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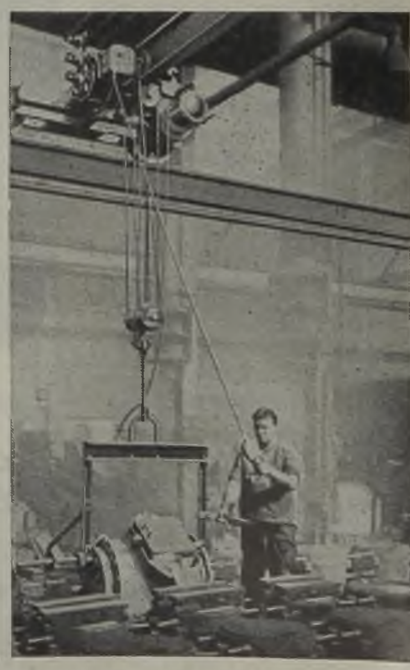


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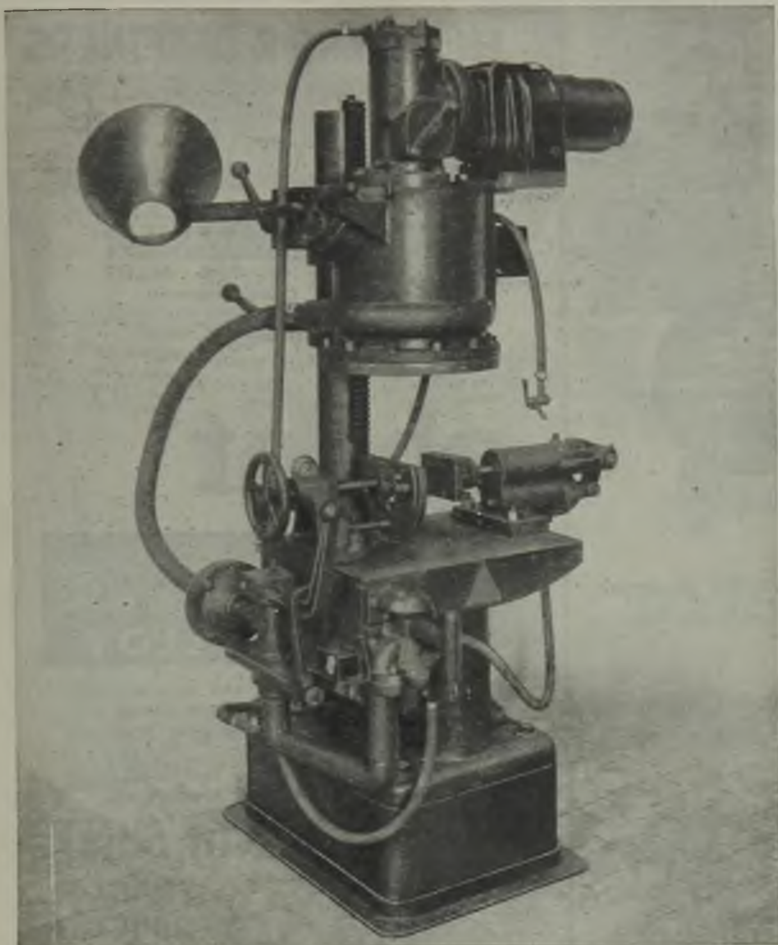

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FOUNDRY TRADE JOURNAL

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WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 73 Thursday, June 1, 1944 No. 1450

The Institute's Proceedings

The somewhat attenuated aspect of Vol. XXXVI of the Proceedings of the Institute of British Foundrymen is due entirely to the thin paper which war conditions have imposed, as there are almost three hundred pages. The growing attention which the Institute is paying to non-ferrous foundry practice is reflected by the fact that seven Papers are included, covering various aspects of this subject, as against eight for cast iron and five for steel. This is a direct result of the policy first put into practice at the 1928 Conference in Leicester of holding a special session for members interested in non-ferrous work. A feature of the new volume is that it carries a larger number of illustrations than ever before, and despite the thinness of the paper they have reproduced very satisfactorily.

The high standard which is expected from the Edward Williams' Lecturer was well maintained by Dr. S. F. Dorey. As the character of steelfounding is changing, the description of past achievements will, in the future, be particularly valuable. We are inclined to the view that the publication of Reports by the Institute is especially appreciated by the members, because they have more confidence in data when presented in this form. This is due to the fact that there is an implicit belief that much discussion has preceded presentation, whereas with an individual Paper it follows. As would be expected in wartime, much space is rightly devoted to control of quality and the means for ensuring this. Thus not only are well tried systems included, such as is typified in Mr. Warrington's Paper, but extensive consideration is given to such subjects as X-ray and spectrographic analysis. Another typical wartime Report of great practical use is one which shows the way to get the best out of the raw materials now available to the iron-founder.

The contributions to the study of steelfoundry practice are of a high calibre, especially the one by Mr. C. W. Briggs on hot tear formation, given as the American Exchange Paper. The Papers which we classify as "general" are fewer than usual. One on education by G. L. Harbach and J. R. Horton is not only topical, but was of real service to the Institute's Committee, when creating its Report on this subject. The second one entering this category is by A. Tipper, who dealt with corebinders, whilst finally there is a most interesting study by E. Longden on fluid pressure. We note that the American method of utilising atmospheric pressure in conjunction with a blind riser is referred to as Taylor and Rominiski, just as the use of pencil runners is still called the Ronceray system. Both are wrongly designated, but we fear both names will persist as, in each case, the methods were disclosed to the public by "proxy." Mere disclaimers, even if persistent, fail to correct the error when once made. An outstanding Paper is that by John Vickers and B. MacDougall, because it shows that where a progressive management will provide the necessary tools to an enlightened foundry staff, results can be achieved which places the castings industry on a level comparable with that reached by the mass-production precision engineering concern.

The proceedings of a technical institute, mirroring as they do the activities of its members, should be of increasing value to the industry served. In forty years the Proceedings of the Institute have consistently improved, and with it the membership has grown from a handful to about 3,000. The policy set up by its founders has not been materially changed, and many of the precepts then established have been emulated by other and older institutes. The stress upon giving service to members through branches is an example. The new volume, despite war conditions, is the most valuable of the whole series, and we congratulate Mr. J. Bolton, its Editor, on the excellence of its production.

Contents

TURNOVER FRAMES

By "CHECKER"

The purpose of turnover frames is to give support to the bedding out sand while the core is being turned over, and their use is frequent in core shop practice. Generally the frames are made in wood and have a level top, so that a flat plate can be placed on for turning over purposes. The underside of the frame should on all cases be made to fit the corebox joint whether it is a straight or irregular shape, as shown in Fig. 1.

The addition of legs to these turnover frames can, where necessary, be utilised to allow the coremaker to draw off the half corebox without injuring the core, especially where sections of the core are frail, and an unsteady draw may cause damage or breakage to

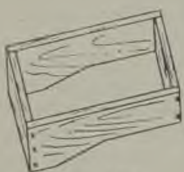

FIG. 1

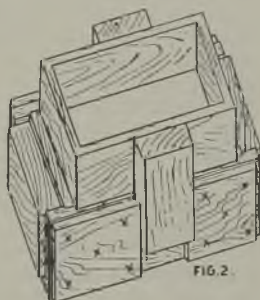

FIG. 2

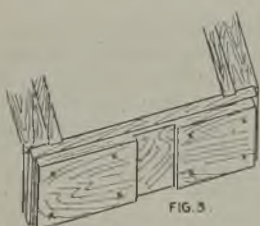

FIG. 3

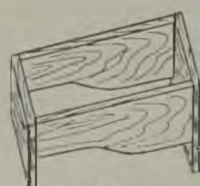

FIG. 4

the core. Fig. 2 shows one type of turnover frame with a leg on each side, in position on the corebox; slots must be cut out of the corebox sides or side-battens to correspond with the legs, as shown in Fig. 3; both legs and slots should be parallel, this ensures a good lift every time, as the half corebox can only move upwards, and is controlled by the legs and slots, which, if they are a good fit, will allow for very little deviation in any other direction.

These turnover frames can be made with two, three or four legs, whichever is most suitable after taking into account the size and shape of the corebox in question. If metal turnover frames are required for metal coreboxes, the same method of legs and slots can be adopted. Another type is shown in Fig. 4. This has the ends made deeper than the sides, so that they fit over the ends of the corebox, and can be used to advantage with open-ended coreboxes.

PUBLICATION RECEIVED

"Resistance Welding of Wrought Aluminium Alloys." Issued by the Wrought Light Alloys Development Association, Union Chambers, 63, Temple Row, Birmingham, 2, as Information Bulletin No. 6.

This 60-page, well illustrated Bulletin is complementary to the previous one (No. 5) published by the Association, which dealt with the welding of the wrought aluminium alloys by gas and the electric arc. Resistance welding includes spot, seam and butt welding. Of these, spot welding is by far the most important, seam welding and butt welding being scarcely used at present in this country as machines suitable for the purpose are not available. The greater portion of this booklet deals with the spot-welding process, and after discussing the general requirements of spot welding, attention is devoted to the weldability of various classes of aluminium alloy. The different types of welding machine available, namely, a.c. machines and the two ranges of stored energy machines, are described and illustrated, and there is a short section dealing with the choice of suitable equipment. Attention is given in this portion of the Bulletin to the design, materials, cooling and cleaning of electrodes. The importance of surface preparation is stressed, and particular attention is paid to the various recommended methods of cleaning the sheet and removing the oxide film. The chrome-sulphuric acid pickle and phosphoric-acid solution are dealt with in detail.

Methods of assembly are briefly summarised and there is a section on machine settings. It is not possible to detail the exact settings for particular materials at present owing to the different characteristics of individual machines and the peculiarities of particular jobs, but an indication is given of the range of settings for each type of machine. A set of diagrams illustrates the various defects to be avoided. The inspection procedure is also summarised.

Design considerations, including recommendations for minimum weld spacing and edge distance, are also dealt with. It is apparent that spot welds should be taken into account by the designer in the early stages rather than regarded as substitutes for rivets. The booklet concludes with appendices summarising British Standard Specification 1138, the pickling of aluminium alloy sheets, and a selected bibliography.

NEW CATALOGUES

Temperature Control. Two leaflets received from Sarco Thermostats, Limited, of Alpha House, Cheltenham, Glos., deal with the control of room temperature and process work. The system, though automatic, is not necessarily a cure-all, and needs intelligent application—based on experience.

Tipping Tool Steels. A four-page folder received from Suffolk Iron Foundry (1920), Limited, Sifbronze Works, Stowmarket, Suffolk, details three methods of tipping mild-steel bars with tungsten carbide and the like, using Sifbronze as the welding or brazing medium

MOULDING SANDS AND GASES IN RELATION TO CASTING DEFECTS*

Controlling factors in the satisfactory production of iron castings

By G. W. NICHOLLS

Many factors are involved in the successful manufacture of iron castings varying in weight from a few pounds to as much as 30 tons, and these factors depend greatly on certain physical conditions which must all be co-ordinated in orderly sequence if sound castings with good skin finish are to be obtained. Of the controlling factors, those that predominate above all others are (*a*) the condition of the moulding sand and the reaction of the finished mould at elevated temperatures, and (*b*) the generation of gases from the mould, both of which can be greatly influenced by the human element.

