FOUNDRY TRADE JOURNAL

Established 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 89 Thursday, August 24, 1950 No. 1773

49, Wellington Street, London, W.C.2.

Grams: "Zacatecas, Rand, London"

'Phone: Temple Bar 3951 (Private Branch Exchange)

PUBLISHED WEEKLY: Single Copy, 9d. By Post 11d. Annual Subscription, Home 40s., Abroad 45s. (Prepaid).

Classification

Mr. George Schwartz writing in the "Sunday Times" includes the following observation:—"The fact that a whale is a mammal and not a fish is of significance to zoologists and of incidental interest to people who try to answer 'Do you know?' It should be of little or no economic import. But the introduction of whale meat as an item of consumption may provoke tremendous repercussions and upheavals in the social order. The fishmonger who puts a lump of whale meat on his slab is assuming the role of a butcher. He possibly renders himself liable to a penalty of £100 or twelve months for keeping meat in the same refrigerator as fish. His staff may automatically come into a new category involving different rates of pay, working hours, annual leave, liability to military service and disablement benefit. The early closing day may be shifted from Wednesday to Thursday and the shop front have to undergo expensive alterations." Mr. Schwartz was emphasising, that whenever the Government decides to control an activity it is considered an essential that everything must be classified, and with dire results. If any serious attempt is ever made to classify foundries, the result would be equally puerile. For example, a brassfounder can and does on occasion make a steel casting, so do a few of the Sheffield tool-steel makers—still using the crucible process. Steel founders, especially those using the baby Bessemer process, sometimes make iron castings, whilst of course many predominantly iron founders have a corner where a few non-ferrous castings are manufactured. Thus it is not easy to compile an exhaustive classified list of foundries which has for its object the provision of a service useful alike to buyer and seller. A Government list, however, would have to be much tidier for legislative action and it can be presumed a heading would have to be provided for casters of spurious coinage—for it is *sine qua non* that one government department works independently of all others. Thus a person taking bribes pays to the Board of Inland Revenue authorities his quota of income tax, but the criminal aspect is solely the affair of the Home Office.

The full control of core oils would involve the attention of a wide range of Ministries—Supply, Defence, Food, Agriculture and Fisheries, plus controls set up for oils, plastics, and so forth. Even the classification of brushes for the purpose of purchase tax took up a foolscap page of closely-typed information—a monumental task for a high-grade civil servant. Whilst one recognises that there is need for control, it is obvious that this craze for meticulous classification is overdone and defeats its purpose by creating chaos instead of removing it.

Contents

Film Reviews

Whilst there are distinct advantages in the presentation of several films at one showing, amongst which of course is the welcome saving of time, the reviewer finds that criticism is liable, quite wrongly, to make a comparison of the films shown rather than relating each to its proper place in the wider field of pictorial publicity. Thus, after seeing, through the courtesy of the producers, The Merlin Film Company, Limited, 201-205, Clapham Park Road, London, S.W.4, three films "The Manufacture of Stanton Spun Iron Pipes"; "The Manufacture of Stanton Concrete Products"; and "The Prestcold Story," the outstanding impression as one left the theatre was that the first two were excellent and the third rather poor. Separate consideration might result in according more merit to the third as its purpose was different.

Stanton Spun Pipes

This is a straightforward documentary film of the highest order. The critic is not unfamiliar with the process, but the camera shows details difficult to observe when passing through the works. Rightly, the film, to the virtual exclusion of all else, keeps strictly to its subject. It did, however, show the apprentices' school and indicated that visual teaching was part of the Stanton policy. The most striking feature of the picture was the photograph of the liquid iron entering the spinning mould. The far-distant white spot made by the incoming iron grows and grows, until the screen is just a shimmering white sheet. This is one of the finest shots ever seen in an industrial documentary film. The process of iron-pipe spinning is basically simple and the layman can easily follow and mentally retain the various steps taken. This fact goes far towards the success achieved.

Concrete Products

Immediately one sees how difficulties are introduced when a variety of products are lumped together for the making of a documentary. This one covers spun-concrete pipes, lamp standards, and a wide variety of other products. The method used was to deal first with the raw materials used and their control. Details were given of various spinning processes, curing and so forth. All the material has to be milled but no impression was gained of the type of mill used. Naturally one cannot see through a casing, so if it is impossible for the camera to reach the interior, animated drawings would seem to be indicated. For documentaries in general, it is felt that the fullest details should be given to the minimum number of productions, the ideal being—as with the spun pipes—one.

The Prestcold Story

In this film, the object is obviously to increase the sales of the Prestcold line of refrigerators. Initially, there is the correct use of the "snob" appeal by shots taken in the palatial London showrooms. Then there is a showing of the city of Oxford, and next the huge works in the satellite town of Cowley. Here, there is the first mistake—that of bringing in the making of motor-car bodies. Then in all their complexity are shown the stamping and the gradual erection of the finished apparatus, "ready for painting." Nowadays, the British housewife expects her kitchen utensils to be enamelled—preferably vitreous enamelled—but not painted. The film ends with general propaganda for refrigeration. This type of film would cause the writer much surprise if it materially increased the sales of Prestcold refrigerators. There is need for some emphasis to be placed on the "selling points" of the apparatus.

Whilst scientific control is a basic necessity for the success of industrial processing, a little less stress might with advantage be laid upon it. This applies not only to the films under review but to the general run of recent releases. A new angle needs to be found to replace it.

Council of Ironfoundry Associations

Two-day Conference in London

As briefly announced last week, the Council of Ironfoundry Associations is to hold a conference in London on September 20 and 21, at the Connaught Rooms, London, W.C.2. This conference will be immediately followed by the Fifth Annual Convention of the Joint Iron Council.

The first day of the conference will be devoted to a discussion of the broad aspects of the report of the General Ironfounders' Productivity Team. The morning session commences at 10 a.m. and luncheon will be provided in the Connaught Rooms. The discussion will be resumed at about 2 p.m. Members of the team with the leader, Mr. S. H. Russell, will be present to answer questions and provide additional details.

The second day, Thursday, September 21, starts at 10 a.m. with a morning session devoted to a discussion on the development of the market for iron castings. After luncheon, and until 4 p.m., the members will discuss the subject of working conditions in ironfoundries. The conference will then close.

The Annual Convention of the Joint Iron Council will commence at 4 p.m. and will be followed at 7 p.m. by dinner, at which the principal guest will be Viscount Bruce of Melbourne, chairman of the Finance Corporation for Industry.

A more detailed timetable of the sessions of the conference will be available shortly. In the meantime, those members who have not yet applied for tickets are advised to do so at once, as the accommodation is limited. Non-members will be welcomed at the first-day sessions when the report of the productivity team will be discussed.

Correspondence

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

To the Editor of the FOUNDRY TRADE JOURNAL.

PLATITUDES *versus* TECHNOLOGY

SIR,—I was delighted to see your commonsense leader on "Platitudes *versus* Technology" in your issue of July 27. You will, I know, be pleased to hear that we in the north-west have taken this seriously in organising our top management post-graduate course on "Foundry Management and Technology," the third session of which is to be carried out in the coming year. The curriculum for this course, which is made up of lectures by national authorities, comprises the maximum of technology with generation from this discussion of the management principles and techniques involved. The combined aspect of technology and management is always the true medium of real discussion and training in higher-level executive groups, and in its simplified form at lower levels. This we should bear in mind as a primary rule of our training and conference schedules.

Yours etc.,

M. SEAMAN,

Director and General Manager,

David Brown-Jackson, Limited.

August 17, 1950.

Aluminium-alloy Castings*

Early castings, mainly produced in alloys of aluminium with zinc and copper, had relatively low mechanical properties and their use in engineering was largely confined to such items as handwheels, crankcases, covers and other lightly-stressed parts. Developments in aero-engine construction which took place during the first world war, gave rise to an insistent demand for a better aluminium alloy than was then available, having greater strength, particularly at elevated temperatures. In an endeavour to meet this demand, a research on the subject was undertaken by the National Physical Laboratory. The outcome of this work,[1] published in 1921, was the discovery of the excellent properties exhibited by complex alloys of aluminium containing copper, nickel and magnesium. The alloy finally selected as giving the best all-round properties was one having the nominal composition—copper 4 per cent., nickel 2 per cent., magnesium 1.5 per cent., remainder aluminium. For convenience of nomenclature this alloy was named "Y" alloy; it is used in both the as-cast and heat-treated conditions. The rapid development of high-strength aluminium alloys in Great Britain dates from the advent of "Y" alloy, and the value of this material for internal-combustion-engine pistons and other engineering components operated at elevated temperatures has received world-wide recognition.

CASTING ALLOYS IN USE TO-DAY

ALTHOUGH "Y" ALLOY was developed over thirty years ago, it still remains one of the best alloys for special-purpose applications and is extensively employed, in the cast form, for all types of automobile, motor-cycle and Diesel-engine pistons. (In the case of aero-engines, modern practice favours the use of forged pistons rather than castings.) After heat-treatment, the alloy has a high elastic limit; good resistance to corrosion and its mechanical properties are well maintained at elevated temperatures, as will be observed from Fig. 1. Caven and Keeble,[2] in a recent paper, provided an interesting example of the reliability of "Y" alloy under severe operating conditions by showing how a large composite Diesel-engine piston withstood a repeated impact for a long period.

