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# American Brassfounding Practice

Now that a large number of productivity teams have visited the States and issued their reports, it becomes increasingly difficult for the later ones to say anything either very new or startling. Moreover, it is not easy for the teams to devise fresh methods of "putting over" their findings. A successful method used by the Brassfoundry team was the recording of their visit in the form of a coloured talking film. The primary object of this effort is to arouse interest in the Report, which can be expected in about six months' time. The film is only about 60 per cent. technical, the balance being what is known in cinema jargon as a "travelogue." By so doing, a human interest has been given in advance to the awaited Report.

The film shows two simple layouts for jobbing work, based on the ability of the foundry to create suitable pattern plates. The actual making of moulds is shown in much detail, and discloses that rhythmic methods have replaced brute force and unco-ordinated effort—factors not unknown in the British foundry industry. Reliance was placed on roller rather than power-operated conveyors. Yet emerging from all this is once more the undisputed higher production of American industry. When the film was shown last week to the members of the Association of Bronze and Brass Founders and National Brassfoundry Association in Birmingham, it was highly commended and also met with the approbation of Sir T. Hutton, general manager of the U.K. section of the Anglo-American Council on Productivity.

This team was not wholly occupied with founding, for by some curious kink in the English language, the word "brassfoundry" in the Birmingham area includes the production of many lines made by forging and stamping. So far as drop forgings and the like were concerned, they were dismissed by the statement "that British industry was well in front of American." Whether this statement will appear in the Report we are, of course, in ignorance, but we are quite sure that our American friends will not resent the criticism. On the other hand, they will investigate the reasons and rapidly act on any conclusions reached.

Hoping for added enlightenment, we listened last week to a broadcast on productivity, but were frankly disappointed. By making the subject one for debate and giving the opposition a "fair deal," the main message was lost. Two things should have been stressed so as to leave an unforgettable message:—(1) That American productivity is higher, and (2) without increased productivity in this country the standard of living will be so depressed that only a low standard of "existence" will remain.

## Contents

## Notes from the Branches

*London Branch—Slough Section*

THE OPENING MEETING of the session of the Slough section of the Institute of British Foundrymen was held on October 17 in the lecture theatre of High Duty Alloys, Limited. In his address, the new president, Mr. R. B. Templeton, remarked upon the success of the last session, and in emphasising the aims and objects of the Institute pointed out the necessity for the introduction of new blood both as members and in the section council to pursue those objectives. He was particularly pleased to observe the growing interest of the junior technician and the man on the job, evidenced on the occasion of the successful first I.B.F. national works visit to Birmingham. It was due to the voluntary contributions of individuals that the Institute could carry out its work in the advancement of technical knowledge, and he was pleased to introduce in Mr. E. Longden, consulting foundry engineer, as lecturer for the meeting, one who had fulfilled this function to a high degree through many years as a member and office bearer.

There followed a Paper entitled: "The Economics of Cast-iron Production for Iron Castings," in which Mr. Longden traced the development of cast-iron, starting with the introduction of Lantz Perlit in this country in 1919, followed by Thyssen Emmel and one or two others of less prominence leading to the inoculated Meehanite variety, a pearlitic high-strength iron of considerable use to-day in its various grades, and finally to the cerium and magnesium processes for the production of nodular iron. He commented upon composition, properties, casting characteristics and economics of production using a comprehensive series of slides to illustrate his points.

### Discussion

MR. CHAMBERS wondered, in view of all that had been heard of nodular iron, what special properties it had to commend it over malleable iron.

MR. PARKES said that it was well to remember that while attention was focused on producing high-strength alloy irons, for special purposes, the engineering industry mainly required more uniform supplies of a general purpose, grey, easily machinable iron. About 95 per cent. of foundry iron production was in this category.

MR. LOGAN recalled the development of Perlit iron and its popularity over a number of years, with, however, in his opinion, a subsequent inexplicable decline, since he had found it to be a most useful wear- and heat-resisting material, still superior as a material for crucibles for melting aluminium alloys. With regard to nodular iron he thought that its future would be limited to special applications in view of the composition, control, and expensive and complicated ladle treatment. In his opinion the "quasi-flake" variety also had a promising future, which led him to reaffirm that the biggest single factor in the development of cast-iron lay in graphite control.

MR. TEMPLETON asked whether more credit were not due to the skill and experience of the operative, as well as to the metallurgist for the high degree of development in the past 25 years. Mr. Longden thought that the major credit should be allotted to the technician; progress could not have been made without the knowledge and supervision of the metallurgist.

The meeting concluded with a vote of thanks proposed by Mr. J. P. P. Jones.

*Wales and Monmouth*

The Wales and Monmouth branch of the Institute of British Foundrymen held their opening meeting of the session on Saturday, October 7, at the Engineers' Institute, Cardiff. Before business commenced members stood in silence as a token of respect for the late Mr. J. J. McClelland and Mrs. McClelland, both of whom recently passed away.

MR. E. G. AMOS, branch president, in his opening address, said:—

I am very pleased to be honoured and to be again working with Mr. Wall, the branch secretary. The last time we worked together was on the foundry floor about 28 years ago. At that time, Mr. Wall decided to quit the practical side and maybe it was a good choice, for his present occupation as a commercial man has enabled him to perform a tremendous amount of work for the Institute in the course of his normal duties.

It is a pleasure to see such a large audience on this first evening of the session and I trust all will attend subsequent meetings, thereby strengthening the social value of the branch, increasing knowledge, and encouraging the officers, and particularly the lecturers, who come from far afield to give us the benefit of their knowledge and experience.

This gathering turns my mind back more than twenty years when I was first introduced to the branch. Then about a dozen practical men would be present, led by Mr. McClelland. From this small beginning the branch has steadily grown to a membership of approximately 180 members, and, in addition to this, our offshoot, the Bristol & West of England branch, has an equal number. We also have the West Wales section, which we hope will continue to expand. With so many members ready to sacrifice their Saturday evening leisure in order to learn more of the art and craft of our trade, this age-old industry must surely continue to make progress until it is acknowledged as the leading branch of the engineering industry.

The meeting was then addressed by MR. C. R. VAN DER BEN and MR. H. HAYNES, of the Lancashire branch. A film illustrating the production of castings for internal-combustion engines, with a running commentary by Mr. van der Ben, was followed by an address by Mr. Haynes on the training of apprentices in the foundry. A prolonged discussion followed, during which the lecturers replied to questions upon every aspect of their subjects to the complete satisfaction of the audience.

Proposing a vote of thanks to the lecturers, MR. H. J. V. WILLIAMS congratulated them upon the way they had kept the interest of the meeting throughout the evening. It was their second visit this year and, as upon their previous visit, he was sure that those present had learned quite a lot.

MR. JELLEY seconded the vote, which was carried with acclamation, and MR. VAN DER BEN and MR. HAYNES briefly replied.

# Reorganisation of a Moulding-machine Section*

By R. F. Ottignon

*After steady if somewhat piecemeal development in a moulding section over several years it became apparent that, by complete reorganisation, the man-hours per ton of castings produced could be cut down by almost half, and all-round efficiency improved. In the original layout the machines were served by heavy-duty travelling cranes, which proved to be slow in operation; the re-equipped section is independent of cranes, and mechanised shake-out has greatly reduced wear on the moulding boxes.*

THE MOULDING SECTION referred to is installed in the foundry of K & L Steelfounders & Engineers, Limited, Letchworth, and is responsible for that type of work which will go into 24-in. by 18-in. moulding boxes, having a maximum depth of 12 in. to each part. The average finished weight of the castings made is just over 20 lb., with a maximum weight of about 1 cwt. Normally, an average of two castings per box is maintained, giving a figure of about 42 lb. as the weight of castings produced per box. At the end of 1949, that is, four months ago, it was realised that the amount of both direct and indirect labour used on this class of work was nearly double what it ought to be. This position was largely due to the fact that, although over the past six or seven years a fair amount of improvement in equipment and detail had been effected, there had not been at any time a major effort at a complete reorganisation. Although it was considered that double the amount of labour was being used, the Author has since checked with one or two foundries and found that, even at that stage, the output was better than that from some others.

### Original Layout

Prior to 1943, this class of work was made on plain jolt tables, sand being shovelled from the floor, and the boxes closed by means of sight holes in the top part. During the following three years, Pneulec machines were installed together with better pattern plates and Sterling boxes were used so that pin closing could be universally used. Sand hoppers and a simple conveyor system were also added at later dates. The location was not ideal, as the machines were in a bay 76 ft. wide served by four electric overhead travelling cranes of from 5 to 20 tons capacity. As a result largely of the heavy capacity of the cranes, they were all on the slow side, with hoist speeds of only 16 to 20 ft. per min. The major part of the bay was occupied by much heavier types of moulding machines, dealing with boxes from 5 ft. to 7 ft. square, where the slower crane speeds were not so obviously wrong as they were on the Pneulec section.

No mechanical shake-out was put in; boxes were knocked out by suspending them from an overhead crane and striking them with a sledge hammer. Under these conditions, the boxes were distorted quite quickly, and a fair amount of box maintenance was needed to maintain accurate pin centres. In an endeavour to minimise the box maintenance necessary, the heaviest design of box which Sterling make had been chosen. It was, in fact, so heavy that two men could only just handle a 24-in. by 18-in. box on to the machine. Even with this robust design, however, the boxes did not stand up too well to the rough treatment they got at the knockout.

Fig. 1 shows the Sterling box after five years' manual knocking out, and Fig. 2 shows the layout before alterations. As can be seen from this illustration, two machines were installed side by side, so that copes and drags could be made simultaneously. In practice, this was never done, and each machine made first a run of drags and then followed up with the requisite number of copes. This was mainly due to the variety of work handled, as one machine would at one time be producing a complete pair of 18-in. by 18-in. boxes at each cycle, while the other would be working on a job where there was only a half-pattern for producing both copes and drags, with fairly small batches. Under these conditions,

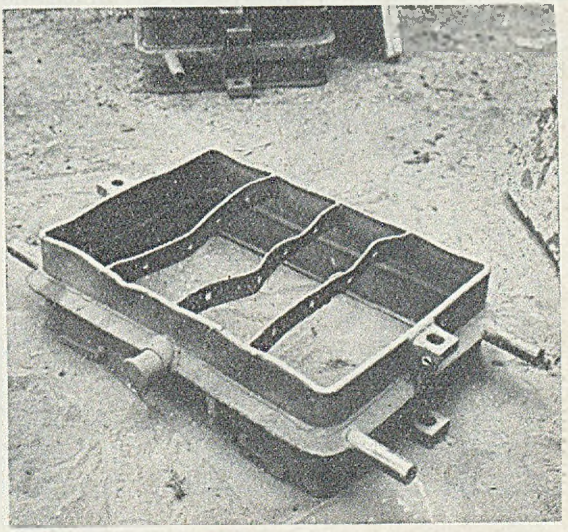


FIG. 1.—*Moulding Box after Five Years of Manual Knock-out.*

* A Paper read before the British Steel Founders' Association Second Productivity Convention.

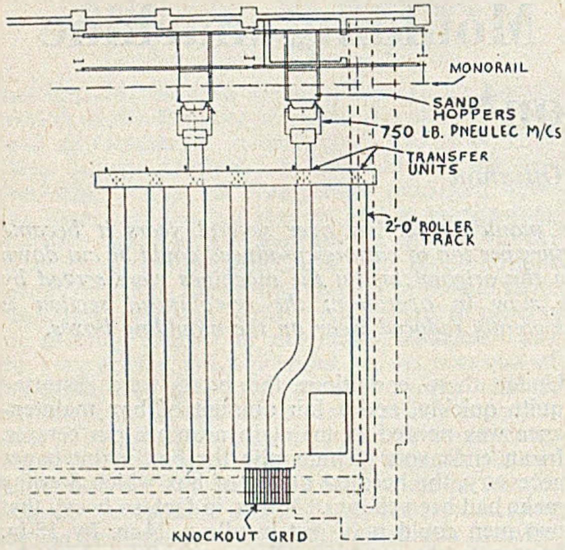



FIG. 2.—*Layout of Mechanised Unit prior to Alterations.*

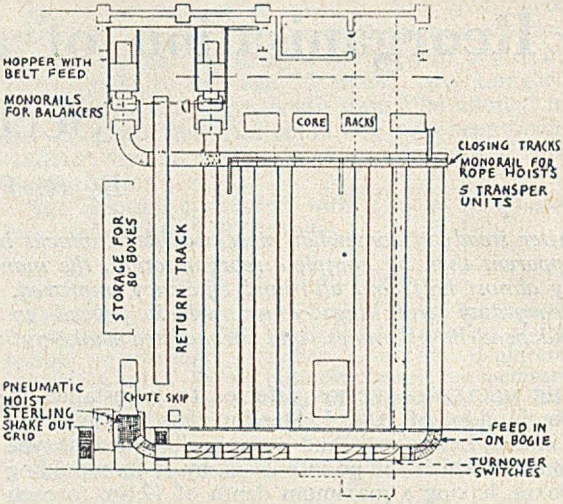



FIG. 3.—*Plan of the Mechanised Section after Reorganisation.*

it was easier to run each machine with a separate team. Three men worked in each team, one man operating the machine, the second man helping load the box and trimming and nailing, while the third man, with the assistance of the overhead crane and a slinger, assembled the cores, etc., and closed the mould.

Under these conditions, each team produced about 75 moulds per nine-hour day. An allowed time of 45 min. per mould was the average for the section, and this enabled the men to earn just under double time. A further 10 min. per mould was paid for knocking out and clearing castings away, etc., at night, while, say, a one-third share of the crane driver and two slingers employed on day would add a further five to six minutes to the time. Added together, this gave us a total of 60 min. allowed per box for moulding, closing and knocking out. With men earning double time, this meant about 30 man-minutes taken for each box made.

### Specified Requirements from the Reorganisation

The requirements for the new layout were that the section should be self-contained and independendent of the overhead cranes, and that the total man-hours per ton should be reduced to 50 per cent., namely, the man-minutes per box had to come down to 15. With a required production of 150 boxes per day at 15 min. each, the total minutes allowable were only 2,250. With 540 min. to a nine-hour day the output had to be obtained with four men producing a complete mould every 3½ min.

One man was required full-time at the knock-out, leaving three men to work two machines and do the

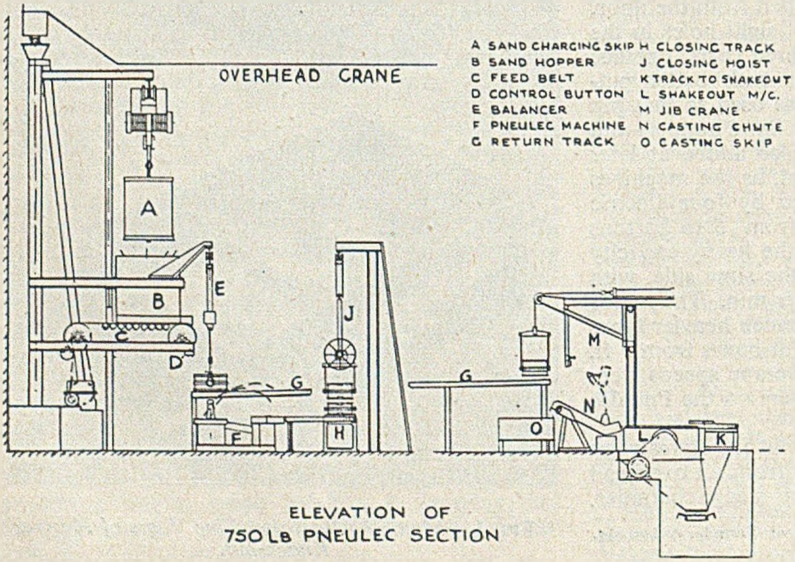



FIG. 4.—*Elevation of the Reorganised Section.*

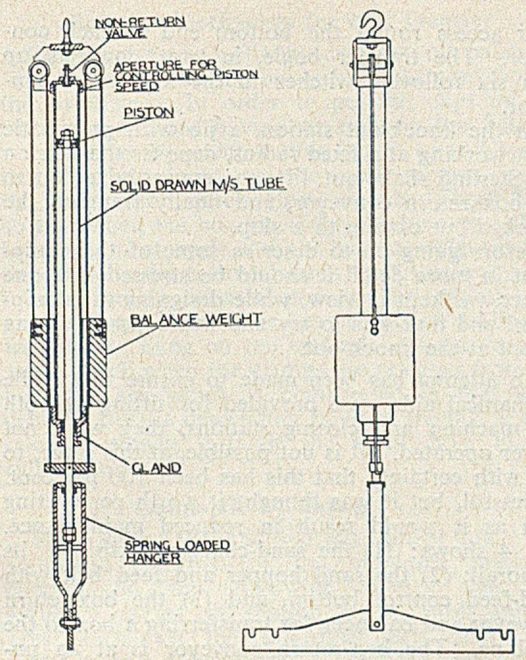



FIG. 5.—*Balancer for Transferring Boxes from the Conveyor to the Machine.*

coring and closing. In view of the average of two castings per mould, the number of cores, chills and nails per mould was fairly high, and after some consideration it was decided that the best approach was to have two out of the remaining three men on coring and closing, leaving the third man to operate both moulding machines. In order for the machine operator to work both machines and turn out a complete mould every 3½ min., it was obviously necessary that far more of the machine operation than usual would have to be fully automatic, and it was on these lines that the layout was approached.

The layout drawings were started in January, and one senior draughtsman, with two juniors for detailing equipment, were allocated for this work. The first 14 days were spent in preparing and discussing alternative types of layout, and by January 20 the layout had been completed and it was possible to draw up a programme for the detailing, manufacture and installation of the required equipment. At this time there were eleven weeks to go before Easter, and it was decided that the installation work should be completed during the holiday shut down.