If one were to review all the technical literature of the past 15 years, there would be noticed immediately a great wealth of information relating directly or indirectly to the subject, based on research and practical experience, expounded by such authorities as F. Hudson, W. Dietert and others, and recorded in the proceedings of the Institute of British Foundrymen and the American Foundrymen's Association. Yet, despite the availability of all this valuable information, many foundrymen still experience periods in which a sudden increase in defective castings occurs without any apparent change in the metal charge, sand mixture or moulding practice. This proves that in many cases efficient sand control is not practised.

When such epidemics occur, profound arguments sometimes arise between the various personnel in the foundry as to whether defective metai or mould conditions are the cause. It will generally be agreed, however, that inasmuch as all moulding operations carried out in the foundry essentially introduce a greater number of potential hazards in respect to the moulds than to the metal mixture (the personal element being involved to a greater extent in constructing the majority of moulds than in melting of the iron), it necessarily follows that a correspondingly greater number of opportunities are created for things to go wrong with the mould that has to receive the molten metal.

A careful survey of the cause of defective castings in the majority of foundries invariably reveals that at least 50 per cent. can be directly traced to an unsuitable sand condition and gases generated therefrom, resulting in such defects as blow-holes, scabs, burnt-in sand, gas seams and sand intrusions. The other 50 per

* A Paper read before the West Riding of Yorkshire Branch, Mr. L. Turner presiding.

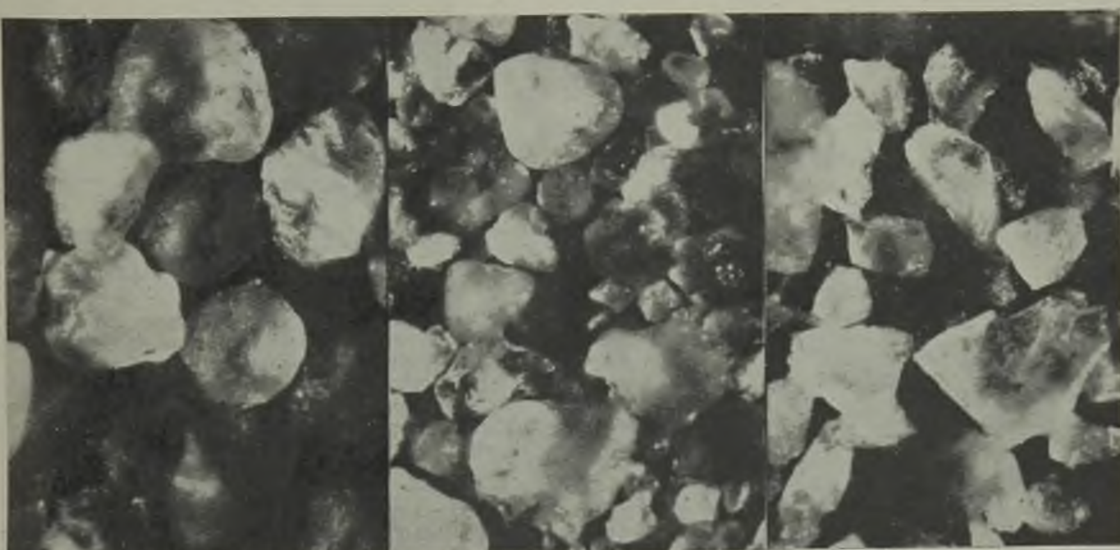

FIG. 1.—SAND GRAINS OF VARIOUS SHAPES AND DISTRIBUTION.

Moulding Sands and Gases

cent. is due to such factors as incorrect design of casting and placing of gates and risers, metal composition and temperature, and faulty moulding tackle. Therefore, in maintaining a steady flow of sound castings free from sand and gas defects, a well controlled sand with the required proved characteristics will greatly help in substantially reducing losses attributed to this constituent of mould construction, and every foundry should attach as much importance to the study of the sand condition as to the metal condition, and the effects which the various sand characteristics have on the quality of their castings. This immediately suggests that records are of primary importance, so that defective castings may be checked constantly, thereby aiding in determining the cause to which they may be attributed.

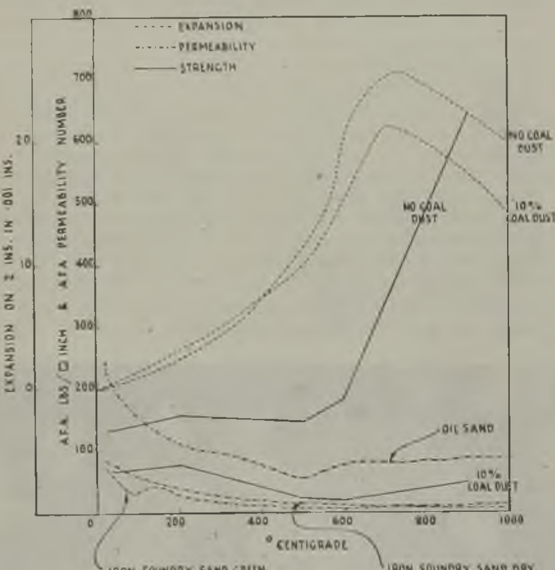

FIG. 2.—EFFECT OF HEAT ON THE PROPERTIES OF MOULDING SANDS.

In dealing with this subject it is realised that differences of opinion are held and openly expressed by the various personnel of the industry. There are still some who do not consider it necessary to practise sand control, and even suggest that good moulding practice can overcome deficiencies in the moulding sand condition. With the latter point in mind, this Paper has been compiled to indicate the relationship between sand condition and certain casting defects, and if some of the points dealt with appear to some to be obvious and straightforward, they are nevertheless usually the factors which are often overlooked. It would, of course, be impossible in the space allowed to deal with all the factors which contribute towards defective castings, and to consider each one in detail. Therefore, the scope of this Paper is confined to sand and gases and their relationship to defective castings such as are invariably produced in the majority of foundries.

The most important characteristics of moulding sand are those exhibited at high temperatures (*i.e.*, the moment when the metal enters the mould cavity), and no matter how a mould has been constructed and its condition appears at room temperature, the deciding issue is its behaviour at that moment when subjected to thermal shock. It is proposed, therefore, to deal firstly with the reactions that occur at high temperature, all of which centre round the physical and chemical composition of the sand.

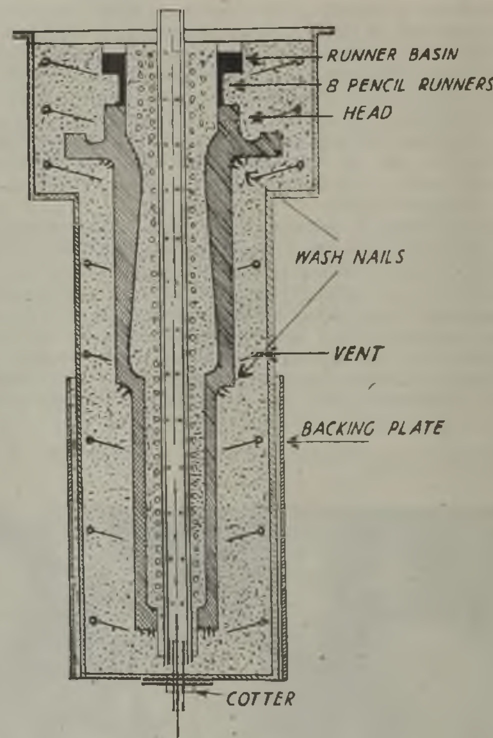

FIG. 3.—MOULD FOR DRILL SLEEVE.

Nature of Core Sands

The core sands usually comprise variable sized sand grains, oil and/or cereal binder, and the moulding sands are composed chiefly of variable-sized grains, clay, coal dust or other carbonaceous material. The base of all sand grains used is quartz, which may vary considerably in grain size distribution, structure and purity according to their formation in nature. The shape of the grain also varies, being either round, angular, sub-angular or a mixture thereof, and these two factors alone (*i.e.*, size distribution and shape combined) have an important bearing on the resultant permeability and strength of the rammed sand. For example, a sand with round variable-sized grains gives a resultant rammed mass possessing numerous contact points and a small volume of pore space, resulting in a high strength coupled with low permeability when rammed. A sand with large rounded grains of fairly uniform size results in a large volume of pore space possessing a relatively small number of contact points, producing a rammed sand of low strength and high permeability. Those containing angular-shaped grains possess large contact area with a small or medium pore space producing moderate permeability and high strength, whereas a mixture of rounds and angular or sub-angular grains increases the strength, due to increased contact points, without greatly reducing the permeability. Fig. 1 shows sand grains of various shapes and distribution, illustrating these points.

When subjected to heat, these sand grains undergo two physical changes, first, when heated to 550 deg. C., they change from the alpha to the beta state and at the same time rapid expansion commences. On further heating to approximately 1,250 deg. C., a further change takes place, followed by contraction, and a constant usage above this temperature lowers the sand's resistance to withstand sudden heating and cooling, thereby slightly increasing the fines content through fracture. This property of expansion is, however, greatly affected by the amount of bond present and the manner in which it is distributed, coupled with the resulting density produced by ramming. If excess bond be present, more of the volume of air pores become closed, leaving a mass offering greater resistance to the passage of mould gases. The clay content, comprising colloidal, hydrated aluminium, silicates and iron oxide, exhibits on heating two stages of shrinkage, the first at 100 deg. C. when the hygroscopic water is driven off during drying; the second commencing at 550 deg. C. and ending at about 800 deg. C., when the chemically combined water is evolved and the clay loses its plastic properties permanently. This shrinkage and dehydration is largely controlled by the alumina content of the clay which, if high, causes excessive shrinkage. The clay may also tend to fuse, depending upon the iron content which, when converted to the oxide under the action of heat, tends to slag with the silica grains at the casting temperature.

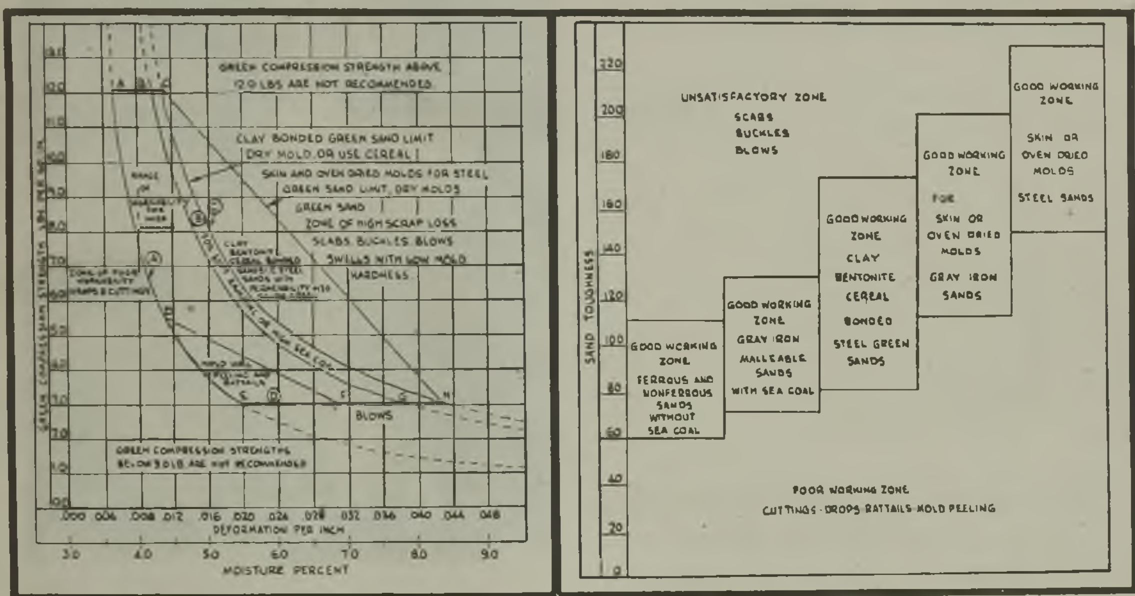

FIG. 4.—SHOWS THE RELATIONSHIP BETWEEN TOUGHNESS OF SAND AND THE CHARACTERISTICS OF THE RESULTING CASTINGS (DIETERT).