R.R. Alloys

"Y" alloy is not an easy alloy to handle in the foundry, being susceptible to oxide formation and intercrystalline shrinkage porosity. It was a natural consequence, therefore, that the founder should endeavour to improve its casting properties. With this in mind, some years later, the "R.R." group of aluminium alloys was developed and patented by Rolls Royce, Limited, and manufacture was taken over by High Duty Alloys, Limited. Casting alloys such as Hiduminium,[3] R.R.50, R.R.53 and R.R.53B are in common use to-day for a wide variety of applications. The original R.R.50 alloy, developed for sand and die castings for general purposes, is characterised by excellent founding properties. Unlike most high-strength light alloys, R.R.50 requires no solution-treatment, and only a low-temperature precipitation treatment is needed to develop optimum properties. This feature is particularly valuable in the production of large castings of varying section, since internal stresses, which frequently follow severe quenching, are avoided. Castings in this alloy are not subject to age-hardening in service and are regularly employed for water-cooled cylinder blocks and heads, crankcases and other parts in automobiles and aircraft which demand a high standard of performance. On gas-turbines this alloy is used for air intakes, compressor stator casings and bearing housings. The other two alloys, R.R.53 and 53B, on account of the high degree to which they retain their strength and hardness at elevated temperatures, have been developed principally for such castings as automobile and motor-cycle pistons, and for parts other than pistons, such as air-cooled cylinder heads, operating at high temperatures in aircraft engines.

Ceralumin Group

During recent years, a range of rather similar alloys has been developed by J. Stone & Company, Limited, under the name of Ceralumin[4] B, C, D and A.S.M. In these alloys, grain-refinement is effected by means of a small addition of niobium instead of titanium. Ceralumin B and A.S.M. are probably the most widely-used alloys in this group. Like R.R.50 alloy, the outstanding features of Ceralumin B are its excellent castability and the useful mechanical properties obtained by a simple low-temperature heat-treatment operation. Ceralumin A.S.M. has high strength, reasonable ductility and good resistance to shock, which makes it particularly attractive for a wide range of applications.

The latest developments indicate that for certain specialised service conditions the R.R. and Ceralumin alloys may be superseded by the aluminium-magnesium alloys which have much greater ductility. It is worth noting, however, that these latter alloys are very difficult to handle in the foundry and require specialised technique for successful production. Furthermore, they are not suitable for service at elevated temperatures, for which Y, R.R. and the Ceralumin alloys remain supreme.

* Based upon the British exchange paper, "Aluminium-alloy Castings—A Review of British Achievement," presented by Frank Hudson, F.I.M., on behalf of the Institute of British Foundrymen to the 54th Annual Congress of the American Foundrymen's Society, at Cleveland, Ohio, U.S.A.

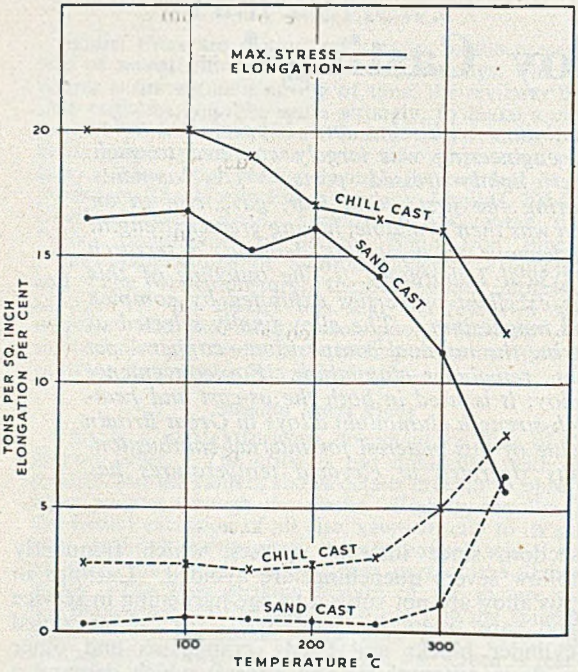


FIG. 1.—*Mechanical Properties of "Y" Alloy at Elevated Temperatures. Tests made on 1-in. diam. Cast Bars, Solution-treated at 520 deg. C. for Six Hours and Quenched in Boiling Water. Aged Five Days at Room Temperature.*

Silicon Alloys

The lightness of aluminium alloys, combined with their high thermal conductivity, gives them definite advantages over cast iron for automobile and other pistons. However, most aluminium alloys have a high co-efficient of linear expansion (of the order of 23 millionths, as compared with 12 millionths per deg. C. for cast iron) and attempts have, therefore, been made to overcome the differential expansion between the aluminium-alloy piston and the cast-iron cylinder or cylinder liner. In the aluminium alloy known as Lo-Ex, advantage is taken of the fact that silicon in sufficient quantity (14 per cent.) considerably reduces expansion whilst the addition of 2 per cent. of nickel increases hardness and improves the properties at elevated temperatures.

The plain high-silicon type of aluminium alloy possesses excellent castability, coupled with good resistance to corrosion, but gives rather a low value for proof stress. Taking this material as a basis, the Birmingham Aluminium Casting (1903) Company, Limited, have developed an alloy known as Birmasil Special.[5] By adding nickel up to 3½ per cent., they have produced an alloy having high tensile strength in the as-cast condition, coupled with good mechanical properties. This firm also developed the P.2 aluminium alloy containing 4.0 to 5.0 per cent. silicon and 1.75 to 2.5 per cent. nickel, a material which is especially suitable for the production of pressure die-castings to close dimensional tolerances.

In addition to the special alloys already mentioned, there are many other compositions of aluminium-zinc-copper, aluminium-copper, aluminium-silicon-copper, etc., in use for less important applications. In fact, during recent years a multiplicity of aluminium-base alloys has come into being, many of them being redundant and not justified by any special properties. The real need for simplification is signified by the introduction of British Standard 1490, 1949, entitled "Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes." This limits the number of alloys to twenty, and is a step in the right direction. B.S. 1490:1949 gives representative compositions and properties of some aluminium alloys commonly used for the production of castings in Great Britain to-day. Figs. 2 to 7 illustrate a few of the many modern engineering and industrial applications of these useful alloys.

Technical control has always been an important feature of the aluminium-alloy foundry industry in this country. After satisfactory production methods have been determined in the experimental foundry, routine check tests on all important components are made, using radiographic, metallographic, pressure-

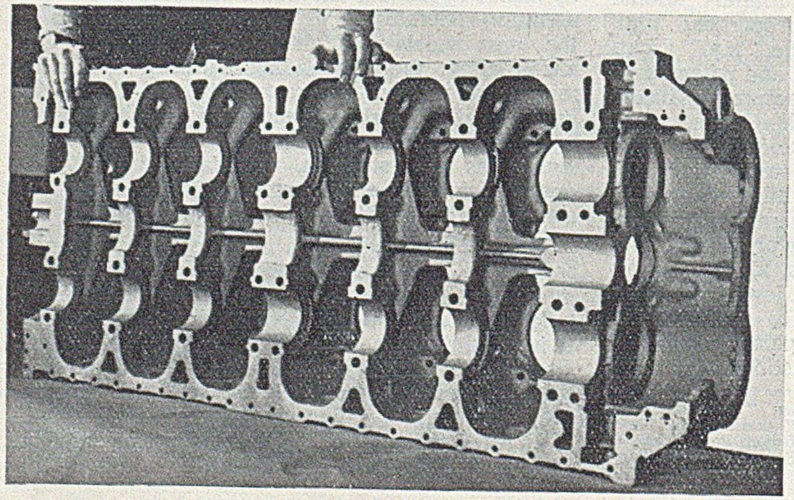


FIG. 2.—*Cylinder Block for Napier "Sabre" Engine, Sand Cast in Hiduminium R.R.50 Alloy. Length, 47¾ in.; width, 23⅛ in.; depth, 8¼ in. Entire weight, 191 lb.*

[*Courtesy High Duty Alloys, Limited*

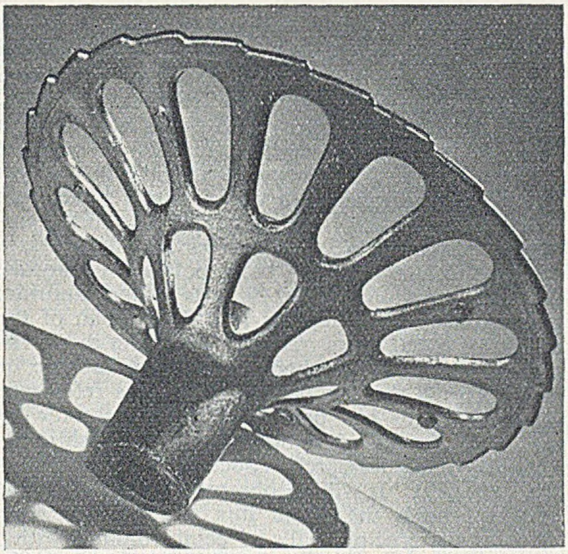


FIG. 3.—*Thread Guide for the British Northrop Loom Company, Limited. Gravity Die Casting in Hiduminium R.R.51 Alloy containing 0.8 to 1.75 per cent. Nickel. Base, 13 in. diam.; shank, $2\frac{1}{4}$ in. diam.; centre hole, $1\frac{3}{8}$ in. Notches around Edge for Guiding Thread.*

[*Courtesy High Duty Alloys, Limited*

and mechanical-testing methods on representative castings selected from production batches.

METALLURGICAL DEVELOPMENTS

Melting Practice

Aluminium and its alloys, when molten, readily absorb hydrogen, and considerable research has been carried out on preventive measures and on methods of degasification. Melting in a reducing atmosphere, which may contain free hydrogen, is a possible source of hydrogen pick-up, but recent investigations indicate that the main source of hydrogen is the presence of water vapour in the furnace atmosphere. It has been shown that the reaction between aluminium and water vapour, represented by $2\ Al + 3\ H_2O \rightarrow 3H_2 + Al_2 03$, is irreversible at melting temperatures employed in normal foundry practice. Thus the reaction proceeds from left to right, with the formation of stable aluminium oxide, which is insoluble in the melt, and the liberation of hydrogen, which may be dissolved in the metal and subsequently liberated during solidification, forming gas porosity. Oxidation of the gassed melt, therefore, serves no useful purpose and merely forms more insoluble aluminium oxide, which is difficult to remove.

