman of the Nuffield organisation, assured Cardiff Rotary Club on September 11. Many people, he said, feared that we were going to be dogged by the spectre of mass unemployment. Rather than make us shrink up in caution, that likelihood was a challenge to a race whose forebears carried its trading over the waters.

TO INCREASE THE abrasion resistance and the resultant life of parts of equipment subject to wear, nickel-chromium white iron has been successfully and extensively used in castings. The following composition limits have been found best for obtaining a material of optimum wear-resistance for the applications made: Total carbon, 3.40 to 3.75 per cent.; silicon, 0.35 to 0.50; manganese, 0.40 to 0.70; nickel, 4.50 to 5.00; and chromium, 1.50 to 1.75 per cent. These applications include dredge-pump shell liners, impellers, pipe and flanged elbows; pulleys for copper-casting wheels; welding rod for hard-surfacing worn-down equipment, etc.

PERSONAL

MR. JOHN PHILP, commercial manager of Scotts' Shipbuilding & Engineering Company, Limited, Greenock, has retired after over 43 years' service with the firm.

MR. W. H. CATHCART, of the metallurgical staff of Lobnitz & Company, Limited, Renfrew, has been presented with a cheque by the firm for his research work, and a wallet of Treasury notes from the staff, on the occasion of his retirement. Widely known in engineering circles, Mr. Cathcart was for 20 years lecturer in the Royal Technical College, Glasgow, evening classes for blacksmiths and forgers.

MR. E. W. JOHNSTON, who as joint honorary secretary has for a considerable time past dealt with the secretarial work connected with the Diesel Engine Users' Association, is resigning his post owing to ill-health. Mr. Johnston is an honorary member and past-president of the association. He is succeeded as secretary by MR. HAMISH FERGUSON, who for some months has been assisting him in the work.

MR. W. W. WOOD, who has been Master Cutler for the last four years, and also in 1924, was re-elected at a meeting of the Cutlers' Company at Sheffield last week. He thus becomes Master Cutler for the fifth year running. Mr. Wood is a director of the Wardsend Steel Company, Limited, whose shares were acquired by Darwins, Limited, in March this year, when Mr. Wood joined the board of both Darwins and Andrews Toledo, Limited.

Wills

BROWN, F. H., of Hove, iron merchant	£20,803
CARSTAIRS, W. D., of Glasgow, lead manufacturer and metal merchant	£36,682
SAYER, JAMES, of Moseley, late chairman of Joseph Lucas, Limited, and Joseph Gillott & Sons, Limited	£183,073
COOMBE, L. J., of Calver, Derbyshire, deputy chairman and managing director of Spear & Jackson, Limited	£36,370

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.

563,292 JEFFREYS, S. T., and JONES (MACHINE TOOLS), LIMITED, E. H. Sharpening of twist drills and the like.

563,326 SUPERIOR STEEL CORPORATION. Bimetallic billets and methods of preparing and rolling the same.

563,358 CASTINGS PATENT CORPORATION. Method and means for forming metal castings.

563,409 TINKLER, A. Apparatus for smoothing or finishing the surfaces of balls utilised in ball bearings.

563,436 STANTON IRONWORKS COMPANY, LIMITED, and WILSON, P. H. Centrifugal casting of metal bodies or articles.

COMPANY RESULTS

(Figures for previous year in brackets)

A. Reyrolle—Interim dividend of 5% (same).

Glover & Main—Interim dividend of 5% (same).

G. Hopkins & Sons—Interim dividend of 6% (same).

Craven Bros. (Manchester)—Interim dividend of 5% (same).

Thomas Robinson & Son—Interim dividend of 2½% (same).

Qualcast—Final ordinary dividend of 10%, plus a bonus of 10%, making 30% (same).

Fodens—Net profit for the year to May 31 last, £34,362 (£32,116); dividend of 8% (same).

Central Provinces Manganese Ore—Interim dividend of 9d. per unit of 10s. stock, free of tax (same).

Vaughan Bros. (Drop-Forgings)—Final dividend of 10%, making 20%, for the year ended June 30 (same).

Irish Steel—Net credit balance for the year ended March 31, 1944, of £10,551, reducing the debit balance at profit and loss to £82,279.