As there were a fair number of detail drawings to be done before any equipment could be made or purchased, it was apparent that the last of the drawings would only be available a week or so before the completion date, and that the

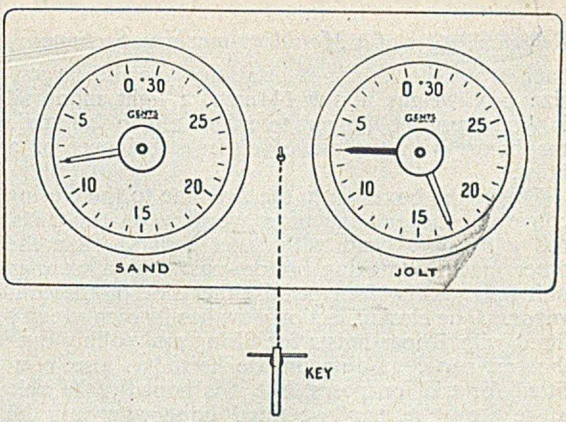
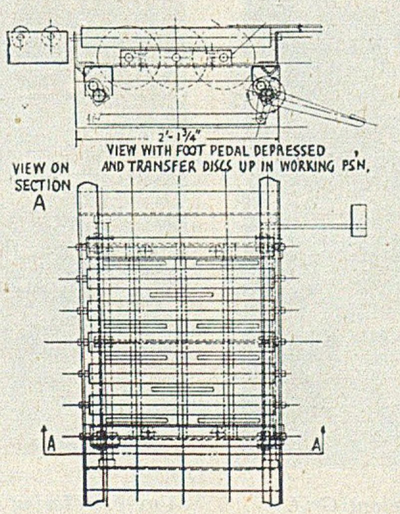



FIG. 6.—*Sand and Jolt Control Unit.*

last two or three weeks would be fairly hectic. It was accordingly agreed that the drawing office should first clear the details for all equipment which had to be bought outside, so that the last-minute rush would be on items being made in the home works, where an extra effort could be made to complete in time.

### New Layout

With the exception of the automatic controls for the moulding machines, most of the equipment was ready and the section re-started after Easter as planned, except that there were five men to the group instead of four, as, until the automatic controls were ready, one man was required on each machine instead of one man working two machines as planned. Fig. 3 shows the revised layout, which will be described briefly before giving details of some of the equipment. The floor was previously a sand floor; this was concreted to ensure keeping the conveyors at satisfactory levels. Starting with the moulding machines, these were situated under a monorail, which delivered the sand to all moulding-machine hoppers by means of drop-bottom skip holding about one ton of sand. New belt-feed sand-hoppers were provided above the machines, and a return conveyor arranged to bring the boxes



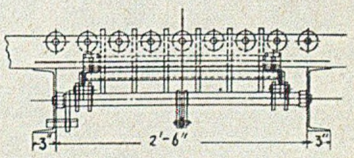




FIG. 7.—*Roller Transfer Unit for 2-ft. Roller Track.*

*Reorganisation of a Moulding-machine Section*

back from the knock-out station. As the largest-size box weighs about 1½ cwt., a light monorail is slung from the hoppers to enable a man to handle the boxes with the aid of either a balancer or a hoist.

To get the boxes from the machine to the closing conveyor, the end machine, working on top-parts, has a 90 deg. bend with taper rollers, while the other machine making bottom-parts has a transfer unit operated by foot pedal either side of the conveyor. The closing section now has its own runway fitted with Roper hoists for lifting and rolling over the top parts. A pneumatic hoist has also been fitted for trial purposes, but it is hoped to be able to rely on the hand-operated hoist when all the snags have been dealt with. As the largest half-box handled weighs about 4 cwt., when filled with sand, the completed mould may weigh up to 8 cwt. when it is transferred to the casting conveyor. The change in direction from the closing to the casting conveyor is effected with a transfer unit similar to that used on the one moulding machine.

Due to the size of a heat of steel, length of time per heat and variety of specifications to be cast, perhaps an over-generous amount of space was provided on the casting conveyors. They will, in fact, take six or seven hours' output from the machines, namely, approximately 120 boxes. To connect the casting conveyor with the knock-out conveyor, a transfer bogie was used, so that the ladle men had clear access round the bottom end of each conveyor. The transfer bogie, in turn, connects up with six rollover switches in the knock-out conveyor.

At the knock-out station, a jib with pneumatic hoist working at a fixed radius, deposits the box on the Sterling shake-out, lifts the empty boxes on to the box return conveyor, and finally transfers the knocked-out casting to a skip.

Before going on to describe some of the equipment in more detail it should be stressed that one object was kept in view, while designing the equipment, and that was to try and avoid power lifting except at the knock-out.

An attempt has been made to ensure that while mechanical aids were provided for lifting at both the machine and closing stations, they were not power operated. It is not possible, at this stage, to say with certainty that this has been 100 per cent. successful, but it was thought it worth persevering with as it would result in reduced maintenance. Fig. 4 shows: (1) the sand-charging skip on its monorail; (2) the sand hopper and feed belt with sand-feed control button, and (3) the box-return conveyor and balancer for transferring a box to the machine. The box-return conveyor is at an unusually high level, but it is proposed to make a virtue out of necessity by building into this a rack for pattern plates which should enable a fair number of those in constant use to be stored in an easily accessible position.

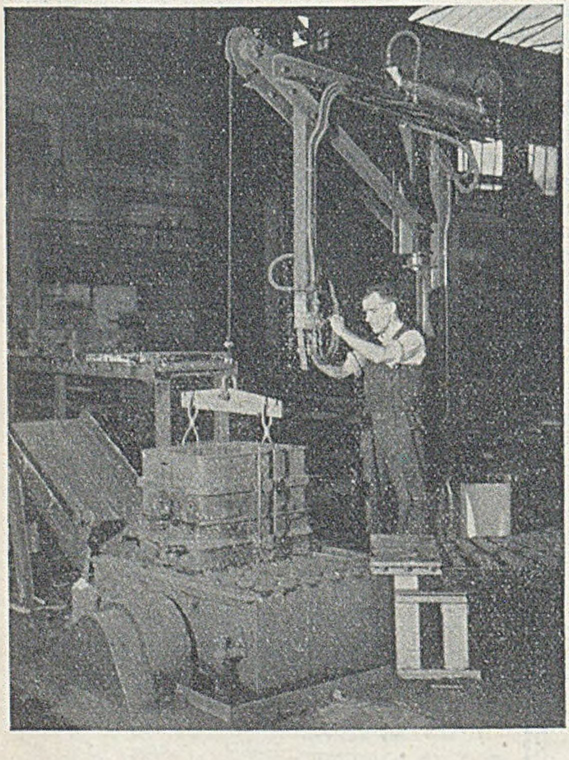


FIG. 8.—*Box being placed on Shake-out Grid.*

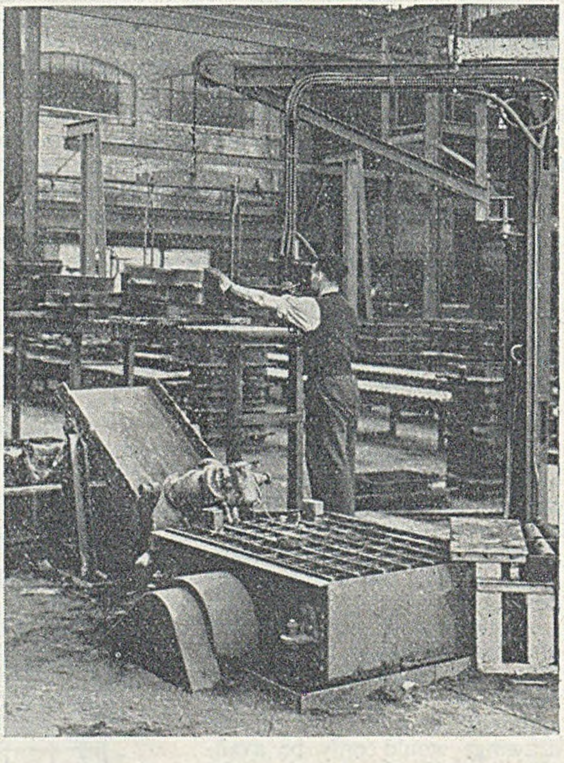


FIG. 9.—*Placing the Box on the Return Conveyor.*

### Balancer Mechanism for Box Transfer

Fig. 5 gives a sectional drawing of balancer. This is for transferring boxes from the conveyor to the machine. In order to get the clips on the trunnions without having to pull up the balance weight an easily compressible length of coil spring has been introduced into the beam support. For the same reason, quick-release clips have been fitted so that when the box is on the machine pins there is no need to struggle with the balance weight before the clips can be removed from the trunnions. The balance weight counterbalances the lightest box used—about 75 lb. For heavier boxes, additional weights are hung on the vertical pegs shown. To avoid shock when the clamps are released from the box, the air, which is compressed in the upper cylinder by the descending balance weight, is only released slowly through the small hole in the cylinder top.

### Automatic Moulding Cycle

Fig. 6 shows the sand and jolt control unit. The automatic controls for the moulding machines operate on the following lines: The first sequence is set in motion by a push button. This starts up the sand-feed belt and, after a two-second delay, opens a Solenoid-operated air valve controlling the jolt cylinder. Both sand feed and jolt cylinder knock off automatically after the lapse of a pre-determined time, which has been previously selected according to the size of box. The timing unit with its two dials, one controlling length of sand run and the other length of jolt, is shown in the illustration. Any alteration in timing of these operations is only a matter of seconds, it being done by moving the control finger to the desired position on the dial by means of a key.

While the automatic feed is at work on the first machine, the operator will be putting a box on the other machine. On returning to the now filled and jolted box, he flat rams it with the pneumatic rammer, strickles, positions the bottom board, clamps and then pushes the start button which operates the roll-over and pattern-draw sequence. The five air valves controlling this sequence are operated by a motor-driven camshaft. While the roll-over sequence is taking place the operator will be at the first machine engaged in flat ramming and so on.

### Other Details

Fig. 7 shows the transfer unit. This is a simple piece of equipment, very useful for transferring moulds to conveyors which are at 90 deg. It is thought to be much better than a turntable. Fig. 8 shows the box on shake-out. The knock-out section was laid out so that the hook on the jib always works at a fixed radius from the centre post so that no time is lost in sliding the hoist mechanism along the jib. The horizontal position of the hoist cylinder allows a jib of lower height to be used than if the hoist cylinder had hung vertically from the jib. A control arm fitted to the jib enables it to be moved without pushing or pulling the load, while the arm also carries the control valve for the pneumatic hoist and the stop and start buttons for

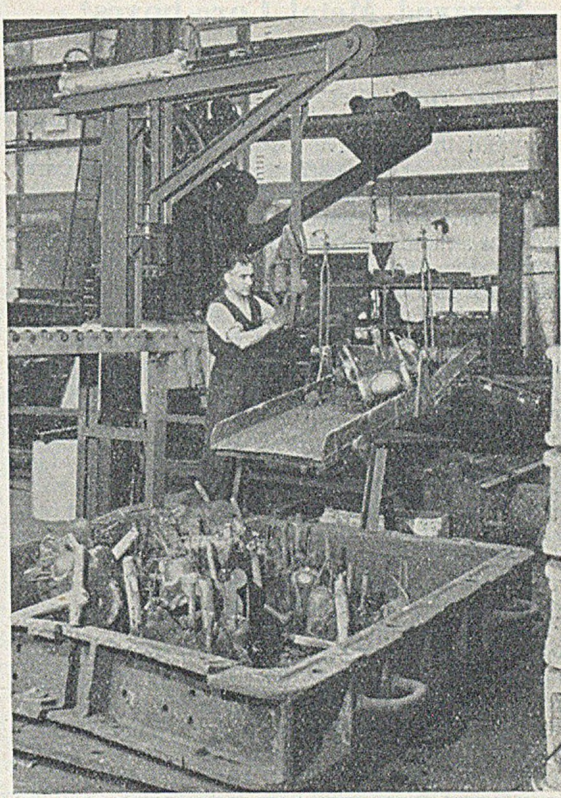


Fig. 10.—*Chute for Loading Castings into a Skip.*

the shakeout, which is accordingly only in operation for 10 or 15 seconds in each 3½-min. cycle.

Fig. 9 shows the box on the return conveyor. This does not call for any special comment, and Fig. 10 shows the casting chute. This last illustration shows an attempt to get the castings into a skip without using any lifting equipment other than the box-lifting gear which is permanently on the jib. The knock-out grid is tilted slightly so that the castings tend to walk on to the chute shown.

(*Continued, on page* 472.)

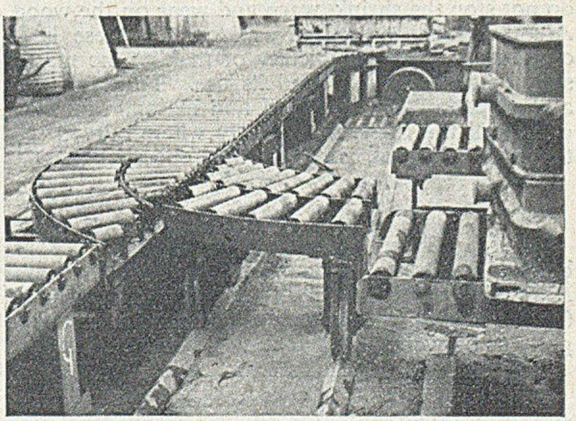


Fig. 11.—*View of a Roller-conveyor Junction.*

# Sprayed Metal Core-boxes*

*By F. Schumacher*

THE NEED FOR better core-producing equipment has long been recognised by foundry executives. But the excessive costs involved in the production of metal core-carriers, blow-boxes and core-boxes, particularly core-boxes for larger cores, has seriously limited advancement. It is good news to learn that a method which permits the production of metal drying shells for even less money than they would cost in wood has been perfected.

The heart of producing good drying-shell equipment is the production of the master shell pattern. This is an art which requires special skill and years of experience. Patternmakers often guard their secrets for producing these shell patterns, with the result that there are almost as many types of drying-shell equipment as there are master patternmakers. Unfortunately, previous attempts at reducing costs were always coupled with an inferior product, so that old-fashioned methods have continued. Shell patterns of uniform thickness cannot be produced in wood.

A survey of foundries will show that much metal drying-shell equipment is relatively heavy, expensive to produce and, in addition, the wall thickness is generally uneven; this means uneven core bake and consequently higher cost. To avoid the higher cost of metal equipment, some foundries use dryers made out of core sand produced in their own core rooms. Many other methods are known for producing carriers and core-boxes, but most of them are inaccurate and expensive. Some advantages of metal boxes are listed in Table I.

TABLE I.—*Advantages of Aluminium Core-boxes.*

| | |
|---|---|
| 1. Accuracy of dimensions. | 6. Durability and long life. |
| 2. No warping. | 7. Easier to handle and store. |
| 3. No shrinking. | 8. Uniformity of cross-section. |
| 4. Suitable for use as dryers. | 9. Minimised foundry handling. |
| 5. Light in weight. | 10. More economical in first cost. |

Larger core-boxes are frequently made out of wood, pieced together like a jig-saw puzzle with an almost endless number of parts, and heavily reinforced to stand the strain and punishment received in the core shop. Costly brass facings are often used to increase the life of wooden boxes, but these do not stop the shrink, warp and wear on the wood. Aluminium is recognised as ideal for these large core-boxes, but the difficulty of making the master shell pattern has restricted its use. To make such a shell pattern out of wood and maintain an even ⅛-in. wall thickness, particularly where curved sections are involved, is almost an impossibility.

### Novel Approach

Ignoring all previous attempts to make metal core-boxes and carriers economically, the staff at Cooper Alloy Foundry Company has worked out a method (patent applied for) for producing sound master shell patterns of even wall thickness. These are produced with a minimum of equipment, time and labour. And these uniform shell patterns permit the production of large aluminium core-boxes for less money than they can possibly be produced in wood.

Basic to the method developed is the use of a spray gun designed for the spraying of low-melting-point lead-base alloys. Since a suitable gun was not found on the market, the company developed one of original design and is currently manufacturing it on a production basis.

The procedure for producing metal core-boxes and shells in accordance with the newly developed methods is as follows:—

(1) Make a core plug and mount it on a plywood board.

(2) Brush graphite on the plug and board to act as a separator for the small shell patterns.

(3) Spray the low-melting-point alloy (approximately $\frac{3}{16}$ in. thick).

(4) Add ribs for reinforcement and bosses for dowels and blowing holes.

For larger core-boxes and shells the low-melting-point alloy is applied in a thin coat, approximately $\frac{1}{16}$ in. thickness. Cheesecloth is then cut to fit the sprayed surface of the core plug, and brushed on with shellac. This binds the cheesecloth with the sprayed metal. Further to increase the thickness, burlap is tailored to fit the surface, dipped in a pail of plaster of paris and added to the thin shell. From two to three coats of this plaster-dipped burlap will produce a thickness of approximately ⅛ in. Ribs for reinforcement or to supplement the feet of the core-box can then be added to finish the shell pattern.

Although the shell pattern made in this manner has sufficient strength to be moulded, it is recommended that the core plug be used as a ram-up block to preserve the pattern. The alloy used for spraying may be any of the low-melting-point alloys on the market. Cerro-Safe, which melts at 125 deg. C., was found to be the most suitable for this application.

The purpose of the sprayed metal is to obtain a smooth, true surface and accurate dimensions on the part of the core-box where dimensions are curved.

*Reprinted from an article carrying the caption "Aluminium Core-boxes, Better and Cheaper," by permission of the Editor of the *Iron Age*. The Author is chief patternmaker, Cooper Alloy Foundry Company, Hillside, N.J.

## *Moulding-section Reorganisation*

(*Continued from page* 471.)

This chute should hold the castings from about four boxes, so that once for every four boxes knocked out, the sling on the jib is attached to the chute, which is then lifted at the one end so that all castings fall into the skip provided at the far end.

### Conclusion

At the time of writing this Paper the section has been running on a day-work basis for a fortnight, and has achieved about 75 per cent. of its final target. There is no doubt that when the final stages are complete, and the men go on piece-work, the target set will be attained.

# Time Study in Foundries

## Some Aspects of Application to Rate Fixing

*By H. S. Ward**

*It is no exaggeration to say that time study is becoming more recognised as a very important and necessary factor in any industrial enterprise where sound products must be produced at economical and competitive prices. Time study is a method of breaking down an operation into detailed elements or parts. Motion study is also linked with time study, inasmuch as motion study determines the most efficient method of working and so eliminates wasted effort or operations.*

THE AIM OF the time study is to determine the correct amount of time for a given amount of work. The most efficient method of working must always be considered prior to the application of the time study, and in the following remarks it will generally be assumed that this factor has been given its full consideration. Everybody applies motion study to some degree by trying to avoid complicated methods of production and so aiming to produce work as economically as possible. Whether a job in a foundry justifies a time study depends entirely upon the quantity on order and the likelihood of repeat orders.