Coal Dust

Coal dust, under the action of heat, softens at approximately 350 deg. C. At 450 deg. C. distillation

Moulding Sands and Gases

of the volatile matter occurs, which is accompanied by the evolution of a large volume of gas. This evolution is generally completed at 800 deg. C., leaving coke particles which fill up the voids between the sand grains.

The effect of heat on the principle substances utilised as core-binder, *i.e.*, linseed oil, compounds and cereals, causes a much more rapid disintegration under the initial action of the heat, which greatly contributes towards gas evolution. Some idea of the relative amounts of gas generated from these substances can be obtained from the graph showing the relationship between gas evolution and loss in weight for various types of core bond, printed in the recent report of the Iron and Steel Institute's Moulding Materials Sub-Committee.[1]

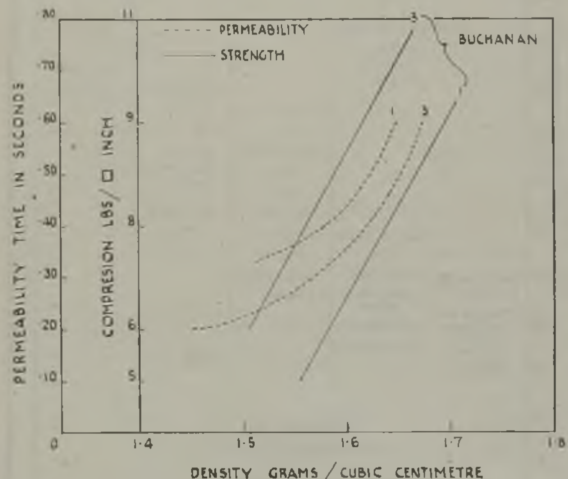

Fig. 5.—Influence of Milling on Compression Strength and Permeability.

Effect of Heat on Sand Mixtures

The effects of heat on the moulding sands as a mixture, particularly with respect to permeability, expansion and strength, are of primary interest. Permeability for any one mixture is generally reduced at high temperatures compared with that obtained at room temperature, mainly because of the rapid rate of gas evolved from the organic materials, the free water present and the expansion of such gases at elevated temperatures; also, in the case of a weakly-bonded tightly-rammed sand, to the partial reduction of air voids through expansion effect of the sand grains. The amount of expansion or contraction which occurs varies according to the nature of the mixture, and is controlled largely by the amounts of ingredients present, such as clay and coal dust.

In some moulding sands, consisting of sand and clay and depending on the amount of the latter present, an initial slight contraction occurs, followed by rapid expansion of the sand grains; this, however, tends to be offset by the final shrinkage of the clay content. Therefore, it is apparent that, if reasonable dimensional stability of the sand mixture is obtained, there is less chance for defective castings to occur. If the mixture is such that the effects of heat on the various

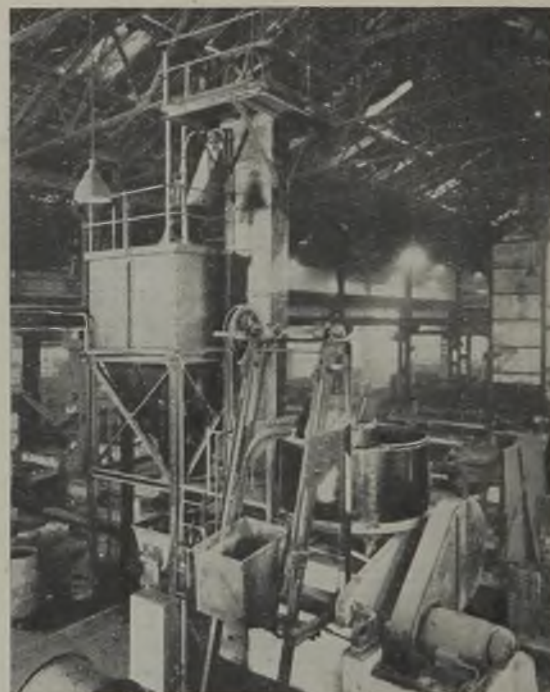

Fig. 6.—Sand Reconditioning Plant.

ingredients do not reasonably balance, distortion or rupture of the mould face will occur. The Sub-Committee on Moulding Materials have recently carried out expansions of various types of sand mixtures made up with Arnold's 52 silica sand and various types of clay bond. The result of their tests is shown in a graph, and their Report[1] states that it is doubtful whether differences of this order would have any significant effect on the behaviour of the sands containing a different clay in actual use in the foundry.

In the opinion of the writer, this statement, based on the effects up to 700 deg. C., cannot be regarded as being of any practical value. The tests should have been continued up to a temperature of at least 1,400 deg. C., and the rate of expansion and contraction determined, because it is the difference between maximum expansion and maximum contraction and the time factor in which these are developed that determine the stability of the mould face.

Influence of Coal Dust

In the presence of coal dust, these expansion defects are minimised, provided it is used in suitable proportion and grit size for the type of work being moulded; for example, a superfine grade for light green sand work and a coarse grade for heavy work. The stage at which the softening of this coal occurs appears to counteract the shrinkage effect of the clay, thus maintaining adhesion of the sand grains whilst at a slightly higher temperature. This softening also tends to cushion and thus decrease the effect of the expansion of the sand grains. At higher temperatures still, the coke formed must shrink, thus making room for the still expanding sand grains.

F. Hudson[2-3] has carried out work on these points, and his results of the effects of coal dust on expansion and strength are shown in Fig. 2. These show that coal dust prevents any large increase in the dry compressive strength which occurs to the straight sand-

Fig. 7.—Showing Automatic Control for Water Additions to System Sand.

clay mixture, whilst the expansion is reduced from 0.152 in. per ft. down to 0.128 in. per ft. As a result of his investigations, he suggests that "the addition of coal dust to dry sand mixtures will impart superior physical properties to the sand at elevated temperature, and this will undoubtedly promote safer casting production. Its action on the expansion is not so pronounced, and, inasmuch as it decreases the permeability in conjunction with increased gas evolution, warrants care being taken in this direction."

Moisture Content

Also shown is the effect of heat on the permeability of green and dry facing sand. The question now arises as to what limits these factors should be controlled. First it is generally agreed that all sands require a definite moisture content ranging from 5 to 6 per cent. for green sand work, and from 8 to 10 per cent. for dry sand work, to give the required strongest condition of the finished mould. It is essential for this moisture to be present if the bond is to develop the required plasticity and become uniformly distributed and evenly coated on each sand grain.

These moisture contents quoted are variable, and depend largely on the grain size of the sand. For example, fine Erith loam requires approximately 12 per cent. The amount also depends on the quantity of coal dust added, which should be as little as can achieve the desired result. The following figures obtained by the Author give some indication of the general effects of the addition of coal dust to moulding sands at elevated temperatures. At 1,200 deg. C. it was found that 10 per cent. by volume, of coal dust, produced 390 mls. of gas from 10 grms. of the mixture, compared

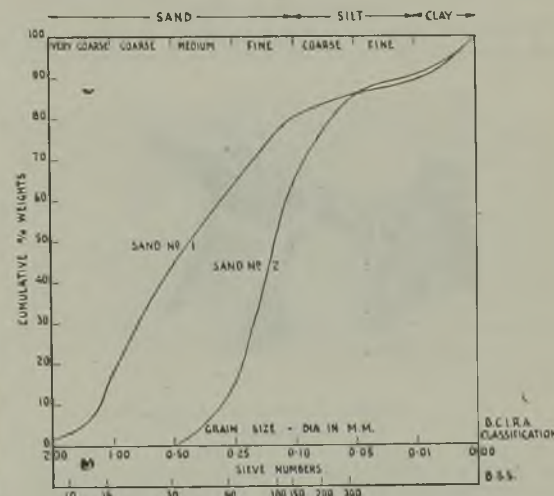

Fig. 8.—Mechanical Analysis of Sands Shown Graphically.

with 65 mls. generated from 10 grms. of the mixture minus coal dust, whilst the effect on the green strength room temperature was found, on an average, to increase slightly, whilst the permeability dropped from 33 secs. to 72 secs.

Fine sawdust, which is sometimes utilised to replace coal dust, has been found to act in a similar manner, although it tends to decrease the green and dry strength. On the other hand, it increases the permeability in both conditions. The decrease in strength can usually be improved by the addition of extra bond without seriously influencing the permeability.

Deterioration at High Temperature

The constant use of sands under high temperature results in the gradual deterioration of their properties.

Moulding Sands and Gases

Every time the sand comes into contact with molten metal a proportion of the clay bond is dehydrated, coal dust is burnt to ash, and some of the sand grains fracture, thus slightly increasing the silt content, which automatically decreases the permeability, although in some cases without producing the same degree of decrease in the strength. From experience it has been found definitely to affect the shock resistance of the sand, *i.e.*, its ability to deform without rupture under momentary shock produced either by gas pressure or impact of the metal stream, thereby increasing the tendency for dirty castings, and whilst this may not prove detrimental on certain classes of work, it is an important point in the production of castings which have to possess a perfect skin.

Machine-tool Castings

Two such types of castings in which it is essential that the skin be perfectly free from surface sand blemishes are machine-tool sleeves and rolls. Fig. 3 shows the mould construction of a machine-tool sleeve, and a similar construction is used for the rolls. It will be noticed that the protruding shoulder will require a sand possessing resistance to impact in order to produce a clean sound casting of this type, which is eventually machined over 100 per cent. of its surface; the presence of any inclusion whatsoever will cause the rejection of a casting, whilst in the mould construction of an ingot mould, the condition of the sand must be such as to prevent any formation of scab or buckle. The interior of this casting is not machined, so that the presence of any such imperfection will also lead to its rejection.

Fig. 9.—Defect Caused by Excessive Gas Generation.

Toughness of Sand

This property, *i.e.*, the ability of the sand to deform under shock, would appear to be similar to that termed by Dietert[4] as "the toughness of the sand," and which he expressed as "the product of the green strength times the deformation of the sand expressed in inches per inch of length plus the deformation at ultimate load times 1,000." Fig. 4 illustrates graphically the relationship between toughness and other characteristics of various types of castings as obtained and recorded by Dietert, who explains it as follows:—"Where the point falls to the left of the line A.D.E. the sand is rotten, dry or brittle, and will cause casting defects, droppings of sand projections, swells, cutting or washing of the mould by the metal. In many cases the mould will break. Should the point fall in the area 'A,' and preferably on a line slightly nearer to 'B-G,' the sand under normal foundry usage will serve satisfactorily and will be responsible for very few defective castings. Some sands, natural and synthetic, have been known to produce mould wall peeling when worked dry and weak. These have properties falling in area 'D.' This condition is aggravated in low refractory sands. Curved line 'B-G' shows the limit to which clay-bonded sand can be worked. By soft ramming or with the addition of coal dust the workable range can be extended to include area 'B.' Beyond these green sand limit lines, skin drying or oven drying is required to stabilise the mould surface." The second part of the diagram shows rectangular areas which indicate the safe working limits for toughness of moulding sands used for various classes of castings.