International Aluminium—Profit for 1943, after amortisation and N.D.C., £33,941 (£27,499); income-tax, £7,600 (£4,000); preference dividend, £17,374 (same); no ordinary dividend; forward, £24,231 (£17,663).

Metropolitan Electric Cable & Construction—Net profit for 1943, £43,726 (£34,626); taxation, £24,518 (£18,655); to preference share reserve, nil (£10,000); dividend of 7½% (same) on the ordinary shares; forward, £17,452 (£2,969).

Brightside Foundry & Engineering—Profit for the year to June 30, 1944, £127,303; net profit, after £50,816 (£87,475) for taxation, £76,059 (£75,246); war contingencies, £20,000; special depreciation, £15,000; ordinary dividend of 35% (same); forward, £100,000 (£90,816).

Steel & Company—Net profit for the year to March 31, 1944, after charging depreciation, £20,099 (£19,588); to reserve, £5,000 (£4,953); superannuation, £1,000 (same); preference dividend, £3,300; ordinary dividend of 12½% (10%), £6,875 (£5,500); forward, £12,542 (£8,618).

Aluminium Corporation—Profit for 1943, after depreciation and E.P.T., £44,703 (£51,186); loan interest, £4,000 (same); debenture interest for 1941 to 1943, inclusive, bringing payment up to date, £15,750 (1937-40, inclusive, £21,000); income-tax, £27,000 (£26,700); forward, £2,145 (£6,591).

CONTRACT OPEN

The date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Halifax, September 30—Supply and erection of six cast-iron purifiers, complete with substructure, valves and connections, and oxide handling plant, for the Town Council. The Manager and Engineer, Gasworks, Mulcture Hall Road, Halifax.

NEW COMPANIES

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

Prolen, Vine Street Chambers, Nelson, Lancs—Engineers, etc. £1,000. H. Proctor and A. Simpson.

Walter Davies & Son (Wellington), Green Bridge Works, Stafford—Engineers, etc. £15,000. H. F. and W. D. Burgess.

Thomas Trusty, 104, High Holborn, London, W.C.1—Engineers, etc. £1,000. W. H. Southgate and G. E. Martindale.

Nyland Engineering & Supply Company, 70, High Street, Burton-on-Trent—£500. T. W. Davis, C. E. Rees, and E. J. Everett.

J. Mealor & Sons, Providence Works, Neston, Wirral, Ches—Engineers, etc. £2,000. L. N. Shakeshaft and E. B. Gasking.

M. A. Johnson, 1, The Close, Fernbank Road, Ascot, Berks—Engineers and founders, etc. £1,000. W. Belcher and H. Biddulph.

Precise Engineering Welding (East Ham), 51, Milton Avenue, East Ham, London, E.6—£1,000. S. E. Mason and N. F. Gernat.

Biltonhill Company, 113, Park Street, London, W.1—Manufacturers of engineering equipment, etc. £100. P. Bilton and W. L. Hill.

John Morgan (Chiswick)—Engineers, tool makers, etc. £1,000. P. T. Heyes, 5, Hamilton Gardens, Hockley, Essex, subscriber.

Adair & Company (Liverpool), 7, Victoria Street, Liverpool—Engineers. £5,000. M. H. Adair, T. McNeish, and C. P. Dean.

Regwell—Manufacturers of temperature and pressure controls, etc. £500. A. Fletcher, Ellerwood, Bowness-on-Windermere, subscriber.

Howard Pyper, 30, High Street, Kempston, Beds—Engineers, etc. £5,000. D. S. Judge, M. J. Cairns, and H. L. and W. I. Pyper.

Andrews Maclaren, 208, Fulham Palace Road, London, W.6—Engineers, etc. £1,000. O. F. Maclaren and H. and W. G. Andrews.

Vickers Goodwin, Albion Engineering Works, Kidsgrove, Staffs—Engineers, metal workers, etc. £25,000. A. Goodwin and A. W. Vickers.

Milsanjeph, 139, Pembroke Road, London, N.10—Founders, toolmakers, etc. £10,000. I. C. Sanderson, A. E. Mills and P. H. R. Jephson.