In endeavouring to outline a sound basis for the application of time study to rate fixing in the foundry and its allied departments, it is not intended to give the impression that perfect piecework conditions will automatically result. However, if the standards of application aimed at are high, it is more probable that the standards achieved will be higher than would otherwise result. Piecework rate anomalies will still be encountered, but they can be reduced to a minimum, and it is hoped that the various aspects detailed in this article will help to show how to achieve the best possible conditions.

### Excessive Earnings

Sound p.w. rates encourage maximum production and the rate fixer who thinks that piecework easily earned encourages maximum production has false hopes. It was once considered that jobs yielding exceptional p.w. earnings were a stimulus to production, but modern times have proved with the 27½ per cent. p.w. guarantee (which eliminates the justication for p.w. rates that cannot be worked to) that this is far from being correct. Such jobs and operations which yield excessive earnings become the causes of dissatisfaction and low production. This is especially the fact when the jobs are confined to a particular machine or group of men. Sometimes the fact that the nature of the work entails considerable experience in order to reach the present production makes it difficult to permit a loss in production whilst other men are receiving training. Present-day conditions do not permit a complete change-round of operators in order to equalise the benefits of the exceptional p.w. items.

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Uniform p.w. earnings in relation to effort applied is a difficult condition to maintain, and only a careful initial time study can help to achieve this aim.

In the successful application of time study to rate fixing the following five factors play an important part:—(*a*) The make-up of the time-study form; (*b*) the time-study observer (or rate fixer); (*c*) the operator; (*d*) the allowances, and (*e*) the time-study details.

### Make-up of the Time-study Form

The time-study form (Table I) is designed to allow for the breaking down of the operation into approximately 15 elements for a moulding or machining job cited, and this number is generally ideal for work of a repetition nature. Where the class of work takes considerable time to produce, then the time-study form would require modification to suit. Each column is sub-divided and headed "consecutive" and "independent" times. At the actual time of recording the study, the rate fixer (or observer) only inserts the consecutive times. The independent times are part of the office calculations.

The breaking down of the operation should not be done to the extent of distracting the time-study man's judgment of the operator's ability. Both factors must be considered. There should be no secrecy regarding the recordings of the time study, and any operator who shows interest in its application should be given the opportunity to understand it.

### Recording the Time Study

The recording of the time study is very simple. Decimal watches are used to simplify the calculation part of the study and the operation is broken down into standardised elements. All elements used should be standardised, both so that all time-study men record times which can be compared and because it is always possible then to revise any element in the time study. This is a very successful method to apply when the original base time has been proved fair and satisfactory and considerable time is saved by eliminating a complete check. For example, placing a flask on a machine and returning the hoist to its idle position would be commenced when the operator prepared to obtain the flask, and would be finished when the hoist was returned to its idle position. Similarly, with a machine-shop operation which included an element such as "position turret, set facing tool and engage self act"; either would be termed a standardised element. The watch readings are re-

*Time Study in Foundries*

corded as each standardised element is completed and these recordings are continued until the operation is completed; the procedure is then repeated until the required number of units have been recorded. Table I is a typical foundry time-study for a job of a repetition nature. When breaking down the moulding operation into elements for recording, the procedure should always be to ensure that elements which should yield identical times (providing all equipment except the pattern remains standard) should not be combined with elements which vary according to product encountered. For example, elements 3 and 8 would be variable elements, whereas element 1, for foundry practice, could be classified as a non-variable one. By adhering to this practice, the resulting time-study records can be used for compiling standard times for non-variable elements. The application of such times can reduce considerably the demands for actual time studies. Providing the standard times are taken from time studies which have been proved to be sound, more consistent piecework rates should result. Standard times developed from time studies made in a foundry where the basis of payment has been irrespective of output, will generally prove unreliable and far in excess of what would result from time studies taken in a foundry where piecework methods have been well established. The foregoing remarks regarding standard times apply mainly to machine work of a repetition nature, although the method of recording elements for all classes of work should conform to the same rules.

A column on the record card for recording minimum times can be incorporated at the right-hand side of the "average" column. Minimum recordings (other than possible recording errors, which are excluded) can be utilised for reviewing operator's consistence and ability rating and can have a bearing upon the maximum output possible. The reverse of the time study, Table II, is used to furnish full details of cores, flask depths, miscellaneous equipment used, etc.

The occupational base rate for each man consists of the agreed basic rate per hour plus a piecework margin of not less than the agreed 27½ per cent. of the basic rate. For example, a basic rate of 63s. per 44 hr. represents approximately 17.2d. per hr. Adding 27½ per cent. to this results in an occupational base rate of 21.93d. per hr. Thus 22d. per hr. would normally be applied for piecework calculations. The basic rate details quoted in all cases are for example purposes only and may not compare with the recognised base rates.

These detailed records which accumulate in the files can often be used as a basis to determine a piecework rate for batch work which does not justify actual time studies. A sound basis is also available for estimating and costing purposes. Elements which incorporate additional work to the standard element are, wherever possible, split up.

### Stop Watches

The average stop watch used by any time-study department undergoes considerable use during its life and the best-quality industrial stop watches or timers are the soundest investment. Considerable effort is often applied to ensure that an operation to be timed is being performed as efficiently as can be foreseen and, therefore, when the time study is in course of being taken, it would often result in excessive delay if low-grade stop watches resulted in a hitch during the recording period. A common fault with low-grade watches is that the minute hand often records either forward or behind the minute line when the decimal minute hand is on the zero mark and so misreadings can result.

Large clear dials are a distinct advantage; the time-study observer does not then experience any undue eye strain in recording the readings, and correct readings are more likely to be maintained. The centre dial, for recording the minutes, is a distinct advantage when it is graduated to give a 60-min. reading in one cycle.

### Period of a Time Study

The period of the time study is such as to enable the observer to obtain a fair incentive basis. This period depends entirely upon the class of work and can vary between minutes, hours or even days. For example, on a job made on a small air-press moulding machine where the production was approximately 20 moulds per hour, then 10 to 15 moulds would generally be satisfactory. Similarly, a gunmetal casting machined on a turret lathe where the production was 10 to 12 pieces per hour, then 10 pieces time studied would generally be sufficient. This depends on the difficulties experienced on the job and the variations in times recorded. There is no set period of recording for any job—the rate-fixer stays until he is satisfied that the time study shows a true reflection. Upon completion of the time-study period, the calculations can be made. This part of the study will be dealt with in conjunction with the allowances.

### Time-study Observer

The time-study observer must be a man with full knowledge of the class of work to which he is attached. He must obtain the confidence of the operator so that a fair timing is obtained. The success of any time-study department, no matter what system of payment is applied, hinges upon gaining the confidence of the operators. Having received a fair timing it remains for him to ensure a fair incentive basis, and any doubt he may have at this stage regarding the incentive should be given to the benefit of the operator.

Possessing the necessary knowledge, he must be a man of the correct personality and must understand any problems that may arise during the timing of the product. He must have the patience and the willingness to help the operator to overcome temporary difficulties. He must be genuine in what he does and says, and must be a man who always keeps his word. The confidence which time and care have built up in an organisation can be broken down very rapidly if a rate-fixer does not abide by his word. A time-study observer should always be a man who has made a complete study of the branch of the trade to which he is attached. He will encounter many obstacles if he is to fulfil his duties successfully. He must have his own trend of thought when studying the various angles of the work in question. Although he must be persevering, he must be willing to see the point of view of the supervisory staff, so that the final decisions are generally accepted by those concerned.

There is considerable variation in the standards set by time-study observers generally, and basic training is imperative so that he is able to foresee: (*a*) The best methods of working; (*b*) possible improvements to equipment in use; (*c*) correct rating of the operator, and (*d*) assess the amount of physical effort required.

No time-study man will be successful if he is easily led to believe that the methods in application, when he approaches the operation to be time studied, cannot be improved upon. As one becomes more experienced in time study, the usual approach to any operation becomes one of expecting to find some means of improving the methods—and this invariably results. Failure to view the job in this light especially as regards the best methods of working are so often found to be the reasons for excessive piecework earnings. Excessive piecework earnings can imply earnings received in excess of the effort and skill applied. There is always a reason for excessive piecework earnings, but nothing is excessive if the skill, effort and conditions of working justify them.

Thus, part of a time-study observer's duties should always be the study of the reasons why excessive earnings have resulted from particular jobs, and this often reveals weakness in: Shop methods; supervisory control; or time-study technique. Bad shop methods can find their way into time-study recordings: such as are caused by poor positioning of the work and tools, or gauging in excess of that justified by the importance of the work (bearing in mind the possible variations that can result when completing every piece). Operations such as gauging a previous piece whilst the machine is working automatically during part of the operation, should always be recognised as proper shop methods. When similar production departments are compared, it is then that efforts which have been made to apply the best possible shop methods can be detected.

### Supervisory Control

A high proportion of those operations yielding excessive p.w. earnings so often result from lack of supervision. Changes made in methods of manufacture, which result in increased production, should always be referred to the time-study department and should not be allowed to be brought to light by excessive p.w. earnings. Many labour problems to-day would never develop to that stage if good supervision existed. Labour problems so often develop from operators getting to know the earnings of operators around them, who should be classified as belonging to the excessive p.w. earnings group.

It is often assumed that excessive p.w. earnings automatically denotes poor time-study application, but it is no exaggeration to say that, when such cases are investigated, it is invariably proved that the increased effort is in no proportion to the increased earnings but has resulted from the elimination of operations which, although considerably reducing the quality and finish, do not cause the rejection of the product.

Good supervisors and foremen will, as much as possible, avoid being burdened with these conditions by ensuring that any changes made in method of manufacture, whether resulting in increased production or otherwise, are reported to the time-study department. Supervisory control thus becomes more correctly applied by its avoidance of such factors that are the responsibility of others and by ensuring that such information is forwarded through the right channels to be dealt with.

Core shop and foundry practice is such that minor changes are often applied which, if the above conditions are rigidly adherred to, would mean an excessive number of revisions to p.w. rates. To overcome such minor changes, it can generally be agreed that, provided the change made does not incur a difference either way of 5 per cent. in the time taken, such changes can be accepted as standard practice for such work. Should, however, additional changes occur, then it can be agreed that the first change made can be allowed for in the latest revision.

### Time-study Technique

The wealth of information which a time-study department accumulates can greatly assist in providing the time-study observer with such details as to assist him in the most efficient method of application. He is able to collect the best points of various time-studies and try and achieve ideal conditions. He has prepared a target to be aimed at and the results of time-study made will generally reveal the efficiency of the present methods of working.

It is at this stage that the observer becomes a great asset to the departmental foreman. Generally speaking, the foreman's greatest concern is to avoid excessive scrap and, bearing this in mind, it is easy to account for work being produced at lower production efficiency than considered reasonable by the time-study observer. Therefore, it is necessary to bring to the notice of the foreman such detailed information as will convince him that he can still produce a sound product within low scrap limits, even when minor or unimportant elements are eliminated from the work. Providing proposed changes always allow that margin for slight errors and variations that so often occur during production. the observer and the foreman will always look upon each other's duties as essential features of any efficiently-operated department.

### Back Application

The practice is often made of applying the p.w. rate from the commencement of the job and not from the actual time the rate is established, which may be a day or so after the run has commenced. Existing methods of production are so often subject to necessary changes prior to the application of the time-study. It is at this stage that the ob-

*Time Study in Foundries*

server must apply the soundest method of approach to the operator. Where the operator has been engaged some considerable part of the pay period in question under those conditions prior to the proposed changes, then in fairness to the operator and also so as to develop goodwill and understanding, it is necessary to make some compensation for time lost prior to the methods applied in the study.

Generally speaking, daywork time allowances for minor changes to methods can always be satisfactorily agreed upon, but when continual major changes result then such departments require investigation of the supervisory staff, as good working conditions will never develop whilst this exists. The spirit of confidence and understanding can be developed so that p.w. rates can be applied from the date of the commencement of the run and this will mean an increase in production (by avoiding the preliminary operation under daywork conditions) and an increase in total p.w. earnings will result, which most operators aim to achieve.

The method of approach to the operator by the observer must be developed to a very fine degree if the best time-study conditions are to be obtained. The qualifications of a successful time-study observer must always include ability to obtain the fullest co-operation of the operator. Fair incentive earnings may be the primary factor with most operators, but the wrong psychological approach on the part of the time-study man has often resulted in the loss of good operators to vital industries.

The observer must always realise that foundrymen, like others, are individuals with their own ways and ideas and, in any dealings with a problem raised by an operator, he must be treated as an individual. The observer's duties to a large extent consist of handling and approaching operators and developing confidence by handling the human aspects of their problems.

### Fast Workers

In the past, the practice of timing the fast operator (which from the rate fixer's point of view may have been a safe basis) generally resulted in p.w. productions which average operators could not maintain. The accurate rating of the operator's ability is one of the most important factors in rate fixing. The considerable detail which time-study elements offer will often serve as a reliable check upon the ability rating applied by the observer. The development of confidence between the time-study man and the operator will ultimately result in more consistent time-study records. The ability rating of the operator, although almost consistent, should not become an established rating as variations will often be encountered.

### Guaranteed Piecework Earnings

Recent efforts made by employers' and employees' organisations to ensure that all p.w. systems are fundamentally sound by applying the 27½ per cent. clause to p.w. rate application, has resulted in p.w. conditions which call for a duty to be performed by *both* the operator and the rate fixer. Any person is capable of setting p.w. conditions which are far from being sound, just as any operator is capable of doing an operation in a very slow and inefficient way. Such clauses in recent awards have offered the opportunity to operators and rate fixers alike to determine the cause why p.w. cannot be earned on any particular item. To the rate fixer with a sound application basis this should be welcomed, just as it should be welcomed by the genuine operator of at least average ability who is concerned about the reason why he cannot earn the piecework margin.

In reviewing any request for the retiming of an operation, and provided the methods being applied are comparable with the methods detailed against the time-study for the p.w. rate, there are only two factors to be considered, namely, the p.w. rate and the operator. First, if the p.w. rate is unfair, then it must be adjusted—there is no economy in the application of p.w. rates which have no incentive. Secondly, if the operator be at fault by being below the average ability, this may probably be due to the short period of time he has worked on the job.

Thus, the 27½ per cent. guarantee (which makes provision for all p.w. rates to yield this margin to the average operator) makes it impossible to ignore bad p.w. rates. If the provision be intensively applied to p.w. schemes, it should eliminate the reason for operators making unofficial increases to speeds and feeds during machining operations. This practice in the past has often caused excessive tool breakages and consequent additional costs and delays, and it continually throws up false shop-information regarding tool costs and machine capacities.

### Improvements

Suggestions on the part of the operator which result in improved production, must always ensure some reward to the operator—either in lump-sum form or in a revised p.w. rate. However, suggested improvements should mainly come from the supervisory staff, and if these are not forthcoming, then the right supervisory staff has not been chosen.

One often hears the remark that the present-day standard of the average operator is lower than the pre-war standard, but has not this 8s. difference in the national award for a pieceworker and time-worker caused part of this tendency? His 27½ per cent. p.w. allowance is really reduced thereby to 15 per cent. over his day-work basis, and operators view the matter from this aspect.

The true spirit of understanding and co-operation is only maintained by ensuring that time studies prove the average operator and those above the average to receive always the fairest possible treatment. To fall short of this commitment will result in the breaking down of the confidence in the rate fixer. When in doubt, nothing is lost by giving any benefit of the doubt to the operator who has played his part by giving a good, fair time study.

To the operators below the average (and this category is stressed as being those genuine operators who have yet to make the standard grade) it is not always advisable to be too anxious to apply any form of incentive. (Calculating on an average basic rate plus the national award, operators who fall into the above class are those rated below 90 per cent., and with no immediate prospects of improving.) To the ‘(‘ go-slow ” operator (those who work below the average and are capable of much faster working), there should be extra caution shown to ensure that any incentive applied will not act as an encouragement to others to act likewise. Benefit of the doubt should never be given to this class of operator. This factor of the average worker being able to earn the $27\frac{1}{2}$ per cent. p.w. margin is, however, rather vague.

TABLE I.—*Time-study Record Card Completed (all names are fictitious).*

**TIME STUDY, STANDARDS DEPT.**

Date . 6.6.50.
Observer .. *Smith.*
Part Name .. .. *5-in. Connecting Piece.*
Operation .. .. *Moulding—2 men.*
Machine No. .. .. *224 Group.*
Name and Type .. *Pneulec Jolt and Squeeze 14 in. × 17-in. Flask.*

OPERATORS.
*Jones*
Helper: *Williams*

Catalogue No. .. *M 46.*
Patt. No. .. 1160.
Part No. .. *DD* 12.
Operation No. .. 6.
Section .. .. 21.
A'c. No. 55A.

| No. | Detailed element. | 1 Con. | 1 Ind. | | 10 Con. | 10 Ind. | Average. |
|---|---|---|---|---|---|---|---|
| 1 | *Reset patt. and air blow, hand lift, drag flask to machine* | 0.34 | 0.34 | | 36.25 | 030 | 313 |
| 2 | *Two shovels of facing sand, from floor to flask* | 0.50 | 0.16 | | 36.42 | 0.17 | 165 |
| 3 | *Tuck round 2 shrinkheads* | 0.65 | 0.15 | | 36.58 | 0.16 | 152 |
| 4 | *Part fill flask from hopper and jolt machine 20 jolts* | 0.82 | 0.17 | | 36.75 | 0.17 | 171 |
| 5 | *Fill up flask from hopper* | 0.97 | 0.15 | | 36.90 | 0.15 | 156 |
| 6 | *Pos'n bottom board m'c head over, ram, vibrate, and strip pattern, M'c head back* | 1.31 | 0.34 | [COLUMNS 2–9 | 37.23 | 0.33 | 325 |
| 7 | *Hand lift drag flask from m'c, carry to floor rail and set on bogey* | 1.47 | 0.16 | ARE COMPLETED BY REPEATED | 37.38 | 0.15 | 158 |
| 8 | *Hand set 2 cores and hand bellow drag half* | 1.95 | 0.48 | OBSERVATIONS.] | 37.89 | 0.51 | 513 |
| 9 | *Reset patt. and air blow, hand lift cope flask to machine* | 2.25 | 0.30 | | 38.18 | 0.29 | 298 |
| 10 | *Set auto down-gate on pattern. 2 shovels facing sand from floor to flask* | 2.47 | 0.22 | | 38.43 | 0.25 | 240 |
| 11 | *Tuck round 2 shrinkheads* | 2.63 | 0.16 | | 38.60 | 0.17 | 165 |
| 12 | *Part fill flask from hopper and jolt machine. 20 jolts* | 2.83 | 0.20 | | 38.79 | 0.19 | 207 |
| 13 | *Fill up flask from hopper, tuck down gate* | 3.04 | 0.21 | | 39.01 | 0.22 | 218 |
| 14 | *M'c head over, ram, vibrate, strip pattern, m'c head away* | 3.29 | 0.25 | | 39.28 | 0.27 | 262 |
| 15 | *Remove auto down gate, clean gate, set strainer core and 2 closing pins* | 3.50 | 0.21 | | 39.49 | 0.21 | 221 |
| 16 | *Hand lift cope flask, close mould, remove 2 closing pins* | 3.68 | 0.18 | | 39.69 | 0.20 | 185 |

DELAYS.