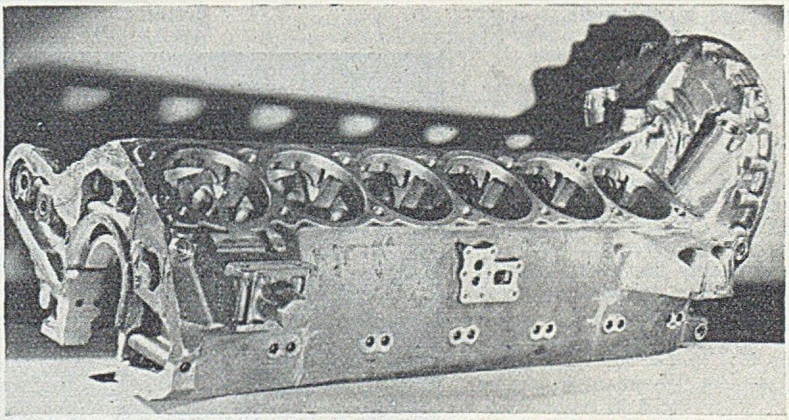
In view of the above consideration, probably the best way of minimising hydrogen absorption in aluminium alloys is to maintain a thin unbroken oxide film on the surface of the molten metal during melting. Any factor which causes this oxide film to be disturbed, such as flame impingement, excessive stirring, etc., is likely to cause more trouble than will incorrect furnace atmosphere. In this latter direction it is of course, advisable, wherever possible, to employ a slightly oxidising atmosphere. The amount of gas dissolved increases with rising temperature and it is important that the metal should not be heated above the normal temperature required to produce good castings.

De-gasification

Gas-scavenging methods are widely employed for the removal of hydrogen from aluminium alloys. In Great Britain, de-gassing is most commonly effected by the use of nitrogen or hexachloroethane (C_2Cl_6). The latter is an organic compound which evolves chlorine when heated to aluminium melting temperatures, and consequently provides a convenient method of gas-scavenging. Flux manufacturers sell hexachloroethane, usually under a trade name, in the form of powder or tablets made up into units, weighed for melts of various sizes. The surface of the molten metal, at a temperature of between 700 and 750 deg. C., is covered with a layer of suitable flux and the required amount of hexachloroethane is plunged to the bottom of the melt and held there for about 3 to 5 minutes, until no further gas bubbles are evolved. The evolution of chlorine from the de-gasser should not be too violent as small and evenly distributed bubbles promote more effective de-gassing. After de-gassing, the melt is preferably allowed to stand for 10 to 15 minutes before casting, whilst the flux is rabbled into the metal surface, prior to its removal, together

FIG. 4.—*Crankcase for Merlin Aero-engine, Sand Cast in R.R.50 Alloy.*

[*Courtesy Rolls Royce, Limited*



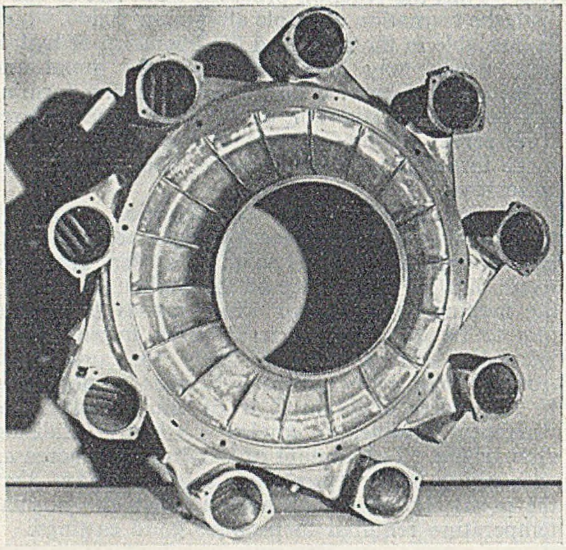


FIG. 5.—*Compressor Casing for Derwent 5 Gas Turbine, Sand Cast in R.R.50 Alloy. The Cascade of Guide Vanes is made from Extruded Bar and " Cast In."*

[Courtesy Rolls Royce, Limited

with the dross, by means of a perforated hand ladle or scoop.

The use of chlorine gas for de-gasification purposes is to-day being largely superseded by the more convenient hexachloroethane. With some alloys, chlorine treatment has been found to increase grain size, but this can be easily corrected by the addition of suitable grain-refining elements, either after degassing or as a constituent of the flux. Treatment with chlorine, hexachloroethane, and fluxes containing chlorides also leads to a slight reduction in the magnesium content of the melt, which must be taken into account when melting complex alloys. The removal of gases from aluminium alloys has also been effected by treatment with other volatile chlorides, such as titanium tetrachloride and boron trichloride. These compounds, in addition to removing hydrogen, promote grain refinement, due to the reduction of titanium and boron which is absorbed by the melt.

The British Non-Ferrous Metals Research Association have done a large amount of work over the past 20 years on the effect of gases on aluminium alloys, and have developed a de-gassing process, which combines treatment with fluxes and with an inert gas such as nitrogen.[6] In this process the nitrogen acts as a scavenger, whilst the flux serves to remove the oxide film which would hinder the escape of hydrogen from the melt. The fluxes employed consist of alkali chlorides and fluorides, a typical mixture being 50 parts potassium chloride, 40 parts sodium chloride, 10 parts sodium fluoride; the amount of flux used is 1 to 2 per cent. of the weight of metal to be treated. The main disadvantage of de-gassing methods embodying the use of such fluxes is that the liquid flux attacks refractory crucibles. This has been effectively overcome by the latest process developed by the British Non-Ferrous Metals Research Association (British Patent No. 569, 619). It will be observed from Fig. 8 that in this process the liquid flux is prevented from reaching the crucible walls by being confined within a removable graphite sleeve which dips into the molten metal. Agitation of the metal within the sleeve is effected by means of dry nitrogen passing through the lead-in tube. By this method de-gasification of melts weighing around 1,000 lb. has been satisfactorily effected in about 12 minutes.

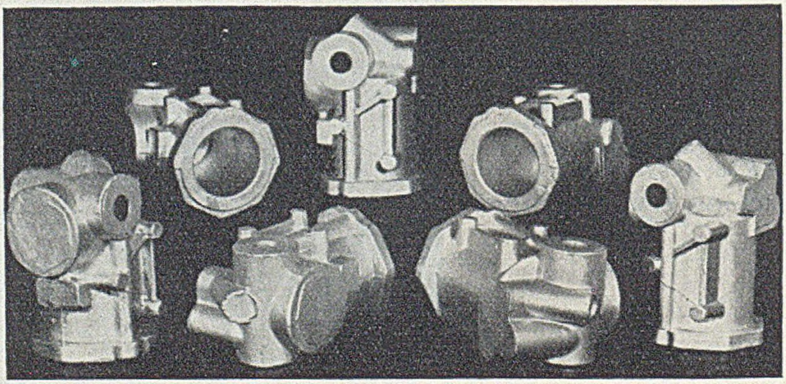
It is most important that all gases used for de-gasification be dry. In this connection, high-pressure nitrogen cylinders can be employed, without the need for drying towers, provided that the gas pressure is not allowed to fall below 20 atmospheres. The minimum quantity of nitrogen required for treatment of aluminium and its alloys is about 25 cub. ft. per ton of metal. Furthermore, the flow of gas should be controlled at such a rate as to cause the surface of the melt to roll gently. Violent agitation should be avoided and, as mentioned previously, small and evenly-distributed gas bubbles best promote de-gasification.

Fluxes

In the melting of aluminium alloys, a flux serves three main purposes:—(1) It cleans the surface of the molten metal by removing oxide and dross; (2) it provides a protective covering during melting, to minimise formation of oxide, etc., and (3) under certain conditions, acts as a de-gasser. Whether or

FIG. 6.—*Accumulator Bodies for Diesel-engine Fuel Pump. Gravity Die-cast in B.S. 1490-LM-7-M Alloy. These Castings have to withstand Pressure and must be absolutely free from Porosity. They are subject to X-ray Examination.*

[Courtesy John Dale, Limited



not it is necessary to use a flux depends upon various factors, *e.g.* composition of the alloy, melting conditions and nature of the furnace charge. Alloys containing more than 2 per cent. magnesium tend to form dross and absorb hydrogen much more rapidly than do lower-magnesium or magnesium-free alloys. A protective low-melting-point covering flux, usually composed of fluorides and chlorides of magnesium and potassium, is therefore, recommended when melting alloys of high magnesium content. For alloys containing little or no magnesium, the use of a flux is not essential, and need only be employed when melting conditions are excessively oxidising in character, as when the furnace is of a type which permits the flame and products of combustion to come into direct contact with the molten metal, or if the charge contains a considerable percentage of scrap. In the case of these latter alloys, fluxes are generally composed of sodium or potassium chlorides and sodium fluoride, a typical mixture being two parts by weight of sodium chloride and one part of sodium fluoride. Chemicals of commercial quality are satisfactory but it is important that they be perfectly dry when added to the metal, as the use of damp flux is likely to result in gassy castings.