Par-Nik Engineering Company, 67, Hawkesley Mill Lane, Northfield, Birmingham—£1,000. C. R. Parsons, A. H. Nickless and G. W. Parsons.

Jas. E. Reed & Sons (Shiremoor), Hill Top, Shiremoor, Northumberland—Agricultural engineers, etc. £7,000. J. E., J. F., and W. D. Reed.

Darwins Magnetic & Radio Alloys, Fitzwilliam Works, Sheffield—£100. W. J. Wigney, C. E. Adams, A. Linley, J. E. Gould and S. Evans.

Frigid Supply, 90, Holdenhurst Road, Bournemouth—Manufacturers of refrigerating machinery, etc. £7,500. G. F. Howard and E. J. Haysome.

Raw Material Markets

IRON AND STEEL

The decline in foundry work, more noticeable in the light-castings trade, is now affecting the engineering and allied foundries, and the weekly specifications for pig-iron, particularly high-phosphorus grades, are only for very limited tonnages. The shrinkage in the consumption of low-phosphorus and refined iron has not been so pronounced, but deliveries of these grades also can be obtained at short notice. The blast furnaces continue to turn out ample tonnages of basic iron for the requirements of the steelworks. Only hematite is scarce. The new allocations are as generous as circumstances permit, but there is little prospect of increased production until more liberal supplies of hematite ores from Spanish or Mediterranean ports are available.

There has been a considerable improvement in the scrap position during the past week or so. Supplies are now flowing much more freely. However, there is still a ready market for all the available supplies of wrought-iron scrap, while cast-iron in foundry grades moves off steadily. Demand for first-class machinery metal is still in advance of the supply.

At the moment coke supplies are adequate, but there is every indication that the position will deteriorate with the advance of winter. An announcement of the extent of the increase in blast-furnace coke prices has not yet been made, but we understand that an advance of 5s. 6d. per ton has been agreed upon. This compares with 6s. for foundry coke.

The re-rolling industry is the one branch of the steel trade which has so far been exempt from the general story of recession. The demand for light sections, small bars and strip is extensive, and if the pressure for sheets has temporarily eased a little, the requisitions for steel semis have been increased by heavy demands from the wire drawers. In the aggregate the output of blooms, billets, slabs, etc., falls short of requirements, and re-rollers are still making liberal use of defective billets, double sawn crops, old rails and other forms of re-rolling material.

Prospects for the heavy steel trade in the fourth period are still obscure. No sanguine hopes are entertained of any early release of surplus capacity for civilian business, and the shrinkage in the volume of war work is still very marked. A steady flow of specifications for railway and colliery material is maintained, and it is questioned whether the capacity of the sheet mills will be equal to the post-war demand. On the other hand, the flow of orders for plates is distinctly sluggish, and heavy joists and channels figure still more inconspicuously in the rolling programmes. This, however, is a period of unexpected changes, and the best that can be said is that the steelworks are in a position to make an instant response to emergency requirements.

NON-FERROUS METALS

There has been no increase in the demand for the non-ferrous metals, although the scale of our operations on the Continent must entail a large consumption of material. Soon there should be a call for metal from France and Belgium, as in recent years all available material has been taken up in the German war production drive. Copper is known to be particularly scarce. A proportion of these requirements may be met with battlefield scrap. With the rapid Allied advance this source of supply is not available to the Germans, whose position in regard to copper supplies must now be extremely insecure. Although all the needs of industry in this country are being fully satisfied, there has been no disposition on the part of the Control to relax the restrictions on civilian production.

Conditions in the tin market remain virtually unchanged, both in Britain and the United States, there being a sufficiency of metal for all essential purposes. According to reports from New York, Mr. Mauricio Hochschild, the Bolivian tin-mine owner, has denied that he is in the United States for the purpose of negotiating with an American company for the sale of his mines. He stated that his visit was in connection with obtaining a higher price for the tin supplied to the Texas tin smelter in order to offset the higher cost of mining in Bolivia.

The United States War Production Board has announced a further reduction in the output of aluminium. Four Government-owned plants are affected by this decision. It has also been announced that imports of aluminium from Canada, scheduled over the remainder of the year, have been sharply reduced.