*Metal*
13.45 2.20

| Male 2 | Boy .. | Female.. |
|---|---|---|

| Labour Class | Un-skilled 1 | Semi-skilled 1 | Skilled.. |
|---|---|---|---|

Cancelled by ....................

Changes to detailed elements above or any equipment used subject this time study to revision.

Study Ref. No. .. F.670.

This study supersedes study
Ref. No. .. F.421.
.......... Dated .. 14.12.44
Former rate 390*d. per* 100 *mlds.*
Reason for change
*Auto-down gate now replaces hand-cut down-gate methods. No sieve required for facing sand.*

Set-up allowance.

| Hours. | Minutes. | Normal run pieces. |
|---|---|---|
| — | — | — |

Office calc'ns. :—M'c Op'r. 182*d*. Helper 166*d*. 3.749

CALCULATION.

| | | | |
|---|---|---|---|
| Base time | 3.749 | Total P.W. Rate per 100 moulds | 348*d*. |
| Std. allowance factor, 15 per cent. Add'l fatigue all'ce, 5 per cent. | 0.750 | Occupational .. Base rates/hr. .. | Op'r. 22.0*d*. H'lp'r. 20.1*d*. |
| Total std. min. per piece (time study base) .. | 4.499 | Checked by .. *Atkins.* | |
| Prod. ab'ity rating .. | 110 per cent. | Noted .. *Ellis*, Supt. | |
| Std. time per piece .. | 4.949 | Approved by ...... Gen Supt. | |
| Production per hr. .. | 12.1 | Date effective ................ | |
| | Moulds. | | |

*Time Study in Foundries*

The standard of the average worker is not universal and every foundry or machine shop has its own views of what an average man should produce. The general standard of the foundry or machine-shop efficiency will help to make the operator more efficient. The amount of effort required may be reduced where the use of mechanical aids and equipment is part of the set-up.

### Completion of Time Study

Upon calculating the base time (see Table I), certain allowance factors have to be added before applying the ability rating. The standard allowance factor is generally 10 to 15 per cent. and remains constant. Work of a heavy or hot nature will justify a fatigue allowance in addition to the standard allowance. (Heavy work is intended to apply to the continuous handling of smaller castings over a period of time, and not to the lifting of castings which justify the use of a hoist.) It is recommended to commence this fatigue allowance when the weight handled is approximately 15 cwt. to 1 ton per hour. This fatigue allowance may increase to as much as 20 per cent., but it is recommended that towards the higher limit an investigation would be advisable aiming at reducing the effort employed.

### Details

Lack of detail when making a time-study can be the root cause of bad rates and excessive earnings. The more efficient a foundry or machine-shop becomes, the greater the need for exact detail, because changes in methods are gradually reaching the stage when further improvements are difficult to apply. Even when it is necessary to estimate the p.w. rate, it is very important to obtain the details of methods applied. Details such as type of pattern, loose-pieces entailed, types of cores used, flask used, methods of lifting, etc., should always be shown (Table II). Machining work should also show tools, speeds and feeds in used. This information will prove of considerable help to the foreman, as it shows the methods previously applied. With the variety of castings and products being produced, the foreman cannot be expected to memorise every detail on every product. Also, each foreman responsible for an operation, towards the completion of the product, has available sufficient detail to assist in eliminating errors. For example, insufficient venting of cores when a casting is first made, may have caused "blows." The details of the core-shop foreman's card would show the venting operation for cores and so avoid repetition of previous troubles. Similarly, important machined faces for ensuring a tight seating would show the best speed and feed details to avoid rejects in the machine-shop.

TABLE II.—*Reverse of Time-study Record Card shown in Table I.*

| SKETCH OF JOB. | MOULDING DATA. | | | |
|---|---|---|---|---|
| | Type of machine .. | *Pneulec Jolt and Squeeze.* | | |
| | Metal used .. | *Grey iron.* | Formula No. .. | 0. |
| | Type of flask .. | *Hand type—iron.* | Height { cope .. | 8 *in.* |
| | | | { Drag .. | 6 *in.* |
| | Size of flask : length | 14 *in.* | Width .. | 17 *in.* |
| | Type of pattern .. | *Metal on iron base.* | | |
| | No. of pieces on gate .. .. | 2. | | |
| | Total No. of cores per mould .. | 2 *main cores, 1 strainer core.* | | |
| | Type of cores .. .. .. | *Oil.* | | |
| | No. of loose inserts on pattern, etc. .. | *Auto down gate for cope.* | | |
| | Riser and shrinkhead details .. | 2 *fixed shrinkheads.* | | |
| | No. of men .. | 2. | Moulders | — |
| | M'c operators .. | 1. | Shakeout | — |
| | Helpers .. .. | 1. | | |

REMARKS.—*Existing flasks for this type of work are deeper than necessary. Due to amount of this type of work being encountered, the purchase of some shallower flasks is recommended.*

### Adjustments

Wherever possible, adjustments to p.w. rates should always be made at the time an alteration occurs, as small adjustments can so often repeat themselves in different ways and can build up a large item and finally cause a major p.w. complication. An initial change of, say, 5 per cent. either way could be agreed upon to be held in abeyance until a further change takes place, if any. Failing a second, the initial change would be generally accepted, which might be to the operator's advantage or otherwise. It is stressed that all such changes, and what action was taken, must be recorded, so as to keep records up to date.

When the number of men in a gang is altered, then, due to the changed conditions, a separate p.w. rate would be necessary for the revised gang. It cannot be assumed that when a moulding gang is increased from three to six men, that the same degree of production increase can be expected. Furthermore, the idle time factor of part of the gang may tend to increase.

In concluding, it should be emphasised that: (1) The stop watch should always be placed in the hands of qualified men; (2) everything must be done to encourage fair timing; (3) there is no exploitation of the ability of those operators above the average; and (4) it is realised that everybody (whether operator or staff) belongs to an industrial nation whose livelihood depends upon producing the necessities of life at an economical price. On these understandings the rate-fixing department will play a very successful part in any foundry or organisation.

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# Process and Product

## *Mr. James G. Arnott's Presidential Address**

THE YOUNG MAN who is undergoing his training to-day, with a view to a career in foundries of ten to forty years hence, would obviously be greatly assisted if he could accurately forecast what changes would take place during that interval. The only guide to such forecasting that is likely to be of much use to him, however, is a study of the changes that have taken place over the last few decades, particularly in relation to supervisory personnel.

Foundrywork has become a tremendously diversified business to-day and shows every sign of becoming more so. Nearly every foundry has some intention of applying more technical control to metal, sand, waste-reduction, or the application of more mechanisation to sand preparation and distribution, to mould production or perhaps to the cleaning of castings. Many techniques have come into being, as for example standardised sand testing and control, almost non-existent thirty years ago. The procedures of core blowing, metal inoculation and hydroblasting, etc., are examples of developments that have taken root in very short span of years. These developments have not taken place without repercussions of the personnel who staff the foundries. The chemists, as they were usually called in Scotland, employed by but a few foundries in the 1910 to 1920 period, have multiplied greatly in numbers to become the metallurgists of to-day and the scope of their activities has also been greatly extended. Engineers, too, have also increased their influence at all levels.

### Division of Activities

If one were to divide foundry activities into two groups, one pertaining to the "process" and the other to the "designed product," I think we may see an outline of what has been happening and how our trade is at present tending to divide itself. For the purpose of illustrating these terms we might think of the product in terms of a pattern number while process work we might regard as typified in flour milling or brewing.

The following lists can then be assembled:—

*Process Activities.*

1. Metal selection; melting testing; analysis.
2. Sand selection; preparation; testing.
3. General supplies; stores and storage.
4. Drying and annealing-stove performance and cycle; control of combustion generally.
5. Process plant; performance; layout; improvement.
6. Disposal and reclamation of waste materials.
7. Transport of process materials.
8. Costing of process materials and labour.
9. Supervision and training of process labour, *i.e.*, most of indirect labour, and providing the appropriate incentives.

*Product Activities.*

(*a*) Examination of design drawn, and planning the method of production.
(*b*) Estimating weight and production times and cost.
(*c*) Designing and making patterns, jigs, drying shells, etc.
(*d*) Box provision in correct quantity, sizes and design.
(*e*) Gating, feeding and chilling.
(*f*) Job progressing and customer liaison.
(*g*) Pricing to direct labour.
(*h*) Job costing.
(*i*) Job dressing and inspection.
(*j*) Supervision and training of direct labour.
(*k*) Marketing of product.

While I cannot say that I know of any foundries where there is an actual separation of personnel in charge of the two groups as listed, I do suggest that what has been happening over the last ten or twenty years indicates a trend in that direction. A very simple approach to this alignment can occur, for example, in a small to medium-size foundry, run as a department of an engineering shop and in charge of a departmental foreman and metallurgist, although in some cases the metallurgist very unwisely shows a strong disinclination to take anything more to do with process labour than he can help.

Shortcomings in the education and training of both process and job-production personnel have in many cases paved the road for the entry of engineering-trained personnel who on the whole have proved themselves willing to re-educate themselves fairly intensively in most phases of foundry activities with some bias probably in favour of the "process" side. In the larger foundries, the engineer has in many cases been very successful as manager. Having no particular *forte* he can take a well-balanced view of the general activities and equipment. In other words, his value is that of the general practitioner rather than the specialist.

### Specialty Foundries

The various types of foundries have, of course, very varying proportions of "process" to "product" functions. In a specialty mechanised foundry, making motor cylinders, electric switch boxes, or baths, for example, once it is running, practically any changes in the quality, and to some extent quantity, of the product are likely to be a reflection of the "process" work, the product itself being neither more or less difficult from day to day. It is therefore in such foundries that one can look for the highest development of the "process" in all its aspects.

### Jobbing Foundries

As an example of a foundry where the importance of the job requirements comes more prominently into the picture, consider a medium-to-heavy type of engineering jobbing foundry. In this case, the main preoccupation is with the product itself from the time it starts as an enquiry until it leaves the shop, and the total of all such jobs probably induces much more "job" thought than "process" thought, especially if the foundry operates mainly on dry-sand or loam moulding. In the growth of such a foundry it is most likely that by the time it has reached an output of, say, forty to sixty tons a week some separation of functions will be desirable. If the manager be moulder- or patternmaker-trained he will probably leave some of the process

* Delivered to the Scottish branch of the Institute of British Foundrymen.

*Process and Product*

work in the hands of the laboratory personnel, for example, metal and sand supervision. If he has been trained in the laboratory or engineering shop it is very probable that the moulding technique is largely decided by a moulding- or pattern-trained man, perhaps termed superintendent or perhaps the chief planner.

### Balance

Often to-day one sees a process man succeed a moulder or patternshop-trained man as manager, and about as often one sees the reverse. Provided these people are of equal ability in their respective spheres and are well supported by their opposite number, it is probably a very good thing to have changes of this sort over a long period.

One thing that happens very noticeably in engineering foundries generally is that if there is one person in charge without any supporting person of reasonable status and executive ability, in the opposite group, the person in charge is by the force of circumstances compelled to become pre-occupied in the functions attached to the job or " product," *i.e.*, in the second group, and just at that issue is the point where process stagnation may set in.

It has fallen to the laboratory-trained men in most cases to incorporate many of the control checks and tests into everyday foundry practice, and I think that the term " metallurgist " is now hardly descriptive of their activities, and they would be more adequately recognised as " foundry processmen," as that would appear to be the trend of their future development.

### Basic Training

At the present time, apprentice moulders, some with good secondary-school education, are working in the shops and attending evening classes, and will continue to do so for several years, taking drawing, mathematics, foundry courses, etc. During this time they will probably have acquired some book learning on the process side of foundry work, but I am afraid that in very many cases much of what is taught is too remote to have real significance. Nowadays many foundries can quite easily arrange that these lads get experience in process work, particularly in control checks. In our foundry, apprentice moulders, if they wish, spend up to six months doing sand testing and metal chill-testing and inoculation. They therefore get experience of day-to-day variations that take place. In this way figures take on some real significance. What is much more important, of course, is that the apprentice's outlook is greatly broadened. You will probably have noticed that vacancy advertisements commonly call for a " practical man." We want to impress on our young men that to be a practical man in any executive position in a foundry of the future, it will be more to his benefit to become knowledgable about permeability figures, silicon additions, machine moulding, etc., than to acquire great ability with rammer or trowel.

Laboratory assistants, or junior processmen, are apt to follow courses based mainly on chemistry. A spell of production work should obviously be incorporated somewhere in their training, otherwise it will be too narrow.

### Patternmaker Apprenticeship

I have not, up to this point, mentioned the apprentice patternmaker at all. If I might take the liberty to define patternmaking as " joinering to a moulding technique," the joinering skill is unfortunately one which in a general shop takes a long time to acquire. In a five-year apprenticeship, not a lot of time can be spent away from the trade, if the boy is to finish up as a reasonably good journeyman. A year perhaps: the American apprenticeship of four years would tend to support this. In the foundry, I would divide this year into three months on process work and reporting, and nine at moulding.

### Appreciation of Shape

Shape is a factor of very great importance in most of the items listed under " product activities," and all potential foundry executives should have the best possible training in the interpretation of drawings, not only as the engineer uses them (that is relatively easy), but in acquiring the ability to resolve difficult drawings into the full external and internal forms that the foundryman has to deal with. This is somewhat different from what is taught in evening classes, and I believe can best be accomplished through the medium of isometric drawing. The idea behind that is simply to make the student use the drawing, and there are very few ways of using a drawing—in practice only two—to make either a model or a pictorial drawing.

I was most interested in finding among literature on training brought back from America, that the Allis Chalmers Company also pay particular attention to the teaching of isometric drawing, and publish a booklet on sketching in general, with emphasis on that particular form. In practice, our boys get experience of pictorial drawing in connection with pattern design and the recording of defective castings, the period being usually about six months.

It should be impressed on every ambitious young foundryman that pattern design can be completely divorced from patternmaking, and that it is essentially a foundry function. I believe that companies can help to train their young men in the subject of interpreting drawings, even if they do no more than let them have the use of blueprints of really complicated castings to study; also they might do everything in their power to encourage their laboratory personnel to include this among the subjects they study.

All the foregoing merely boils down to a plea for a broader basis of training, both in works and in college, for those who at present in the laboratories or on the shop floor show signs of possessing the ability and energy to help the industry to work at maximum efficiency in years to come.

# Productivity Comparisons

A PAPER which Mr. Kenneth Marshall, director of the Joint Iron Council, read before the Institute of Management at its recent Harrogate Conference, contained extended references to foundry practice. The title of the Paper was:—

"Whether Comparison between different Manufacturing Units in the same Industry on the basis of Cost and Physical Performance Ratios can be of use to Management?"

In the course of his remarks, Mr. Marshall said that, according to the classical theory of economics, free competition between different manufacturing units in the same industry will see to it that higher-cost (or less efficient) units are eliminated. In practice, for long periods conditions may be such that the less-efficient units prosper or, on the other hand, that even the efficient units lose money. Some test of relative efficiency can be of value under circumstances where the law of the market is as it were in suspense. A rough measure of the overall effectiveness of the unit can be worked out from the ratio of profits to capital, provided that the true capital figure is used which, of course, bears little or no relation in most cases to the nominal or issued capital. This Paper is not concerned with this form of comparison, and it is sufficient to say that its calculation bristles with difficulties. Comparisons can be made on the basis of cost or on physical performance, and these two conceptions will first be analysed before their usefulness to management is discussed.

### Relative Costs

The value of cost accounting to management is generally accepted whether as a basis for estimating and price policy or as a check on internal efficiency. Nothing need be said on the first count, but on the second it is convenient to emphasise that total costs require breaking down into appropriate headings corresponding to controllable items of expenditure, *e.g.*, material cost, fuel, power, etc. The precise determination of these heads must be made with due regard to the particular process or manufacturing method employed. Such comparisons repeated at regular intervals of time will be of value to management in a variety of ways, *e.g.* (*a*) bringing to light wasteful utilisation of material, labour or plant; (*b*) enabling comparisons to be made between costs when the process is varied. Such comparisons can be extended to embrace the costs of separate units of production as will be exemplified shortly.

### Physical Performance Ratios

The total production of a manufacturing unit is generally recorded over appropriate periods of time. Production may be measured as either a total number of articles, or the total weight or volume of material produced. If the articles are not uniform, it may be necessary to measure production by weight or value. Alternatively, it may be possible to break down the production into parcels each of similar units, and to relate these separate parcels by some system of weighting. In practice, production is seldom uniform, and for this reason output comparisons lose some of their value. That is not to say that they can therefore be discarded altogether as, for example, on a steel rolling mill the products may vary from shift to shift or even within a single hour, but over a sufficiently long period the differences may cancel themselves out. Where they do not, due allowance should be made in the comparison for the variation in product. It is easy to reject such comparisons because of the inherent imperfections in the basis of measurement, but the moral surely is that they should never be applied blindly or unimaginatively.

Performance may be measured not by total output alone, but by relating the output to man-power, to capital, to materials used, etc., or to a combination of some or all of these factors. Thus we enter the field of productivity comparisons which have been given prominence in the Anglo-American productivity teams' reports. It seems a logical step to extend comparisons on the basis of cost and physical performance ratios within a single unit to comparisons of similar ratios between different manufacturing units in the same industry. In the case of independent competing units, such comparisons can only be conducted on a voluntary basis and some central co-ordinating authority will be required. These comparisons, if they can be effectively devised, can give competing firms a means of assessing their efficiency in relation to (*a*) other firms; (*b*) a standard or average.

The ironfounding industry both in this country and in the United States affords a good example of the method. Experience suggests that the following principles should be followed:—

(1) So far as possible like should be compared with like.