Fig. 10.—Defect Caused by Poor Permeability and Faulty Artificial Vent in Core.

Thus, whilst according to this diagram quite a wide range exists in the various mould sand conditions before defectives are likely to occur, it is apparent that this property of toughness can be greatly affected by any one variable, such as clay content, grain size and distribution, percentage of silt content and moisture content. It can also be affected by the manner in which the sand is milled. The amount of milling to which the sand should be subjected will depend on such factors as percentage bond and strength desired. Efficient milling will always bring out an improvement in the mechanical strength and permeability, resulting in a decrease in the amount of virgin sand required. Fig. 5 illustrates this point, which is a generally accepted view. These values were obtained by Buchanan[5] during some of his investigations, and he states that "by efficient milling compared with a straight riddle mix the new sand required to give the desired strength can be cut down by 50 per cent."

Milling Conditions

Whatever method or type of plant be used, the milling should be carried out in a damp condition unless the new sand added contains badly distributed clay in the form of hard balls, when it is advisable to dry out first and to mill in this condition, thereby crushing and powdering the clay content so that its distribution becomes more regular on the addition of the moisture and other materials. Before an accurate adjustment of the moisture content can be made, it is necessary that the moisture content of the returned black sand should be checked.

The plant shown in Figs. 6 and 7 comprises a three-part unit, first for screening and cleaning and to remove metal and other foreign matter; secondly, controlled reconditioning with the required amount of moisture for workability (note the automatic control for water additions on Fig. 7); and, thirdly, milling and aeration of the sand to increase its flowability.

Bearing in mind the opening remarks on the effect of grain size and distribution, no attempt should be made to blend different types of sand unless the predominant grain sizes to be mixed are known. These can be readily estimated by a normal sieve test combined with elutriation, then graph as shown in Fig. 8. Core-sand mixing, if made from the same type of sand as the facing mix, requires similar conditions of mixing, but it is preferred that a coarser-sized grain sand be used to increase the permeability. If oil-sand mixtures are used, the following points should be borne in mind:—

Oil Conservation

Sea sand, which is usually of a spherical shape grain, is preferred free from fine grains, dust and sea shell, and for cores of normal strength it is not advisable to add naturally-bonded sand, as this immediately increases the proportion of oil necessary to produce the required dry strength. This increase in oil is due to the increase of surface area of small grains compared with large grains in a bulk of sand of the same volume. For example, 1 cub. cm. of sand, comprising cubes of 0.1 mm.-side, have a total surface area of approximately 93 sq. in., whereas with a cube size of 0.01 mm.-side, the surface area is approximately 930 sq. in. Therefore, any increase in fines content necessitates more oil to produce an evenly dispersed film covering each grain.

The proportion of oil required to give the desired dry strength of the mixture is dependent on the size of a core and the volume of metal required to fill the mould cavity, too much oil developing extra gas.

Typical Defects

Fig. 9 shows an example of the excessive generation of coal gas, the volume being so great that the vent was unable to cope with it, and a pressure was developed inside the mould cavity, forcing the metal back through the runners. Fig. 10 shows a similar defect. In this case less oil was used, but the permeability and artificial vent of the core were at fault,

(*Continued at foot of next column.*)

(*Continued from previous column.*)

whereby the pressure of gas developed retarded the metal flow, with the result that, when the gas did eventually permeate through the sand, the metal was too dull, and solidified in its attempt to fill the mould cavity.

Too little oil causes too rapid a collapse of the core at elevated temperatures, resulting in possible sand inclusions. The suitability of any core composition can be observed by placing in an open mould and observing its reaction with molten metal, or it may be determined by physical tests.

(*To be continued.*)

REFERENCES.

1 "Second Report of the Moulding Materials Sub-Committee of the Steel Castings Research Committee."

2 F. Hudson. "Composition and its effect upon the Properties of Mould and Core Sand Mixture at Elevated Temperatures." *Proceedings, Institute of British Foundrymen*, vol. 29, 1935-36.

3 F. Hudson: "Some Properties of Mould and Core Materials at Elevated Temperatures." *Proceedings, Institute of British Foundrymen*, vol. 29, 1935-36.

4 H. W. Dietert and E. E. Woodliff: "Measure Deformation of Moulding Sand." *The Foundry*, September, 1939.

5 W. Y. Buchanan: "Sand Testing in the Foundry." *Proceedings, Institute of British Foundrymen*, vol. 25, 1931-32.

CONFERENCE ON INSTRUMENTS

The Institution of Chemical Engineers and the Institute of Physics announce a Joint Conference on "Instruments for the Automatic Controlling and Recording of Chemical and Other Processes." Provisional arrangements have been made for the Conference to take place in London on Friday afternoon, September 22, and Saturday morning, September 23. The purpose of the Conference is to promote the interchange of knowledge and experience between those employing automatic controllers and recorders in different fields, and to encourage collaboration between physicists and chemical engineers.

The Conference will be open to all interested without charge, whether members of the organising bodies or not.

Further particulars will be sent, in August, to those sending a request for them to the Organising Secretary, Joint Conference, c/o the Institution of Chemical Engineers, 56, Victoria Street, London, S.W.1.

Brackelsberg furnaces in America, according to a Paper presented by Mr. W. Zennik and Mr. K. Mason to the American Foundrymen's Association are used for melting malleable iron quite extensively. They are lined with silica brick, using standard 6-in. cupola-blocks as a backing. They last when running 16 hrs. a day, making heats about every two hours, between 100 and 200 heats. As fuel low volatile (20.75 per cent.) coal, of which 90 per cent. will pass through a 200 mesh sieve, is used. The fuel consumption is of the order of 350 to 450 lbs. per ton of melt. These figures relate to 5-ton heats.

BOOK REVIEWS

Industrial Publicity. By C. K. Shaw. Published by C. & J. Temple, Limited, 20, Tudor Street, London, E.C.4. Price £5 5s.

This book, though containing, *inter alia*, an account of publicity as applied to war production, does not itself enter into the category "wartime production," for neither money nor space has been spared, so that it merits the appellation of "lavish." There is no contents list, a feature which any reviewer misses, because it normally discloses the tidiness of the author's mind in the presentation of his subject. There is, however, an index which is not too good a substitute. The Author, who writes pungently, deals with the methods which have been used so successfully to direct the thoughts of the workers into channels useful for the prosecution of the war. Naturally such subjects as absenteeism, increased production, safety-first measures, scrap reduction, are fully covered. Then much space is devoted to the creation and maintenance of morale by concerts, talks and the like.

In all cases, extensive use is made of illustration by the reproduction of posters from the service ministries and large industrial concerns. The reviewer looks forward to the time when the level of intelligence amongst workers all over the world will be so high that the slogans will be regarded as being as old-fashioned as crinolines and equally suspect as masking the true shape of things. The production, printing and illustration of this book are delightful, but whether it can be considered as text book or subtle propaganda for industrial publicists is a question the reviewer has not quite solved.

Towards the end the Author makes a plea for the creation of a Ministry of Industrial Development. This appears to be merely a modern adaptation of the Department of Overseas Trade. It would suffer from the same defect, that is, having done its work in finding out where business is to be had, it announces the fact to the whole world and thereby increases overseas competition. The reviewer prefers a method based on trade organisations, backed by Government help, collecting business data for the use of its own members. If the cost of the book was lower, its value to industry would be proportionately greater, but this could not be done without limiting its extensive illustration, typography and general "get-up."

V. C. F.

Engineering Materials Annual, 1944. Edited by H. H. Jackson. Published by Paul Elek (Publishers), Limited, Africa House, Kingsway, London, W.C.2. Price 8s. 6d.

This book purports to give a concise but complete review of all important development work carried out during the past year. It may be useful to some technicians, but so far as iron and steel foundry practice is concerned, it merely covers the same ground, but not in such detail, as the Iron and Steel Institute's Abstracts. This also applies to ceramics and refractories, where a similar service is given by the Ceramic Society. However, in its 105 pages, there are sections devoted to plastics, precious metals, lubricating oils, fuels, plywood and adhesives, which may or may not be similarly catered for. At the end of each section there is a list of recent books, but it does not include Modern Foundry Practice, published by Odhams. It is not a book which the reviewer can unreservedly recommend to foundrymen.

V. C. F.

The Application of Radiant Heat to Metal Finishing. By J. H. Nelson, Ph.D., and H. Silman, B.Sc. Published by Chapman & Hall, Limited, 11, Henrietta Street, London, W.C.2; price 8s. 6d. net.

This book carries a sub-title, "A Critical Survey of Infra-Red Process for the Stoving of Paints and Enamels." Thus the field covered excludes foundry mould drying, of which no mention is made. It does, however, give all the necessary data to enable vitreous enamellers to work out whether or not they would find it advantageous to adopt the system for drying sprayed ware prior to stoving. The reviewer feels reasonably sure that the system will find application in this field.

Chapter VI of this book gives much useful information on paint formulation, and directs the thoughts of foundrymen into the case of core drying, especially as tung oils are specifically considered. In this field drying times have been reduced to a fifth or less. The baking temperatures cited are of the order of 120 to 175 deg. C., which seems, in the light of existing knowledge, to be on the low side for oil sand core work, but should suffice for removing water in the case of vitreous enamelling and in skin drying moulds, especially where very close contact can be made. The book is recommended to those whose job it is to design low temperature heating plants for the foundry and ancillary industries. V. C. F.

PORCELAIN-ENAMELLED TANKS STANDARDISED

A United States commercial standard for porcelain-enamelled tanks for domestic use has been adopted, effective for new production from July 1, 1944. The standard was circulated to American manufacturers on May 3, 1943, as a recommended standard, and sufficient numbers of manufacturers, distributors, and users to represent a satisfactory majority accepted the recommendations to establish them as Commercial Standard CS115-44 with the U.S. Department of Commerce, National Bureau of Standards.

The standard covers porcelain-enamelled tanks for domestic use in sizes from 15 to 80 gall., inclusive, for 300 lbs. per sq. in. maximum hydrostatic test pressure. It sets general requirements on the base metal, enamelling, operating conditions, types, sizes, and test pressures, as well as many other physical features of the products and methods of testing, labelling, and construction.

WASTE PAPER FOR MORE MUNITIONS

SOME PRINCIPLES OF MELTING MALLEABLE IRON*

By DR. H. A. SCHWARTZ

This Paper discusses, on a semi-popular basis, the principles which limit the temperature obtainable in a furnace

Unlike the processes of steel melting, those of the malleable industry are intended generally to produce as little chemical change as possible. An exception may exist in the second stage of duplexing. We are thus confronted mainly with problems of the generation and transfer of heat and only secondarily with the unavoidable chemical reactions.

Heat Losses in Furnaces

If heat units be liberated inside a closed container, the temperature within rises until the heat is dissipated through the enclosing walls as fast as it is furnished to the interior. The rate of heat loss (per unit area) through a furnace wall is inversely proportional to its thickness and directly proportional to the temperature difference between the inner and outer faces. The inner face will thus strive to rise in temperature until a given wall dissipates heat as fast as heat is furnished per unit area. If, to do so, the inner face gets hotter than the refractories can stand, the wall will grow thinner until a balance is obtained. In all these cases, exemplified by an electric arc furnace, the limit of temperature is determined by the refractoriness of the brick, and the limiting rate of energy input is that which walls of given material and thickness can dissipate. Any attempt to raise the temperature by thickening the wall or raising the rate of energy input results merely in destruction of the refractory.