The procedure commonly employed in using a flux is to raise the metal temperature to 700 to 750 deg. C. and then spread the dry flux evenly on top of the metal surface, in an amount varying from 0.5 to 2 per cent. by weight of the metal charge, according to individual conditions. The flux is then gently pushed, or rabbled, under the surface of the molten metal (by means of an iron skimmer or plunger) until it is seen to be fused. The metal is then stirred, the dross is removed by skimming and the metal then cooled to the required pouring temperature. Care should be taken to avoid excessive agitation of the molten metal. It is now generally appreciated that fluxes containing fluorides are the most effective de-gassers and that changes in chemical composition of aluminium alloys can occur as a result of flux treatment. Murphy, Wells

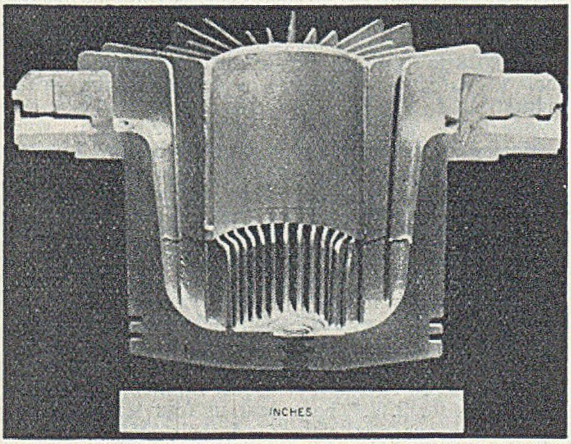
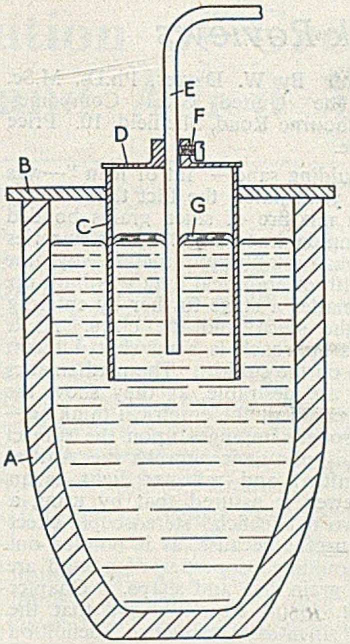


FIG. 7.—*Finned Cylinder, Sectioned to show Solidity. Die Cast in " Y " Alloy by the Low-pressure Process.*

[*Courtesy Birmingham Aluminium Company, Limited*



A. Plumbago Crucible
B. Vented Cover Plate to hold C
C. Inner Plumbago Sleeve
D. Vented Plate covering inner sleeve
E. Nitrogen Delivery Tube
F. Set Screw for fixing Nitrogen Delivery Tube
G. Flux Covering

FIG. 8.—*Latest Method for De-gassing Aluminium Alloys. Developed by the British Non-Ferrous Metals Research Association. British Patent* 569,619.

and Payne[7] have shown that a serious loss of magnesium can arise from a repetition of the sodium chloride/sodium fluoride flux treatment. It is clear, therefore, that if for any reason a melt of an aluminium alloy containing magnesium is treated more than once, with a flux of the type stated, an addition of magnesium should be made to compensate for the loss due to the action of the flux. The same consideration should be borne in mind if remelted runners and risers constitute a large proportion of the charge.

(*To be concluded*)

REFERENCES

1 W. Rosenhain, S. L. Archbutt and D. Hanson: " Eleventh Report to the Alloys Research Committee on Some Alloys of Aluminium." Instn. Mechanical Engineers, 1921, p. 256.
2 J. Caven and H. W. Keeble: " Examples of Aluminium-alloy Foundry Practice." FOUNDRY TRADE JOURNAL, 1949, vol. 86, pp. 621–6.
3 Registered trade mark of High Duty Alloys, Limited.
4 Registered trade mark of J. Stone & Company, Limited.
5 Registered trade mark of Birmingham Aluminium Castings (1903), Company, Limited.
6 British patents 435104, 456462, 569619.
7 A. J. Murphy, S. A. E. Wells and R. J. M. Payne: " The Effect of Melting Conditions on Light Alloys." Proc. Inst. Brit. Foundrymen, 1938–39, vol. 32, pp. 133–47.

ALAR, LIMITED, of 3, Albemarle Street, London, W.1, have issued a new data sheet of their standard type which covers the heat-treatment of aluminium-alloy castings. This publication details the treatment conditions for all the heat-treatable alloys included in B.S. 1490, and contains notes on recommended practice; the heat-treatment of pressure castings, and stress relieving. Whilst these data sheets are extremely useful and very interesting, the reviewer wishes that they did not so closely resemble a company prospectus. Copies are available on application to Alar.

Book Reviews

Foundry Sand Control. By W. Davies, Ph.D., M.Sc. Published by The United Steel Companies, Limited, 17, Westbourne Road, Sheffield, 10. Price 30s., plus postage.

Fifty years ago moulding sand—"fat or lean"—was just sand. About 20 years later, the fact that natural moulding sand was a mixture of silica grains bonded with clay became common knowledge. Then a series of physical tests was established mainly by the Americans, and a wealth of empirical data was built up. This book takes the matter a stage further by entering into the nature of the silica and the clays. As a geologist, the Author's approach is somewhat different from the earlier works on the subject. The mathematics which are introduced are desirable, as they show the way towards the elimination of the empirical thinking—a factor which too strongly impinges upon the subject of sand testing. In his photomicrographs the Author has used both transmitted and reflected light as an illuminant. The reviewer is assured that by using a combination of the two a beneficial stereoscopic effect can be had. This is useful because, as is pointed out by the Author, the moulding properties of a sand are partially governed by grain size and shape. Chapter III is very important, for it clearly shows that the "silica" part of the "silica sand and clay" definition of a sand may be and in fact is a variable. It would have been interesting if the Author could have added an adverb before the word "used" in his phrase "The olivine (magnesium silicate) sands are being used experimentally in certain foundries." In his closing remarks in this chapter, it is disclosed that in a steel foundry an increase in waster loss was traced to an increase in fines in the sand. Again, an attempt in wartime to replace a rounded-grain sand by a "matched" one with an angular grain failed completely.

Chapter IV is equally important, as again it is very clearly shown that "clay" is not just "clay." Here the Author has had recourse to information not readily available to the foundryman. The theoretical concept of milling is splendidly set out on page 55. To study this and its implications is an essential for the foundry technologist. The temperature of the sand has, we are told, a fundamental influence on the milling practice, as acceleration is needed with increasing temperature. The ascertainment of the optimum moisture content is clearly set out in Chapter V. It shows how by relating the subject to minimum bulk density a proper basis can be established—a subject developed later for further application. It is a pity that bulk density is difficult to put on a routine basis. However, hardness tests can do much to ensure uniformity. Fig. 47 will bring to the skilled craftsman a sense of satisfaction, for it shows an example where hand work gave a variation in hardness ranging from 70 to 82, whereas jolting only yielded a range spreading from 58 to 94 and jolt squeezing 75 to 93. The fact that "wall drag," that is friction between the sand and the wall of a moulding- or core-box when ramming, is greater than that in the body of the material is full of interest, and an instrument has been devised for measuring this "drag."

In the same manner, the reader is taken through the strength of moulding sands, the mould surface, the foundry sand system, the selection of foundry sands, and the selection of bonding clays. Finally there are few notes on the future of foundry control. There is need perhaps for two more chapters, one dealing with the drying and baking of moulds and cores, and a second one on bonds other than clays. However, despite this, the reviewer is convinced that it would be difficult for any foundry not to recover—and recover quickly—the cost of this book, by putting into practice a few of the many excellent precepts disclosed.

V. C. F.

Non-ferrous Metal Melting and Casting of Ingots for Working. A Symposium. Published by the Institute of Metals, 4, Grosvenor Gardens, London, S.W.1. Price 15s.

It is essential to draw attention to the fact that this book deals with the metallurgy of the casting of non-ferrous ingots and thus its appeal to founders is thereby limited, yet there is much of interest for them. The book reprints six Papers, four of which cover melting and casting in general and as applied to aluminium bronze, brass and nickel silver. The other two are devoted to studies of the production of refined copper shapes and the application of flux degassing to commercially-cast phosphor bronze. This last Paper is essentially practical and many worthwhile tips are disclosed. The reviewer is of opinion that metallurgists on the staff of heavy non-ferrous foundries will derive much pleasure and profit from a study of this book.

V. C. F.

New Catalogues

Oxygen Profiling and Cutting Machines. Being a little tired of the repetitive design on trade literature covers, the reviewer found distinctly refreshing the treatment given by Hancock & Company (Engineers), Limited, Progress Way, Croydon, to their latest publication. For once in a way the publishers have realised the charming effect that can be obtained by retaining a white background. The balance and colouring are alike excellent. The central double-page-spread illustration of the firm's most popular line of machine is also commendable. The catalogue runs to 24 pages and cover and we esteem it to rank amongst the best reaching this office since the war.

Pellets. A four-page pamphlet received from the Pellets Sales Inc., 528, Fisher Building, Detroit 2, Michigan, U.S.A., describes and illustrates a line of shot made from wrought steel cut wire instead of chilled iron. It seems that with the passage of time, the little cylinders become globular without losing weight. A claim of 46 per cent. saving in blasting costs due no doubt to the non-frangibility of the material. The size of the pellets ranges in four steps from 0.028 to 0.041 in. So far as the reviewer is aware, such a material is not yet available on the British market.

Marine Propellers. Jarrow Metal Industries, Limited, of Western Road, Jarrow-on-Tyne, have sent us a four-page illustrated leaflet which gives data on the mechanical properties of a range of steel propellers. It is interesting to read of a claim that an austenitic stainless steel is quite competitive in price with the bronze type. The aerial picture of the ship would have been better if photographed from the stem instead of the stern, as the funnel and masts now appear to be raked over in the wrong sense.

Lubrication. Acheson Colloids, Limited, of 18, Pall Mall, London, S.W.1, have sent us four leaflets covering the various applications of their Dag brand of colloidal graphite. It is bulletin No. 94, which is of special interest to our readers as the application in this case is to die casting and the like. These four pamphlets are available to our readers on writing to Pall Mall.