(2) Comparison groups should be formed on a local basis.

(3) The bases of comparison whether of cost or physical performance should be simple.

(4) Information should be regarded as confidential and preferably handled by an independent authority.

(5) Firms should be given their own results with an average standard for comparison. In addition other firms' figures can be disclosed when suitably coded for secrecy.

In one group of ironfounders in this country, numbering between 30 and 40 members, a productivity figure has been worked out for each member, and the final report circulated to each, arranges the members in order of the productivity figure, each firm being listed by a code number. The report gives other information for comparison purposes such as the degree of mechanisation and the average price per ton of sales. The productivity figure has been arrived at as follows. The total tonnage over the chosen period is multiplied by the average sales

*Productivity Comparisons*

price per ton. The value of materials consumed is deducted and the result divided by the numbers employed to give the net product per worker. To the actual numbers employed is first added a figure to express the manpower equivalent of the productive plant employed. This is arrived at by dividing the present value of the plant by a devisor arbitrarily fixed at £1,500, but which may be appropriately nearer £3,000, according to the rate of amortisation considered suitable. The case for including the manpower equivalent of capital equipment has been well argued by Sir Ewart Smith and Dr. R. Beeching in their Paper on the Measurement of the Effectiveness of the Productive Unit, published by the British Institute of Management.

It is necessary to lay down somewhat arbitrary rules for the exclusion of certain categories of manpower and capital equipment in order to make the comparison most effective, *e.g.* . . . . " the labour to be included to be all paid servants of the company, including director, but excepting sales representatives, patternmakers and engineering staff other than those engaged on foundry maintenance " . . . . " the labour-saving plant to include moulding machines, all lifting and shifting tackle and sand-preparation plant at replacement value, not to include such items as furnaces, stoves and ladles which perform operations which could not otherwise be done manually. . . ." The validity of the results obtained by the use of such a formula is open to question, but it will be noted that when the sales value is used as the basis of measurement of production this gives a result which would not be obtained by taking the simple tonnage figures where the class of work varies considerably. The use of sales value is open to many objections. Similarly the valuation of plant and its assessment on a manpower basis introduces many difficulties, and may favour one type of foundry over another. Nevertheless the group which has been using this formula has found its application useful for bringing members together and for stimulating enquiries into the causes of the varying results. The survey of inter-firm comparisons conducted abroad suggests that once interest in comparisons of overall efficiency has been aroused a need for inter-firm comparisons of detailed operating data is revealed.

The Malleable Founders' Society of the U.S.A. analyse the man hours per ton of castings produced within different geographical sections of their industry. Labour is sub-divided for this purpose among the different departments, and the complete table is as shown in Table I.

The tabulated results for each month are circulated to members of the group, each member's result being identified by his code number, which is not disclosed to any other member.

The Council of Ironfoundry Associations, in reviewing the findings and conclusions of the Grey Ironfounding Productivity Team Report at a conference held in London on the day of its publication, decided to encourage the formulation of local cost groups based on a uniform method of costing.

TABLE I.—*Record of Man-hours (Exclusive of Supervision, Technical and Plant Clerical) per Ton of Castings Produced, as prepared by the Malleable Founders' Society (U.S.A.).*

| Company's code number. | A. | B. | C. | Etc. |
|---|---|---|---|---|
| Melting Department .. .. .. | | | | |
| Moulding Department : | | | | |
| Moulding* .. .. .. .. | | | | |
| Pouring† .. .. .. .. .. | | | | |
| All other .. .. .. .. | | | | |
| Core Department : | | | | |
| Coremaking .. .. .. .. | | | | |
| All other .. .. .. .. | | | | |
| Hard Iron Cleaning Department .. | | | | |
| Hard Iron Trimming and Inspection Department .. .. .. .. | | | | |
| Annealing Department .. .. .. | | | | |
| Soft Iron Cleaning Department .. .. | | | | |
| Grinding and Finishing Department .. | | | | |
| Despatch Department (including inspection) .. .. .. .. .. | | | | |
| Patternshop (not charged to customers) | | | | |
| Maintenance .. .. .. .. | | | | |
| Power plant .. .. .. .. | | | | |
| Yard‡ .. .. .. .. .. | | | | |
| TOTAL PLANT LABOUR .. .. | | | | |
| Avge. production per moulder per hour, lb. .. .. .. .. .. | | | | |
| Avge. weight of castings per piece, lb. .. | | | | |
| Avge. weight of castings per mould, lb... | | | | |
| Hard iron scrap loss, per cent. .. .. | | | | |
| Soft iron scrap loss, per cent. .. .. | | | | |
| Returns from customers, per cent. .. | | | | |
| Average yield, per cent. .. .. .. | | | | |
| Production in relation to capacity, per cent. .. .. .. .. .. | | | | |

* Including pouring when done by moulders and labourers.
† When not done by moulders or labourers.
‡ Including commissionaires, watchmen and guards.

Up to this point, the Paper has confined itself to competing units in the same industry. Comparable production units may be found within one manufacturing organisation, notably in the production of metals and in the engineering and textile fields. It is an everyday task of higher management in such undertakings to compare costs and physical performance of the different units. Such comparisons are essential to the formulation of policy apart from their value as a stimulus to efficiency. Varying degrees of obsolescence, the size of plant, the availability and quality of raw materials, the number of types or patterns being made, are only some of the variable factors which have to be taken into account in assessing the significance of differences in performance between one unit and another. It is axiomatic that no two units ever operate under precisely the same conditions, and a higher cost in one plant may be offset by a higher average selling price for its product.

Where manufacturing units of an undertaking are compared the interpretation of the results and their application is one of the essential tasks of higher management. Close collaboration between works manager and accountant is vital if the task is to be performed efficiently. The accountant left to himself may produce comparisons which present an unfair picture, while the works manager without the accountant's aid will tend to draw too heavily on his accumulated experience and may be misled into taking decisions based on inadequate data.


# Set and Grinding of Porcelain Enamel*

*By E. E. Bryant*

ENAMEL SET may be described as the consistency of the milled enamel ready for application. It is generally judged by the amount of slip remaining on any object placed in the liquid enamel and then withdrawn, allowing the excess enamel to drain off. A suitable test-piece is a two-square-foot flat sheet or a cylinder which has one or two square feet of area. Flat sheets are almost universally used for testing ground coat enamel for draining, while cylinders are the more common method of determining yield for enamels which are to be sprayed. The test-piece is dipped into the enamel slip and removed in a standard way to avoid variations due to draining and handling differences. The wet or dry weight, or both, may be used as an indication of the set of the enamel.

Another method of testing enamel set is by means of a flow tube, which measures the time required to allow a certain volume of enamel to pass through a given orifice with a standard pressure supplied by the enamel slip in an elevated container. Most flow tubes are in the form of a section of pipe about 1 in. in dia. and long enough to hold from 150 to 200 cub. cm. of enamel, with an orifice at the bottom. The orifice may vary in diameter, a normal-size opening being $\frac{3}{16}$ in. This method of testing enamel is most frequently used for tong-dipping enamels and is rarely employed for any other type.

The most recent method of determining set, and one which has proved extremely adaptable for sprayed enamels is the Irwin Slump Test (Fig. 1).

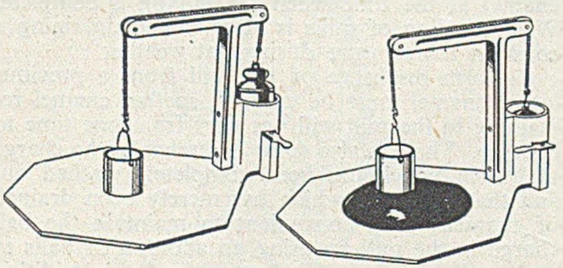

FIG. 1.—*Irwin Slump Tester in operation, showing (left) Cylinder filled with Porcelain Enamel, and (right) "Slumping" of the Enamel after the weight has been released.*

When a measured amount of milled enamel is released on the surface of a flat plate, a circular area is covered; the diameter of the area in inches indicates the set of the enamel. The testing equipment consists of a cylinder set on a flat plate and filled with enamel. When this cylinder is suddenly raised, it allows the milled enamel to slump on the flat plate into the "pancake" form.

In addition to set, which is necessary for the application of enamel, suspension of the enamel must be sufficient to avoid settling (excessive separation of water from the enamel) under normal storage and handling conditions. Suspension is obtained with the same materials which produce set, but some further balancing of materials may be required even when a standard set is obtained. Thixotropic or false set in an enamel should be avoided as much as possible. This apparent set will form in the enamel slip when it stands, and will disappear when the enamel is agitated, returning when the enamel is allowed to stand.

## Application of Enamels

### *Draining*

In draining, the article is removed from the liquid enamel, and placed on a rack or conveyor to allow the excess to drain away. Enamels to be applied by draining may require a different type of set from enamels which are to be sprayed. Water content or gravity is important, since a high gravity or low water content will cause the enamel to hang at the edges or corners of a piece and may cause the enamel to slide off rather than drain to a smooth finish. An enamel with low gravity and high water content will tend to drain thin on edges and at corners, and may start to drain a second time after the draining is apparently complete.

Ground coats, which are the types of enamels most commonly applied by draining, are normally drained at a gravity of 1.60-1.63 and a water content of about 38-40 per cent., based on 100 parts of milled enamel. Until recently, draining was very rarely used for cover coats. However, with the advent of titanium enamels and their thin application, it has been found advantageous to use the draining operation for such items as refrigerator crisper pans. Generally, the titanium enamels are drained at a gravity of 1.66-1.70. Mill additions are not greatly different from those used for the spraying of titanium enamels.

### *Tong-dipping*

Enamels for tong-dipping vary considerably in gravity and set, and it will be found that practically no standard conditions prevail in the industry. Tong-dipping is performed by placing a piece of ware in a

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* Substantially abstracted from a Paper appearing in *The Enamelist*. The Author is on the staff of the Ferro-Enamel Corporation of America.

*Set and Grinding of Porcelain Enamel*

set of tongs which will grip it at some point at which it will not cause streaks in the enamel; the part is then dipped into a tank of milled enamel. When the part is removed from the liquid enamel, the operator removes the excess enamel and keeps the enamel smooth by a series of shaking and twirling motions, which can only be learned by actual performance of the operation. The set of enamel for tong-dipping must be such that it will flow and produce a smooth coating on the piece, having at the same time sufficient body to hold itself in place when the dipping operation is complete.

*Spraying*

Enamels which are to be sprayed must be well controlled for set properties, and the slump test or the yield test may be used for this purpose. It is necessary to maintain a consistency which will spray smoothly and will not flow or run on the ware. Enamel is said to run on the ware when it flows down a vertical surface or blows a bead of enamel at the edge of a piece. It is possible to have either of these conditions with enamel which is properly set, but which has been sprayed at too heavy an application by the operator. They may also be produced by too low a set or too low a gravity.

Cover-coat enamels are generally sprayed, and each particular type of cover coat is used in a range of gravity found by experience to be best. Usually the gravity for spraying antimony-type cover coat is in the range above 1.85. Cast-iron enamels vary widely in their specific gravity, due to their various densities depending upon whether they are lead or lead-free; the gravities may vary from 1.80 to 2.00. Zircon cover coats range from 1.80 to 1.85 in gravity. Clear glasses and coloured cover coats are used at gravities of 1.70-1.90 and, as in the case of cast-iron enamels, enamel formulations vary so much that the range of gravity used is rather wide. The new titanium cover coats are normally sprayed at a gravity of 1.67-1.73, and in exceptional cases a gravity as high as 1.80 is used. When ground coats are being sprayed, it is generally found best to use a gravity between 1.66 and 1.73; however, in some cases it has been found practical to spray ground coats with gravities as low as 1.60.

### Milling Procedure

Whichever method of application is used, it is essential that the set of the enamel is first adjusted to suit the operation in the particular shop. There is a possibility of producing a variation in set in most any of the operations where the enamel is handled before it is supplied to the sprayer, or until such time as it is actually applied on the parts in process. The first step in the preparation of milled enamel is to ascertain that the raw materials, which consist of frit, clay and other mill addition materials, such as electrolytes, opacifiers and feldspar, are obtained from a source which has tested them for enamelling purposes and compared them with standard materials. It is necessary to provide efficient storage facilities so that the materials are not damaged in storage or contaminated by one another. The water supply for use in the mill room must also be considered as a raw material which must remain constant in its qualities. When the water supply is not of good quality, there are water-treatment units available which will supply essentially pure water for use in milling porcelain enamel.

The set of milled enamel is affected by the fineness and solubility of the frit. Since the solubility is affected by temperature and condition of milling, and since fineness is normally tested only on one sieve (usually 200-mesh), the grinding operation must be closely controlled. Experience has shown that there is an optimum speed of revolution (revolutions per minute) for each diameter mill. The supplier of ball mills normally specifies the standard r.p.m. to be used, and it is important that this speed is maintained. Incorrect r.p.m. may cause excessive heating of the enamel in milling, or unusual distribution between the finer and coarser particles.

### Charging the Mill

The size of the ball charge in the mill and the charge of frit, mill addition materials and water, also affect the temperature of milling and, consequently, the solubility as well as the fineness distribution. When the correct ball charge and mill charge (Fig. 2) have been determined for a particular mill, it should be maintained at all times. A close watch

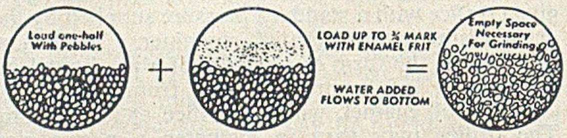


FIG. 2.—*Sections through a Ball Mill, illustrating the proper charge of Pebbles and Frit.*

should be kept to make sure that the time to grind an enamel does not vary beyond reasonable limits, and to make sure that there is not a wide difference in temperatures of the milled enamel at the time when the milling is complete. Water cooling of mills is helpful in maintaining a constant temperature during hot weather.

Uniform discharge of the mill from a previous lot of enamel must be ensured, so that enamel remaining in the mill will not vary from one time to another. There is also some difference in the charge of a mill which has been completely washed out and that of a mill which has merely been drained of enamel. It is convenient to maintain the ball charge in the mill by using an addition of balls to each mill charge. The amount of this addition must be determined by experience and records over a considerable period. A proportion of size of the balls from the largest specified by the manufacturer down to smaller sizes is desirable in a mill, and the proportion of balls and sizes should be made up when a new ball charge is placed in a mill. However, when the balls are added to keep up the size of the ball charge, they should be of the largest size specified for the mill.

Another problem in regard to charging is caused by the opening which is normally present between the lining of the mill and the lining for the lid of the mill. It is important that the smaller volume mill addition materials are placed in the mill in such a manner that on the first revolution of the mill they are not trapped in this crevice, where they remain during the complete grinding. This is best prevented by making sure that the frit is the last material on the top of the pile in the mill.

### Fineness Testing

It is a general practice to grind the mill to a specified fineness before allowing it to be discharged. A 200-mesh sieve is the normal method of checking fineness, and the sample for the fineness test may be a 100-gm. sample of liquid enamel, or it may be a 50-cc. sample. The sample is washed through a 30-mesh sieve and on to the 200-mesh sieve, with the washing being continued until no more clay or fine particles come through the 200-mesh sieve. The residue on the 200-mesh sieve is then dried and tapped until no more dry material will pass, when the residue on the sieve is weighed. The specifications for milling of a certain enamel will specify the acceptable range of fineness allowable, and the mill must be ground until the fineness falls within this range. Too fine or too coarse an enamel will cause variation in set, with fine enamel producing high set and coarse enamels producing low set and settling.

When the mill has been ground to fineness, it is advisable to test the gravity and set in order to make sure that the milling is normal in these qualities. A fired sample can also be made at this time to test the quality of the milled enamel. The gravity will have an effect on the rotospray (Fig. 3) and magnetic separation of the enamel, which should be done before the enamel is placed in storage. Enamel in storage should be held at a standard gravity, and it is better to make this adjustment at the mill than in the storage tanks.

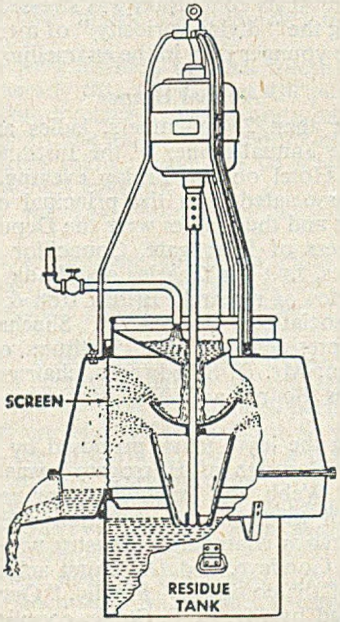


FIG. 3.—*Diagram of Rotospray, showing principle of operation.*

### Storage Practice

In storage, some agitation of the enamel is advisable, but constant or high-speed agitation which will whip air into the enamel or keep the enamel continually in motion is undesirable. The best practice is to provide a short period of agitation once every 30 min., or at regularly timed intervals and for standard periods of time. Controlled temperature of storage is advisable to avoid additional solubility of the frit and consequent change in set. When milled enamel is removed from storage and prepared for use, it is again advisable to screen by rotospraying and magnetically separating the enamel. At this time the additions specified to be made after milling are added in a solution, so that they can be stirred into the enamel. The gravity and set of the enamel are adjusted to the specification which has been set up for the particular use intended.

### After-milling Additions

Materials such as urea and sodium nitrite are more effective when added after milling. In the case of sodium nitrite, there is a tendency to increase mill solubility, unless it is added after milling. The other reason for making additions after milling is to adjust to the proper set when a standard gravity has been obtained. In the case of spray enamels, the enamel is generally adjusted after it has been placed in a pressure tank. Enamel such as ground coat which is being drained is best adjusted for use by careful additions of water until the proper yield is obtained. This check can be made in a container which will gradually be emptied into the dip tank, or it may be made in the dip tank which is rolled into place for use.

Possible variations in the set of milled enamel may be briefly summarised as follow:—Fineness variation; variations in gravity; changes in materials, including the water; variations in the charging of the mill, and variations in the temperature of milling and storage of enamel.

### Adjustment of Mill Formulæ

When a change is made from one type of frit formulation to another, it is usually necessary to adjust the mill formula, since different types of frit vary in their set characteristics. This is especially the case when changing from one type of enamel to another; different ground coats vary more than do other types of enamel.