In fuel-fired furnaces, the "caloric effect" of the fuel sets another limit to maximum temperatures which may be lower or higher than that just discussed. When unit weight of a given fuel is burned with sufficient oxygen, a definite amount of heat is liberated. This heat is imparted to the products of combustion and raises their temperature by an amount calculated by dividing the number of heat units liberated by the product of the mass and mean specific heat of the products. The flame temperature can thus be raised by heating the fuel and air in advance and by minimising the weight of the products of combustion by avoiding needless excess of air. Since air is about four-fifths nitrogen, which contributes nothing to combustion and must be heated, obviously, burning fuel in pure oxygen produces higher temperatures than burning it in air, hence, the use of oxygen in the welder's torch.

Combustion Reactions

Since carbon and hydrogen are the source of heat when burning most fuels, one is prone to say that the oxygen supplied should be exactly that to form CO_2 and H_2O from these combustible elements. This is not strictly correct, for flame temperatures have still another limitation which prevents raising them indefinitely by heating the fuel and air. The reactions

$$C + O_2 = CO_2$$

and

$$2\,H_2 + O_2 = 2\,H_2O$$

do not proceed completely to the right in the presence of sufficient oxygen. Water dissociates at high temperature into its elements, and CO_2 into CO and O_2. The expression

$$\frac{P^2_{H_2O}}{P^2_{H_2}\,P_{O_2}}$$

where P with a subscript indicates the partial pressure of H_2O, H_2, or O_2 in the flame, has a constant value for every temperature which decreases as the temperature rises. It is not of interest here to discuss the numerical value of this constant as a function of temperature which is well known. If then

$$\frac{P^2_{H_2O}}{P^2_{H_2}\,P_{O_2}} = k \text{ or } \frac{P^2_{H_2O}}{P^2_{H_2}} = P_{O_2}\,k \qquad (1)$$

it is plain that if it is necessary to have a large proportion of the hydrogen burned the partial pressure of oxygen must be increased either by an increase in pressure or in the oxygen content of the gas. Since every increment of oxygen adds a little to the completion of the reaction and, hence, to the amount of heat evolved, but adds also to the mass of flue gas and, hence, to its heat capacity, there is obviously an optimum excess of oxygen for maximum temperature.

Similar statements can be made for the expression

$$\frac{P^2_{CO_2}}{P^2_{CO}\,P_{O_2}} \qquad (2)$$

Most fuels contain both hydrogen and carbon and burn to mixtures of CO, CO_2, H_2 and H_2O in which

$$\frac{P_{CO}\,P_{H_2O}}{P_{CO_2}\,P_{H_2}} \qquad (3)$$

is a known constant varying with the temperature.

The adjustment of a furnace gas to this equilibrium is quite perfect and this reaction constant, and the carbon-hydrogen ratio of the fuel is a better guide to the moisture and hydrogen content of a flue gas than most gas analyses.

* A Paper presented to the American Foundrymen's Association. The author is Manager of Research, National Malleable & Steel Casting Co,. and an E. J. Fox medallist.

Melting Malleable Iron

Combustion in Various Types of Furnaces

A German investigator has said that combustion takes place as rapidly as fuel and air can mix. In the case of oil or pulverised coal, mixing takes place only as rapidly as the liquid or solid can volatilise from the surface of the particle, or, for fixed carbon, gasify chemically to CO. Combustion rates then depend upon the fineness of dispersion of the fuel.

In the old-fashioned hand-fired air furnace, burning lump coal, the function of the fire box was only to act as a crude gas producer, producing coal gas by distillation and CO by the reaction of insufficient oxygen with fixed carbon. The mixture of combustible gases was then burned to equilibrium by air from the top blast.

The cupola always contains an excess of coke. Right at the tuyeres, before the air blast has penetrated far, there is temporarily so large an excess of oxygen that the product is nearly all CO_2. As the hot gases move farther in and farther up, this excess of O_2 disappears and the equilibrium constant (2) requires the simultaneous presence of significant amounts of all three gases in relative amounts determined by temperature. As the gases move on still further, the excess of oxygen disappears further and the reaction

$$C + CO_2 = 2CO$$

sets in where equilibrium constant is

$$\frac{P^2_{CO}}{P_{CO_2}}$$

As the temperature falls, the numerical value of this constant shifts toward lower CO and higher CO_2 values, but the gases are so cold that this reaction does not take place rapidly. Cupola gas, however, will burn with additional oxygen and the heat equivalent to the oxidation of its CO to CO_2 can be thus recovered and imparted, partially, to the blast.

In the case of the electric furnace the source of heat is merely the thermal equivalent of the electrical input I^2R when I is the current (amperes) and R the resistance (ohms) of the electric arc and the metal and/or slag layers through which the current passes in the furnace.

Transfer of Heat to Metal

Having generated heat, it must be imparted to the metal. The induction furnace where the heat is generated in the metal is of little practical interest to the malleable founders. The transfer to and through the liquid iron is by radiation, convection or conduction. Radiation, the transfer of heat without contact and without the transfer of any material substance, is important in electric and reverberatory (air) furnaces. The energy leaving a body by radiation is proportional to the fourth power of its temperature and to a constant called emissivity which is specific to each substance. The heat transferred by radiation from the bottom of an electrode or an incandescent furnace roof to a layer of molten metal is thus proportional to the difference between the fourth powers of the two temperatures, corrected for the respective emissivities. Obviously the cold body gains heat and the hot one loses. The emissivity of most hot gases is poor and, hence, flames must be made "luminous" by carrying glowing particles of solid matter, usually coke, if they are to heat metal by radiation. Evidently, if the heat generated by burning fuel is to be transferred to a bath, the fuel, air and products of combustion must stay in the furnace at least until the reaction is complete (probably somewhat longer) and, hence, there is a relation between hearth volume and rate of combustion of fuel.

The transfer of heat within a mass of burning gas is primarily by convection, *i.e.*, by the formation of currents of hot and cold gas tending to equalise the temperature. This is also an important method of distributing heat in a reverberatory furnace bath for the diffusivity of liquid iron, the property by virtue of which the temperature is raised, due to the transfer of energy from one vibrating atom to another, is not very great. This makes it very desirable to have the flame of an air furnace "rub" the surface of the metal, driving it backward with an equivalent forward flow of metal along the bottom promoting a circulation. Those who have had a bung fall into a bath stopping this circulation will appreciate the practical aspects of this matter. In the cupola, there is some heating by radiation in the melting zone, but, very largely, the solid iron is heated by conduction from contact with hot gas and the liquid iron by this and by contact with glowing coke.

At present, all malleable iron is believed to be melted in acid furnaces. Thus the industry is not concerned with the desulphurising reactions. Unless the CO content of a flue gas be very high (above about 50 per cent. CO and 50 per cent CO_2), oxygen or carbon dioxide will convert metallic iron to Fe_3O_4 up to a temperature of about 700 deg. C. At higher temperatures, either FeO or Fe_3O_4 will be found, depending on the CO content. The equilibria are well understood.

Slag Effects

While melting down a cold air furnace charge, a considerable amount of liquid oxides is formed by this method which reacts with the silica of the furnace to form a liquid silicate slag. This slag loses oxygen to any liquid with which it comes into contact, forming impure ferrous silicate and oxidising carbon to CO, silicon to SiO_2 and Mn to MnO, the two latter entering the slag. The slag keeps itself saturated with SiO_2 from the furnace structure, resulting in a roughly constant concentration of something like 50 per cent. In this slag, the MnO and FeO are present in chemical combination with SiO_2, and the activity of their oxygen is negligible. Under such slags, white cast iron does not lose much more carbon and silicon.

Such loss as there is, is mainly due to the oxidation of some FeO to Fe_2O_3 at the upper slag surface, its diffusion downward through the slag or its transfer by convection and the reduction of this Fe_2O_3 to FeO at the slag-iron interface or surface of contact by C, Si or Mn in the slag.

The Mn content of the slag is determined almost completely by the Mn content of the metal, for the expression

$$\frac{(MnO)}{(FeO)\ [Mn]} \qquad (5)$$

in which the quantities in square brackets are mol fractions in the metal and those in parenthesis mol fractions in the slag, is constant for equilibrium conditions. It is, therefore, unavoidable that the manganese loss when making high manganese alloys is greater than when making low Mn alloys.

At high temperatures the reaction

$$2\ C + SiO_2 = 2\ CO + Si$$

can proceed in either the slag by reaction with coke particles or in the iron by reaction of refractories or minute traces of dissolved SiO_2 with the dissolved carbon of the iron. Since the partial pressure of CO bubbles is of necessity nearly constant at just over atmospheric pressure and the SiO_2 is constant by saturation toward silica, the relation

$$\frac{[Si]}{[C]^2} \qquad (6)$$

in the iron should tend to approach a constant value. In the author's experience, however, this equilibrium contributes little or nothing to the malleable melting reactions though it is of importance in acid electric steel practice.

Oxidation

In air furnace duplexing the formation of iron oxides during melting down occurs in the cupola, and the accumulation of slag in the reverberatory furnace is relatively little. Oxidation thereafter, as in batch type air furnace melting, occurs by direct contact of flame and metal on a relatively clean surface. The flame will attempt to adjust itself to a CO_2-CO-O_2 equilibrium with the carbon content of the liquid metal. If made too oxidising for this equilibrium, it will try to seize carbon; if too reducing, to deposit carbon. The apparent equilibrium composition for ordinary carbon contents and melting temperature represents about 1.1 per cent. O_2, 12.7 per cent. CO_2 and 3.6 per cent. CO, the remainder H_2O and N_2. The presence of CO is an expression of the dissociation of CO_2 at high temperature, plus the equilibrium with the carbon of the iron.

It is quite possible that the oxidation of C in the metal involves first the formation of FeO in the bath and then its reduction by C. At room temperature oxygen is diatomic, but it dissociates at high temperatures partially into molecules of one atom. To dissolve in iron and form FeO or SO, only atomic oxygen is to be considered so that the FeO content should and does rise as the temperature goes up, except to the extent that the increased reaction rate with carbon brings it down again. Reaction rates in solution are generally related to temperature by the expression of the form

$$k = e^{-\frac{\triangle H}{RT}}$$

where k is a numerical constant measuring the rate, e is the base of the natural logarithm table, $\triangle H$ is the heat evolved by the reaction, R the gas constant, and T the absolute temperature.

In the final analysis, a reaction between gas and bath involves something occurring at their surface of contact. The quantitative result is therefore dependent on the area and time of contact per amount of reacting substances. Decarburisation and similar reactions are thus largely dependent on the bath depth and the time the metal is in the furnace after melting and skimming.

There is also to consider that most charges are rusty, most fuels contain hydrogen and most blast air is moist. All this introduces hydrogen or water into the furnace. Hydrogen dissolves in iron as single atoms so that the equilibrium concentration depends on the total hydrogen in the flame, the degree of its dissociation into water and its components and the degree of dissociation of the orthodox diatomic hydrogen into atomic hydrogen, the two latter being determined by temperature. In steel making hydrogen can be removed by oxidation. In malleable melting, not so, for the equilibrium (3) is such that in the presence of white cast iron carbons, not enough oxygen can exist in the metal to remove the small amounts of hydrogen present.