Repair and Reclamation of Grey-iron Castings by Welding and Allied Methods*

SUB-COMMITTEE T.S.23

Dr. A. B. Everest (chairman), Mond Nickel Company, Limited.
Mr. F. A. Ball, Mond Nickel Company, Limited (Birmingham Research Laboratory).
Mr. F. Clark, M.B.E., British Oxygen Company, Limited.
Mr. W. J. Colton, Newton Chambers & Company, Limited.
Mr. J. Dawson, Ferranti, Limited.
Mr. F. Y. Drinkwater, Ford Motor Company, Limited.
Mr. G. G. Musted, Quasi Arc Company, Limited.
Mr. G. Southern, Metropolitan-Vickers Electrical Company, Limited.
Mr. M. H. Thomas, Welding Technical Services, Limited.
Mr. L. Tibbenham, Suffolk Iron Foundry (1920), Limited.
Mr. G. Lambert (committee secretary), Institute of British Foundrymen.

THIS CODE OF PRACTICE for the repair and reclamation of grey-iron castings by welding and allied methods, has been prepared by Sub-committee T.S.23, which was set up by the Technical Council of the Institute of British Foundrymen in September, 1947, with the following terms of reference:—

"To consider the reclamation of grey-iron castings by burning-on and welding."

After the sub-committee had drafted the code, it was submitted for consideration by twelve selected experts outside the committee, representing welding engineers, inspecting authorities, research organisations and technical institutions. The majority of these experts commented favourably on the committee's work, and in addition submitted many valuable suggestions and amendments to make the code more complete and useful. The sub-committee wishes gratefully to acknowledge the valuable help and encouragement given in their difficult task.

The outside authorities who considered the draft were:—Mr. H. Annis, Metropolitan-Vickers Electrical Company, Limited; Mr. R. E. Dore, British Oxygen Company, Limited; Dr. S. F. Dorey, Lloyd's Register of Shipping; Mr. J. A. Dorrat, North Eastern Marine Engineering Company (1938), Limited; Mr. G. Foster, The Railway Executive; Mr. A. H. Goodger, National Boiler and General Insurance Company, Limited; Dr. H. H. Harris, Babcock & Wilcox, Limited; Mr. H. W. G. Hignett, Mond Nickel Company, Limited; Mr. C. S. Milne, C. S. Milne & Company, Limited; Dr. E. C. Rollason, Murex Welding Processes, Limited; the British Cast Iron Research Association, Birmingham; and the Institute of Welding.

The sub-committee also wish to acknowledge help in connection with the sections on "burning-on" received from:—Mr. C. Gresty, North Eastern Marine Engineering Company (1938), Limited; Mr. P. A. Russell, S. Russell & Sons, Limited; Mr. R. C. Shepherd, Ruston & Hornsby, Limited, and Mr. C. R. van der Ben, National Gas & Oil Engine Company, Limited.

Foreword

The repair or reclamation of grey-iron castings by welding calls for knowledge and experience. No two repair or reclamation jobs are exactly alike, and a large number of variables, including form and size of casting, composition of the iron, facilities for pre- and post-heating, and welding methods available, all influence the production of a satisfactory repair. The large number of variables involved prohibits the publication of detailed instructions in this code, and it has therefore been confined to general considerations for the guidance of operatives, engineers and inspectors. For more-detailed working instructions on particular methods, reference should be made to the extensive literature on the subject.

Only experienced operatives should be employed in this class of work. It is equally important that only experienced men should be employed in reclamation by burning-on methods. Suitable facilities of space, light, ventilation, etc., should be provided for all welding operations.

(I) General Statement

This code of practice applies to the reclamation of grey-iron castings, either as-cast or machined, by oxy-acetylene or arc-welding methods (section A), or by burning-on (section B). The code applies only to methods for the repair or reclamation of grey-iron castings to render them serviceable. It does not cover special welding techniques, *e.g.*, those for hard surfacing.

(II) Specification of Grey Cast Iron

This code of practice applies to general grey iron castings such as, for example, those in which the material conforms to B.S. 1452:48, but attention is drawn to clauses quoted later referring to composition, especially in respect of higher

* Report of Sub-committee T.S.23 of the Technical Council, presented at the Buxton Conference of the Institute of British Foundrymen.

Reclamation of Grey-iron Castings

grades of material in the specification. The welding of other types, such as white cast iron, malleable and high-alloy irons, is not covered by this code.

(III) Types of Defect which can be Repaired by Welding, Burning-on, or Similar Methods

(*a*) Foundry defects:—

Blowholes, gasholes, draws, etc.
Laps, scabs and other surface blemishes.
Mis-runs and short casts.
Cracked and broken castings.

(*b*) Production defects:—

Over-machining.
Broken castings.
Errors of design.

(*c*) Service defects:—

Broken castings.
Worn castings.

(IV) Factors Limiting Repair or Reclamation

Extent of the defect.
Location of defect, *i.e.*, accessibility.
Form of casting, *i.e.*, section variations, thickness, weight and bulk of casting.
Service conditions imposed on casting, including special conditions of stress, shock, etc.

The decision whether a defect is to be repaired will depend also on the value of the casting, urgency of repair, production considerations, facilities for replacement, delays involved in replacement, and so on.

(V) Available Methods of Reclamation by Welding and Burning-on

(*a*) Oxy-acetylene fusion welding with ferrous (cast iron) filler rod.
(*b*) Oxy-acetylene non-fusion methods (bronze welding).
(*c*) Metallic-arc welding with ferrous electrode.
(*d*) Metallic-arc welding with non-ferrous electrode.
(*e*) Burning-on.

(VI) Choice of Method

(*a*) *Approach*

The approach to the considerations and factors determining the choice of method may vary, depending upon the classification of defects as given in paragraph III (*a*), (*b*) and (*c*), in conjunction with the last factor in paragraph IV, and will, therefore, be influenced and emphasised by individual circumstances, *e.g.*, the repair of defects developed in service, where the time factor and production needs may permit and fully justify a "make-do-and-mend" method which would not be considered for the repair of foundry defects in new castings.

(*b*) *General*

Where full pre-heating is possible, gas fusion welding is recommended.* Where only limited pre-heating or no pre-heating can be effected, an arc-welding method is preferred, provided that due consideration has been given to the type of defect and the limiting factors stated. Where, however, pressure tightness is required, arc welding is not generally recommended. "Burning-on" methods permit a wide application for the repair of foundry defects, paragraph III (*a*), particularly for heavy castings, and under suitable circumstances can be used for the (*b*) and (*c*) classes of defects.

The scope of the oxy-acetylene fusion method of welding depends upon the facilities available for adequate pre- and post-heating. The method is, therefore, more universally employed in the repair of the simpler types of castings. Arc welding, on the other hand, with its small over-all thermal effect, has advantages for the reclamation of complicated castings, provided due regard is given to the type of defect. Because of difficulties usually experienced in fully pre-heating large or bulky castings, burning-on or arc-welding methods are considered more suitable for such work.

In general, arc welding is limited to the repair of relatively minor faults. This limitation, however, does not necessarily apply to the repair of castings which have failed in service. In addition, arc welding finds a particular application in the reclamation of defects on machined surfaces; in this case a non-ferrous electrode may be used with advantage.

For all methods of welding cast iron, pre-heating is desirable, since the control of the rate of heating and, more particularly, the rate of cooling considerably influences the quality of the repair. Provided the rate of cooling can be adequately controlled, fully machinable welds can be obtained with full fusion welding.

(*c*) *Other Factors determining Choice*:—

Size of the casting, *i.e.*, large, medium or light.
Form and complexity of casting.
Extent and location of defects., *i.e.*, on machined face or not.
Service conditions on defective member, *e.g.*, bronze welding, or non-fusion welding, is not recommended for castings operating at temperatures in excess of 250 deg. C.
Properties required, *e.g.*, mechanical strength, machinability, etc.
Facilities available—type and capacity of plant and equipment, and experience of operatives in method selected.

SECTION A: RECLAMATION BY WELDING

In addition to the remarks on the choice of method in paragraph VI, the widest possible field of reclamation by welding can only be fully covered provided both gas and arc methods are available. Each method has its limitations and, where the

*Non-fusion methods are available and may be used, but are not considered so acceptable as the other methods given. Their field of application is largely in the repair of defects which occur in service.

factors determining choice point to one process, it is advisable to use another.

(VII) Effect of Composition on Weldability of Grey-iron Castings

Variations in the percentages of the elements normally found in cast iron, namely, carbon (including both combined and free-graphitic-carbon), silicon, manganese, sulphur and phosphorus, and the presence of alloying elements now commonly used in cast iron, such as nickel, copper, chromium and molybdenum, all affect the facility with which cast iron can be welded. The composition of a grey-iron casting can affect its weldability in two ways:—(*a*) The ease of carrying out the welding operation; and (*b*) the liability of the cast iron adjacent to the weld to change in structure and properties as a result of the heating effects due to the welding operation.

The carrying out of the welding operation involves the obtaining of a continuous bond between the cast iron and the weld metal with the deposition of a sound, dense weld metal having the desired mechanical properties. Alteration in the metallurgical structure of the casting adjacent to the weld can involve softening and a loss of strength, or, alternatively, hardening with resultant difficulties in machining and liability to cracking. The effect of the more common elements which may be present in cast iron on these two aspects of weldability are considered in detail in Appendix I.

(VIII) Choice of Welding Rods and Electrodes

(*a*) *Gas Fusion Welding Rods*: Care should be exercised in the selection of good-quality welding rods. The composition should be such that the deposited metal approaches as nearly as possible that of the casting to be welded. Alternatively, high-silicon (*i.e.*, silicon up to 4.0 per cent.) rods may be used where ease of weldability and good machining properties are the first considerations. The use of high-silicon rods also assists in preventing oxidation of the weld metal deposit and so avoids the development of blowholes and inclusions. Cast-iron rods alloyed with nickel, etc., can be used where high-quality weld metal is desired and for the welding of high-duty castings. High-quality rods may also contain titanium or molybdenum. Cast-iron welding rods should be clean, and as free as possible from surface oxide, sand or other contaminants.