The clay addition in the enamel which is used in the range of 1-8 parts per 100 parts of frit helps to keep the frit particles from settling and produces bisque strength. Clays are available which produce low set, while other clays are available which produce high set. An opaque clay is of high bubble structure, while a clear clay has a low bubble structure. Bentonite is of the same nature as clay, but it has much greater effect in set properties and is

(*Continued on page* 487)

# Institute of Vitreous Enamellers

## *Sixteenth Annual Conference at Harrogate*

ON NOVEMBER 1 to 4, the sixteenth annual conference of the Institute of Vitreous Enamellers was held at the Queen Hotel, Harrogate, upwards of one hundred members, ladies and guests participating. The evening of the first day was set aside for assembly and for council meetings; on the second day was the annual general meeting and a works visit (while the ladies had a trip to York and a visit to a chocolate factory). The third day was devoted to technical sessions and the Saturday morning to "question box" discussions and sub-committee reports.

The main social event, the annual dinner, took place on the Friday evening and was followed by dancing in the hotel ballroom. On Thursday evening a theatre party was organised and much enjoyed.

### Annual General Meeting

The retiring president, Dr. H. W. Webb, took the chair at the annual general meeting, supported by the chairman of council, Mr. C. P. Stone, the honorary secretary, Mr. W. Thomas and Mr. W. S. Grainger, honorary treasurer. Following a welcome to members by Mr. C. P. Stone, the minutes of the 1949 annual meeting held at Birmingham were read and approved. Then Mr. Stone presented his report as chairman of council, in the course of which he outlined the main events of the full year of activity in which the Institute had been engaged. On the technical side, he paid tribute to the work of Mr. J. Gardom, as chairman of the technical sub-committees, the reports of which would later be presented.

In educational spheres, he recounted the steps which had been taken under the auspices of the North Staffordshire Technical College towards instituting training courses for beginners and executives in the industry. He also drew attention to the library facilities at the college which were at the disposal of members, a catalogue being in course of preparation covering some 25,000 volumes available. The activities of the raw-materials sub-committee had been reduced this year, but its services were available on request.

The Spring conference, held at Torquay, had been a success. Bournemouth was suggested as next year's venue. A Continental tour had been proposed and members interested could obtain information from Mr. Grainger.

Finally, Mr. Stone on behalf of the members, thanked the honorary treasurer, Mr. W. S. Grainger, and the secretary, Mr. W. Thomas, for their unflagging zeal shown during the past year and added a few words of appreciation for the managements of works who had so kindly received organised visits of members.

### Treasurer's Report

Then followed the presentation by Mr. W. S. Grainger of the treasurer's report, discussing the income and expenditure account and balance sheet which had previously been circulated to members. A satisfactory state of affairs was disclosed, there being a surplus accruing from the increased subscriptions which had enabled some £400 to be set aside for research and £25 for housing the library. A special conference fund subscribed by company members for such things as encouragement of young members and entertaining foreign visitors had realised some £600. This fund was being kept quite separate.

The adoption of the accounts being proposed by the treasurer was seconded by Mr. Biddulph and carried unanimously.

### Election of Officers

The ballot for the election of council members next followed, Mr. C. P. Stone, Mr. W. Thomas, Mr. H. Laithwaite and Mr. S. H. Ryder being chosen to fill the four vacancies.

The next business was the formal induction of the new president, Dr. J. E. Hurst, J.P. The retiring president, Dr. Webb, said the new president exhibited that rare quality of scientific and business efficiency combined with a judicial capacity, and he considered the Institute was fortunate in securing his services. Before handing over the seal of office he thanked the members for a very happy term of office during which he had cemented many friendships.

Dr. Hurst's acknowledgment and presidential address then followed, his subject being "Industrial Research."* At its conclusion was stressed the need for fostering the "divine curiosity" of men and particularly the younger men in the enamelling industry.

### Annual Dinner

No fewer than 250 members, ladies and guests attended the annual dinner of the Institute, held in the Queen Hotel on the Friday evening. At the top table associated with the principal officers of the Institute and their ladies were the Deputy Mayor and Mayoress of Harrogate, Councillor and Mrs. J. S. Holmes, J.P.; Sir Charles and Lady Goodeve, O.B.E., director of research, British Iron & Steel Research Association; Mr. J. J. Sheehan, B.SC., A.R.C.SC.I., president of the Institute of British Foundrymen; Mr. R. S. Edwards, chairman, North Eastern Gas Board, and Mr. Barrington Hooper, C.B.E.

Following the loyal toast, proposed by the president, "The Borough of Harrogate" was given by Mr. H. W. Webb, the Deputy Mayor responding. The toast of the Institute of Vitreous Enamellers and the vitreous enamelling industry was given by Sir Charles Goodeve, and Dr. Hurst acknowledged on behalf of the company. Finally, "Our Guests" was proposed by Mr. C. P. Stone, coupling with it the names of Sir Charles and Lady Goodeve, the

* Shortly to be published in the JOURNAL.

Deputy Mayor and Mayoress, and Mr. and Mrs. Edwards. Mr. Edwards replied for the guests.

The occasion was used by Mr. W. S. Grainger to make a formal presentation from the members to Mr. W. Thomas, the honorary secretary, who had indicated his impending retirement from that position owing to pressure of other business. Mr. Thomas had held office in the Institute since 1939, acting as secretary since 1943. The presentation took the form of an 8-mm. ciné camera and projector purchased from a fund contributed by all grades of membership. Mr. Thomas made suitable acknowledgement and the remainder of the evening was given over to dancing and entertainment.

### Technical Committee Reports

On the Saturday morning, reports were received from various committees of the Institute. There was general discussion on these reports and on the future work of the technical committee. Mr. Bioouipn gave a brief *resumé* of the work of the technical committee during the year. He said that the pickle titration and welding committees had terminated their work, and a new sub-committee had been appointed " to investigate scumming of enamels." Mr. Ryder's report on sheet metal cleaning had been circulated and discussed.

Mr. Grainger reported progress on the subject of enamel standards, and Mr. Stone summarised the position regarding zirconium oxide.

### Question Box

The "question box" produced a number of enquiries, and time was found to discuss four of these.

*What is the future of zirconium-opacified enamel in view of the recent developments in titanium enamels?*

Opinions were divided on this question, but it was felt generally that there were still purposes for which zirconium enamels were quite satisfactory, and in view of the restricted amount of titanium oxide available there would still be scope for the use of zirconium enamels.

*Can the meeting recommend a good reflectometer?*

Attention was drawn to the various machines demonstrated at the previous annual meeting, details of which would be furnished to anyone applying.

*What are the advantages of nickel dip?*

Nickel-dip plants installed in the U.S.A. have helped in the production of a good adhering ground coat. The use of nickel dip involves very close control of the operation, and it was suggested that some of the improvement might be due to the control as much as to the nickel dip.

*What are the best methods of cleaning enamel to avoid scratching?*

Mention was made of the report circulated as a confidential document within the Institute a few years ago, and also it was suggested that a wetting agent plus french chalk gives good cleaning without scratching.

## Enamel Set and Grinding

(*Continued from page 485*)

used in the range of $\frac{1}{8}$-1 part per 100 parts of frit. It is a means of obtaining suspension and set without increasing the clay content, and allows the use of a low clay content such as one part per 100 parts of frit.

Electrolytes are used to produce the final adjustment of set. The materials used are ordinarily salts which ionise and act on the clay and fine particles, in most cases to increase the set of enamel. Borax, magnesium carbonate, potassium carbonate, sodium aluminate, barium carbonate, potash chloride, calcium chloride, barium chloride, ammonium chloride, ammonium carbonate, boric acid, potash nitrate, and barium sulphate are common additions. Magnesium sulphate and sodium nitrite are used on occasions, but they are not generally recommended, although sodium nitrite is helpful in the control of tearing.

Some electrolytes perform functions other than control of set in the enamel. Urea is used to prevent tearing in the enamel and has practically no effect on set. It is possible to use urea in the mill addition, but it is most effective when added after milling. Sodium thiosulphate has little effect on set, but prevents water lines when enamels are beaded. Certain electrolytes, such as tetra sodium pyrophosphate or citric acid, will reduce the set of an enamel. These materials must be used with caution, since excessive amounts can cause difficulty in the fired enamel. A standard amount of tetra sodium pyrophosphate is 5-20 gms. per 100 lb. of frit; it is best added after milling.

Opacifiers, titanium and colouring oxides seldom produce any marked change in the set of the enamel. Feldspar and silica are normal components of the ground-coat mill addition to give resistance to a high fire, and zinc is an addition for cover coat which helps in the firing of certain whites. Gums which are used to produce film strength in the dry enamel very seldom affect the set. Alginates are used for the film strength and in certain cases may reduce the set. Excessive additions of gum or alginates will produce a poor surface on the fired enamel.

### Control of Set after Milling

Any material which is used as an addition after milling can cause difficulty if used in too large an amount, and there should always be an allowable limit for the amount of such an addition. The most common electrolytes for addition to increase set after milling are: potash carbonate, sodium nitrite, potash chloride, calcium chloride and magnesium sulphate. Potash carbonate and sodium nitrite are fairly easy to add, since they stir into the enamel without difficulty. Potash chloride may cause some difficulty, due to its quick action in producing set and a curdling of the enamel. Magnesium sulphate and calcium chloride also tend to curdle the enamel, and care must be taken to make sure that the enamel is well mixed after the addition is made; clear solutions of all electrolytes should be used for addition to enamel, and any foreign material should be screened from the solution.

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# Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

## COMPARATIVE PRODUCTIVITY

*To the Editor of the* FOUNDRY TRADE JOURNAL

SIR,—Your report of the annual general meeting of the Foundry Trades' Equipment and Supplies Association refers to the Report of the Ironfounders' Productivity Team, and states that "As several members of the Association had also visited the States, additional views were expressed."

Whilst I am sure that the members of the Team will endorse most of these "additional views," I am taking it upon myself to disagree with No. 2, which reads as follows: "Most of the foundries visited were rightly of the best-organised type and, if visits had been made to a similar number of our best establishments, equally startling results could have been reported."

This goes far beyond the Team's opinion as recorded in the introduction: "A glance at Appendix III, which gives some productivity figures, should, however, stifle any feeling of complacency. American foundries produce far more per man than the British. The best in Britain may equal the best in America, but the average in America is much better."

There is a danger that because productivity is high in certain sections of the foundry industry, statements such as the one referred to above will spread a feeling of complacency through the whole industry with disastrous results, and to give a true picture of the difference between productivity in the U.S.A. and in Great Britain, the following points extracted from the Report should be kept firmly in mind.

"There is no fundamental difference between moulding practice in the United States and in Britain. The essential difference lies in the American policy of using mechanical methods of moulding whenever possible and of making every effort to economise in the use of skilled labour.

The Team found that there is a larger proportion of skilled men than had been expected and that many of them produce castings by very similar methods to those employed in Britain, but, even so, the supply of skilled men is limited and every effort is made to service them and to obtain maximum production by concentrating their skill on actual production while all ancillary work is done by a lower grade of worker."

"Numerous air hoists and some electric hoists were seen, but what is important is the fact that whatever mechanical aids were installed, the workers made the fullest use of them. This applied to every section of the foundries." Yours, etc.,

S. H. RUSSELL, Team Leader.

November 15, 1950.

## NODULAR IRON

*To the Editor of the* FOUNDRY TRADE JOURNAL

SIR,—In reply to Mr. Pollock's letter given in your issue of November 16, manganese as such, within the range indicated, does not influence in any way the production of graphite nodules by the cerium process, and hence we would not expect a manganese change of the order indicated to affect nodulisation one way or the other. Possibly, the low manganese iron carried a higher sulphur content, but it is not practicable to give a complete reply in the absence of fuller information about the mixtures and compositions employed.

Yours, etc.,

J. G. PEARCE,

Director, British Cast Iron Research Association.

November 20, 1950.

# News in Brief

G. L. MURPHY, LIMITED, have plans approved to extend their foundry at Ellar Ghyll, Otley, Yorks.

THE ANNOUNCEMENT made recently that the Hillington (Glasgow) factory of Rolls-Royce, Limited, is to play an important part in the company's increased production of Avon engines means that for the first time jet aero engines are to be manufactured in Scotland.

NU-WAY HEATING PLANTS, LIMITED, have opened a London office at 110-111, Strand, W.C.2 (tel.: Temple Bar 5671). It is hoped that this central position will be found especially convenient to intending visitors from overseas. Mr. G. A. Foster has been appointed as manager.

IT IS NOT OFTEN that a total of 3,650 years of service can be assessed in one evening. This was done recently at the Luton works of Radiation, Limited (Davis Gas Stove Company), when Mr. Kenneth Davis presented gold watches to 76 members of the staff in recognition of their long service.

AN OFFER by Imperial Chemical Industries, Limited, to covenant for seven years a sum to provide the University of Wales with additional research fellowships of an average value of £800 a year, and stipulating that two of the fellowships should be tenable at the University College, Swansea, has been accepted by the Council of the University of Wales.

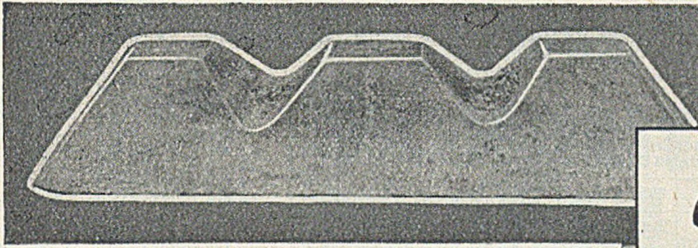
ORE TRANSPORTER GEAR for the new iron-ore discharging quay to be built at Tyne Dock is to be supplied by Simon Handling Engineers, Limited, Cheadle Heath, Stockport (Cheshire), for £555,700. Cranes will be supplied by Stothert & Pitt, Limited, Bath, for £250,000, while the Yorkshire Hennebique Contracting Company, Limited, Leeds, will build the actual quay at a cost of £374,000.

DAMAGE AMOUNTING to thousands of pounds resulted from a blaze which swept the premises of Jones & Campbell, Limited, ironfounders, Larbert, for five hours last Saturday night. Two three-storey buildings were gutted, and temporary office accommodation has been set up in a house in the town. Among the buildings destroyed were two patternshops, storerooms, and the firm's general office.

THE FACTORY of Bristol Tractors, Limited, of Soughbridge, Earby, is now turning to the home market. It has evolved a new mechanical rhubarb lifter, which has been hailed as a boon to the rhubarb-growing industry. As the producing of rhubarb is essentially a British, and almost an exclusively Yorkshire, trade, the new implement is unlikely to become a major export. Britain first for a change.

## Latest Foundry Statistics

According to the September/October issue of the Monthly Statistical Bulletin of the British Iron and Steel Federation, the total number of all workers engaged in ironfounding was 146,883, or 558 more than a month earlier and 1,321 increase as compared with September, 1949. During the month there was a loss of 25 in the total of female labour employed, but so far a year earlier the figure remains virtually the same. In steelfounding, too, a notable increase was shown. At 18,826, on September 9, it showed an increase of 236 over August, but still 163 fewer than September, 1949. The Bulletin only gives the August figures for steel production. Thus during that month the average weekly melt of liquid steel was 7,000 tons, as against 7,800 in July and 7,800 a year earlier. The average weekly production of actual steel castings during September was 3,700 tons compared with 4,300 tons in August.



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**STANTON**

**FOUNDRY PIG IRON**

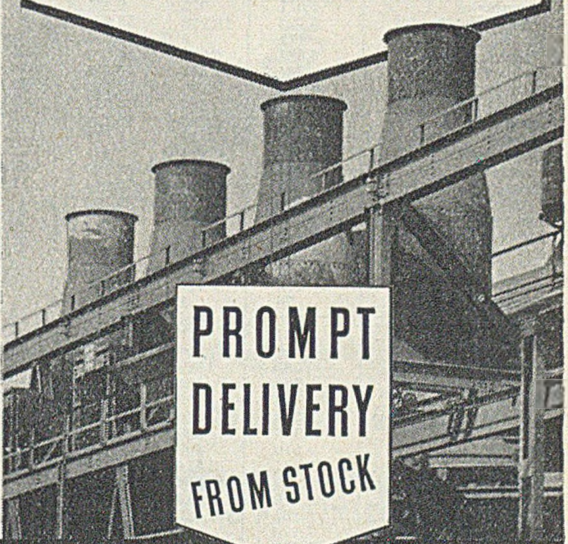
Stanton Machine-cast Pig Irons are clean-melting, and economical in cupola fuel.

All types of castings are covered by the Stanton brands of pig iron, including gas and electric fires, stoves, radiators, baths, pipes, and enamelled products generally ; repetition castings requiring a free-running iron, builders' hardware and other thin castings.

Other grades of Stanton Foundry Pig Iron possess the necessary physical properties and strength ideal for the production of fly-wheels, textile machinery, etc.

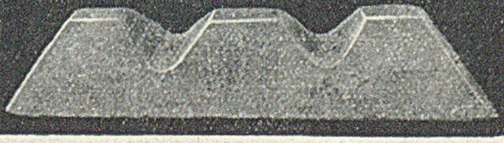
Stanton Foundry Pig Iron in all grades is also available in sand cast form.

We welcome enquiries on foundry problems and offer free technical advice.



PROMPT DELIVERY FROM STOCK

THE STANTON IRONWORKS COMPANY LIMITED - NEAR NOTTINGHAM



# Imports and Exports of Iron and Steel

*Board of Trade Returns for October*

The following tables, based on Board of Trade returns, give figure of imports and exports of iron and steel in October. Figures for the same month in 1949 are given for purposes of comparison; respective totals for the first 10 months of this year and of 1949 are also included.

