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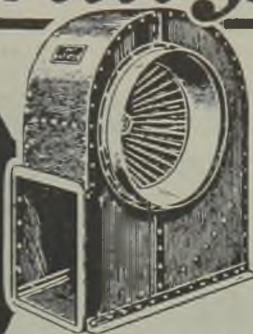

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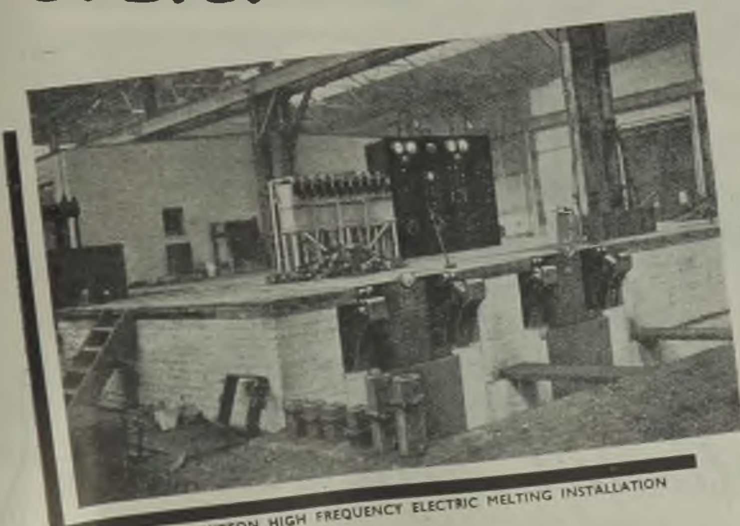

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"Let There Be Light"

It is difficult not to associate the increase in pulmonary diseases amongst shot-blast operatives in the steel foundry industry with the factory black-out regulations, but this is only one reason for urgency for their abolition at the earliest possible moment. Other reasons are the banal influence on the morale and health of everybody working in the foundry industry. There is no light reflection from black sand, and this makes for particularly depressing conditions. Generally speaking, the imposition of black-out regulations makes for poor ventilation. The black-out is directly responsible for much absenteeism; untidiness; increased fuel consumption; and defective work. We are sure that whenever a body of foundrymen meets for any purpose whatsoever, if resolutions were passed urging the rescinding of the black-out regulations in so far as they apply to the foundry industry, they would receive sympathetic reception by most of the Ministries.

The Ministry of Fuel and Power would readily recognise the important savings that would accrue from the reduction in artificial lighting. The Ministry of Labour and National Service being responsible for the health of industrial workers must have on record statistical proof of the increased prevalence of illness and accidents directly ascribable to this cause. Surely their support can be relied upon. The Ministry of Supply, the personnel of which is largely drawn from industry, will well recognise that the flow of munitions to the fighting services rests on the dual bastions of the health and morale of the operatives in key industries. The support of this Ministry should be enthusiastic. The Board of Trade is insistent that if we are to survive after peace is established we must export, and to do this successfully there must be industrial efficiency. The foundry cannot achieve a high standard of efficiency with a lowered morale and impaired health. Here, too, then, industry can look for support.

Against all this is the Ministry of Home Security, which has to be guided in its decisions by the High Command. In this connection it is germane to point out that black-out is no defence against "doodlebugs" or any other device based on remote control. The only other consideration we can visualise is a last minute suicide attack by the Luftwaffe against the civil population from motives of revenge, the destruction of munition plants being of little or no importance to a beaten enemy. Obviously there may be good reasons for the continuation of the industrial black-out regulations, but we question whether they are geographically generally applicable, and suggest that as a minimum there are large areas reasonably immune from air attack by the much depleted Luftwaffe. In quite a few establishments there is, at the moment, the labour available for removing the black-out equipment and affecting a general tidying up of the shops, and the time is propitious for launching a campaign for a relaxation if not a complete rescinding of the black-out regulations.

Dr. Zay Jeffries, the internationally known non-ferrous metallurgist and a pioneer in the development of high strength aluminium alloys and of tungsten, has been elected to the Board of Trustees of the Battelle Institute.

American production of magnesium sand castings showed a reduction of 9 per cent. in April at 3,088 tons, but that of pressure die castings increased slightly; there was also a decrease in the production of gravity die castings.

The Washington correspondent of the American "Metal Market" attributes the small decline in the May figures for the production of American munitions to the shortage of man-power in the foundry industry, as the main factor was a decrease in the production of heavy lorries owing to the shortage of castings and forgings.

Contents

DISTORTION FREE METALLIC HEARTHS

For many years furnace engineers have sought to evolve a metallic hearth for heat-treatment, carburising and annealing furnaces, by reason of the many advantages ensuing from the installation of such hearth protection—a metallic surface facilitates charging and discharging operations—hearth temperature is quickly recovered after the charging of a cold load; and there is a far greater resistance to abrasion than with a brickwork hearth, thereby greatly reducing maintenance charges of the equipment.

Because of such advantages, it has been common practice to fit heat-resisting plates on an ordinary brickwork hearth in furnaces subject to unusually rough and heavy usage, but the general development of this form of hearth protection has been hindered by the relatively high distortion of such plates when they become continually subjected to the loading of cold components. Such distortion not only makes it difficult to charge and discharge the furnaces, but the life of the plates is considerably reduced because the protective scale, normally formed on the surface of a heat-resisting metal, is cracked off when the plate distorts, with the obvious result that oxidation in depth quickly develops.

Designed for use in furnaces operating at temperatures up to 1,000 deg. C., the Patent Nicrotectile hearth developed by the Incandescent Heat Company, Limited, of Cornwall Road, Smethwick, Birmingham, completely eliminates these disadvantages. The complete hearth area is covered by a series of small heat-resisting tiles positively interlocked in all planes in such a manner that the tiles cannot be displaced even when subjected to rough handling.

The design of the small tiles is such that distortion is completely avoided, and a complete hearth can be built up, or dismantled, in a few minutes, so that if, after long service, a tile should fail, it can be replaced at negligible cost, whereas the failure of any portion of the surface of an ordinary plate hearth means the replacement of the complete large plate. Apart from protecting the hearth itself, the design of the Nicrotectile hearth also provides protection for the furnace guard tiles on either side of the hearth, and this additional feature is of the greatest practical value. In most instances the small turn-up along the side and back of the hearth provides ample guard tile protection, but when required this height can be increased to 12 in. or more by the use of special interlocking vertical side elements, as shown in Fig. 1.

The design of the hearth is clearly indicated in the illustration, which shows how a complete hearth area is covered by a series of special standard interchangeable elements. Special sizes are supplied to complete the dimensions of a standard hearth when necessary, and suitable front locking plates for bolting to the existing furnace cill plates are also provided.

Although originally designed for hearth protection, the Patent Incandescent Nicrotectiles can be used for many other purposes, being particularly suitable for the construction of waste gas dampers operating at temperatures up to 1,100 deg. C., their use eliminating in many cases the necessity for water cooling with all its attendant complications.

FIG. 1.—PATENT INCANDESCENT "NICROTECTILE" FURNACE HEARTH AND SPECIAL NICROTECTILE GUARD TILES FITTED INTO A 6 FT. × 4 FT. HEAT-TREATMENT FURNACE.

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"WENDOR"—Engineering hand tools. Ben Sless, 20, Park Cross Street, Leeds, 1.

"NEWMAN"—Electric motors. NEWMAN INDUSTRIES, LIMITED, Yate, Bristol.

"WHEWAY"—Metal chains. JOB WHEWAY & SON, LIMITED, Birchills Hame and Chain Works, Green Lane, Walsall.

"TRICRANE"—Mobile cranes. A.C.E. MACHINERY, LIMITED, Harlequin Avenue, Great West Road, Brentford, Middlesex.

"AFECO"—Agricultural and road making machines. E. ALLMAN & COMPANY, LIMITED, 115, The Hornet, Chichester, Sussex.

SAVE WASTE PAPER

THE DEVELOPMENT AND PRODUCTION OF INOCULATED CAST IRON*

Experiments to overcome some current difficulties of the ironfounder

By H. P. HUGHES and W. SPENCELEY

This Paper deals with the investigation and experiments which led to regular production of inoculated cast iron developed to replace ordinary cast iron, and so attempt to overcome some of the present-day problems of the ironfounder. The shortage of certain desirable materials has presented many problems, not the least being the inadequate supply of suitable base irons. To many the hematite stock in the yard was a regular resort when trouble occurred that was thought to be due to metal, and more often than not the fault was put right.

FIG. 1.—× 75.

The faith in hematite is not without logical reasoning, because it has many valuable properties to recommend it, some of them only now becoming fully understood. Many have attempted to fill this void by the use of refined irons and have been soon to realise that it does not adequately replace hematite. This is probably not due to the unsuitability of the material, since refined irons carefully used can give good results, but rather that the latitude in its use is greatly reduced and calls for more rigid control.

Most hematite irons fall in the hypereutectic range, refined irons, on the other hand, in the hypoeutectic range, and this fact no doubt accounts for the outstanding difference between the two. During the cooling of a hypereutectic iron, excess carbon in the form of graphite is thrown out of solution due to the decreased solubility, this graphite then forming a large number of "inoculated" centres for further precipitation and the liberty to build up in a random formation giving graphite in the most desirable distribution. On the other hand, with a low carbon or hypo-

FIG. 2.—× 75.

eutectic iron, this carbon will not be thrown out of solution so easily, and therefore does not show satisfactory graphitising effects.

In the light of present-day knowledge, hematite could be treated as a naturally inoculated iron due to the graphitising nuclei it contains, an advantage over "synthetic" graphitised irons being its power to retain the graphitising effects over a complete time range, whereas ladle inoculation has a short graphitising period. This may be due to the fact that irons of the "synthetic" type are normally hypoeutectic, and in the hematite range are hypereutectic, so that when once complete solution of the graphite nuclei

* Paper read at the Forty-first Annual Meeting of the Institute of British Foundrymen.

Inoculated Cast Iron

has taken place, no further graphitising properties are available.