(*b*) *Welding Rods for Non-fusion Gas Welding*: Various proprietary types of bronze rod are used for non-fusion gas welding. Typical is a welding rod of 60/40, copper/zinc type containing a small percentage of silicon, with or without manganese and other elements. The manganese improves the flowing qualities of the molten metal and improves the bonding properties to the cast iron. The silicon prevents volatilisation of the zinc and so avoids blowholes and oxide inclusions, and thus improves the soundness of the deposited metal, and confers greater mechanical strength to the weld.

Special compositions of bronze are frequently used—for example, those containing a proportion of nickel. With nickel about 10 per cent., improved strength is obtained, but for a good colour match with iron and steel 15 per cent. of nickel is recommended. Bronze welding rods for non-fusion gas welding are sometimes supplied with a flux coating.

(*c*) *Arc-welding Electrodes*.—For arc welding, a wide variety of electrodes is available. These include flux-coated dead-mild steel (*e.g.*, Institute of Welding/B.E.A.M.A. Classification E.527), nickel-iron alloy, stainless steel, nickel-copper and pure nickel. The commonest electrode for arc welding is that known as a "nickel" or nickel-alloy rod, which, in fact, has a core wire of a nickel copper alloy. Electrodes based on pure nickel are now also established. All the above electrodes are flux coated. Tin-bronze and aluminium-bronze electrodes are also used for welding cast iron.

In arc welding, a dead-mild steel coated electrode, specially made for welding cast iron, may frequently be used to form the major portion of the joint; the weld may be completed by surfacing with a rod to give colour match, machinability or other properties to this part of the weld.

(IX) Fluxes

A good flux for welding cast iron should perform the following functions:—

(1) Clean the metal surface.
(2) Protect the metal from oxidation during welding.
(3) Dissolve oxides and other impurities.
(4) Improve the fluidity of the weld metal.
(5) Prevent loss from the molten metal of volatile constituents.

Fluxes are usually supplied in powder form, but for arc welding suitable fluxes are almost always present as coatings on the electrodes.

(X) Preparation of Castings for Reclamation

(*a*) *General*.—The defect and the surrounding area must be thoroughly cleaned prior to any welding operation. This includes the opening up of any cavity and the removal of any sand and scale therein. The operation may be effected by chipping, grinding, machining or flame gouging. The last method should not be employed unless the casting is first pre-heated, at least locally, and the gouging must be followed by suitable cleaning methods (*e.g.*, grinding) to remove the oxide formed on the gouged surface.

For explanations and illustrations of the terms used reference should be made to B.S.499 (Glossary of Welding and Cutting Terms).

The type and extent of cleaning required will, of course, depend on the nature of the defect to be repaired, or method to be used. If blowholes are present, the defective area should be chipped out. For dirty castings—that is, castings contaminated with sand or slag inclusions—the defective material should be removed until clean metal is exposed. If the casting in the area of the defect has become contaminated with oil, it is necessary to clean the casting with paraffin, and then to heat the casting in that area to a temperature of at least 300 deg. C. to remove the remaining oil.

It cannot be too strongly emphasised that proper preparation is essential before any type of reclamation, and must be carried out thoroughly,

Reclamation of Grey-iron Castings

otherwise the repair may prove unsatisfactory (see B.S.499, revision and new specification to be published).

Cracks should be veed, after holes have been drilled immediately beyond the ends of the crack to prevent its spreading further. The shape of the groove for the welding of cracks should be such that the filler metal can be applied satisfactorily, that is, the groove should be of sufficient width, the sides should slope outward from the base and the ends of the groove should have a slope of approximately 45 deg. to permit reasonable accessibility. For oxy-acetylene welding, vee preparation for cracks, etc., is not required where the section thickness is less than 3/16 in. Over 3/16 in. a vee preparation is required. For arc welding a vee preparation is required for all thicknesses up to ½ in. Where both sides are accessible in sections over ½ in., a double vee preparation should be used, the angle of the vee should be from 70 to 90 deg. With thickness greater than about one in., it is preferable to use a U preparation, with the walls sloping at about 20 deg. instead of the vee preparation.

(*b*) *Pre-heating.*—In all pre-heating of iron castings, whether locally or general, it must be realised that temperatures in excess of 600 deg. C. will cause major structural change in the metal, with deterioration of mechanical properties in the casting as a whole. Such possible loss of strength through pre-heating must be taken into consideration, especially in connection with high-duty iron castings. Where maximum mechanical strength must be retained, therefore, care should be taken that a temperature of 600 deg. C. is at no time exceeded. For bronze welding, lower temperatures (*e.g.*, 400 deg. C.) are satisfactory and, indeed, desirable.

Electric-arc welding and bronze-welding methods are usually employed in conditions where total pre-heating is not possible, or is limited to temperatures much lower than those given above. It is preferable not to weld a cold casting; wherever possible, therefore, it should be warmed by gentle heating before welding. In the case of difficult repair jobs, however, local pre-heating by blowpipe methods can be used in conjunction with arc welding, but once again precautions must be taken to see that the castings are not over-heated.

For local pre-heating for small jobs, gas blowpipe or burner methods may be used in combination with a temporary chamber built around the defect and constructed from brick and asbestos. Care should be taken that the heating flames do not impinge directly on any part of the casting. For more important work, such as extensive fractures, the whole casting, or, where this is not possible, a considerable section of it, should be heated by a charcoal fire in a brick chamber, as by this means a more uniform temperature can be maintained. The welding should be done in the fire and, when it is completed, the casting should be covered with asbestos sheet and left to cool, as the fire dies out, right down to room temperature.

The greatest care should always be exercised in heating the casting so as to avoid the development of severe stress, due to sudden local heating, especially in complicated castings. More cracks are extended and more new cracks are formed during careless heating than are ever developed in the casting during cooling after welding.

In conjunction with the preparation of castings and pre-heating, jacks or wedges may be employed to open the fracture prior to welding. These must be inserted with care to avoid further damage to the casting, and must be removed immediately welding is completed, so that there may be unrestrained contraction of the casting.

During pre-heating all machined surfaces may be protected against scaling by smearing them with a graphitic compound bound with grease, but it is not possible to preserve machined surfaces fully when pre-heating temperatures of the order of 500 deg. C. and over are used.

(XI) Procedure for Repair and Reclamation of Castings by Welding

(*a*) *Oxy-acetylene Fusion Welding with Ferrous* (*cast iron*) *Filler Rod.*—The instructions supplied for the operation of blowpipes should be strictly adhered to in order to maintain the proper conditions for welding. Careful control over all the factors involved is essential if proper welding temperature and conditions are to be maintained. A strictly neutral flame of sufficient size to obtain full fusion of the metal is recommended. If necessary, the flame should be adjusted to a neutral condition from time to time during the welding operation.

All welds should be completed in one pass where possible. Where superimposed runs are necessary, each run should be made in short stages of not more than 2 or 3 in. As already indicated, local or general pre-heating is necessary with this method of welding, in order to get approximately uniform expansion throughout the whole section being welded, to avoid additional fractures from sudden local expansion produced by the application of the blowpipe flame, to assist in maintaining fusion and the desired welding conditions, and to minimise the formation of hard spots by slowing up the rate of cooling. A fairly large molten pool of metal should be maintained during welding. A small weld pool usually denotes lack of heat. Castings which have been totally pre-heated should, wherever possible, be welded in the furnace with the furnace heat maintained.

The parent metal should be brought to a state of fusion at the point of welding before adding the filler rod, and the molten pool, created by blowpipe manipulation, should be of sufficient size to melt the filler rod without direct flame application to the rod, and on no account should metal be melted off the rod and allowed to drop into the pool. It is desirable to keep the rod immersed in the molten pool and to rub the sides of the vee with it gently at intervals, and thus agitate the pool slightly in order to release entrapped gases and impurities. This should be done without causing unnecessary turbulence by vigorous puddling. The rod should from time to time be removed from the puddle and plunged into the flux and again submerged in the puddle and rubbed gently on the sides and bottom of the vee to maintain good fluidity and help to bring entrapped impurities to the surface of the molten metal. This will ensure satisfactory fusion of the filler metal to the parent metal.

Hard spots may be caused by insufficient pre-heat or by sudden cooling of the weld puddle by the immersion of a cold filler rod. The end of the rod should, therefore, be pre-heated by laying the end of it in the line of the weld a little in front of the blowpipe or by warming it in the pre-heating fire before use. Careless manipulation of the blowpipe which allows the inner cone of the flame to touch the surface of the molten pool is also liable to cause hard spots.

(*b*) *Oxy-acetylene, Non-fusion Welding.*—Bronze welding can satisfactorily be accomplished if the parts have been properly cleaned, as referred to in paragraph VIII. Bronze welding is carried out at approximately 850 deg. C., and is recommended where it is not possible to pre-heat the casting to so high a temperature as for fusion welding. Generally speaking, localised or general pre-heating to a temperature of 400 deg. C. is recommended.

A specially prepared flux must be applied to the whole of the surface prepared for welding so as to minimise the oxidation which occurs during pre-heating. The casting at the point at which welding is to commence should then be heated to approximately 850 deg. C. The end of the bronze welding rod is warmed by the blowpipe flame and is then dipped into the flux. The rod is then heated by the flame, and the melting end of the rod is allowed to touch the heated surface of the casting. The molten bronze should, if conditions are correct, spread out and wet or "tin" the parent metal. If tinning does not take place, the conditions are wrong and a successful weld cannot be obtained. If conditions are satisfactory, "tinning" will continue automatically as welding proceeds. This "tinning" is most important and is the secret of successful bronze welding.

As "tinning" proceeds, more bronze is added, until the vee, or defect, is filled up. For lighter sections, the groove is filled as welding proceeds, but for heavier sections, a second or third pass may be necessary to build up the weld to full thickness. The temperature of the parent metal is maintained by means of the blowpipe.

(*c*) *Metallic-arc Welding, with a Ferrous Electrode.*—This method may be employed where machinability of the finished weld is not required. It can also be used for filling the main part of welds which are subsequently to be completed with a nickel or other non-ferrous electrode which gives the necessary machinability and colour match, where these are required.