The reaction of H_2O vapour with carbon can result in the removal of considerable amounts of the latter element as observed by Bean. The writer once thought that the reaction might be

$$2\ H_2O + 3\ C = CH_4 + 2\ CO$$

both components of water removing carbon. The dissociation constant of CH_4 at melting temperatures is, however, such that only traces of that compound should be present in contact with the elements. The removal of carbon, however, is a demonstrated fact.

It has been suggested by Vacher, Darken and others that, in molten iron, carbon may exist partly as the element and partly as the carbide. Presumably some reaction such as

$$Fe_3C = 3\ Fe + C$$

tends to approach an equilibrium. This equilibrium is probably too far to the left for best annealing and a shift toward the right from completeness may be brought about by the introduction of graphite material, perhaps late in the melting process.

The equilibrium conditions for many reactions have been briefly touched upon and others could have been included. It would not be difficult for the physical chemist to prove that the system is "over determined," that is, that there is no combination of compositions which would fulfill all the conditions. This is not unusual in practical problems. Actually there is not time to attain equilibrium for all reactions and only the conditions for the faster reactions are approached. The flame composition is the result of exceedingly rapid reactions, and will usually approach equilibrium. The reactions between two layers (or phases) of gas, slag, metal, are usually the slowest and the reactions within a single liquid somewhat faster. It is quite impossible to generalise, and this is the reason why the chemistry of melting can not be told in a short and simple statement.

EDUCATION OF THE FOUNDRY APPRENTICE*

By A. J. DAVIDSON (Assoc. Member)

The author, having carefully read the Institute's report on "The Education and the Workshop Training of Young Foundrymen," considers that it falls far short of expectation. It is based on the fact that facilities are available in some large cities and towns, at local technical schools in co-operation with large foundries, who can, between them, be a successful partnership in fostering and training boys as foundrymen. But what of the apprentices in places where there are no facilities? Large towns do not always help by classes for a special industry and, therefore, the recommendations put forward in the Institute's report mean only a partial solution of the problem. Roughly, only 10 per cent. of the boys who enter a foundry stay. This is due to lack of direction and finding no response from older craftsmen, who continually advise the boys that the industry is a snare and a delusion. Thus, early unsettled, they are able to see only the grime and the dirt of the foundry, which cannot offer the romanticism of the machine and engineering shops. Too often they are treated as youthful labourers, as helpers round the fires, can-lads, etc. This is wrong. As future craftsmen they should be given, by easy stages, definite responsibilities under the guidance of skilled tradesmen. Having learned the rudiments of the craft instruction in technical details should follow, and this should be the responsibility of the employers and the trade unions. The suggestion of trade unions is made because the Institute has branches in only a few towns, and therefore its sphere of influence in apprentice education is limited. For this reason it is only by co-operation between the Institute, employers' federations and trade unions that a scheme can be successful nationally.

If lists of technical awards to foundry trained youths in recent years are examined, the local influence of Manchester, Sheffield, etc., will be found to be predominant. Thus apprentices in other towns are handicapped without this guidance and kindly interest of men who can give advice, tuition, and, above all, confidence to these craftsmen of the future. The author lives in a city where foundries are small and numerous, and apprentices are without any technical advice. Yet despite this, a number of them become excellent tradesmen, but totally unfitted to control modern foundries. Had they been given the chance of education in their apprenticeship days they would certainly have made their presence felt.

Propaganda and Progressive Education

Until foundrymen give to their own industry and to themselves the dignity which less important sections of the engineering trades take unto themselves they cannot hope for success in attracting the type of boy required. It is only by propaganda and a wide policy of progressive education, with a definite promise that a good foundryman will be a key man and rank for recompense with the best in the heavy industries that boys will wish to make founding their career. Knowing, too, that research and experiment have been speeded up by the war it is all the more necessary that the modern foundryman should be equipped to meet the challenge which is expected from the manufacturers of plastics, etc. The very backbone of the founding industry is the practical handicraft moulder, the man who alone can do those jobs on which the machine or repetition shops cannot make a profit. Yet this type of workman, who, all experts agree, must be an essential feature of the foundry of the future, receives scant consideration in the report. He is to receive proper training for this position, but yet finds little place as regards advancement in status, the higher places being set aside for efficiency experts. "Bedaux" enthusiasts and white-coated pseudo-metallurgists, who want to fill a place in an odd side which the practical moulder reserves for his "gate."

The author, being a working foreman in a ship repair shop, knows the necessity for first-class moulders, and regrets the fact that those young craftsmen who are products of repetition shops have to start all over again when faced with average jobbing work.

Apprenticeship System

In conclusion, the following observations and suggestions are made:—

The Institute's Education Report is based upon the continuance of the apprenticeship system. This, it is suggested, is fallacious, for it may be assumed that by the raising of the school-leaving age and the introduction of vocational training, youths at eighteen years of age will be enabled quickly to learn the trade which hitherto has taken five to seven years to master. This type of youth expects and will demand a high standard of reward, which will call for an all round stepping up of the dignity of the craft of moulding.

The Institute should leave the technical education of boys to the local educational authority until sixteen years of age, making its presence felt by intelligent interest in municipal affairs. It could give aid by scholarships to the British Foundry School and by setting out a uniform system of indenture of apprenticeship with a list of approved firms which will accept apprentices. Members should pledge themselves to carry out this recommended system of education in the foundry.

The question of places with only a few foundries, remote from the influence of the Institute is difficult, but it is suggested that its solution is the job of propaganda by the spoken word. Could there be a better one than the members of the Institute, who travel from town to town regularly on business? They are usually gifted in making contacts and making the most of them. How easy for them to propagate the Institute's cultural aims and ideas for the future general education of these almost forgotten boys.

Pig-iron has been decontrolled in Canada, and the foundries can now place orders with producers of their own choice.

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* A prize-winning entry for a Short Paper Competition organised by the Lancashire Branch of the Institute of British Foundrymen.

A COMPARISON OF ACID AND BASIC ELECTRIC PRACTICE*

By FLOYD F. DORE

At Verona only electric melting furnaces are operated. About a year ago the second electric furnace was started, and the last remaining open-hearth furnace was dismantled. Until starting the second electric furnace, the acid practice had been used in both the electric and open-hearth furnaces, but about this time satisfactory grades of scrap for acid melting were difficult to obtain, and conditions indicated that it would become more difficult to obtain; therefore, it was decided that the new electric furnace would be lined so that basic practice could be followed.

A rammed bottom and a full 13½-in. magnesite brick lining were put in, which were later changed to a 9-in. lining, which has since been continued. The roof is of 9-in. silica brick. The rammed bottom has been perfectly satisfactory, and there have been about 3,000 heats from it with no trouble. While its cost is higher than that of a sand bottom, its longer life will make the cost comparable. The sand bottom is taken out after 1,000 to 1,200 heats. It is believed that this basic bottom will last for 5,000 heats. The magnesite brick lining, while considerably more expensive than a silica brick lining, lasts for a period of eight weeks, thus giving a cost quite comparable to that of the acid furnace when figured on a basis of tons produced per dollar of cost.

The tapping holes of both furnaces are rammed and are closed after each heat, just as with an open-hearth furnace. This method of handling the tapping hole permits tilting the furnace back after the heat is melted, if for any reason it is necessary to do so, and it frequently is necessary when the carbon boil starts.

In both practices the furnaces are charged with a chute so that it is necessary to buy scrap in such shapes and sizes as will slide out of a chute. The maximum size used in this foundry in most grades is 12 in. in length or width; but in the case of rail scrap, 18-in. lengths can be handled.

The charges are so arranged that the acid furnace gets the choice of own scrap, its charges consisting of about 70 per cent. of this scrap, the largest portion of which comes from the basic furnace, thus providing the acid furnace with low phosphorus, low sulphur scrap at a low price.

A Rapid Schedule

The acid furnace has a rated capacity of 3-ton charges, but 4 tons are regularly charged which melt in one hour or less. The basic furnace has a rated capacity of 10 tons; 9 tons are regularly charged, which this furnace will melt in 50 minutes to an hour. These two furnaces are usually scheduled so that they will each make heats on a 2-hr. 40-min. cycle, thus making nine heats during each 24-hr. period. Running either furnace alone, 10 and 11 heats per 24-hr. period have been made. The acid furnace operating alone has produced 572 tons of good castings in a month when the yield was 50 per cent. Tonnages varying from 250 to 1,500 or more per month can be produced economically, thus providing marked flexibility.

Charges in both furnaces are melted down rapidly, using full power; when the charges are about all melted, iron ore is added and the bath is kept boiling through to the block, and the carbon is oxidised to 0.15 to 0.17 per cent.

As most of the acid heats are tapped very hot for shank pouring, it is necessary to carry a rather oxidising slag well up to the point of blocking; otherwise, the reduction of silicon from the slag becomes excessive. All of the 50 per cent. ferro-silicon and half of the ferro-manganese are added to the furnace, the ferro-manganese first and the other 5 min. later. The balance of the ferro-manganese is added in the ladle alone with 2 lbs. per ton of aluminium. These heats are tapped at 1,740 to 1,750 deg. C. A normal slag analysis: FeO 15 to 17 per cent., SiO_2 60 per cent., MnO 15 per cent.

Single Slag Process Used

The basic practice is a single-slag one, which promotes such good time with these heats. If it were necessary to use a two-slag practice, the time of heats would be extended from 30 to 60 min. over that of the present method. However, under present conditions there are no requirements for steel with phosphorus and sulphur under 0.03 per cent., and this is being met satisfactorily with the single slag. If it is necessary to meet specific low phosphorus and sulphur analysis, the foundry is able to do it.

With the basic practice the heats are melted down rapidly under full power, and iron ore is added just before they are completely melted. During the oxidising period, mill scale is added to the slag, to keep its iron oxide content up to about 10 per cent.; otherwise, the reversion of manganese from the slag to metal becomes excessive when it is blocked with 15 per cent. ferro-silicon.

This block is added after the final preliminary steel test is taken, and will hold the bath blocked long enough to obtain the carbon-manganese analysis. All of the ferro-manganese is added in the furnace; the 50 per cent. ferro-silicon and 2 lbs. per ton of aluminium, to the ladle. An analysis of final slag is about as follows: CaO 48.6 per cent., FeO 9 per cent., MnO 9 per cent., SiO_2 20.0 per cent.

Costs Favour Basic Practice

It was not necessary to make any changes in the ladle practice to handle the basic heats other than to use certain specific ladles; nor was it necessary to make changes in the moulding practice as to heading or gating, etc. In fact, those handling the heats pay no attention as to whether it is acid or basic steel. One can be hand-shanked as satisfactorily as the other, so that there is little or no difference in fluidity

(*Continued overleaf, col.* 2.)

* From Steel "Foundry Facts"; the author is on the staff of American Steel Foundries, Verona, Penna.

AUSTRALIAN BLOOMING MILL HOUSINGS

MADE AT NEWCASTLE AND PORT KEMBLA

Australian rolling mill housings are the joint product of the Broken Hill Pty. Company's Newcastle steelworks and the A.I. & S., Limited, Kembla works, recently illustrated in the "B.H.P. Review."

A blooming mill assembly comprised two cast-steel housings, each weighing 45 tons, complete with cast-steel spreaders, seated on a cast-iron bedplate which weighs 30 tons. The housing patterns and castings were made at the Newcastle steelworks, and in view of the large amount of metal required, the following details of the moulding and casting of these units should be of interest.