The complete structure of present-day knowledge of cast iron has been built up to a great extent around graphite, its shape, size and distribution and to a lesser degree in the type of matrix. Having this in view, it is the authors' intention to indicate some of these formations found and developed during investigation, so that it may be possible to arrive at a cast iron having the most desirable graphite structure, thus giving the maximum mechanical properties, soundness and good machinability.

ment. Fig. 4 is the structure of a low carbon cast iron and is typical of such irons cast without ladle treatment. The dentritic or grain boundary effect is generally accepted as undesirable, due to the many unsatisfactory properties it possesses.

Fig. 5 is the structure of a medium carbon cast iron and shows the graphite in a cluster or rosette formation. It is contended that this rosette distribution is a modification of the dentritic structure previously shown. This distribution is again undesirable, due to the lack of continuity throughout. Fig. 6 is the structure of a medium carbon iron and shows the graphite in a random and flaky distribution, which it is maintained is the ideal formation for the production of cast iron with all-round suitable properties.

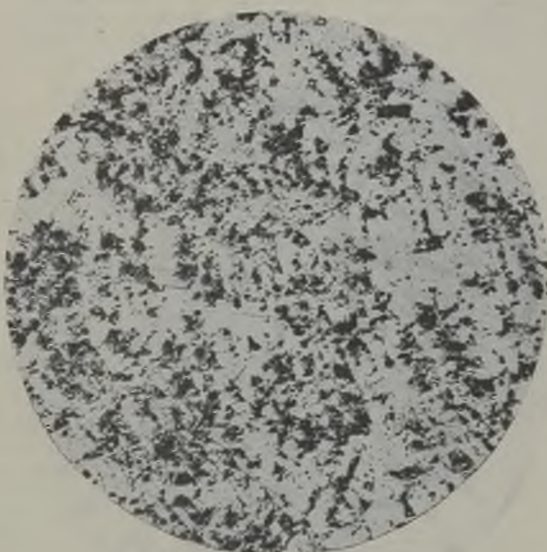

FIG. 3.—× 75.

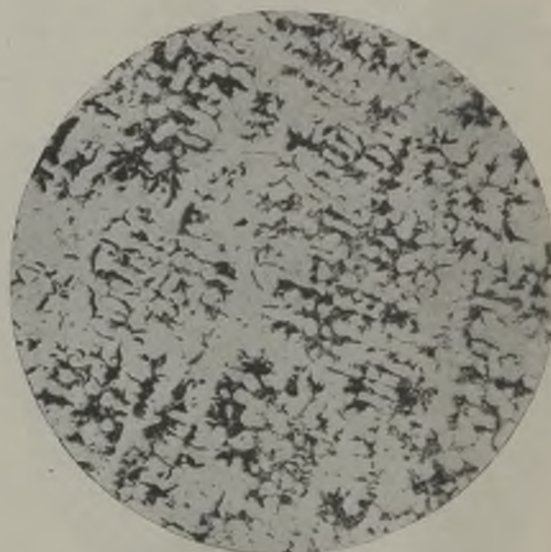

FIG. 4.—× 75.

Structure of Raw Materials

Fig. 1 is the structure of a high carbon iron chill cast showing two distinct sizes and shapes of graphite. The large graphite apparently forming at a higher temperature when there would be more freedom to grow and the fine graphite probably the decomposition of a carbon rich austenite formed at a lower temperature. It would appear that it is only possible to produce this effect with high carbon and rapid cooling. Fig. 2 is the structure of a Scotch grade of foundry pig-iron, which also shows two distinct sizes and forms of graphite structure, the large flake characteristics of slow cooling and the fine cluster formation of decomposed austenite.

Fig. 3 is a very fine distribution of graphite. This is the structure of a cast iron of American origin which was almost wholly ferritic. At high magnification it is shown in very fine flakes as a cluster arrange-

It was with this knowledge available and the fact that the cast iron that was being regularly produced did not show the most desirable distribution of graphite that the present investigation had its origin. Combined with this was the fact that serious difficulty had arisen in the machine shop. When dealing with certain types of castings, a large amount of distortion developed during machining, and to overcome this it was often necessary to exceed the number of cuts normally removed, till this movement ceased. Fig. 26 shows one such casting; it is a band saw table and is 30 in. square and $\frac{5}{8}$ in. thick, with a splitting plate introduced to leave an opening for the saws to enter.

Problem of Distortion

Under normal conditions these castings were produced from an iron containing an appreciable amount of hematite and had an added advantage of a long period of weathering in the yard before machining. It is therefore easy to visualise the difficulty of present-day conditions when no hematite is available and the speed of production did not allow a lengthy period of weathering.

Different methods were resorted to, to try and overcome this trouble; a rough machining and a further period of weathering did not obviate it, a low temperature anneal gave better results, but, as this would result in a considerable increase in the price of the casting, it was not to be decided upon unless there was no other alternative.

There has been a great deal of information on the improved machining properties of inoculated irons, but nowhere have the Authors found any on its effects on distortion. However, working from the basis that the use of hematite irons showed reduced distortion, and assuming that the beneficial properties were primarily due to their graphitising power, it was decided to try and induce similar conditions by inoculation so that in this respect it might compare favourably with hematite.

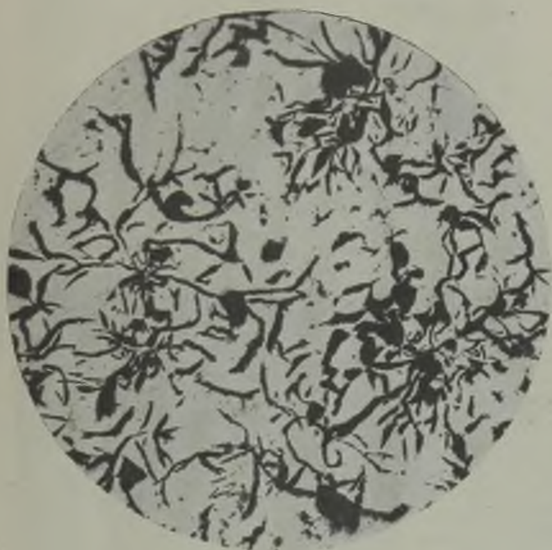

FIG. 5.—ORDINARY IRON EDGE OF 5 IN. SECTION × 75.

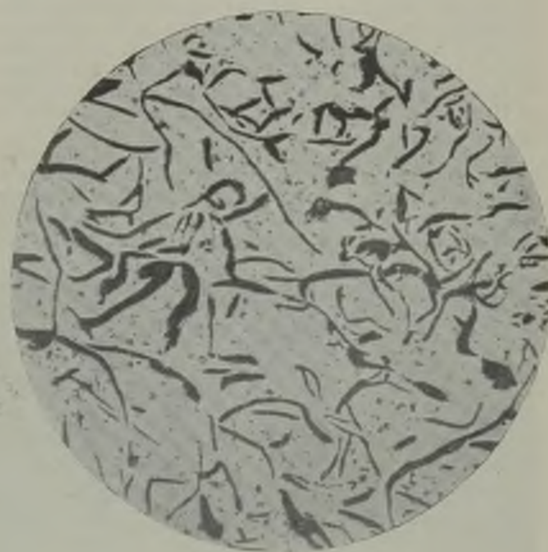

FIG. 6.—× 75.

It was therefore decided, after becoming conversant with the present trends in cast-iron metallurgy, to carry out experiments with a view to developing a practical method for the production of a suitable iron to overcome these difficulties. As is later seen, many other advantages were forthcoming from this development. As the Authors were regularly producing high strength cast iron by inoculation, and a full knowledge of the theory relating to the process became built up, it was decided to adopt a somewhat similar procedure in the production of the general cast iron.

Introduction of Inoculants

A number of complications presented themselves, first the high strength irons were produced from a small cupola with intermitting tapping, and removing a specified quantity to which was added a fixed amount of inoculant, whereas the general iron was produced from a larger cupola with continuous running from a syphon brick. Secondly the metal from the small cupola was tapped out in moderately large quantities, whereas 50 per cent. of the general metal was tapped direct into hand shanks.

It was obvious that by holding a scoop over the stream of metal and allowing the inoculating material to drop in would not be satisfactory with a continuous run of metal, due to the difficulty of determining a suitable rate of flow. After much searching a machine was found that gave every indication of meeting the requirements, *i.e.*, able to give either a regular or variable rate of flow. Fig. 7 shows this machine. Other than the control valve, there is only one adjustment necessary, and that is to raise the small hopper sufficiently far above the vibratory spout to allow the maximum size of inoculant to pass through.

It was also realised that no matter how regular the flow of inoculant into the metal, it would hardly be satisfactory when only very small quantities of metal are removed (in the order of 50 to 100 lbs.). In view of this, it was decided to incorporate a mixing ladle at the spout to ensure effective dispersion and absorption of the inoculant, and give a more satisfactory metal mix, and retain any coarse particles of inoculant that may still exist undissolved in the ladle until solution took place.

Inoculated Cast Iron

Fig. 8 shows the layout adopted to obtain the desired results, and it has proved to be what might be termed ideal inoculating facilities, through introducing a continuous trickle on to the molten stream of metal as it flows in the spout, thus allowing all the metal to come into contact with the inoculant and carry it into the ladle.

The machine adding the inoculant is operated by compressed air, and is of the vibratory type; control is by a needle valve, to give adequate movement for any necessary variations in the supply. A large scale dial is included to facilitate regulation. By suitable test, the speed of flow in lbs. per min. has been determined, and this is detailed on the dial in suitable terminology to give the furnaceman full knowledge of what is required. The versatility of the machine can be appreciated when it is realised that a variation in flow from as low as 0.25 lbs. per min. to as high as 10 lbs. per min. can be obtained with the material in use.

During continuous tapping, the speed of flow has been regulated to suit the melting rate of the cupola. When bulk metal is being removed the flow has been regulated to a fixed diameter of tap hole. This machine has given a consistently regular supply of

FIG. 7.—VIBRATORY FEEDER.