It is recommended that the smallest gauge electrode suitable for the job on hand should be employed, so that the casting is not heated more than is necessary, and that light peening* immediately after welding should be carried out to minimise the build-up of internal stress. "Buttering" or pre-coating, that is the coating of the surfaces of the joint with weld metal, prior to the actual filling of the weld joint, is recommended.

Arc welding with ferrous electrodes is also sometimes used on massive castings, if adequate pre-heating can be effected; large electrodes are used and the operation is followed by slow cooling. Suitable welding currents are recommended by the makers of the electrodes.

(*d*) *Metallic-arc welding with Non-ferrous Electrodes.*—Non-ferrous electrodes of the nickel and nickel-alloy type are those most commonly used for the arc welding of cast iron. D.c. or a.c. welding should be used in accordance with the instructions supplied by the electrode makers. Peening, to minimise contraction stresses, should be carried out with care, since peening at certain critical temperatures can cause cracks. Short beads of weld metal are often employed in conjunction with rapid peening, rather than the deposition of long beads followed later by peening. Tin-bronze and aluminium-bronze electrodes as mentioned in paragraph VIII (*c*) may also be used.

As with the ferrous electrodes, it is preferable to coat the two faces of the joint with weld metal before filling in the body of the weld, that is, to use the "buttering" process. This method ensures complete bonding between the cast iron and the weld metal.

If pre-heating has been used and the joint is not rigidly restrained, continuous welding can be employed. If a fully machinable weld is required and pre-heating is not carried out, then the welding should be in short runs not exceeding 3 in. long, and the weld metal should be lightly peened to minimise internal stress and allowed to cool before further weld metal is deposited. A reinforcing layer should be deposited on the weld metal after the weld has been built up to the general level of the casting. This is to ensure that there is sufficient metal for machining and to temper any hardened zones that may have been formed at the surface of the casting. This final layer must not overlap on to the cast-iron parent metal, or fresh hard zones may be formed.

(XII) Precautions to Maintain Dimensions and Alignment

Distortion caused by welding is due to volume changes in the applied weld metal on cooling and possibly to over-heating of the casting under repair. When full pre-heating is applied, distortion also may follow the sagging or flow of the casting under any applied stress, or even under its own weight.

Precautions to be taken during welding, therefore, include such items as the full support of castings during pre-heating and the holding of parts adjacent to the weld to restrict their movement during, and immediately after, the welding

* Peening is defined as striking the surface of the fresh weld metal with a large number of rapidly repeated light blows, *e.g.*, with the hemispherical end of a peen hammer.

Reclamation of Grey-iron Castings

operation. It should be noted, however, that total restraint should be avoided. Bolting, clamping or plating may also be necessary to maintain the alignment of fractured parts during repair. The use of wedges or the heating of other members of the casting may also be required for assisting the maintenance of dimensions and alignment. All such aids should be removed immediately welding is completed. In clamping or supporting the casting during welding, every care must be taken to check dimensions—*e.g.*, sizes between holes. Tack welding must be used with caution, since incorrectly-placed tack welds may be under severe stress during the welding operation and are likely to fracture before being incorporated in the main weld.

(XIII) Post Treatment

Castings welded after being pre-heated in a furnace should be slowly cooled and not withdrawn from the furnace until they have cooled to a temperature of at least 250 deg. C. or, preferably, to room temperature where this is possible. Post-heating to minimise internal stresses is desirable. Re-heating for stress-relief treatment should not exceed 600 deg. C. owing to the danger of structural change in the parent metal. Some degree of stress relief is obtained by heating to lower temperatures, *i.e.*, in the range of 450 to 500 deg. C. If stress-relief treatment is applied to castings which have been welded after only light preheating, the subsequent heating should be gradual so as to prevent unequal expansion in adjacent sections and possible cracking as a result. The degree of stress-relief heat-treatment applied will, of course, depend on the extent of the welding operation carried out, the general nature of the casting in question and, particularly, upon the conditions of service for the casting.

(XIV) Inspection of Welds

The inspection of castings repaired or reclaimed by welding methods should cover both the weld metal and those parts of the casting affected by the weld. The first inspection should be for cracks. A small lens will assist visual examination. The use of the chalk-paraffin method is probably the most satisfactory way of determining whether fine cracks are present.

The magnetic method of crack detection, whilst of assistance on repairs in which the weld metal has the same magnetic properties as the grey-iron casting, must be used with reserve on castings in which the weld metal differs from the base metal, *e.g.*, arc welds with non-ferrous electrodes. X-ray and radium inspection can also be used where the casting section is suitable.

Where the form of casting permits, pressure tests such as hydraulic tests, or an air test carried out under water, may be employed to check the soundness of welds.

Where the repair has to be machined after welding is completed, the hardness of the weld and adjacent metal may be estimated with a file, or by indentation with a centre punch. Light hammering, with a pointed hand pick, will enable any marked unsoundness to be readily detected. In addition to the above, any tests for the inspection of welds specified from time to time by the British Standards Institution should be applied.

(XV) Mechanical Properties of Welds

The mechanical properties of welds in grey cast iron have been determined by a number of investigators, mainly by transverse and bend deflection tests. The statement was made as long ago as 1933, at the American Society for Testing Materials Symposium on Cast Iron, that properly-made welds in grey cast iron have practically the same strength as the base metal, and the results of tests carried out before and since support this statement. It must be emphasised that the statement only applies to properly-made welds, prepared as set out in this code of practice and which have been examined and found to be free from defects.

The strength in tension of the weld-metal deposits prepared by any of the methods is as high or higher than that of the base cast iron. The interface between the weld metal deposit and the original base cast iron also has adequate strength both when the weld metal is cast iron and also when mild steel and non-ferrous alloys are used as the weld metal deposits. Brittleness in the weld metal deposit can result from contamination of this metal by elements picked up from the cast iron, and this is particularly the case if carbon is picked up by mild steel, or if sulphur and phosphorus are taken up by non-ferrous alloys, where the base cast iron is high in these elements. Such brittleness may result in a loss of effective strength in tensile or transverse loading. Reference should be made to the clause on "The Effect of Composition of the Cast Iron on Weldability," for further information.

The heating of the original casting which occurs during welding can affect the strength of the cast iron, particularly near the weld. Where full pre-heating is used, as with oxy-acetylene welding using cast-iron weld metal, annealing of the cast iron can occur, with some reduction in the tensile strength of the casting. There have been some cases, however, where the combined annealing effect of the pre-heating and the welding has conferred a small increase in strength, probably due to stress relief. To a lesser extent, the same will occur with bronze welding.

On the other hand, some hardening of the cast iron adjacent to the weld occurs when arc welding is used with any type of electrode, although this can be minimised by the procedures set out in the code. With this local hardening, the cast iron may be more brittle in these heat-affected zones than when it is unaffected.

SECTION B. RECLAMATION OF IRON CASTINGS BY "BURNING-ON"

"Burning-on" may be considered as a special form of welding. It consists in adding molten metal to a casting in the foundry under such conditions that the molten metal is fused to the surface of the casting, and on solidification effectively adds to, or replaces, some of the metal of the parent casting. The general remarks under paragraphs I to VI of this Code of Practice apply to "burning-on" methods.

In considering the choice between "burning-on" or welding for the reclamation of castings, consideration must be given to the facilities available and, in particular, to the provision of an adequate supply of molten metal of suitable type for the "burning-on" operation. The heat involved in this method is considerable and may lead to serious thermal stresses in the casting, which might cause failure. "Burning-on" must, therefore, be used with caution on complex castings, and especially on castings with marked variation in sectional thicknesses, and normally should only be considered for locations where there is little restraint.

"Burning-on" is more suitable than welding where a substantial quantity of metal must be added to a casting, *e.g.*, to replace a part broken off. Due to the conditions under which "burning-on" must be carried out, this method is also usually confined to non-repetitive repairs.

(XVI) Metal for "Burning-on"

To avoid chilling and undue brittleness in the "burnt-on" portion of the casting and surrounding parent metal, it is recommended that a medium- to high-carbon, high-silicon, low-phosphorus iron should be used. For burning of high-duty iron castings, metal of alloyed compositions may be used. It should also be noted that high-sulphur metal should be avoided unless sufficient manganese is present to neutralise the effects of this element. Alloy additions in the ladle are, however, not recommended in this case as metal of the maximum possible temperature must be employed, such as is obtained direct from the melting furnace. The alloy content must also be so adjusted that no danger of chilling arises.

High metal-temperatures are essential in order to ensure good penetration and rapid melting of the surface of the iron casting which is to be "burnt," and metal at a temperature of at least 1,350 deg. C. should be employed and kept free from slag by skimming.

(XVII) Preparation of the Casting

(*a*) *General.*—The general principles for the preparation of the casting for "burning-on" are broadly as set out in paragraph VIII(*a*) of this Code of Practice. As in the case of preparation of castings for welding, all dirty areas must be removed and a clean face of metal must be presented for the repair. The usual methods, such as shot blasting, grinding, chipping, and flame gouging, may be used. Blowholes, drawn or porous areas and gas-holes, are opened up and, if defects are numerous over the surface, the bad section is cut away.

Dirty castings must be completely cleaned before burning. Cracks are preferably opened to ¼ in. wide, and drilling the ends of a crack helps to prevent it from spreading. Broken sections may be treated in a similar manner to a crack, and the broken section may be fused on to the parent casting or, alternatively, an entirely new piece may be "burnt-on."