The jobs were cast in a horizontal position, as the limited size of the steelfoundry's pits did not permit of the customary on-end casting. This occasioned careful consideration being given to the moulding practice employed and to the positioning of heads and risers.

The pattern was bedded in the foundry floor, the sides of the mould being reinforced with pig-iron and steel plates to ensure that the finished mould would withstand the ferro-static pressure when being cast. As a single cope would have been too cumbersome to handle, it was made up in four sections. New local rock sand was used throughout for the facing sand, and reconditioned return sand for the backing. The mould was dressed with silica paint, after which the drag was dried with gas jets and the cope by stoving. All cores were made up with rock sand, and after a surface washing with silica paint were stove dried. On closing the mould, 90 tons of weights were placed on the cope to prevent lifting whilst casting.

To facilitate filling the mould two 6-in. down-gates fitted with spray-runners were used, these being provided because two ladles were used simultaneously for teeming.

The steelfoundry's furnaces are each of 40 tons capacity, and it was necessary to use both furnaces to obtain sufficient metal for the cast, *i.e.*, approximately 80 tons of 0.35/0.40 per cent. carbon quality finished steel. The furnaces were tapped into two 40-ton capacity bottom-pour ladles fitted with 3½ in. nozzles, and the casting of a housing took 3½ min., the mould being filled to the bottom of the feeding heads. Upon the hot metal reaching this position, the heads were immediately filled by pouring metal direct into the largest heads, thus ensuring that there was plenty of hot metal to give correct feeding. After filling, the heads were insulated with anti-piping compound and were left in this condition without further attention until solidification had taken place.

The cast weight of each housing was 73 tons, the finished casting weighing 45.6 tons. Each housing was left in the sand for ten days, then stripped, heads and runners being removed whilst the job was still hot. The castings were then placed into the 90-ton capacity side-fired annealing furnace, where they were raised

(*Continued at foot of next column.*)

PERSONAL

Mr. Andrew W. Crowe has been appointed managing director of the Coltness Iron Company, Limited.

Dr. Andrew McCance, F.R.S., has been appointed deputy chairman and joint managing director of Colvilles, Limited. He has been a member of the board since 1930.

Mr. W. L. Govier has been elected president and Mr. L. C. Batchelor, Mr. N. F. Fletcher, Dr. T. Wright, and Dr. J. W. Jenkin vice-presidents of the Birmingham Metallurgical Society.

Mr. M. Burningham has been elected deputy chairman of Keith Blackman, Limited, engineers. Mr. Burningham joined the firm in 1896, became secretary in 1925, and was elected to the board in 1929.

Sir Walter Jenkins, on medical advice, is relinquishing at the end of June the Independent Chairmanship of the National Federation of Iron and Steel Merchants, which he has held since the formation of the Federation in 1938.

Will

Walton, T., of Burnley, formerly director of the Universal Boilers & Engineering Company, Limited £33,875

A COMPARISON OF ACID AND BASIC ELECTRIC PRACTICE

(*Continued from previous page.*)

in the two steels at the same temperature. From a quality standpoint, they are the same when the tensile, bend or impact test is used as a measuring stick.

Averaging the physical properties of heats of a given composition, little difference has been found between acid and basic steel. The power figures show that about 525 kw.-hr. per ton is used for acid steel and 475 kw.-hr. for the basic steel. Electrode consumption runs about 9 lbs. for the acid and 8 lbs. for the basic. The total costs show that the basic steel will run less per ton than will the acid steel.

(*Continued from previous column.*)

to a temperature of 900 deg. C. in 24 hrs., held for a similar period, and then allowed to cool slowly in the furnace. The machining and assembly of the housings were done at the Kembla Works, the bedplate being cast in the Kembla Works foundry.

Owing to the great weight of the blooming mill components, the machining operations were planned to involve a minimum number of crane lifts. The merit of this planning will be recognised when it is explained that for the movement of each housing to the various machines, it was necessary to use both the machine shop crane (20 tons capacity) and the foundry's 40-ton overhead crane.

Further, to simplify the lifting problem, three machines were so set up in the machine shop as to do the necessary machining operations at the one time.

NEWS IN BRIEF

LUTON AND BEDFORD business executives recently attended a private showing of a film, "The Old Iron Way," at Luton, sponsored by the Bedford branch of Cox & Danks, Limited. The firm has possession of a copy of this film, and will be pleased to have news as to how it might be shown to other business executives.

A NEW COMPANY has been formed by High Duty Alloys, Limited, Reynolds Tube Company, Limited, and Reynolds Rolling Mills, Limited, to collaborate with designers and constructors in any industry to secure the best use of Hiduminium alloys. Information will be sent on request to Hiduminium Applications, Limited, Farnham Road, Slough, Bucks.

REPLYING TO A question in the House of Commons, Mr. Foot (Parliamentary Secretary, Ministry of Economic Warfare) told Mr. A. Edwards that German stocks of wolfram and chrome ore were believed to be small. There was evidence that the shortage of wolfram was particularly acute. Stocks of tin were thought to be relatively rather larger. The Germans had, of course, supplies of these metals in the form of scrap.

THE SAVINGS GROUP associated with the works of Hunt Bros. (Oldbury), Limited, Griffin Foundry, Oldbury, near Birmingham, has a fine record. Even in the earliest days of the savings campaign the Griffin group could be relied upon to raise its minimum of £20 per member during the special savings weeks; in fact, during Warships Week the group raised £30 per head, and the Borough of Oldbury adopted a namesake in H.M. Destroyer "Griffin." In the recent "Salute the Soldier" week the Griffin group again realised their minimum of £20.

THE NATIONAL ARBITRATION TRIBUNAL, which heard the application of the unions in the engineering industry for an increase of 10s. a week on the base rates for both time and piece workers, has awarded an increase in the national bonus of 4s. a week to adult male workers and proportionate increases to non-adult males. Since June, 1939, the total advances to engineering time-workers are by this award brought up to 25s. 6d. a week and those to payment-by-result workers to 19s. 6d. a week. In addition, the minimum piece-work balance has been increased from 25 per cent. over the pre-war basic time-rate to 27½ per cent. over the new basic time-rate, which is 20s. higher.

FOR SOME TIME High Duty Alloys, Limited, have felt that the public would be interested in seeing some of the light alloy castings which play such a large part in modern operational aircraft. To this end a display has been arranged by the showrooms of the Bristol Aeroplane Company, Limited, 69, Piccadilly, W.1. Among the exhibits are the Bristol Hercules cylinder barrel and centre crankcase, Lancaster tail wheel fork and the Halifax undercarriage leg, which, incidentally, is the largest magnesium casting made in the world—its weight being 265 lb. This last casting has been the subject of a Paper by Mr. Ian Ross, which was reproduced in our columns.

IRONFOUNDRY FUEL NEWS—V

The last article in this series dealt with the air compressor, as a large consumer of electricity in the foundry. The following notes indicate other directions in which electricity may be saved.

Clean electric lamps and reflectors regularly. Dirty reflectors can absorb 50 per cent. of the light from the lamps. Foundry walls should be light in colour and kept clean. (A foundry in the East Midlands found that much less electric light was needed when the foundry walls were whitewashed.) Keep idle running of motors down to a minimum. The fitting of spring return foot switches can save a lot of electricity in some applications.

Replace lightly loaded motors by ones of lower power (a general "promotion" of a series of motors of the same speed can sometimes be carried out), or, alternatively, lightly loaded A.C. motors can be run on "star" (the normal starting connection) instead of "delta." One ironfoundry in Yorkshire has replaced its cupola fan with a smaller one, with a saving of 16 h.p. Another, in East Anglia, has cut out a 14 h.p. motor altogether by combining the exhaust from the sand-blasting plant with that from the grinding wheels. The easiest and most important step is, however, *to read your meters at least every week.*

Further information on saving electricity is given in Fuel Efficiency Bulletin No. 13, obtainable from the Regional Offices of the Ministry of Fuel and Power, or from the Fuel Officer, Ironfounding Industry Fuel Committee, Alvechurch, Birmingham.

PIG-IRON MERCHANTS' ASSOCIATION

The annual meeting of members of the Pig-iron Merchants' Association has been held in Birmingham, and the following officers were elected:—Chairman, Mr. Arnold Carr (Thos. W. Ward, Limited); vice-chairman, Mr. H. Basil Darby (Darby & Company); treasurer, Mr. Claude A. Parson (Parson, Limited); secretary, Mr. A. Dudley Evans. Committee:—Messrs. A. E. Bond (J. C. Abbott & Company, Limited); C. Fanshawe (Dudley Coal, Coke & Iron Company, Limited); V. Farrow (Chas. B. Pugh, Walsall, Limited); C. V. Fitton (Parson & Crosland, Limited); F. Napier James (William James); S. G. James (Hubert Whitfield & Company); A. P. C. Pennington (G. Pennington & Sons, Limited); J. Sillavan (Leigh & Sillavan, Limited), and E. Martin Smeeth.

The chairman and treasurer reported on the year's work, which had been satisfactory.

Cutting Metals.—According to "Steel," a new method of cutting metal has been employed in America. Use is made of slightly worn band-saw blades run at a speed of approximately 10,000 ft. per min. The high speed of the saw, it is claimed, actually melts the metal in its path.

COMPANY RESULTS

(Figures for previous year in brackets)

Derbyshire Stone—Dividend of 10% (same).

Marshall Sons & Company—Interim dividend of 3½% (same).

Enfield Rolling Mills—Net profit, £25,174; dividend of 5% (2½%); forward, £123,058 (£111,884).

G. W. King—Net profit, after tax, £18,341 (£18,136); dividend on the ordinary shares of 12½% (same).

Bede Metal & Chemical—Net profit, after tax, for 1943, £3,257 (£9,403); dividend of 9d. (1s.) per 8s. share, £3,271 net (£8,723 gross); forward, £8,919 (£8,932).

Scottish Stamping & Engineering—Net profit, after depreciation and taxation, for 1943, £16,554 (£15,742); to general reserve, £5,000; dividend on the ordinary shares of 10% (same); forward, £5,641 (£4,120).

Alexander, Fergusson & Company—Profit for 1943, after taxation, £12,648 (£11,868); depreciation, £4,500; dividend on the "A" and "B" ordinary shares of 9%, free of tax (8%, tax free); forward, £15,626 (£15,528).

Babcock & Wilcox—Profit for 1943, after providing £29,000 for N.D.C., £638,583 (£594,943); income-tax, £362,333; dividend of 10% (same) on the ordinary stock and a bonus of 1% (same); forward, £131,224 (£107,063).

B. Finch & Company—Net profit for 1943, £7,575 (£7,893); written off preliminary expenses, £2,000 (same); preference dividend, £3,000 (same); ordinary dividend of 6%, less tax, £2,100 (same); forward, £4,499 (£4,025).

Yorkshire Engine Company—Trading profit for 1943, £7,328; brought in, £14,570; reserved for E.P.T. and income-tax, £2,500; three years' dividend on the preference shares, £2,250; forward, subject to any adjustment of taxation liability and depreciation, £9,820.

Harrison (Birmingham)—Net profit for 1943, £54,919 (£53,307); adjustments relating to previous years, £210; to building reserve account, £15,000; dividend on the preference shares of 7%, less tax, £5,250; dividend on the ordinary shares of 4s. per share, free of tax, £33,000; forward, £106,914 (£105,035).