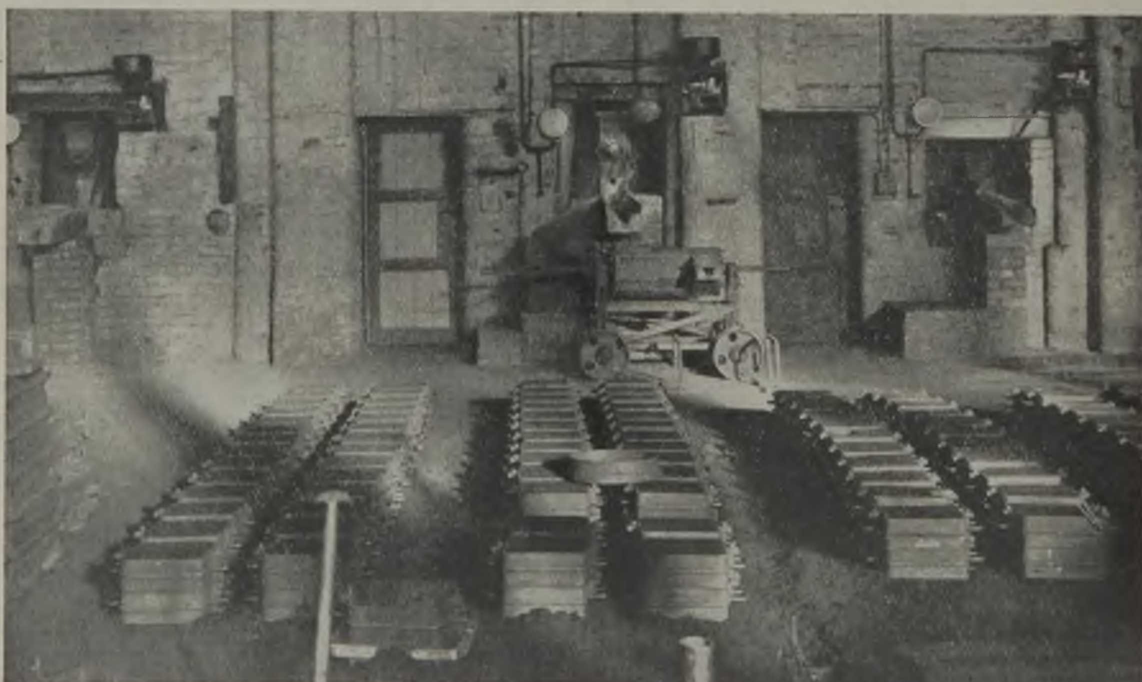

FIG. 8.—ARRANGEMENT OF FEEDERS AT THREE CUPOLAS

inoculant since it was installed. Tests taken over a period of 1 hr. gave a maximum variation of 5 per cent. Slight alterations in the melting rate of the cupola show little effect on the composition of the metal. The melting rate is taken at 5 tons per hr. with a possible difference of 10 per cent. Working on a spout addition of 0.4 per cent. silicon, the maximum difference through a change in melting rate will only give a difference in the silicon content of 0.5 per cent., and combining with it the error liable to develop in the machine, the greatest difference will not exceed 0.10 per cent. silicon.

The machine is operated at 80 lbs. per sq. in., and

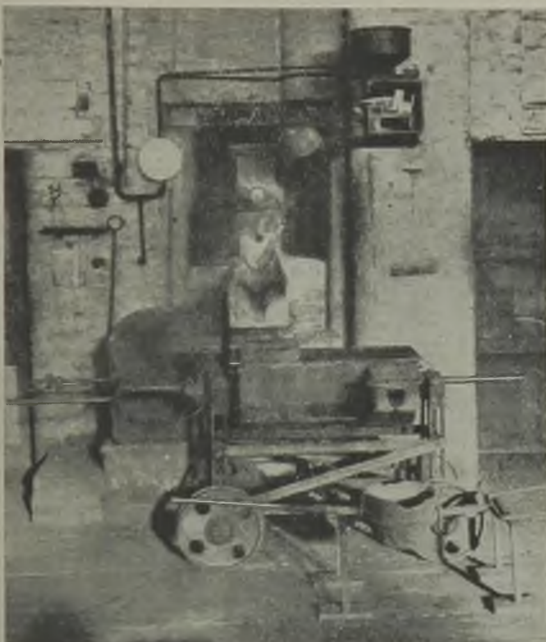

FIG. 9.—SHOWING VIBRATORY FEEDER, CONTROL VALVE, MIXING LADLE, SHANK AND BLAST-CONTROL HANDLE.

it was found necessary to instal a control valve to maintain this pressure as variations were found with alteration in pressure. As Fig. 8 shows, independent machines were installed at each of the three cupolas, and special equipment was constructed to attach them to the wall and to incorporate a large stock container to ensure a continuous supply over a considerable period of time. On the large cupolas these containers hold 80 lbs. of inoculant and on the small cupola 30 lbs. of inoculant. The tube carrying the inoculant into the metal is adjustable to suit a variation in the metal flow, and is kept approximately 2 in. above, thus cutting down the flow to a small area.

The inoculant is added to the stream near the tapping hole in a position that does not interfere with the tapping arrangement. This machine has given very satisfactory results with little attention, and only on rare occasions has a choke developed, and then either through the inoculant not being riddled or a piece of oversize material finding its way into the larger hopper.

Fig. 9 shows the mixing ladle in position at the cupola spout, which has been made readily movable to suit the three cupolas. The capacity is 6 cwts., and is of the syphon spout type to ensure a flow of metal free from slag or any undissolved inoculant. The position of tilt can be controlled with the utmost ease, and a friction brake maintains any desired location. The ladle is of the shallow longitudinal type, with the metal flowing in at one end and removed at the other. It is lined with 2-in. firebrick, and during the first run 350 tons of metal was put through before a further reline. A shield, not shown in the illustration, covers the flow of metal from the cupola spout so that the shanker is not adversely affected by heat.

The drop in height from the tap hole to the end of the spout was also reduced to a minimum so that further time would be allowed the inoculant in contact with the metal while it was running. Results have since shown that normally the inoculant is almost all in solution before it enters the mixing ladle, unless on particular occasions where greater quantities of inoculant are required.

The inoculant in general use with the Authors is ferro-silicon, the 75 to 80 per cent. variety, dust free, and passed through a ⅛-in. riddle. It was adopted partly because it is the most widely used material, and a considerable amount of information was available for making comparisons. The main opposition to dust was the trouble developing in the spout through slag forming and bridging, thus producing a stop in the flow of ferro-silicon. Dust has been found to collect during storage, and the procedure now adopted is to dry sufficient material in the stove for a day's run and sieve to remove dust. This gives a spout as clean as one would expect without inoculation procedure.

Size and Type of Inoculant

There are still conflicting ideas as to the most suitable type and size of inoculant to give the best results, and a great deal of beneficial work would be done if a thorough unbiassed investigation of the available inoculants was carried out. The amount of inoculant required to develop maximum properties has also been a subject of controversy; whereas one investigator maintains that satisfactory inoculation is produced with only 0.1 per cent. addition, with the same material, another investigator finds that 0.35 per cent. is required to develop the best results. The present investigation has so far shown that varying quantities to suit the different requirements with fixed minima and maxima has given beneficial results.

Inoculants other than ferro-silicon were tried out, calcium silicide with only a measure of success, the failure being, of course, due primarily to the particu-

(*Continued overleaf, column* 2.)

SANDSLINGER MOULDING PRACTICE

(*Continued from page* 360.)

left the meeting, as he (Mr. Wilson) wished to correct the impression that had been created, at any rate in his mind, that the Sandslinger was an expensive item of foundry plant from a maintenance point of view. Any mechanised plant could be expensive to maintain if this aspect did not receive the attention which it warranted.

It was obvious that, if the cost of production was to be reduced and products improved, by the introduction of suitable machinery, it was necessary to provide an adequate maintenance service for such machinery, the cost of such maintenance being offset against the increased production and resultant reduction in costs. It was not good policy to wait until a breakdown occurred in any part of a mechanised plant and then carry out repairs. The more sensible way was to anticipate possible breakdowns and keep the plant or machine in continuous working order.

Various types of Sandslinger were in use in his foundries, but the type most commonly used was a very simple type of machine, which was provided with an overhead hopper from which the sand was fed by a belt. These machines were operated in a similar manner to that explained by Mr. Peace. The moulding boxes were positioned in pairs for ramming up, and as soon as one box was rammed up the operator moved on to the adjacent box, alternating between the two the whole day long.

Mr. Wilson had found from experience that it was a decided advantage to have spare Sandslinger head and arm units. The maintenance department did not wait for a breakdown, but changed these units at regular periodic intervals. The fitting of a spare head or an arm unit complete could be carried out very speedily and could be accomplished during the lunch hour break or during any time off for meals. By following this practice breakdowns were almost completely eliminated and Mr. Wilson could not recall a single instance where production had been stopped due to failure of a Sandslinger.

He did not consider that sand control was of greater importance when using Sandslingers than with other types of machines. At the present time Sandslingers were operating in his grey-iron foundries using a fairly open green sand and at the same time he had similar machines in a steel foundry using a very strong sand, no difficulties being experienced in either case.

Mr. Buchanan thought there was no occasion for him to make any reply to the last two speakers; they had both emphasised points to which he had previously referred. He was much indebted for their point of view on the subject.

Vote of Thanks

The Chairman, in proposing that a hearty vote of thanks be accorded to Mr. Buchanan for his Paper, said he was particularly pleased to find that the Author had dealt with the subject of his Paper from

(*Continued at foot of next column.*)

THE DEVELOPMENT AND PRODUCTION OF INOCULATED CAST IRON

(*Continued from previous page.*)

lar practice adopted. The collection of slag from the inoculant quickly covered the metal in the mixing ladle and a gradual reduction in the effectiveness of the inoculant became apparent. Graphite electrode was also tried out, as it was thought that if the mixing ladle could contain a reasonable quantity of electrode always in contact with the metal, it would give a very simple and easily controllable method. However, the inoculating effect evident with the first quantity of metal through the ladle very soon disappeared and no further proof of its usefulness could be found. This may be accounted for by slag breaking the contact with the metal, or as a result of the very high temperature which it very soon attained with the closed ladle effects were produced similar to that obtained when using molten inoculants.