## *Total Exports of Iron and Steel.*

| Destination. | Month ended October 31. | | Ten months ended October 31. | |
|---|---|---|---|---|
| | 1949. | 1950. | 1949. | 1950. |
| | Tons. | Tons. | Tons. | Tons. |
| Channel Islands .. | 1,467 | 1,002 | 10,093 | 7,345 |
| Gibraltar .. .. | 109 | 62 | 1,522 | 1,445 |
| Malta and Gozo .. | 326 | 307 | 4,301 | 3,006 |
| Cyprus .. .. | 187 | 800 | 3,883 | 7,600 |
| British West Africa .. | 11,643 | 6,894 | 72,419 | 74,296 |
| Union of South Africa | 8,971 | 18,316 | 120,582 | 151,749 |
| Northern Rhodesia .. | 1,093 | 1,822 | 16,875 | 23,995 |
| Southern Rhodesia .. | 5,816 | 4,335 | 45,404 | 59,368 |
| British East Africa .. | 7,590 | 8,009 | 71,777 | 83,393 |
| Mauritius .. .. | 668 | 656 | 6,595 | 7,393 |
| Bahrein, Koweit, Qatar and Trucial Oman .. .. | 798 | 871 | 18,637 | 6,340 |
| India .. .. .. | 6,804 | 6,282 | 70,940 | 83,573 |
| Pakistan .. .. | 2,582 | 8,449 | 30,714 | 84,310 |
| Malaya .. .. | 5,480 | 5,443 | 48,510 | 64,008 |
| Ceylon .. .. | 3,328 | 2,436 | 21,707 | 29,074 |
| North Borneo .. | 309 | 326 | 8,822 | 4,091 |
| Sarawak .. .. | 146 | 1 | 1,519 | 743 |
| Hongkong .. .. | 2,818 | 6,425 | 28,171 | 40,907 |
| Australia .. .. | 25,479 | 60,070 | 148,599 | 359,820 |
| New Zealand .. | 13,627 | 16,516 | 93,518 | 148,413 |
| Canada .. .. | 4,985 | 28,835 | 57,695 | 174,190 |
| British West Indies .. | 7,147 | 5,076 | 54,099 | 51,846 |
| British Guiana .. | 679 | 735 | 3,871 | 6,295 |
| Anglo-Egyptian Sudan | 1,921 | 1,903 | 12,230 | 15,044 |
| Other Commonwealth countries .. .. | 1,011 | 975 | 9,851 | 11,788 |
| Irish Republic .. | 5,722 | 10,932 | 55,959 | 82,233 |
| Russia.. .. .. | 111 | 9 | 8,848 | 538 |
| Finland .. .. | 8,681 | 6,740 | 64,307 | 60,758 |
| Sweden .. .. | 4,264 | 11,525 | 49,575 | 75,877 |
| Norway .. .. | 6,772 | 7,190 | 57,113 | 72,198 |
| Iceland .. .. | 510 | 227 | 6,791 | 3,634 |
| Denmark .. .. | 8,422 | 6,906 | 75,121 | 95,147 |
| Poland .. .. | 93 | 157 | 1,047 | 1,438 |
| Germany .. .. | 20 | 146 | 471 | 828 |
| Netherlands .. .. | 8,280 | 6,280 | 94,167 | 65,497 |
| Belgium .. .. | 772 | 1,655 | 9,214 | 11,191 |
| Luxemburg .. .. | 500 | 12 | 5,378 | 394 |
| France .. .. | 3,736 | 2,198 | 28,802 | 21,033 |
| Switzerland .. .. | 2,145 | 918 | 11,101 | 9,154 |
| Portugal .. .. | 1,146 | 938 | 15,338 | 17,215 |
| Spain .. .. .. | 700 | 312 | 8,720 | 6,382 |
| Italy .. .. | 160 | 1,819 | 2,608 | 10,856 |
| Hungary .. .. | 76 | 1 | 895 | 330 |
| Greece.. .. .. | 228 | 394 | 4,423 | 6,589 |
| Turkey .. .. | 2,024 | 527 | 15,891 | 7,953 |
| Indonesia* .. .. | 2,162 | 248 | 22,806 | 10,066 |
| Netherlands Antilles | 780 | 623 | 7,045 | 7,306 |
| Belgian Congo .. | 225 | 354 | 1,515 | 1,572 |
| Angola .. .. | 60 | 39 | 5,697 | 1,948 |
| Portuguese E. Africa | 349 | 546 | 3,786 | 4,006 |
| Canary Islands .. | 111 | 200 | 2,449 | 1,947 |
| Syria .. .. .. | 510 | 406 | 1,819 | 1,643 |
| Lebanon .. .. | 1,681 | 2,514 | 25,015 | 10,685 |
| Israel .. .. .. | 1,499 | 2,354 | 14,625 | 19,763 |
| Egypt .. .. | 5,470 | 4,614 | 48,494 | 49,823 |
| Morocco .. .. | 34 | 1,345 | 1,119 | 3,842 |
| Saudi Arabia .. | 1,196 | 82 | 5,377 | 2,178 |
| Iraq .. .. .. | 1,834 | 1,706 | 46,119 | 29,321 |
| Iran .. .. .. | 19,291 | 6,806 | 128,741 | 85,943 |
| Burma .. .. | 856 | 1,573 | 7,876 | 10,520 |
| Thailand .. .. | 578 | 1,780 | 3,905 | 7,488 |
| China .. .. | 40 | 1,176 | 2,656 | 4,383 |
| Philippine Islands .. | 242 | 661 | 3,040 | 8,014 |
| USA .. .. .. | 229 | 11,869 | 2,996 | 34,219 |
| Cuba .. .. .. | 27 | 379 | 373 | 1,920 |
| Colombia .. .. | 840 | 931 | 4,702 | 5,854 |
| Venezuela .. .. | 3,068 | 2,025 | 47,454 | 27,007 |
| Ecuador .. .. | 85 | 492 | 2,592 | 3,244 |
| Peru .. .. .. | 1,686 | 862 | 6,133 | 10,061 |
| Chile .. .. | 699 | 1,148 | 5,979 | 13,781 |
| Brazil .. .. .. | 1,486 | 2,519 | 15,308 | 27,123 |
| Uruguay .. .. | 652 | 1,438 | 7,242 | 8,631 |
| Argentina .. .. | 16,566 | 4,654 | 56,419 | 54,605 |
| Other foreign countries | 1,850 | 2,106 | 11,227 | 28,206 |
| TOTAL .. .. | 234,034 | 301,782 | 1,970,702 | 2,526,191 |

* Includes Netherlands New Guinea in 1949.

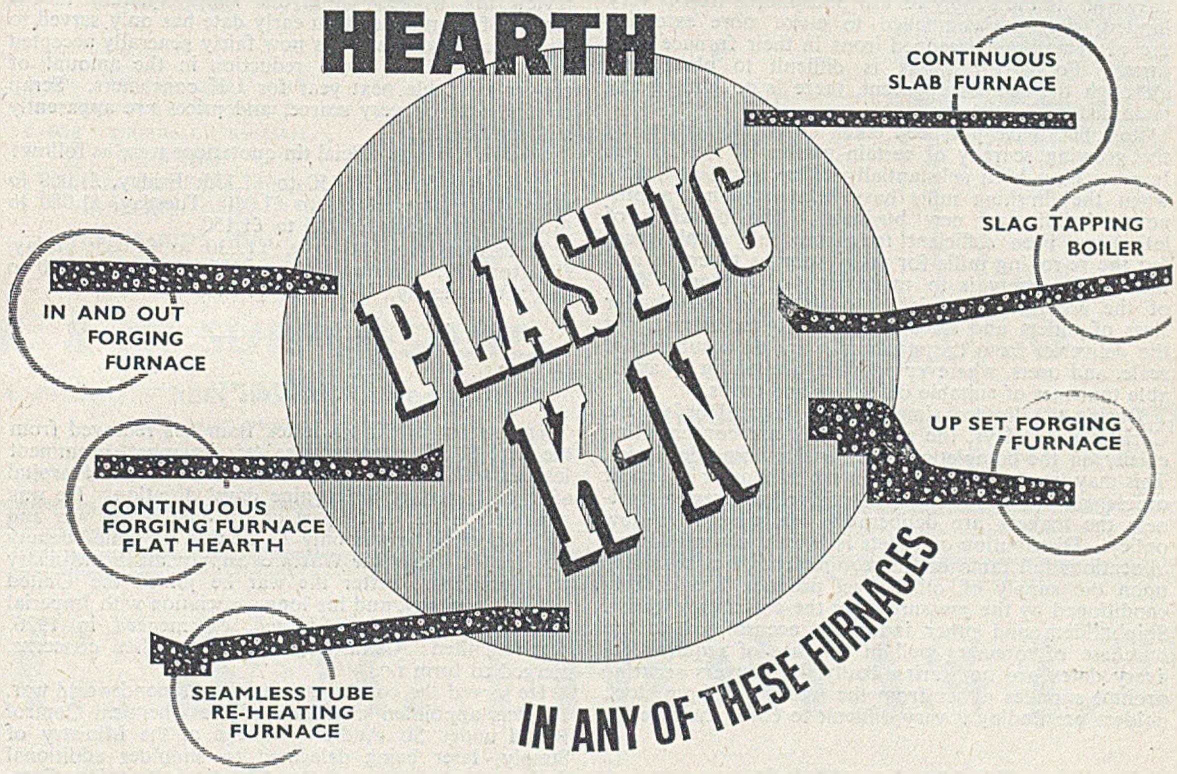
## *Total Imports of Iron and Steel.*

| From | Month ended October 31. | | Ten months ended October 31. | |
|---|---|---|---|---|
| | 1949. | 1950. | 1949. | 1950. |
| | Tons. | Tons. | Tons. | Tons. |
| Australia .. .. | 562 | 6 | 11,751 | 50 |
| Canada .. .. | 7,418 | 3,076 | 55,328 | 82,730 |
| Other Commonwealth countries and Irish Republic .. .. | 1,572 | 132 | 22,830 | 24,291 |
| Sweden .. .. | 1,176 | 1,480 | 14,284 | 10,888 |
| Norway .. .. | 1,904 | 4,518 | 24,479 | 42,187 |
| Germany .. .. | 873 | 2,182 | 18,448 | 65,182 |
| Netherlands .. .. | 4,558 | 2,221 | 84,997 | 41,132 |
| Belgium .. .. | 19,769 | 3,800 | 312,399 | 81,771 |
| Luxemburg .. .. | 8,980 | 2,624 | 149,586 | 35,738 |
| France .. .. | 11,289 | 26,118 | 178,416 | 247,752 |
| Austria .. .. | 264 | 63 | 31,364 | 3,349 |
| USA .. .. .. | 15,590 | 5,650 | 234,837 | 56,154 |
| Other foreign countries | 306 | 137 | 3,072 | 6,115 |
| TOTAL .. .. | 74,261 | 51,962 | 1,141,791 | 647,339 |
| Iron ore and concentrates— | | | | |
| Manganiferous .. | — | — | 7,006 | 10,876 |
| Other sorts.. .. | 760,409 | 614,748 | 7,420,188 | 7,149,319 |
| Iron and steel scrap and waste, fit only for the recovery of metal .. .. | 152,098 | 117,688 | 1,797,413 | 1,789,829 |

## *Exports of Iron and Steel by Products.*

| Product. | Month ended October 31. | | Ten months ended October 31. | |
|---|---|---|---|---|
| | 1949. | 1950. | 1949. | 1950. |
| | Tons. | Tons. | Tons. | Tons. |
| Pig-iron .. .. | 1,130 | 5,215 | 6,290 | 26,141 |
| Ferro-alloys, etc.— | | | | |
| Ferro-tungsten .. | 92 | 92 | 701 | 972 |
| Spiegeleisen, ferro-manganese .. | 569 | 517 | 6,582 | 2,122 |
| All other descriptions .. .. | 82 | 142 | 881 | 1,294 |
| Ingots, blooms, billets, and slabs .. .. | 174 | 519 | 2,521 | 5,415 |
| Iron bars and rods .. | 936 | 397 | 5,867 | 3,676 |
| Sheet and tinplate bars, wire rods .. | 187 | 3,950 | 2,934 | 15,068 |
| Bright steel bars .. | 1,733 | 4,565 | 15,905 | 36,681 |
| Other steel bars and rods .. .. | 15,758 | 30,013 | 143,723 | 213,286 |
| Special steel .. .. | 1,426 | 1,208 | 12,127 | 12,091 |
| Angles, shapes, and sections .. .. | 10,910 | 18,101 | 98,257 | 126,346 |
| Castings and forgings | 792 | 787 | 6,765 | 6,811 |
| Girders, beams, joists, and pillars .. .. | 3,548 | 8,171 | 25,111 | 56,929 |
| Hoop and strip .. | 4,948 | 14,271 | 43,766 | 98,702 |
| Iron plate .. .. | 1,155 | 239 | 5,434 | 2,182 |
| Tinplate .. .. | 22,016 | 18,894 | 160,336 | 205,742 |
| Tinned sheets .. | 135 | 126 | 3,094 | 2,382 |
| Terneplates, decor. tinplates .. .. | 47 | 55 | 358 | 767 |
| Other steel plate (min. ⅛ in. thick) .. | 20,146 | 37,423 | 185,543 | 278,076 |
| Galvanised sheets .. | 10,628 | 9,826 | 75,893 | 97,658 |
| Black sheets .. .. | 15,036 | 13,446 | 115,809 | 117,563 |
| Other coated plates .. | 646 | 828 | 5,593 | 10,319 |
| Cast-iron pipes up to 6-in. dia. .. .. | 8,334 | 6,326 | 66,474 | 63,535 |
| Do., over 6-in. dia. .. | 10,181 | 6,442 | 72,356 | 67,296 |
| Wrought-iron tubes .. | 32,442 | 28,316 | 277,023 | 285,665 |
| Railway material .. | 20,945 | 25,739 | 164,568 | 257,519 |
| Wire .. .. .. | 5,521 | 11,004 | 44,985 | 69,635 |
| Cable and rope .. | 2,764 | 3,074 | 25,794 | 28,008 |
| Netting, fencing, and mesh .. .. | 1,733 | 2,149 | 17,459 | 14,783 |
| Other wire manufactures .. .. | 1,285 | 4,397 | 10,827 | 25,323 |
| Nails, tacks, etc. .. | 489 | 878 | 5,842 | 5,416 |
| Rivets and washers .. | 616 | 670 | 7,615 | 6,838 |
| Wood screws .. .. | 299 | 566 | 2,817 | 3,345 |
| Bolts, nuts, and metal screws .. .. | 2,501 | 2,677 | 21,888 | 25,929 |
| Stoves, grates, etc. (excl. gas) .. .. | 709 | 1,514 | 7,802 | 9,964 |
| Do., gas .. .. | 232 | 256 | 2,192 | 2,162 |
| Baths .. .. .. | 980 | 1,410 | 8,352 | 11,763 |
| Anchors, etc. .. | 1,232 | 819 | 8,208 | 7,622 |
| Chains, etc. .. .. | 993 | 1,074 | 8,596 | 8,697 |
| Springs .. .. | 684 | 466 | 7,088 | 6,920 |
| Hollow-ware .. .. | 7,052 | 8,532 | 68,159 | 73,122 |
| All other manufactures | 22,848 | 26,688 | 218,617 | 232,426 |
| TOTAL .. .. | 234,034 | 301,782 | 1,970,702 | 2,526,191 |

# It pays TO INSTALL A MONOLITHIC HEARTH

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# *Raw Material Markets*

## Iron and Steel

In the pig-iron trade the emphasis of demand is most marked in the case of low- and medium-phosphorus grades. The call for high-phosphorus iron is kept within manageable proportions, reflecting the prevailing conditions in the light and jobbing foundries where bookings are still comparatively light. On the other hand, the engineering foundries are extremely busy and, as the supply of low-phosphorus iron is very limited, they are compelled to make more extensive use of hematite and refined irons in their furnace mixtures. Forward business is difficult to place and, although the need is apparent, there is no hint of any increased production.

Re-rollers have not been taken entirely unawares by the growing scarcity of certain classes of steel semis. Imports have been substantially reduced just at a time when the finishing mills have been enjoying a pronounced influx of new business. The bookings of late have been sufficient to ensure full employment for the re-rolling mills for many months to come, and the chief anxiety is to make sure of a regular flow of the necessary material. Shortages of the smaller sizes of billets and slabs have already developed, but the deliveries from the steelworks are on a substantial scale, and users, wherever possible, are taking up available tonnages of suitable defectives and crops.

During the limited time at their disposal before the Christmas holidays, the rolling mills are concentrating chiefly on the completion of extensive home deliveries. This may involve some delay in the fulfilment of export orders, and in the acceptance of further oversea business the makers are deliberately adopting a go-slow policy. Distribution of sheets is strictly controlled and allocations fall far short of requirements, but restraints upon the supply of other steel products are entirely conditioned by the pressure from the consuming trades. Shipbuilders and other industries accustomed to the purchase of tonnages well in advance of required delivery dates are not faring badly, but buyers securing prompt supplies either from the makers or from stock holders are finding it very difficult to cover their needs.

## Non-ferrous Metals

The British Bureau of Non-ferrous Metal Statistics has issued details of consumption and stocks of copper, lead, and zinc during the month of October. From these it seems apparent that up to the end of the tenth month of this year activity was very well maintained in lead, for example, total consumption, which includes some 8,500 tons of remelted metal, in October amounted to 29,131 tons, against 29,003 tons in Steptember. Stocks of virgin metal showed little change, the figure of 72,044 tons at the end of October comparing with 71,209 tons a month earlier. Stocks at the end of August exceeded 81,000 tons. Considerable interest attaches to the trend of zinc stocks, and here we find that October brought a sharp decline, for the total dropped from 48,414 tons on the first day of the month to 40,981 tons at the end. Consumption during October, which included some 8,650 tons of secondary metal, was 29,863 tons, compared with 30,984 tons in September when usage of secondary was 1,000 less than in October. Stocks of copper showed little change, the total of 120,411 tons at October 31 comparing with 121,388 tons at September 30. United Kingdom usage during October was 47,204 tons, of which 28,935 tons was virgin and the balance scrap. In September the corresponding figures were 31,712 tons and 14,426 tons, a total of 46,138 tons. Consumption of tin in the UK during October was 1,942 tons.

Once again, there have been wide fluctuations in the tin price. But interest has now largely shifted from tin to the other metals.

Last week brought an announcement that the Ministry of Supply was not prepared for the moment to accept any more orders for zinc to be delivered beyond the end of December. This has been interpreted in some quarters to mean that a further cut in zinc supplies is coming, while Mr. Strauss's promise to review the whole non-ferrous supply picture in the House of Commons at an early date has only served to strengthen this view. It is now fairly generally accepted that there will be some reduction in the amount of copper available next year for UK consumers. Scrap continues to be very scarce, and prices are apparently still moving up.

Metal Exchange official tin quotations were as follow:

*Cash*—Thursday, £1,150 to £1,155; Friday, £1,060 to £1,065; Monday, £1,050 to £1,060; Tuesday, £1,080 to £1,085; Wednesday, £1,145 to £1,150.