Union Steel Corporation (of South Africa)—Net profit, £122,795 (£147,015); dividend of 8% on the "A" and "B" preference shares, plus 2% bonus; dividend of 8% on the ordinary shares (same), plus bonus of 2% (nil); to general reserve, £25,000; provision for depreciation of investments, £10,000; forward, £26,522 (£23,726).

Ransomes, Sims & Jefferies—Profit for 1943, after charging depreciation, expenditure on A.R.P., E.P.T., and deferred repairs, £115,064 (£107,735); fees, interest on debenture stock, and reserve for income-tax, £67,750; balance, £47,314 (£44,985); profits on sales of investments, £32,675; to staff pension reserve, £25,000: dividend on preference shares, less tax, £5,500; dividend of 7½%, less tax, on the ordinary stock, £18,750 (same); to reserve for post-war reconstruction and contingencies, £27,240; forward, £58,858 (£55,359).

WAR MATERIALS SUPPLIES

The Combined Raw Materials Board, in its second annual report, remarks that the overall position did not change radically in 1943. Although supplies of certain vital materials are still insufficient, there are some surpluses which may enable supplies of articles for civilian use to be increased.

Towards the end of the year a number of materials had come into surplus supply. In metals, for example, the overall position was generally easier than at any time since January, 1942. But there were other limiting factors—man-power, transport, plant capacity, and shipping. In general, most commodities under allocation by the board must remain under some measure of control at least until the end of the war. Nevertheless, for some materials a more lenient consumption policy could be justified for the time being if no other limiting factor arose. Within the limits of more generous allocations of some commodities, it would be for each country to decide for itself which pressing civilian needs should be met.

INDUSTRY AND EDUCATION

The Education Committee of the Federation of British Industries, which has been considering the educational system in relation to the needs of industry, has submitted a memorandum embodying its conclusions to the Federation's grand council, which has given approval to them.

The memorandum points out that while mechanisation may reduce the need for skilled craftsmen, the new educational policy will mean a smaller intake of those from 15 to 18 years of age than industry has been accustomed to. Quality becomes increasingly important. In the committee's view the education of those entering industry at 14 to 15 is often inadequate. Too much attention is given to the memorising of facts at the expense of instruction in principles. Evidence shows that children from secondary schools have been unduly crammed to meet the needs of stereotyped examinations.

OBITUARY

MR. JAMES FREDERICK WILDY, of Ronald Trist & Company, Limited, Slough, died suddenly on May 17.

MR. H. H. FIELD, director of Burnell & Company, Limited, steel sheet rollers and galvanisers, died recently.

MR. PERCY S. WARD, managing director of Cordingley, Armstrong & Company, Limited, iron and steel merchants, Bradford, has died at Thackley, at the age of 62.

MR. CHARLES WARNER, who was a partner in French & Smith, metal agents and brokers, of Liverpool, and Liverpool agent of the Cornish Tin Smelting Company, Limited, died recently, at the age of 77.

LIEUT. EDWIN COTTAM, a director of Edwin Cottam & Company, Limited, steel rollers and spring manufacturers, of Cardiff and Rotherham, died of wounds in Burma on May 7. He was 27 years of age.

Raw Material Markets

IRON AND STEEL

Pig-iron production is maintained on a fairly even keel and closely approximates to current consumption. Specifications for No. 3 iron reflect the reduced activity in the light-castings trade, but the output has been adjusted accordingly. Very heavy tonnages of basic iron are still required for the steel furnaces, since scrap supplies are by no means abundant, and the demand for low-phosphorus and refined irons is still fairly brisk. The use of hematite iron has been very drastically curtailed, but the limited make suffices to provide indispensable tonnages for authorised purposes.

Shipbuilders continue to provide strong support for the finished iron trade, but other industrialists seem to display an inadequate appreciation of the advantages both in price and speedier delivery to be gained by the use of iron in place of steel bars.

A slightly easier tendency in the steel trade has made possible an increase in the supplies of semis to the re-rolling plants, a most welcome development. During the recent period when supplies were tight the mills were able to draw upon imported supplies, but as far as possible these are retained for emergency use, and a better balance between production and consumption of home-produced billets, blooms, etc., has now been established.

The plate mills are still running at full stretch, and orders in hand assure maximum outputs for months to come. Light plates are coming more prominently into the picture, and some of the sheet mills are now employed on this class of work. A similar tendency is noticeable in the concentration of interest upon light sections, which contrasts with a sluggish demand for heavy sizes. Sheet-makers are working to capacity, and are well provided with slabs and sheet bars, tube makers and wire drawers are very busy, and collieries are prepared to accept deliveries of props, arches, and roofing bars to the limit of their allocations.

The Minister of Supply has made the Control of Iron and Steel (No. 34) Order, 1944, which amends the No. 33 Order, 1943, by the revision of the Fifth Schedule (containing basic maximum prices) and of certain of the Related Price Schedules. In addition, prices are instituted for the first time for tube steel billets and pipe and tube joints. There are only slight alterations affecting pig-iron, chiefly concerned with extras for hematite iron.

NON-FERROUS METALS

The demand for copper in the United States is increasing with the expanded output of large brass shell cases. During 1944, the U.S. War Production Board estimates the country's total copper needs at 3,600,000 tons and the supply at 3,300,000 tons. To ease the position it has been decided that Canada should supply the United States with up to 30,000 tons this year. The American commitments in supplying copper to Russia are to be taken over by the mines in the British Empire. Consumption in this country is well below the former levels, and with the modification of the Rhodesian programme, there should be plenty of surplus production to help our Allies.

There have been no recent developments in the tin situation. The needs of this country appear to be covered satisfactorily by Empire sources. At the moment, there is little definite information as to what is happening in the Bolivian tin mines. All supplies from Bolivia have been going to the United States, and any change in the production policy is likely to have a considerable effect on the tin situation in America. It is unlikely, however, that Bolivia will withhold supplies, as economic stability of the country is dependent on this trade.

Conditions in the lead market have shown little change during recent months. The demand has continued to be mainly from manufacturers who are working under priority contracts. Allocations of the metal for other purposes have been kept as low as possible, although it is understood that adequate reserves are held.

Zinc is in very easy supply. All essential needs are covered, and in addition amounts have been made available for the more urgent civilian requirements. The galvanising trade has shown increased activity of late.

SIDNEY FLAVEL & COMPANY, which was formed in 1902 as a private company, has now been converted into a public company. The business, which is that of range and stove makers, was founded in 1777, and the Flavel family has been associated with the management of the undertaking ever since.

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, May 31, 1944

PIG-IRON

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

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

Hematite.—No. 1 (S & P 0.03 to 0.05 per cent.): Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

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

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

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

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

Cold Blast.—South Staffs, 227s. 6d.

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

FERRO-ALLOYS

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

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

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

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

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

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

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

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

Cobalt.—98/99 per cent., 8s. 9d. lb.

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

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

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

SEMI-FINISHED STEEL

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

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

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

FINISHED STEEL

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

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

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

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

NON-FERROUS METALS

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

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

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

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

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

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

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11⅝d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 10⅞d.; wire, 10⅝d.; rolled metal, 10¼d.; yellow metal rods, 9d.

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

Phosphor Bronze.—Strip, 14d. per lb.; sheets to 10 w.g., 15d.; wire, 16¼d.; rods, 16½d.; tubes, 21½d.; castings, 20d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

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

NON-FERROUS SCRAP

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

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended May 27, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

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

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

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

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

IRON AND STEEL SCRAP

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

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

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

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

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

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

SITUATIONS

GENERAL MANAGER (40); fully conversant with repetition light iron castings trade, production, sales, etc., and expert in mechanisation of large and small quantity production, wishes to contact ironfoundry where his experience can be fully employed, and with view to taking financial interest in the business — Box 524, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

METALLURGIST, well qualified, desires change; blackheart malleable from cupola and other melting methods, cast iron, high-duty cast iron, and most non-ferrous casting alloys; production control, sand control, heat-treatment and foundry practice; analytical and mechanical testing.—Box 516, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

PATTERNMAKER (36), practical and technical, good foundry knowledge, holding executive position, desires same; references; A.M.I.B.F.—Box 520, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

OVERSEAS EMPLOYMENT. — Required, for service in India, with a well-known firm of Contractors :—

Two PIPE FITTING FOREMEN. Maximum salary, Rs. 900 per month, depending on capability, plus 10 per cent. cost of living allowance. Must be really competent practical men experienced in the fabrication and fitting up on site of Steel Mains ranging from 1 in. to 8 in., and Flanged Cast Iron Mains up to 30 in. dia. They should be able to bend Steel Pipes up to 8 in. dia., and would have to train local labour. Adequate Bending and Screwing Plant will be available on the site. Knowledge of plumbing an advantage.

Free passages to and from India. Strict medical examination before appointment. Service agreement for approximately two years. No dependents will be allowed to accompany successful applicants.

Written applications (no interviews), giving full details of age, National and Armed Forces Registration numbers, training, experience, and name of present employers, should be sent to the SECRETARY, Overseas Manpower Committee (Ref. 1376), MINISTRY OF LABOUR AND NATIONAL SERVICE, Alexandra House, Kingsway, London, W.C.2.

FOUNDRY MANAGER wanted for Foundry producing 30 tons per week light grey iron castings; Midlands; practical knowledge and experience in patternmaking, coremaking, moulding; handling of labour essential; applicants please give full particulars, qualifications, previous appointments, age, and salary expected.—Box 526, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY SUPERINTENDENT required for Non-ferrous Foundry, London area, to supervise production of light and medium size castings; capable of planning and progressing work through all stages; a good disciplinarian; salary, £500-£600 per annum.—Write, stating age, experience, and qualifications, to Box 500, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

HEAD FOREMAN required for Steel foundry in Midlands, producing light steel castings, both jobbing and repetition lines; must be thoroughly capable of controlling labour, energetic, and a sound practical man; sound post-war prospects; gool salary paid to right man.—Write, stating age, experience, and salary required, in confidence, Box 514, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

HEAD FOREMAN required; medium sized Foundry, mainly repetition light iron castings; cupola practice essential; knowledge of mechanisation an advantage.—Application, stating age, salary required, and experience, to CO-OPERATIVE WHOLESALE SOCIETY, LTD., Ironworks, Keighley.

REPRESENTATIVES required for Non-Ferrous Foundry; must be keen and energetic men; previous experience an advantage.—Box 508, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

AGENCY

WANTED, by Non-ferrous Foundry, SELLING AGENTS, on a commission basis, to operate in Birmingham, Manchester, and the North, the North-East and Scotland.—Box 486, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

PATENT

THE Proprietors of the Patent No. 455825, for Improvements in or relating to Flexible Wire Tubing and the Method of Making the same, are desirous of entering into arrangements, by way of licence and otherwise, on reasonable terms, for the purpose of exploiting the same and ensuring its full development and practical working in this country.— All communications should be addressed in the first instance to HASELTINE, LAKE & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

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FOR SALE.—One Electric Sand Riddle; one 6-ft. Intensive Sand Mixer; both new.—Box 510, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

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One Sulzer M.D. Cent. Pump; 7 in. suction and delivery; direct coupled to 36 h.p., 220 volts, d.c. motor.

Ree Roturbo 10 in. M.D. Cent. Pump; 50 ft. head; 35 h.p. motor, 220 volts d.c.; 780 to 1,360 r.p.m.

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Broadbent Brick Crusher; 11 in. jaw.
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