So that the fullest information would be available when the proposed alteration in metal was began, it was previously decided to have on record full details of the ordinary metal, so that a true comparison could be made when the alteration was carried out The information sought was the physical properties, including transverse strength, deflection, tensile strength, impact value and hardness, the micro-structure in thin and thick sections, the chill effect as shown by the wedge test, and the shrinkage effect as determined by a standard 4-in. square block. It was felt that, with all these factors detailed, the Authors would be in a position adequately to determine a true comparison. This investigation has been made much more enlightning as a result of this procedure, and has fully and finally shown the superior qualities of inoculated metal.

(*To be continued.*)

NEW CATALOGUE

Cast Crankshafts. Ealing Park Foundry, Limited, Junction Road, South Ealing, W.5, have sent us a 4-page illustrated pamphlet covering the manufacture of cast crankshafts by the Meehanite process. The interesting features are the experience the firm has through making of over 5,000 of these components; the rigid control of the raw materials; the inspection by X-ray and magnetic testing devices to disclose flaws, and suggestions to engineers as to the improvement in design. The pamphlet is good propaganda, not only for the issuing house but for the whole ironfoundry industry.

(*Continued from previous column.*)

the sand angle, because in the Sandslinging system the sand angle was a very considerable factor in promoting its success. The vote of thanks was carried unanimously by acclamation.

Mr. Buchanan, in responding to the vote of thanks, said he had endeavoured to present a Paper which would evoke discussion, and apparently he had been successful. He wished to thank the various speakers for their valuable contributions.

SANDSLINGER MOULDING PRACTICE

By W. Y. BUCHANAN

Discussion on a Paper presented at the Annual Conference of the Institute of British Foundrymen. Mr. Daniel Sharpe, the retiring President, occupied the chair. Mr. Buchanan's Paper was printed in our issues of July 27 and August 3.

Mr. P. D. Pincott (Member) said that after reading the Paper very carefully, his impression was that whilst it recorded the results of experiments with the Sandslinger and the Author's experience with it, Mr. Buchanan was to be complimented on that score, but he should be taken very severely to task for having placed the Sandslinger on a higher plane at the expense of the moulding machine. Such an attitude did not appear to be necessary, and was not borne out in practice. At the commencement of the Paper, there was reference to softness of sand beneath box bars, etc., when machine moulding. Generally speaking, this did not reflect great credit on the foundryman, as it was certainly very bad machine-moulding, and would not be tolerated in well-operated foundries.

The problem of the Sandslinger *versus* the moulding machine was probably a difficult matter to explain. In this country they were really working in two different spheres, so that there was no sound, watertight argument against either. A pattern of, say, 2 to 3 ft. dimension overall in nine cases out of ten would be made on a moulding machine. On the other hand, a pattern 6 or 7 ft. overall, in the case of a progressive foundry, would probably be made by the Sandslinger. There again, however, the line of demarcation was not clear, because there were available moulding machines which would produce a casting of 7 ft. overall very well indeed.

At the same time, a Sandslinger could come down to the 2 or 3 ft. casting and produce it equally well, although such a thing seldom happened in this country; credit was due to the two forms of machinery, because they both produce a perfectly good casting quickly. The Paper did not do justice to the moulding machine, nor to some extent to the Sandslinger.

Complementary Machines

Mr. Buchanan said he had expected that, in spite of any explanations of his, someone would misunderstand the object of the Paper. He would again like to stress the point that what he had been anxious to avoid was to create the impression he was endeavouring to make out a case that no moulding machine would ever work again. In his foundry they had moulding machines of all sizes, from very small ones up to the largest, but some of the large jolting machines had to be removed because they were uneconomical as well as being very old. At the present time they were working a 20-in. by 12-in. squeezing machine and the well-known Herman rollover pattern draw machines. They were operating very successfully, and there was no overlapping of the Sandslinger on their work at all.

He assumed that everything depended upon what sort of machinery there was in the foundry when one went there. Upon taking over the management of a foundry it was not usual to throw everything out which one had not been accustomed to before; the best plan would be to carry on with what there was there, though whether it was wise to buy such machinery in the first instance was another matter.

There was no doubt that certain machines suited certain types of patterns. He was not, however, really dealing with other machines at all, because the Paper was intended solely to state the experience gained on one particular size of Sandslinger and not even the mechanically moved type. It was a stationary Sandslinger, or what was known as a portable type, and he had no experience of any which were either bigger or smaller.

It had been said that the Paper had not done justice to the bigger Sandslinger. He agreed that it could have been more profusely illustrated, but, after all, the subject was a relatively old one and he did not feel justified in overloading the text. He had used one particular size of box as a comparison with the Sandslinger. It had been mentioned that the jolting machine gave a softness under the bars which was corrected by ramming the flat top part, but in the Paper the sole effect of jolting in the one case was compared with the sole effect of the Sandslinger, as was intended to be the case.

Influence of Sand Volume

Mr. F. J. Cook, M.I.Mech.E. (Past-President), asked whether an ordinary type power moulding machine could be used or whether the use of the Sandslinger depended upon the amount of sand necessary to ram into the box. If there was a considerable quantity of sand to ram, then the Sandslinger was the ideal machine to use.

Mr. Buchanan thought Mr. Cook was quite right. The Sandslinger appeared to be really a combination of overhead conveyor and ramming machine. With a well-equipped squeezing and jolting machine the results were quite good, *i.e.*, using overhead feed.

"Isofirms"

Mr. H. J. Young (Member) said that he found no liking for this "isofirm" conception, the very name itself appeared to him to be at fault. He trusted that the scientific side of the ironfoundry industry would rigorously reject new or coined descriptions such as suggest conditions, the degree of which was undeterminable by scientific measurement. It was merciful that the Author found no "random" isofirms. He did not believe that the effect of one stroke of a

Sandslinger Moulding Practice

hand-rammer was unaffected, as this Paper appeared to assume, by the next stroke overhead, but, in any case, the most perfect castings he had seen mass-produced were cast in hand-rammed green-sand moulds-cum-cores; perfect after machining all over.

Mr. Buchanan offered a choice between hand-ramming and Sandslinging based on time, namely, 51 hrs. against 18 hrs., or 38 to 6 and 24 to 7 in other examples. Surely an intricate and costly foundry mechanism could not be chosen or rejected upon such evidence alone or even in particular. Many foundries contained what are known as "monuments," because somebody was so blinded by one factor he could see no other.

Commonly, what one wanted to know about a foundry machine was precisely what nobody seemed able or willing to tell. Here, however, was a Paper about Sandslinging, the title said so, therefore, here was opportunity to enlighten ourselves. Would Mr. Buchanan say what were the best impeller speeds to use for various classes of castings, and what evidence there was to prove them? Sand, even when mixed with oil, was generally known to be a poor lubricant, hence, would Mr. Buchanan state what was the average life, expressed in running hours, of the principal moving parts of the Sandslinger and to which parts the majority of breakdowns were due? Finally, what would Mr. Buchanan estimate was the cost per running hour of a Sandslinger, which had already run for 500 hrs., expressed in terms including all labour and material over and above that required for hand-moulding, interest on capital expenditure, servicing and spares?

Servicing by Plant Makers

While not the pre-historic monster it appeared, it was by no means a newcomer to the industry and its history and origin would form a welcome addition to this Paper. He (Mr. Young) worked a Sandslinger daily, alternately praising it and the reverse, in common with every piece of moving foundry plant. He took the opportunity to throw out a hint to producers of plant, namely, that they visited their customers' foundries regularly to ascertain which parts of their constructions went wrong, wore out, gave trouble, were misused or misunderstood, required modification, elimination or addition, made a noise or a dust, and so forth. The experience of those who had to live with, and make a living with, a piece of apparatus should be invaluable to the makers, but he himself, after thirty years of foundry work, could record the melancholy fact that few seemed to think so.

Limitations of Servicing

Mr. Buchanan said that a question had been asked concerning the breakdown of the machine. In the first place, a foundry was a most trying place in which to instal any machine; care and maintenance were of paramount importance. Any machine could be "made or marred" by the treatment it received wherever it was; this applied especially in the foundry. Any machine taken into a foundry required a little helping over the stile now and again. The foundryman's point of view should be that the maker of the machine had done as much as he could for it in his own engineering works, and that once it came into the foundry it was the foundryman's job to effect any little possible improvement in his own particular place. In a great many instances people did 99 per cent. of the maintenance job, and the odd 1 per cent. left undone was sufficient to spoil the whole performance of the machine.

Apart from the impeller cup and liner, breakdowns very largely depended upon how much care and cleaning a machine received. If a bearing was left ungreased a breakdown would very soon occur, and most of those he had seen were due to that cause. The squeaks were not heard because of the noise of the foundry, and when the shaft started to wobble up and down it was too late to do otherwise than to replace the whole part.

Lines of Equal Hardness

Mr. Young had objected to the term "isofirm" mainly because it was new. The Author certainly did not expect the word to become so important in the presentation of the Paper. However, in studying extensively the behaviour of sand under ramming energy, he had found it necessary to devise this method of putting the results on paper. The conception was similar to the isobars so often referred to in the pre-war days when the B.B.C. reminded us of "a deep depression over Iceland." By drawing these lines the movement of sand, for example, in a standard test-piece, could be readily understood. The Author's statements regarding the arrangements of these lines in hand-rammed sand were not a matter of belief, but proved by repeated observation and painstaking measurements, which he thought were quite as scientific as they could be. They could not be "random" because they were governed by the forces applied to the sand. However, if the members as a whole objected to the new word because it was new, and preferred to say "lines of equal hardness," the speaker would agree to withdraw it.

Regarding the history of the Sandslinger he had gone into this as far as possible, but he had omitted any reference to it in the Paper, which was confined to his own experience. There appeared, however, to be very little change in the principle of the machine during its development. This was to be expected as the underlying idea was very simple. Mr. Young had stated he had seen hand-rammed castings that were perfect. Most foundrymen had, but during the course of a year quite a considerable number in the same foundry would be seen to be far from perfect.