NEW TRADE MARKS

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

"Acme"—Transformers and other electrical apparatus. British Rola, Limited, 3 and 4, Clements Inn, London, W.C.2.

"Hardamant"—Hard metals and compound metals. Leon Nussbaum, 7, Aquila Street, St. John's Wood, London, N.W.8.

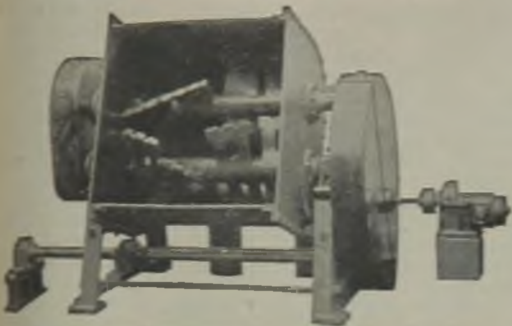
"Speartipt"—Metals; machine tools and parts. Spear & Jackson, Limited, Aetna Works, Savile Street East, Sheffield.

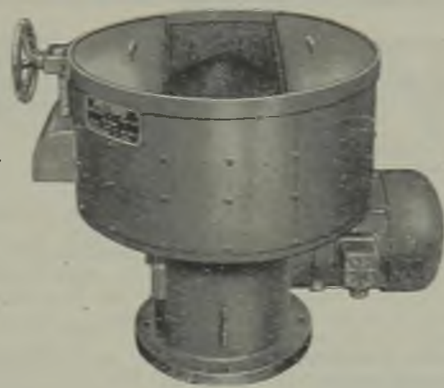
"Testlumin"—Ingots of aluminium and of aluminium alloys. B.K.L. Alloys, Limited, Kings Norton, Birmingham, 30.

"Wright" — Electric motors and machinery. Wright Electric Motors (Halifax), Limited, Pellon Road, Halifax, Yorks.

"Broomwade"—Air and gas compressors, pumps, pneumatically operated tools. Broom & Wade, Limited, Hughenden Avenue, High Wycombe.

"Telechron"—Electric motors. Warren Telechron Company Incorporated, c/o Charles H. Burgess, Crown House, Aldwych, London, W.C.2.





CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, September 20, 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* 3*s. above No.* 3. *No.* 4 *forge* 1*s. below No.* 3 *for foundries,* 3*s. below for ironworks.*)

Hematite.—Si up to 3.00 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* 5*s. 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 per cent., £25 10s.; 75 per cent., £39 10s. 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.—4/8 per cent. C, £46 10s.; max. 2 per cent. C, 1s. 3¾d. lb.; max. 1 per cent. C, 1s. 4¼d. lb.; max. 0.5 per cent. C, 1s. 6d. 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.

SEMI-FINISHED STEEL

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* 15*s. 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, 10½d.; 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.

NON-FERROUS SCRAP

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 Sept. 16, 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.*)

SMALL ADVERTISEMENTS

SITUATIONS

FOUNDRY MANAGER desires post; overseas commission considered; ambitious, strict disciplinarian; technical and practical experience engineering castings, steel and non-ferrous; conversant all depts.—Box 664, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

CAPABLE Representative, with exceptional knowledge of foundry trade, would like to get in touch with first-class firms requiring representation in Midlands area.—Box 660, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY MANAGER wanted for foundry capacity 150/200 tons per week; experience modern heavy foundry practice necessary; considerable scope for development; post permanent and superannuable.—Apply, stating age, experience, and salary required, to Box 662, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Council invite applications for the post of CHIEF OF THE DEVELOPMENT DEPARTMENT. Salary £1,000-£1,200 per annum.—Applications should be sent to the SECRETARY of the Association, Alvechurch, Birmingham, from whom a memorandum relating to the appointment may be obtained.

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"TILGHMANS" Sand Blast Outfit; complete with compressor; motorised, a.c., 400/3/50.—URQUHART, 1023, Garratt Lane, S.W.17.