*Three Months*—Thursday, £1,030 to £1,035; Friday, £975 to £980; Monday, £990 to £995; Tuesday, £990 to £995; Wednesday, £1,040 to £1,045.

# *Obituary*

THE DEATH of Sir Frederick Bain has removed from the world of industry one of its most prominent leaders. He was 61 and died in Westminster Hospital after an illness of about nine days' duration. He was wounded in the early part of the first world war and in 1916, when he was only 27, he was appointed deputy director of Chemical Warfare Supply at the Ministry of Munitions. After the war he joined the United Alkali Company, and his long association with Imperial Chemical Industries, Limited, commenced in 1926, when United Alkali, together with other concerns, merged to form I.C.I.

He served the country again in the second world war. He was appointed chairman of the Chemical Control Board under Sir Andrew Duncan at the Ministry of Supply, later being delegated to shoulder additional duties as chairman of the Chemical Planning Committee of the Ministry of Production. In 1947 he succeeded Sir Clive Baillieu as president of the Federation of British Industries. Sir Frederick became vice-president of the British Employers' Confederation in 1948, and, with the formation of the Anglo-American Council on Productivity in that year, he was appointed a member to represent the chemical industry.

## Engineers' Wage Claim

Complete agreement was reached last Tuesday between the Engineering and Allied Employers' National Federation and the Confederation of Shipbuilding and Engineering Unions on the increases in wages for lower-paid workers in the industry. The agreement is based on the suggestions made by the National Arbitration Tribunal, thus bringing to a satisfactory conclusion a major wage dispute which has been going on for over a year.

The new rates will be retrospective to the first full pay period after November 13. The memorandum of agreement states that it is "in full settlement" of the claim presented on November 30 last year.

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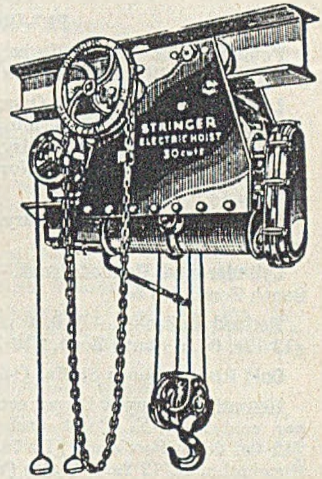


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# Current Prices of Iron, Steel, and Non-ferrous Metals

*(Delivered, unless otherwise stated)*

December 6, 1950

## PIG-IRON

**Foundry Iron.**—No. 3 Iron, Class 2 :—Middlesbrough, £10 10s. 3d. ; Birmingham, £10 5s. 6d.

**Low-phosphorus Iron.**—Over 0.10 to 0.75 per cent P, £12 1s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si)—North Zone, £12 10s. ; South Zone, £12 12s. 6d.

**Scotch Iron.**—No. 3 foundry, £12 0s. 3d., d/d Grangemouth.

**Cylinder and Refined Irons.**—North Zone, £13 2s. 6d. ; South Zone, £13 5s.

**Refined Malleable.**—P, 0.10 per cent. max.—North Zone, £13 12s. 6d. ; South Zone, £13 15s.

**Cold Blast.**—South Staffs, £16 3s. 3d.

**Hematite.**—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. Coast and N.-W. Coast of England, £12 0s. 6d. ; Scotland, £12 7s. ; Sheffield, £12 15s. 6d. ; Birmingham, £13 2s. ; Wales (Welsh iron), £12 0s. 6d.

**Spiegeleisen.**—20 per cent. Mn, £17 16s.

**Basic Pig-iron.**—£10 11s. 6d., all districts.

## FERRO-ALLOYS

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

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

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

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

**Ferro-titanium.**—20/25 per cent., carbon free, £100 per ton.

**Ferro-tungsten.**—80/85 per cent., 17s. 9d. per lb. of W.

**Tungsten Metal Powder.**—98/99 per cent., 19s. 4d. per lb. of W.

**Ferro-chrome.**—4/8 per cent. C, £60 ; max. 2 per cent. C, 1s. 5½d. lb. ; max. 1 per cent. C, 1s. 6d. lb. ; max. 0.15 per cent. C, 1s. 6¾d. lb. ; max. 0.10 per cent. C, 1s. 7d. lb.

**Cobalt.**—98/99 per cent., 15s. 6d. per lb.

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

**Ferro-manganese** (blast-furnace). — 78 per cent., £30 5s. 11d.

**Metallic Manganese.**—96/98 per cent., carbon-free, 1s. 7d. to 1s. 9d. per lb.

## SEMI-FINISHED STEEL

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

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

**Sheet and Tinplate Bars.**—£16 16s. 6d.

## FINISHED STEEL

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

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

**Alloy Steel Bars.**—1-in. dia. and up : Nickel, £37 7s. 3d.; nickel-chrome, £55 ; nickel-chrome-molybdenum,£61 13s.

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

## NON-FERROUS METALS

**Copper.**—Electrolytic, £202 ; high-grade fire-refined, £201 10s. ; fire-refined of not less than 99.7 per cent., £201 ; ditto, 99.2 per cent., £200 10s. ; black hot-rolled wire rods, £211 12s. 6d.

**Tin.**—Cash, £1,145 to £1,150 ; three months, £1,040 to £1,045 ; settlement, £1,150.

**Zinc.**—G.O.B. (foreign) (duty paid), £151 ; ditto (domestic), £151 ; "Prime Western," £151 ; electrolytic, £155 ; not less than 99.99 per cent., £157.

**Lead.**—Good soft pig-lead (foreign) (duty paid), £136 ; ditto (Empire and domestic), £136 ; "English," £137 10s.

**Zinc Sheets, etc.**—Sheets, 10g. and thicker, all English destinations, £170 7s. 6d. ; rolled zinc (boiler plates), all English destinations, £168 7s. 6d. ; zinc oxide (Red Seal), d/d buyers' premises, £139 10s.

**Other Metals.**—Aluminium, ingots, £120 ; antimony, English, 99 per cent., £250 ; quicksilver, ex warehouse, £36 10s. to £37 10s. ; nickel, £386.

**Brass.**—Solid-drawn tubes, 21[illegible]d. per lb. ; rods, drawn, 28[illegible]d. ; sheets to 10 w.g., 26d. ; wire, 26⅜d. ; rolled metal, 24¾d.

**Copper Tubes, etc.**—Solid-drawn tubes, 23¼d. per lb. wire, 226s. 6d. per cwt. basis ; 20 s.w.g., 254s. per cwt.

**Gunmetal.**—Ingots to BS. 1400—LG2—1 (85/5/5/5), £225 to £245 ; BS. 1400—LG3—1 (86/7/5/2), £235 to £255 ; BS. 1400—G1—1 (88/10/2), £300 to £335 ; Admiralty GM (88/10/2), virgin quality, £310 to £335, per ton, delivered.

**Phosphor-bronze Ingots.**—P.Bl, £310 to £345 ; L.P.Bl £240 to £260 per ton.

**Phosphor Bronze.**—Strip, 34d. per lb. ; sheets to 10 w.g., 35[illegible]d. ; wire, 36d. ; rods, 33½d. ; tubes, 38¾d. ; chill cast bars : solids, 34½d., cored, 35½d. (C. Clifford & Son, Limited.)

**Nickel Silver, etc.**—Ingots for raising, 2s. 2¾d. per lb. (7%) to 3s. 1½d. (30%) ; rolled metal, 3 in. to 9 in. wide × .056, 2s. 8[illegible]d. (7%) to 3s. 7½d. (30%) ; to 12 in. wide × .056, 2s. 9d. to 3s. 7¾d. ; to 25 in. wide × .056, 2s. 11d. to 3s. 9¾d. Spoon and fork metal, unsheared, 2s. 5¾d. to 3s. 4½d. Wire, 10g., in coils, 3s. 2¼d. (10%) to 4s. 1d. (30%). Special quality turning rod, 10%, 3s. 1¼d. ; 15%, 3s. 5¾d. ; 18%, 3s. 10d. All prices are net.

## Forthcoming Events

DECEMBER 11

**Institute of Metals**

*Scottish Local Section*:—"Non-ferrous Metals in the Locomotive Industry," by J. D. Glen, at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, at 6.30 p.m.

DECEMBER 12

**Institute of British Foundrymen**

*East Anglian Section*:—To be arranged. (Details may be obtained from the secretary.)

*Coventry Students' Section*:—"Recent Experiences of American Light-alloy Casting Production," by J. Sulley and H. J. Millward, at Coventry Technical College, at 7.15 p.m.

**Institution of Mechanical Engineers**

*Automobile Division*:—"Post-war Public-service Vehicle Development," by T. H. Parkinson, M.I.MECH.E., at Storey's Gate, St. James's Park, London, S.W.1, at 5.30 p.m

**Institution of Works Managers**

*West Midland Branch*:—"Material Handling," by T. Dean, at the Imperial Hotel, Birmingham, at 7.30 p.m.

DECEMBER 13

**Institute of British Foundrymen**

*Lancashire Branch*:—"Core Blowing," by G. W. Fearfield, at the Engineers' Club, Albert Square, Manchester, at 3 p.m.

*West Riding of Yorkshire*:—Supper dance, at the Alexandra Hall, Halifax, at 8 p.m.

**Institute of Vitreous Enamellers**

*Northern Section*:—Discussion on defects (members are asked to bring examples for examination), at the Queens Hotel, Manchester, at 7.30 p.m.

DECEMBER 14

*Lincolnshire Branch*:—"Maintenance of Plant and Equipment," by J. I. Blackbourn, at the Technical College, Lincoln, at 7.15 p.m.

**Institution of Production Engineers**

*London Graduate Section*:—"Production of the XK120 Jaguar Sports Car," by J. Silver, M.I.PROD.E., A.I.I.A., at 36, Portman Square, London, W.1, at 7.15 p.m.

**Institute of Metals**

*Sheffield Local Section*:—"Isothermal Transformation of Copper-base Alloys," by R. Haynes, B.MET., at the Grand Hotel, Sheffield, at 6.30 p.m.

**Engineers' Guild**

*Metropolitan Branch*:—"Atomic Physics" film, at Caxton Hall, Caxton Street, Westminster, London, S.W.1, at 6 p.m.

**Institution of Works Managers**

*Tees-side Branch*:—"Productivity Teams in America," by F. A. Martin, O.B.E., at the Vane Arms Hotel, Stockton-on-Tees, at 7.30 p.m.

*West Midland Branch*:—"Foremen and their Place within Industry," at the Geisha Café, Coventry, at 7 p.m. (Joint meeting with the Institute of Industrial Supervisors.)

DECEMBER 15

**Institute of British Foundrymen**

*London Branch*:—Annual dinner and dance, at the Café Royal, Regent Street, London, W.1, at 7 p.m. Official visit by the president of the Institute, Mr. J. J. Sheehan, B.SC., A.R.C.SC.I.

**Institution of Mechanical Engineers**

"Naval Gearing—War Experience and Present Development," by Cdr. (E) J. H. Joughin, D.S.C., R.N., A.M.I.MECH.E., at Storey's Gate, St. James's Park, London, S.W.1, at 5.30 p.m.

DECEMBER 16

**Institute of British Foundrymen**

*Bristol and West of England Branch*:—"Bonus and Incentive Methods in the Jobbing Foundry," by W. Buckley and A. Makins, at the Grand Hotel, Broad Street, Bristol, at 3 p.m.

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

## SITUATIONS WANTED

FOUNDRY FOREMAN (38) seeks similar position, Lancashire area. 10 years' executive experience jobbing and repetition. All types iron, including Meehanite and non-ferrous metals. Also rate-fixing and estimating experience.—Box 314, FOUNDRY TRADE JOURNAL.

AUSTRALIAN FOUNDRY METALLURGIST (25), arriving early December, requires position in Ferrous Foundry. Part experienced in open-hearth and high-frequency furnaces, annealing control, roll manufacture, refractories.—Box 220, FOUNDRY TRADE JOURNAL.

## SITUATIONS VACANT

ASSISTANT METALLURGICAL CHEMIST, aged 24 to 28 years, required for Engineering Works Laboratory in South-East London.—Apply, giving full particulars of training and experience, to Box 338, FOUNDRY TRADE JOURNAL.

FOREMAN required to take control of Cupola melting 30 tons of grey iron daily. Staff appointment in Foundry situated 30 miles North of London. Written applications are invited and will be treated in strictest confidence.—Box 322, FOUNDRY TRADE JOURNAL.

CUPOLA ATTENDANT, capable of performing the duties of cupola tapping, etc., required for Foundry situated 30 miles North of London. Written applications are invited and will be treated in strictest confidence.—Box 324, FOUNDRY TRADE JOURNAL.

REQUIRED IMMEDIATELY.—MOULDERS for H.W. Connections, and MOULDERS and MATES for 6 ft. and 9 ft. lengths of 4-in. hot water pipes. Piece work rates.—Apply C. P. KINNELL & COMPANY, LTD., Thornaby-on-Tees, Stockton-on-Tees. Co. Durham.

FERROUS and Non-Ferrous Foundry requires MOULDERS and TRIMMERS. Only skilled jobbing moulders need apply. — PLANT MACHINERY & ACCESSORIES, LTD., 136-140, Bramley Road, W.10. Ladbroke 3692.

ESTABLISHED EQUIPMENT.—Manufacturers require experienced FOUNDRY FOREMAN; control small modern mechanised foundry for light grey iron castings. Capable expansion. Good prospects. S.W. Lancs.—Box T833, LEE & NIGHTINGALE, Liverpool.

WANTED. — STEEL FOUNDRY MANAGER for Foundry (Huddersfield district). Specialising in pressure castings.—Reply, stating full details of previous experience, Box 744, FOUNDRY TRADE JOURNAL.

VACANCY for young man, age 25/30. to be trained for above situation in large modern foundries in Yorkshire, producing high-class steel, iron and non-ferrous castings. Knowledge of foundry practice essential. Good prospects for person with ability.—Apply, giving details of age, education, salary, etc., to Box 346, FOUNDRY TRADE JOURNAL.

## SITUATIONS VACANT—*Contd.*

A VACANCY exists for a JUNIOR ASSISTANT in the METHODS SECTION of a progressive Steel Foundry. The applicant must have a good basic training in the industry, together with suitable technical background. It is essential that the applicant possesses drive and initiative as the position is progressive.—Please state age, experience, and salary required, to Box 328, FOUNDRY TRADE JOURNAL.

A STEEL FOUNDRY, with a progressive outlook, is desirous of strengthening its SUPERVISORY AND TECHNICAL STAFF. The applicants must have a sound basic training for the industry, together with suitable technical background. The main essentials are drive, initiative, and a progressive outlook. The present rate of modernisation of the plant and equipment make it essential that only applicants of a high standard will be accepted for the two or three vacant positions.—Write in the first instance, giving details of age, experience and salary required, to Box 330, FOUNDRY TRADE JOURNAL.

SENIOR ASSISTANT METALLURGIST required by large concern (Lancs N.W. region), with knowledge of steel foundry and open hearth practice. Good prospects for suitable type of applicant, and Staff Pension Scheme operating.—Full particulars, stating salary required, to Box 318, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN required for Foundry near Birmingham producing High Duty Iron Castings. This is a progressive position which offers a sound future for the right man. Please give full particulars of experience and salary required.—Box 372, FOUNDRY TRADE JOURNAL.

FOUNDRY METALLURGIST required by Foundry near Birmingham producing High Duty Iron Castings. This is a very good opportunity for a young man who is anxious to establish himself with a rapidly growing organisation. Please give full particulars of experience and salary required.—Box 374, FOUNDRY TRADE JOURNAL.

ENGINEERING DRAUGHTSMAN required by a Company specialising in Foundry Plant and Equipment. The position offers considerable scope to a young man who is willing to work hard and make a place for himself in a rapidly expanding organisation. Please give full particulars of experience and salary required.—Box 376, FOUNDRY TRADE JOURNAL.

REPRESENTATIVE required for Scotland for sale of well established and advertised range of Core Binders. Payment by salary, expenses and bonus.—Apply, giving fullest particulars of age, experience, salary required, etc., to Box 358, FOUNDRY TRADE JOURNAL.

## SITUATIONS VACANT—*Contd.*

FOUNDRY FOREMAN required for Heavy Jobbing Iron Foundry.—Apply, stating age and giving details of experience, to ANDREW STRANG & CO., LTD., Blair Foundry, Hurlford, Ayrshire.

MOULDER required for Non-ferrous Foundry, Middlesex area. Accustomed to jobbing work up to a £100. Good prospects for right man.—Box 364, FOUNDRY TRADE JOURNAL.

WANTED.—FURNACE MAN, conversant with the melting of scrap metals in large reverberatory furnace, for Australia. Salary according to qualifications. Passage paid, also for family.—Apply Box 362, FOUNDRY TRADE JOURNAL.

METAL PATTERN MAKER, having experience on production of patterns for water cocks, and able to produce master patterns, pattern plates, as well as core box patterns in plaster. Required by East London manufacturer. Permanent position. Please give full particulars, age, experience, previous employers, and wages required, to Box 356, FOUNDRY TRADE JOURNAL.

COMPANY of International repute invite applications from FOUNDRY TECHNICIANS/METALLURGISTS who think they have a flair for selling. Some general knowledge of foundry operations essential as service work links up with an extensive range of chemical-metallurgical products. Preferred age group 25/40. Although not essential it is desirable applicant should possess a car or have ability to drive. We are only interested in keen, enterprising hard workers who are willing to submerge other interests for a tough but fascinating job. The provisional areas are Scotland, Yorkshire and South Wales. Reply should be as explicit as possible and interviews probably given in the particular area.—Box 358, FOUNDRY TRADE JOURNAL.

FOUNDRY TECHNICIAN required for modern progressive foundry, situated near London; must have good experience in non-ferrous and foundry processes, including melting, sand control, running and feeding practice. State standard of education, experience and salary required. —Write Box R.48, WILLINGS, 362, Grays Inn Road, London, W.C.1.

## FINANCIAL

WANTED an interest in a good class Pattern-making Concern in the Midlands area. Advertiser in position to place a considerable amount of business and also introduce new ideas and methods, etc.—Box 224, FOUNDRY TRADE JOURNAL.

INDUSTRIAL Syndicate, with substantial financial resources, desire to acquire part or whole interest in an established concern with a profit earning record. A transaction involving from £20-£100,000 is envisaged. — Address "Consultant," Box 348, FOUNDRY TRADE JOURNAL.