The Author had particularly referred to castings with large surfaces which were intended finally for expensive machines. If a customer was going to pay £2,000 for a machine about 7 ft. long overall, he would require the outside surface to be made with an excellent finish approaching mirror polish. Reflected light showed up a minute wave in a painted surface very badly. If the surface was not truly perfect it would certainly detract from the appearance of the machine.

Notwithstanding Mr. Young's contention, he claimed that, when making the same type of casting over and over again with such a flat surface, it would come out far better from a machine than from a hand-rammed job. If one could machine away the lumpy surface then almost any hand-rammed job would do. Mention had been made of the possibility of "monuments" in a foundry. If a machine paid for itself even on ramming time alone as quickly as the Sandslinger as against hand ramming, the question of monuments did not arise till nearer the end of one's career.

Maintenance

Dealing with the life of parts and freedom from breakdowns, he had stated the number of times he had to change the impeller cup and impeller liner. They were the only parts which wore out rapidly. Sometimes buckets were broken off, but this appeared to be mainly due to carelessness of allowing the boot to jam up with sand and the tensioned chain to get a little out of line. When some of the buckets were pulled off and it was found that there was something wrong, it was usually found to be due to lack of cleaning. These breakdowns due to negligence were not so common in peacetime for obvious reasons.

The speaker could not, offhand, give a detailed figure of the cost of upkeep per hour of working time, but would be able to do this later as the weights of sand daily going through one Sandslinger were now being kept for that purpose.

There should not be any serious wear except in such already mentioned parts, and the rate of change of these depended upon how long the Sandslinger actually worked. In his own foundry, the total ramming time during the day was not really great, because there was a fair interval of time occurring between lifting one mould and replacing with another. The changes in design and the changes in orders were very considerable in his foundry, and this operated against repetition moulding. Thus the wear and tear were relatively small, except, of course, where lubrication had been neglected altogether.

It had been stated by Mr. Young that makers of plant should visit foundries regularly, presumably, in order to obtain particulars of their working. His own (the speaker's) experience was that this was done quite frequently. On the other hand, foundrymen could give plant manufacturers a great deal more service by telling them when a plant was obviously not doing its work, because very often it would only be necessary to make some slight alteration or adjustment. A very different point of view must obviously exist in the foundry as contrasted with the machine shop floor which was always kept perfectly clean where the trials were made, etc.

Sand-Ramming Conditions

Mr. F. C. Pearce (Member), thought it was apposite for a Paper on the Sandslinger to follow one on foundry mechanisation. The Sandslinger was probably the most interesting piece of mechanism in the foundry, and could be used in any foundry with advantage, making either large castings or small. Mr. Buchanan had assessed the value of the Sandslinger, and had said it was the nearest thing to placing grains of sand individually in the mould, and that it should be equivalent to hand ramming when done properly. No hand ramming could be carried on for prolonged periods, whereas ramming with the Sandslinger could. It was suggested that one great advantage of the Sandslinger was the aeration accompanying the process. What was meant by aeration? What appeared to be done was that the sand was placed in position grain upon grain so that no lumps were formed in the mould—in other words, there were no hard spots. He understood "isofirms" to mean equal lines of hardness, so that there seemed to be no reason why the term should be withdrawn. The Sandslinger mould was equally firm from top to bottom when the Sandslinger was working properly. There was no other known method which could produce that condition.

The Sandslinger for Small Castings

Mr. Cook had endeavoured to show that the Sandslinger could not be used for small castings, but in the foundry with which the speaker was connected small boxes of 14 in. by 9 in. by 6 in. or 4 in. containing 20 to 40 patterns were being rammed successfully with the Sandslinger. There was no other machine which could make a casting so true to form as the Sandslinger. Other points worthy of attention were:—Mr. Buchanan had said that a mould would not so readily scab when rammed by a Sandslinger. If this is true about scabbing, it must also be true about blowing, and there did not seem to be any reason why a skilled moulder should not make a mould by the use of the Sandslinger rather than by hand ramming. He would certainly be less tired by the end of the day.

Criticism could be offered with regard to the Sandslinger in saying that great strain was imposed on the man who guided the impeller head, and that the machine gave rise to a considerable amount of dust. Also a desirable thing would be the prevention of vibration. The application of the principles used and the finish in aircraft manufacture would seem desirable.

At the present time endeavours were being made to find a more suitable material for the blade and semi-circular ring. Some little success has been achieved with a chromium nickel alloy cast iron. Personally, he was convinced that in the next twenty years the Sandslinger would become the premier machine for making sand moulds, outdoing most others.

Mr. B. Hird (Member) was also of the opinion there would be an extended use of the Sandslinger by the skilled moulder.

Mr. F. H. Hoult (Member) thought the Paper had not presented a big enough picture of the importance of the Sandslinger. As a method for making moulds and cores it had not been sufficiently appreciated by

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the foundry industry generally. Mr. Buchanan had not referred in the Paper to the use of the Sandslinger for the making of difficult cores. This application of the machine gave very excellent results, and its importance cannot be overstressed.

In discussing such a Paper as that produced by Mr. Buchanan, one should ask the question if one were designing a new mechanised foundry, would a Sandslinger in the light of previous experience be used? Mr. Hoult expressed the opinion that this would be the case, and a Sandslinger was to be regarded as a moulding machine of the future.

Handling Moulds made by Sandslinging

Mr. J. Roxburgh, A.M.I.Mech.E. (Member) remarked that those who had had experience of the Sandslinger would certainly recognise its virtues and appreciate its benefits. It could be used on both large and small work. One point he wished to raise was with regard to the jolt rollover machine. The mould was rammed up, jolted, and then rolled over. The pattern was then withdrawn, and the mould placed in a position whereby it could be transported. With regard to the Sandslinger it was an important point as to how to handle the mould once it was rammed up; namely, the drawing of the pattern and the placing of the moulding box into position. How did Mr. Buchanan deal with the problem?

Mr. Buchanan appreciated the remarks made by Mr. Pearce, though he himself would not have cared to have gone so far as that member had indicated. However, the points which had been made were quite correct. A point had been raised concerning aeration. It would be known, of course, that practically all the little aerating machines sold for portable purposes in a foundry worked very much upon the same principle as the Sandslinger. There was always some mechanical part moving at high speed to strike the sand. If drops of water were permitted to fall into dust, mud was created which was finally distributed as little pellets. A similar effect took place, to some extent, with the uneven distribution of bonded material. The Sandslinger created aeration by means of a battering action which was very effective in breaking down the pellets of dry sand which had passed through the riddle.

Special Role of the Sandslinger

It was interesting to learn that in Mr. Pearce's opinion the Sandslinger made castings which were truer to pattern than any other type of machine, though, for his own part, he had not used it in regard to very small castings, at any rate, not below 20-in. square boxes. It was quite right to stress the point that the Sandslinger really only did the heavy work and was not necessarily replacing much of the hand skilled work. He could not quite agree with the popular contention because there was quite a large percentage of moulders who were not as highly-skilled as they were believed to be as far as ramming was concerned. Many of the moulds they made would cause much variation in the appearance of the casting surface produced. The effect of using a Sandslinger was that the machine did the heavy work and the moulder was entirely concerned with the finishing and the really fine art of moulding.

He did not know what to say about guiding the impeller head, because with the size of machine used at his foundry they had experienced very little trouble. There were levelling devices on the machine which made the head more or less balance in any position. In the case of repetition work, such as ramming a box or a mould for a heavy bomb, or anything like that, where the degree of ramming required was very uniform, it might be possible to apply a mechanical device which would guide the head for a particular job. He could not say that he had noticed any excessive presence of dust, but then any foundry was apt to be dusty anywhere and a little extra would not attract much attention. He would not have expected much dust from moulding sand of the proper moisture content.

Cup Replacements

Considerable improvements might be made on the Sandslinger by introducing special metals on the wearing parts; a great deal of research work had been carried on before the war in that respect and one firm adopted special types of plough on which hard steel was deposited by welding and so on. All his firm had done was to make a plate pattern for the impeller cup and mould these on small squeeze, jolt, pattern draw machines. The cost was very low and these cups were replaced after very little wear. In the case of a large skeleton pattern for a one-off casting to be made in a deep pit as referred to by Mr. Hird, the speaker thought they might still leave that work to hand moulding in small foundries. Large turbine castings were, however, being made by Sandslinger in at least one works of which the speaker knew. The Sandslinger moved along the side of the pit on a specially constructed bogie.

With respect to the use of the Sandslinger on cores, his foundry had actually used it on quite a number of cores, mainly those having about 7 cwts. or 8 cwts. of sand in them. This eliminated much work, because the ordinary core maker was inclined to spend half of a day knocking nails in all over the thing as if he were repairing boots, quite apart from the time required in actual ramming. Dealing with Mr. Roxburgh's remarks, the Sandslinger worked best on repetition work, of course, with a stripping machine. His firm used a 20-in. box in conjunction with a small turnover machine which could be wheeled about the floor, and the whole moulding operation was complete in a few seconds. Larger boxes were still rolled over by the operation of a crane. Patterns with flat bottoms were used, and they were pulled out by the crane. The patterns were no different from the originals used for ramming by hand.

Nature of Sand Used

Mr. E. Hunter (Member) would welcome a little more information as to the most suitable type of sand


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for the Sandslinger and also upon the subject of wear of the machine parts.

Mr. Buchanan said it would be noticed from the Paper that he expected to find some sands and sand mixtures to be more suitable in the operation of the machine than others. After making a number of experiments with elaborate measurements, however, he came to the conclusion that any type of sand which had been found to be fit for moulding by any other method was equally suitable for the Sandslinger. He did not know that any one rammed better than another. In his foundry, they used the Scottish Rock sand, which was considered to be the best sand for their purpose ten years ago, but they had more or less discontinued the heavy additions, and what the floor was composed of now he could not state with certainty, being continually diluted with burnt oilsand and rebonded with clay. Green sand was a very fine sand and worked quite well. The Scottish Rock sand for drysand work and the Erith loam for greensand work practically represented the extremes of sand available in Great Britain and these presented no trouble at all in the Sandslinger.