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Standard Size Adaptable Moulding Machines, etc.
"Ajax" No. 9 Macdonald Pneumatic Jolter turnover table, 36 in. by 46 in.
Coal and Coke Crusher; 2 ft. 6 in. dia.
Brealey Type Sand Disintegrator.
Macnab 5 ft. 6 in. Sand Mills, Size No. 2, with or without 3/50/400 v. motor.
Broadbent Brick Crusher; 8 in. jaw.
Broadbent Brick Crusher; 11 in. jaw.
Sandblasting Plant; 50 Air Compressors; 500 Electric Motors, Dynamos, etc.

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CROSSWELLS ROAD, LANGLEY,
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SECONDHAND CENTRIFUGAL PUMPS.

Horizontal Slit Casing Centrifugal Pump; 4 in. suction and delivery branches; 41 ft. head at 1,365 r.p.m.; on combined bedplate; no motor.

"SULZER" Centrifugal Pump; 7 in. suction and delivery branches; ring oil bearings, on combined bedplate; no motor.

Horizontal Slit Casing Centrifugal Pump, 4,200 g.p.m., 122 ft., 1,170 r.p.m., 14 in. suction, 12 in. delivery; arranged for direct coupling to motor drive (no motor or bedplate).

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Pneulec Oil Core Sand Mixer, type P.M.; arranged for motor drive.
Combined Sieving and Magnetting Machine; arranged for motor drive.
UNUSED Alldays & Onions 36-in. Blacksmith's Hearth; hand-operated blower.
S. C. BILSBY, Crosswells Road, Langley Green, near Birmingham.

SKLENAR Patent Melting Furnaces; coke- or oil-fired; capacity 2 tons, 1 ton, ½ ton, 500 lbs.—SKLENAR PATENT MELTING FURNACES, LTD., East Moors Road, Cardiff.

VOGEL & SCHEMMANN, type W1, Rapid Combination Jolt Moulding Machine, secondhand, for immediate disposal; useful jolt load, 1,000 lbs., 12 in. draw, table 32 in. by 24 in.; can be seen working.—BAMFORDS, LTD., Agricultural Engineers, Uttoxeter, Staffs.

MISCELLANEOUS

WANTED.—Keen prices, with prompt delivery, for machined grey iron Furnace Doors and similar castings.—Box 656, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

METAL Patternmaking Firm, having expert knowledge and experience of making Moulding Machine Metal Plate Patterns, and Coreboxes for blowing Cores of Globe and Gate Valves for Steam and Water.—Please write to the advertisers, who have work to place immediately, Box 658, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

CAPACITY available in a few weeks time for Non-ferrous Castings up to 1½ cwt.; particularly small castings for 16 by 12 box parts.—Please send your enquiries to WARWILL, LTD., Abertillery.

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MISCELLANEOUS—*contd.*

LEATHER APRONS for the Foundry Trade—Made of best quality materials; various types available from 10s. each; 16-page catalogue of Aprons and other lines of industrial clothing and equipment sent post free on receipt of 3d. stamps.—WILLSON BROS., Epsom, Surrey.

MODERN North London Foundry have immediate capacity available for Ferrous and Non-Ferrous Castings at competitive prices; non-ferrous up to 3 cwts., ferrous up to 12 cwts.; can undertake speedy deliveries of large quantities and specialise in production of Manganese Bronze and Aluminium Bronze.—Box 648, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

LEATHER FINGER STALLS.—Made of chrome hide; very strong and hard wearing; length 3 in; price 4s. per doz.; prompt delivery; sample on application.—WILLSON BROS., Industrial Clothing Manufacturers, Epsom, Surrey.

PATTERNS for all branches of Engineering, for Hand or Machine Moulding.—FURMSTON AND LAWLOR, Letchworth.

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£170 0 0 per ton
Offers—Box 650, *Foundry Trade Journal*, 3, Amersham Road, High Wycombe.

16—20 in. by 3 in. by 6 in. hole, 22—20 in. by 1 in. by 6 in. hole, 20 grit Carborundum and Universal Grinding Wheels; brand new; suitable for cast iron; cost £7 14s. and £3 10s. respectively; accept £5 5s. and £2 7s. 6d. each for lot.—FILIUS ENGINEERING CO., LTD., Icknield Road Works, Luton.

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Britannia large size plain jolt and pattern draw moulding machine, 8 in. dia. cylinder, table 4 ft. x 3 ft. reconditioned.
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