Mr. A. Tipper, M.Sc. (Eng.), (Member) asked what was Mr. Buchanan's opinion as to the importance of sand control when using a Sandslinger. He was interested particularly from the point of view of Sandslinging for small and medium-sized moulds for which a high-class finish was required. Was the Sandslinger more sensitive to variations in moisture content? As Mr. Buchanan had handled large quantities of Rock sand and Erith loam, what was his experience on the question of maintaining his sand condition uniform?

In his own foundry, they used facing sand on Elektron and on light alloy castings and much Sandslinger time was wasted. The amount of ramming with a Sandslinger represented a very small proportion of the time occupied when the box was under the machine. Furthermore, the moulder seemed to have the idea firmly fixed in his mind that he must have a large heap of sand well above the top of the box, and then he would use a shovel on top of that. What was the minimum amount of sand which need be worked above the top of the box?

Mr. Buchanan did not think the importance of sand control was emphasised any more in connection with the use of a Sandslinger because it was important under any conditions. Certainly the Sandslinger was sensitive to moulding in the presence of moisture. Comparing it with hand ramming, in which any mould could be rammed with mud, but a very damp and sticky sand would obviously begin to clog with any mechanical device such as a metal chute. He did not think any trouble would be caused in the rammer head, but only in the delivery to it. It probably had no different effect upon the mould from any other method of ramming; the wet sand tended to ram very hard and a dry sand tended to be too difficult to patch. The Sandslinger worked best, of course, with dry sand; and this remark probably applied to almost any forms of moulding by machines or otherwise.

It was somewhat difficult to answer the question as to what was the minimum amount of sand to be on the top of the box, because the box was only 20 in. square. It was filled so very quickly that there was soon a pile of sand on the top. He would say there should be 2 in. or so as an average depth on a 20-in. box, but with larger boxes it might rise to 3 or 4 in., depending upon the extent of the area covered. A small box permitted greater spillage over its sides.

Sandslinger and Stripping Machine Practice

Mr. A. E. Peace (Member) confirmed the statements of Mr. Pearce and Mr. Roxburgh that a Sandslinger was not confined to heavy work, but was also suitable for light castings. His firm had used Sandslingers for a number of years on mass-production castings with weights varying from 28 lbs. to 56 lbs. It should be pointed out that the Sandslinger is not a moulding machine, but merely a sand lifting and ramming machine. In their practice it had been equipped with stripper moulding machines, four strippers to a Sandslinger, the Sandslinger being of the tractor type which dug into the sand heap. Each machine was handled by one man, and he was the only man on the job who handled sand. The first difficulty which was experienced was in getting the moulds away from the machine. They put a surprisingly large number of men on the job, and most of them were employed in getting the moulds away.

In connection with the quality of sand, it was found they could use a drier and weaker sand than was usual in their other moulding practice. The sand was of the Mansfield type. There were probably differences of opinion with regard to the maintenance of the machines. He gathered from Mr. Buchanan's remarks that the Author operated a machine during an 8-hr. day, ramming perhaps a total time of only 3 or 4 hrs., whereas in his (the speaker's) foundry, ramming was continuous throughout the day.

The maintenance cost was considerable in as much as they were continually putting in new parts, although they were light and small details. The whole of the time of one millwright was occupied in keeping the four machines in working order, but it must be borne in mind there was only one operator per machine and no other labour was employed on sand handling and ramming. The whole position had to be viewed in a proper perspective. Another point with regard to maintenance was that Ni-hard was used successfully for impeller tips and shrouds, resulting in a great improvement in life.

Maintenance of Foundry Machinery

Mr. P. H. Wilson, O.B.E., (Member), stated that, in the various foundries which formed part of the organisation with which he was associated, there were approximately a dozen Sandslingers in continual use. Most of these machines were operated in fully mechanised plants necessitating continuous running for 8 to 10 hrs. or more per 24 hrs. per machine. He expressed regret that Mr. Young had

(*Continued on page* 354.)

NEWS IN BRIEF

INDUSTRIAL ELECTROPLANT, LIMITED, is being wound up voluntarily. Mr. A. F. Christlieb, 81, Cannon Street, London, E.C.4, is the liquidator.

UNITED SILICA INDUSTRIES, LIMITED, Amman Yard, Brynamman, have given notice of an intended dividend the last day for receiving proofs being September 2. The liquidator is Mr. Reginald Betts, Government Buildings, 10, St. Mary's Square, Swansea.

BRAZIL IS IN URGENT NEED of transport material such as rails, locomotives and lorries, and machinery for her industries is also badly needed. Many industries are working at full capacity with obsolete machinery and, owing to the gasoline shortage, railways are handling 20 to 30 per cent. more than their pre-war goods traffic, mostly with worn-out rolling stock.

THE COMPANIES REGISTRATION OFFICE gives notice that the names of the undermentioned companies have been struck off the register, and such companies are dissolved:—Alcudia Lead Mines, Limited; Atbasar Copper Fields, Limited; British Mining & Metal Company, Limited; Herbert J. Thormann (Engineers), Limited; Silica Supplies, Limited; and Wigan Electro-Metallurgical Works, Limited.

THE MINISTRY OF LABOUR AND NATIONAL SERVICE states that the number of men and boys registered at employment exchanges as wholly unemployed at July 17 (exclusive of 16,586 men classified as unsuitable for ordinary industrial employment) was 44,078; those registered as on short time or otherwise temporarily suspended from work numbered 284; and those registered as unemployed casual workers numbered 670. Compared with April 17, the numbers wholly unemployed showed a decrease of 6,154.

WORKERS EMPLOYED in the shipbuilding and ship-repairing industry on Clydeside are getting copies of a leaflet setting out the procedure for the avoidance of disputes. The printed circular has been issued on behalf of the Shipbuilding and Engineering Unions (Clyde District), and the Clyde Shipbuilders' Association. "In war," the general introduction states, "time is the most precious of all possessions. To lose it is folly. A strike or lock-out means loss of time quite needlessly. In the industry there is procedure for the settlement of all disputes."

THE DIRECTORS of John Holroyd & Company, Limited, bronze founders, machine-tool makers, etc., of Milnrow, Rochdale, propose to issue 100,000 5s. ordinary shares for the purpose of providing the capital required for new plant and equipment, etc. The shares will be offered to holders registered August 18 in the proportion of one new share for every five held at 10s. per share, payable in full on acceptance. The new shares will rank for full payment of all dividends which may in future be declared or paid on the ordinary shares and in all other respects *pari passu* with the existing ordinary shares. Treasury consent to the issue has been obtained.

PERSONAL

MR. F. S. THOMPSON has had sixty years' association with the firm of Thompson Bros. (Bilston), Limited, of which he is chairman and joint managing director, and to commemorate the event, his golden wedding and his mayoralty of Wolverhampton, he was recently presented on behalf of the directors, staff and work-people, with an illuminated album.

MR. LESLIE JOHN DAVIES has been elected a director of Richard Thomas & Company, Limited. Born in 1887, he started as a boy at the works of the Cwmfelin Steel & Tinplate Company at Swansea in 1902. He became manager of the works, where he remained until 1917-18, when that company was merged with Richard Thomas & Company, of whose Ebbw Vale works Mr. Davies has been general manager since 1938.

MR. ROBERT ITHEL TREHARNE REES, partner in the firm of Forster Brown & Rees, mining and civil engineers, of Cardiff and Westminster, has been elected president of the South Wales Institute of Engineers for 1945. He succeeds Dr. F. J. North, head of the Department of Geology at the National Museum of Wales, who has held the office for two successive years. Mr. Rees, who has been a member of the South Wales Institute of Engineers since 1903, is a native of Penarth. Educated at Repton School, he is a member of the Institute of Civil Engineers, a Fellow of the Chartered Surveyors' Institution, and a Fellow of the Geological Society.

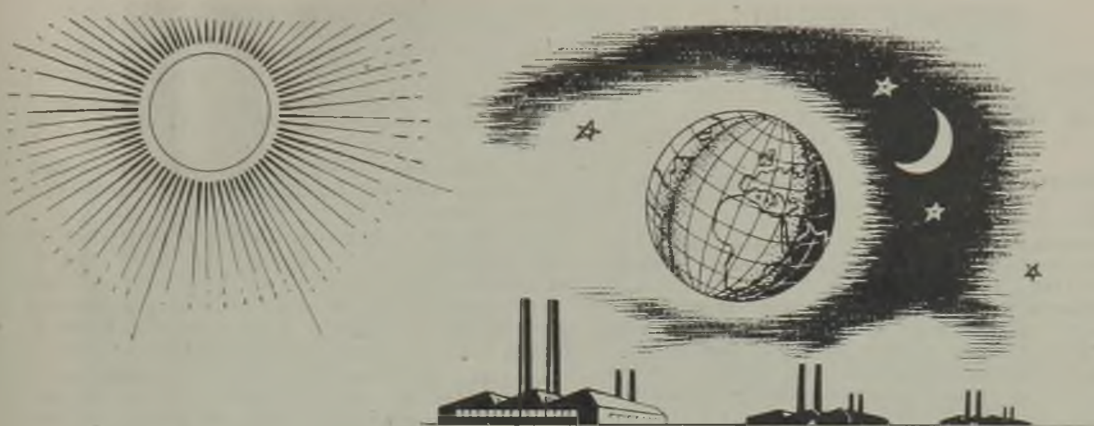
SIR JAMES LITHGOW has resigned from the board of Richard Thomas & Company, Limited. In August, 1939, various changes on the board announced by the Control Committee of the company included the appointment as directors of Sir James Lithgow, the Earl of Dudley and Mr. A. C. Macdiarmid. These three appointments were made after consultation with the British Iron and Steel Federation. Early in 1940 Sir James Lithgow was appointed Controller of Merchant Shipbuilding and Repairs at the Admiralty. At the same time, he resigned from the board of National Shipbuilders' Security, Limited, and obtained leave of absence from the boards of all the other companies of which he was chairman or a director, except the chairmanship of William Beardmore & Company, Limited, and his directorship of Richard Thomas & Company. In May, 1941, Sir James Lithgow became chairman of the Tank Board.

Will

HENDIN, A. J., former shipyard manager and director, Fairfield Shipbuilding & Engineering Company, Limited ... £48,142

Mr. Anthony Haswell, of the Dayton Malleable Iron Company, Dayton, Ohio, has been elected President of the (American) Malleable Founders' Society.

Mr. J. M. Gregory, the author of this year's American exchange Paper to the Institute of British Foundrymen, has resigned his position as factory manager of the Foundry Division of the Caterpillar Tractor Company, Peoria, Ill.



COMPANY RESULTS

(Figures for previous year in brackets)

Jonathan Hattersley & Son—Loss for year to March 31, 1944, £2,799; debit forward, £5,910.

Geevor Tin Mines—Net profit for the year ended March 31, 1944, £19,551 (£24,019); dividend of 12½% (15%).

Brightside Foundry & Engineering—Ordinary dividend of 1s. 9d. per share for the year ended June 30 (same).

Aveling-Barford—Net profit, £90,446 (£84,223); ordinary dividend of 10%, free of tax (same); forward, £44,418 (£46,377).

Engineering & Lighting Equipment—Net profit for the year ended March 31, £21,454 (£23,231); final dividend of 6%, making 10%; forward, £1,896.

Thorn Electrical Industries—Net profit, £24,644 (£24,676); to general reserve, £12,000 (£13,000); ordinary dividend of 20% (same); forward, £10,235 (£9,090).

Tungsten Manufacturing—Profit to September 30 last, £3,061 (£6,726); depreciation, £574 (£607); taxation reserve, £1,000 (£4,250); year's preference dividend to March 31, 1934; forward, £2,568 (£2,220).

Larmuth & Bulmer—Profit for the year ended March 31, after providing for depreciation, £13,111; taxation, £7,753; net profit, £5,357 (£3,732); final dividend of 7½% on the ordinary shares, making 10% (same); forward, £5,363 (£4,139).

Fletcher Hardware—Profit for 1943, £16,129 (£12,759); other income, £538 (£653); purchase of pensioners' annuities, £2,751 (nil); tax, £11,768 (£8,527); net profit, £1,548 (£4,285); ordinary dividend of 7½%, £2,672 (same); forward, £2,786 (£5,035).

Richard Thomas & Company—Combined trading profits for the company and its subsidiaries for the year ending April 1, £4,002,006 (£3,720,980); net profit of the parent concern, £740,123 (£632,439); ordinary dividend of 12½% (10%); forward, £466,989 (£374,781).

Railway & General Engineering—Trading profit, etc., to March 31 last, £7,692 (£5,276); war damage contribution, £207 (£242); depreciation, £1,530 (£556); deferred repairs, £1,500 (nil); net profit, £3,471 (£3,493); ordinary dividend of 7½% (5%); forward, £7,906 (£6,971).

Head Wrightson & Company—Profit for the year to April 30, 1944, £204,283; debenture interest, £6,750 (same); taxation, £145,000 (£140,000); depreciation, £30,000 (same); net balance, £21,533 (£21,093); to reserve, £5,000 (£4,970); preference dividend, £5,074 (same); dividend on the ordinary shares of 6%, £9,450 (same); forward, £31,256 (£29,247).

The Swedish Geological Institute is continuing its tests of the newly-found deposits of iron ore in the Jokkmokk district (northern Sweden). The mineral represents a type so far undeveloped in Sweden. It is rich in manganese, and while it is free from sulphur it contains a certain percentage of lead.

OBITUARY

Mr. R. P. Finlay, managing director of the Finlay Conveyor Company, Limited, Newport, died recently.

Mr. Robert MacGregor, head of MacGregor's Port-Glasgow Engineering Works, Limited, died recently.

Mr. Allan Inglis Fraser, a director of Wm. Bain & Company, Limited, Lochrin Ironworks, Coatbridge, died on August 20.

Mr. Walter J. Buchanan, who for more than 25 years had been a lecturer at the Royal Technical College, Glasgow, died recently. He was 55 years of age.

Mr. James Blake Mundell, managing director of Hurst Nelson & Company, Limited, and chairman of Wagon Repairs, Limited, died at Inverness recently.

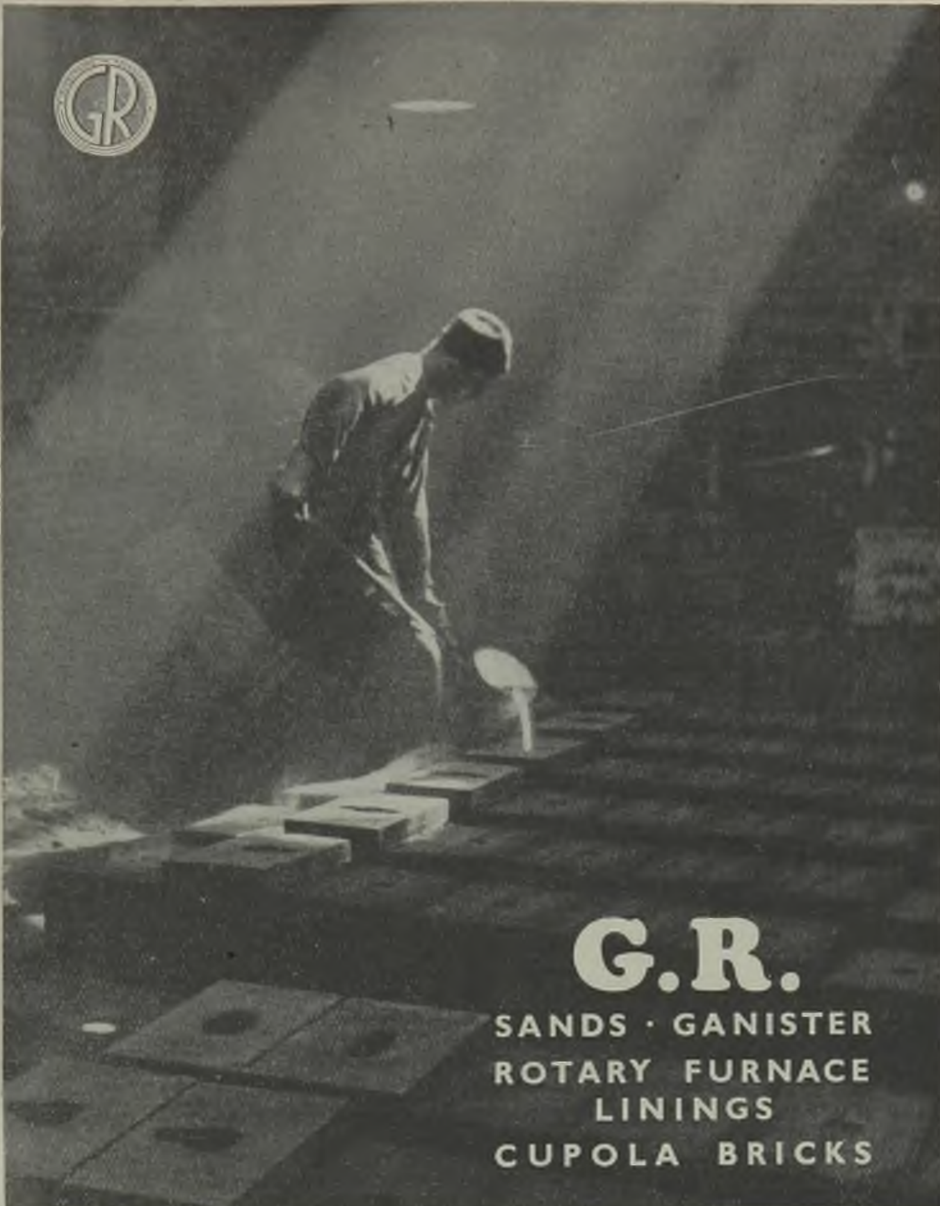
Sub-Lieut. William Derek Wheway, eldest son of Mr. and Mrs. Wheway, of Gorway Road, Walsall, has been killed on active service. He was in the Fleet Air Arm, and before joining was in the family iron business at Walsall.

Mr. Alexander Cockburn, works manager of R. & A. Main, Limited, Falkirk, and one of the best-known figures in Scottish ironfounding circles, died recently. Aged 68, he had been connected with the ironfounding industry for over 50 years. He was originally with the Carron Company, and when he returned after service at sea in the last war he was appointed commercial manager with R. & A. Main. In 1928, he was appointed works manager.

IRONFOUNDRY FUEL NEWS—XVIII

Previous articles in this series have indicated that the design and condition of many of the drying stoves in the ironfounding industry are by no means all that they should be. Such stoves are generally inefficient because of poor firing and flue arrangements, and actually, as far as stoves are concerned, the most frequent recommendation made by the Regional Panels of the Ironfounding Industry Fuel Committe is that a stove should be converted to a forced draft system. But, it may be asked, why forced draft? The answer is simple—ease of control and consistency of operation. There is little doubt that under constant atmospheric conditions a natural draft stove with a good stack could be made to operate as efficiently as a forced draft stove, but, British weather being what it is, there is a natural tendency for operators of natural draft stoves to use every night as much fuel as is necessary completely to dry the load under the worst weather conditions.

Forced draft equipment also, of course, facilitates the use of coke breeze and other low-grade fuels—an increased proportion of which the industry may well be obliged to consume next winter. Applications for licences for forced-draft equipment should be made to the secretary of your Regional Fuel Efficiency Committee of the Ministry of Fuel and Power.


G.R.
SANDS · GANISTER
ROTARY FURNACE LININGS
CUPOLA BRICKS

Raw Material Markets

IRON AND STEEL

Removal of restrictions on the output of the foundries and the freer issue of licences for pig-iron have given a slight impetus to the iron trade, but there is not the volume of work for the foundries that was available a few months ago. The demand for pig-iron is well below normal, and the only quality which is not available in abundance is hematite. Basic, refined, and high- and low-phosphorus irons are all plentiful, and licence holders have no difficulty in covering their requirements at short notice.

In the scrap section, conditions have eased slightly, but there is still stringency in the supply of various grades. There is a very strong demand for wrought-iron scrap, particularly the heavy varieties. The supply of cast-iron scrap has improved recently, although consumers would welcome more heavy machinery metal. Requirements of short heavy steel scrap, for foundry use and refined pig-iron making, are quite easily satisfied, on the whole.

The coke supply position is satisfactory. Requirements of foundry and blast-furnace grades are being promptly met, and many works are laying in stocks for winter use.

Activity of the re-rolling mills, which is assured for several months to come, is the brightest feature of the steel trade. The mills will be heavily engaged for some months, and will need big tonnages of billets, blooms, slabs, sheet bars, etc., provision of which has become the almost exclusive responsibility of British steelmakers. Imported material is no longer available in substantial quantities, and the re-rollers are consequently keen to acquire not only primes, but also all other forms of re-rollable material, such as defectives, crops, etc,

The issue of orders for steel plates for shipment to the United States has given a slight impetus to this branch of the steel trade, but most producers are rapidly clearing their order-books and would welcome new business. Light sizes of both plates and sections are now generally specified. The sheet mills are still provided with regular employment, although activity in this section is rather less brisk than it was. Maximum outputs of rails and colliery equipment are readily taken up and makers are booked well ahead.

NON-FERROUS METALS

With the steady shipment of copper to Britain, a high rate of delivery to consumers is maintained, and all requirements are being covered without any difficulty. No doubt advantage has been taken of the slacker state of the war industries to lay in stocks. While at the present stage of the war it seems unlikely that there will be any sudden revival of the demand in this country, events in America have proved how quickly consumption of metal can increase. In this country the Control seems likely to adhere for the time being to its policy of not allowing a larger amount of copper to be released for commercial purposes, however bright the supply situation may appear to be.

There are no fresh features in the tin market. Consumption continues at a level fixed by the reduced activity at works. Supplies are ample, but with such a large proportion of the tin-producing areas in enemy hands there is little prospect of any relaxation of the restrictions on the use of tin—at any rate for some time. Reports from the United States have indicated that following the signing of the Anglo-American oil agreement, negotiations are about to take place in regard to various other raw materials, tin among them. Further news is not available, but this topic is likely to prove of great interest to the tin market. One of the chief points considered will probably be post-war smelting in America.

Although there has been considerable all-round slackening in the demand for lead, the largest wartime consumers of this metal, the battery and cable trades, are still taking in large tonnages. In the case of batteries the demand has actually been increasing, but in other respects the peak period of production has been passed. The supply position in America seems to be fairly satisfactory. During the Mexican strike substantial withdrawals had to be made from reserve stocks, but the Government stockpile is still believed to be quite large.

Invisible platinum wire, so small only its shadow can be seen, is being used experimentally in the laboratory of the General Electric Company at Schenectady. The wire is 13 millionths of an inch thick—25,000 strands would be needed to equal the cross-sectional area of a human hair. When mounted between glass plates and held to the light. the wire is invisible, but when held to the light, the reflection—or shadow—may be seen.

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, August 30, 1944

PIG-IRON

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

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

Hematite.—Si up to 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 5s. per ton.*)

FERRO-ALLOYS

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

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

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

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

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

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

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

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

Cobalt.—98/99 per cent., 8s. 9d. lb.

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

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

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

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

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

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

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

NON-FERROUS METALS

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

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

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

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

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

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

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16s.; rods, drawn, 11⅜d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 11¼d.; wire, 10⅝d.; 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. 4½d. to 1s. 10½d.; 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 Aug. 26, 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,* 2*s.* 6*d. 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, A.M.I.Mech.E., with 22 years' practical experience in patternshop, foundry, and machine shop, ferrous and non-ferrous work, requires similar position; keen disciplinarian.—Box 622, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

ASSISTANT FOUNDRY MANAGER desires post; technical and practical qualifications engineering castings; steel and non-ferrous.—Box 642, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

NON-FERROUS FOUNDRY FOREMAN desires change; experienced general engineering and centrifugal castings; post-war prospects.—Box 644, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

WANTED.—WORKS MANAGER for Non-ferrous Foundry; applicant must be an experienced moulder; good prospects for right man.—Apply HOPE FOUNDRY (STOKE), LTD., Chesterton, Stoke-on-Trent.

FOUNDRY SUPERINTENDENT required for West of Scotland area; must be good disciplinarian; able to handle male and female labour; thorough knowledge of heavy and light moulding machine practice; also core making by core-blowing and other machines; output consists of various designs of gunmetal and cast-iron high-pressure castings; state age, experience, and salary desired; good post-war position assured, if suitable.—Box 646, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

CHIEF INSPECTOR required by large Steel Foundry in Yorkshire. Must have had first-class experience in inspection of steel and non-ferrous products, and have full knowledge of A.I.D. procedure.

Permanent post with considerable responsibility. Salary £500-£700 p.a.

Applications in writing (no interview), stating date of birth, full details of qualifications and experience (including a list in chronological order of posts held), and quoting reference No. 107, should be addressed to the MINISTRY OF LABOUR AND NATIONAL SERVICE, Appointments Office, The White Building, Fitzalan Square, Sheffield, 1.

WANTED, immediately, LABORATORY ASSISTANT (CHEMICAL); not necessarily qualified, but capable of analysing non-ferrous alloys, including aluminium and its alloys.—Apply HOPE FOUNDRY (STOKE), LTD., Chesterton, Stoke-on-Trent.

AGENCIES

REPRESENTATIVE, with established connection in the foundry trade, Lancs, Yorkshire and N.E. Coast, wishes to hear from manufacturers requiring representation in the above, or part of the above area, on a selling agency basis.—Box 614, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

COMMISSION and full-time Agents required for Refractories; Moulding and Silica Sands; Pig-irons, etc.; state area, connection, age, and terms required.—Apply HINCKLEYS, LTD., Sandiron House, Sheffield, 8.

PATENTS

NOTICE is hereby given that the Minister of Aircraft Production seeks leave to amend the Specification of Letters Patent No. 553,809, entitled "Refining aluminium and aluminium alloy scrap."

Particulars of the proposed amendment were set forth in the Official Journal (Patents) No. 2,900, dated 23rd August, 1944.

Any person may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton Buildings, London, W.C.2, on or before the 23rd September, 1944.

THE Proprietors of the Patent No. 352745, for "Attachment for Cables, Rods, Wires or the like and Method of Securing the same to a Cable or the like," are desirous of entering into arrangements by way of licence and otherwise, on reasonable terms, for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed, in the first instance, to HASELTINE, LAKE & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY

THOS. W. WARD LTD.

BABCOCK WATER-TUBE BOILER; evaporation 10,000 lbs.; working pressure 180 lbs.

LANCASHIRE BOILER; 30 ft. by 7 ft. 6 in. by 180 lbs. w.p.

LANCASHIRE BOILER; 30 ft. by 8 ft. by 120 lbs. w.p.

COCHRAN MULTI - TUBULAR BOILER; 11 ft. 3 in. by 5 ft. by 100 lbs. w.p.

VERTICAL MULTI - TUBULAR BOILER; 16 ft. 6 in. by 6 ft. 6 in. by 100 lbs. w.p.

VERTICAL CROSS-TUBE BOILER; 12 ft. 9 in. by 5 ft. by 100 lbs. w.p.

VERTICAL CROSS-TUBE BOILER; 12 ft. 6 in. by 4 ft. 2 in. by 100 lbs. w.p.

VERTICAL CROSS-TUBE BOILER; 10 ft. 6 in. by 4 ft. by 80 lbs. w.p.

VERTICAL CROSS-TUBE BOILER; 9 ft. 3 in. by 4 ft. 3 in. by 100 lbs. w.p.

VERTICAL CROSS-TUBE BOILER; 8 ft. by 3 ft. 6 in. by 100 lbs. w.p.

PORTABLE BOILER AND ENGINE; 30 b.h.p.; 120 lbs. w.p.

NEW PRESSED STEEL SECTIONAL STORAGE TANKS; plates 4 ft. square.

ALBION WORKS, SHEFFIELD.

'Grams: "Forward." 'Phone: 26311 (15 lines).

FOR SALE.

THREE "Pickles" Patent Turnover MOULDING MACHINES; to take 12-in. boxes and fitted with pneumatic vibrators, control valves, flex, etc.

Three ditto; to take 14-in. by 16-in. boxes, and

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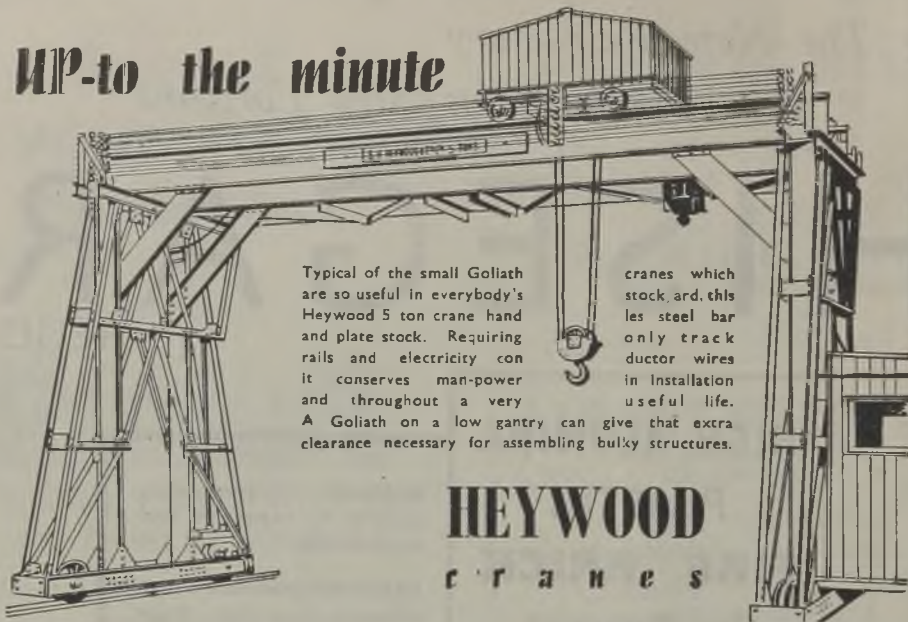

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