(*b*) *Position of Casting for "Burning-on."*—When the defective or damaged part has been cleaned, it is necessary to decide how best to place the casting so as to facilitate subsequent operations, bearing in mind, particularly, that the part to be "burned" should be in an accessible position for easy pouring of the metal and that the added metal should lie horizontally during cooling. In some cases this may be best achieved by embedding the casting in the sand floor of the foundry, with the part to be "burned" at ground level; in others, it may be that its enclosure in a moulding box will be more suitable. In all cases, however, it is advisable to cover up the main body of the casting as much as possible in order to avoid rapid cooling after the "burn" has been made.

(*c*) *Preparation of Mould.*—A temporary mould is built around the part to be repaired, roughly to form the shape of the section of metal to be added to the casting. Since in "burning-on" a considerable quantity of metal must be made to flow through the mould in order to ensure fusion of the face of the parent casting, the parts of the mould in contact with the metal must be highly refractory. This may be achieved by building the mould with suitable well-bonded moulding sand or from fireclay backed up by moulding sand. The mould must be prepared to direct the flow of metal on to the face of the casting to be "burned" and must provide suitable flow-offs for maintaining an adequate volume of molten metal. It must also incorporate any heads or extra metal necessary to ensure soundness of the repair, and an adequate thickness of metal to permit satisfactory cleaning up.

Before "burning-on" is commenced, steps must be taken to ensure that the mould is thoroughly dry, but this will generally be adequately ensured by the pre-heating treatment referred to next.

(*d*) *Pre-heating.*—The casting in the region to be "burnt" should be pre-heated to a temperature not exceeding 600 deg. C. This temperature is recommended to avoid thermal-shock effects in the casting. The body of the casting should in many cases also be pre-heated (though this may be to a lesser temperature) to avoid strain during the "burning-on" process. The extent of general and local pre-heating will depend on the dimensions and form of the casting being treated, but with large castings it is an advantage to carry out the "burning-on" operation, if possible, while the casting is still warm in the mould. Precautions must, however, in this case be taken to allow dimensional changes in the casting to take place freely, *e.g.*, cores should be eased or removed.

Pre-heating methods also depend on the nature of the repair job in hand. Frequently open coke fires may be used, but more satisfactory methods include the setting of the casting in a moulding box, in connection with which a stove may be used to attain the temperature required. Pre-heating is also usually aided by casting dummy pigs of iron in suitable locations around the part to be repaired.

(XVIII) "Burning" Operation

When the mould and casting are suitably prepared and pre-heated, the "burning" operation is carried out by pouring molten metal through the mould. It is recommended that pouring should start slowly and then be built up to a steady stream. Pouring is continued, excess metal passing to the flow-off until the surface of the parent casting is fused, as judged by a suitable prod or by the cessation of the release of gas from the molten metal surface. Care should be taken that pouring is not unduly prolonged, such a precaution minimises possible damage to the parent metal by over-heating. When it is judged that fusion of the parent metal is sufficient, the "burn" is covered with sand or coal dust to retard cooling. It is recommended, also, that a number of red-hot pieces of iron from the run-off troughs or pigs be placed around the burn.

In the case of deep cracks, care must be taken to ensure that the molten-metal stream penetrates to the full depth of the repair. This is often ensured by employing two or more "flow-offs" at different levels, the lowest being closed only after fusion at the bottom of the repair has been effected.

(XIX) Post-treatment of Castings after "Burning-on"

(*a*) *Stress Relief.*—All castings should be given a stress-relief heat-treatment after "burning-on." It is advisable to commence this heat-treatment, if possible, before the burn has cooled down, and certainly before any attempt at cleaning has been made. Stress-relief heat-treatment should be conducted at a temperature between 500 and 600 deg. C., and care should be taken that the latter temperature is not exceeded, as this might lead to deterioration of the properties of the metal of the parent casting.

(*b*) *Cleaning.*—A burn may be cleaned and finished by any of the conventional methods such as chipping, grinding and machining.

(XX) Inspection after "Burning-on"

The finished repair job should be inspected especially for cracks using normal methods, including visual inspection, magnetic methods, etc. Inspection for cracks should not be confined to the immediate area of the burn, but should also extend to adjacent areas, where, through change of section or from other causes, cracking might have occurred due to the thermal stresses involved in the "burning-on" treatment.

(XXI) Mechanical Properties

The mechanical properties of the burn should not be inferior to those of the parent metal if the correct procedure has been carried out.

APPENDIX

Effects of Elements on Weldability of Iron Castings

Carbon.—The total-carbon content, within normal limits, does not materially affect the facility with which welding of iron castings is carried out, but the proportion of "combined" to "graphitic" carbon, and the nature of the graphite, both affect this aspect of weldability. Coarse graphite makes bonding difficult, particularly with bronze welding.

A casting having a fully-pearlitic matrix tends to harden close to the weld more than one with low combined carbon, but the size of the graphite flakes does not materially affect the extent or the nature of the changes occurring in the zones of the casting adjacent to the weld.

Silicon.—Up to about 2.5 per cent. silicon does not appear to hinder welding. The silicon oxidises on the faces of the joint, and the silica so formed makes most welding fluxes more viscous.

Manganese.—Manganese up to about 0.9 per cent. has little effect on welding, but welding is more difficult with higher contents. Manganese neutralises sulphur to form manganese sulphide which passes into the slag, and in this way tends to produce a less-brittle weld metal. Manganese increases the hot strength of the weld and its resistance to shrinkage cracks.

Sulphur.—Sulphur increases the fluidity of the weld metal, and combines with manganese to form manganese sulphide. A high sulphur content makes both the weld metal and the heat-affected zones brittle. This embrittlement is more pronounced when mild-steel or nickel-alloy arc-welding electrodes are used than when the weld metal is of cast iron or bronze.

Phosphorus.—Phosphorus forms a eutectic, with a melting-point appreciably below that of the cast iron and a high phosphorus content is more liable to give cracking in the weld, particularly with deep-fusion methods, or when arc-welding is used.

Nickel.—Nickel up to about 2.0 per cent. assists welding, although this may be due to the effect of the nickel on the matrix of the iron structure and to the graphite size rather than to its effect on any oxides formed on the prepared surface, or on the fluidity of the weld metal. Nickel, like manganese, increases the hot strength and resistance to shrinkage cracks in the heat-affected zones of the casting; in this respect, however, nickel is less potent. Nickel increases the tendency of cast iron to harden on rapid cooling.

Copper.—Copper does not affect the ease of bonding with the cast iron. In percentages up to 1 per cent., copper will not greatly increase the maximum hardness in the heat-affected zones.

Chromium.—This element forms a refractory oxide, and the presence of this oxide hinders satisfactory fusion with the base material unless a very efficient flux is employed. Chromium also forms a carbide, and its presence in the iron casting will increase the liability of hardening in the heat-affected zones. In this respect it is more potent than nickel or manganese.

(*Continued on page* 216)

The "Abreuvage" Defect

WE ARE NOT too satisfied with this caption. It is a quasi translation from the French of "*Les Noyaux Abreuvés,*" and appears in a special number of the *Journal d'Information Techniques des Industries de la Fonderie,* issued by the "*Centre Technique.*" It seems that a founder having difficulties during the casting of a machine-tool component put his case before the raw-materials section. In spite of a dressing, the metal had entered the interior walls of the core. How could this fault be remedied? The raw materials section has given a detailed study as to the causes of this phenomenon and the means for its avoidance. It is necessary first of all to distinguish between true "*abreuvage*" on the one hand and an actual mixture of sand and metal on the other.

"Abreuvage"

Definition.—"*Abreuvage*" is defined as a penetration of the metal by capillary action into the spaces existing between the grains of sand in the core, which are the natural interstices corresponding to the grain size of the sand or perhaps accidental voids of small depth starting from the surface of the core. "*Abreuvage*" can be due to physical causes, more or less connected with refractoriness, or mechanical causes.

Physical Causes

(*a*) *Fusibility.*—It is naturally desirable to utilise the most highly refractory possible, but besides it is quite evident that at the moment of casting, the smallest sand grains are rapidly melted and thereby create voids of which the volume will be further reinforced by the melting of the larger grains. The cure under these conditions is to use a sand of much larger grain size—a remedy which unfortunately is not compatible with the following observations.

(*b*) *Capilliarity.*—The liquid metal evidently only demands that the natural void appear on the surface. To limit this phenomenon an initial attempt is made to reduce the natural voids between the grains either by using a finer grain of sand or one of mixed grain size. Moreover, it is the usual practice to add a dressing which for cast iron is either a graphite or a carbon "compound." Each time that it is deemed useful considerably to reinforce the resistance to metal penetration, it is desirable to resort to the following technique. First a special preparation which will penetrate the surface of the core for a certain depth. This property is due to the presence in the dressing of materials which lower the surface tension of the aqueous medium. By this means, the sand is impregnated to a depth of several millimetres. Then the core is coated with the usual dressing.

Mechanical Causes

(*a*) *Existence of Accidental Voids in the Sand.*—Accidental voids are attributable to ramming conditions or to the use of a sand too low in plasticity. Maximum compaction will be achieved by choosing as a base sand one which has rounded grains and incorporating therein a relatively fluid bond; the ramming of this sand must be hard and regular.

(*b*) *The Formation of Cracks on the Surface of the Mould.*—Cracks which arise at the moment of casting may be due to expansion, because the means of access already dealt with under "abreuvage." These cracks can be related either to the dressing or to the adjacent core skin. As for the dressing it may be useful to recall that this is not really effective unless it is of uniform thickness, since it has a tendency to crack on contact with the metal, because of the differences in expansion between the zones of thick and thin thicknesses of this skin. To ensure a good result the means of adding a coating was set out in the following order of preference:—spraying, dipping and brushing.

So far as the core itself is concerned, cracks, of which the depth can reach several millimetres, sometimes show up on casting, and they are due, for the major part, to over-ramming of the core. However, a sand made up of uniformly rounded grains rams easily and gives a very compact core. From the regular build-up of the grains, such a core cannot of itself withstand the marked expansion to which it is subjected during its brutal heating during casting. The effect of this expansion becomes more marked as the grain size becomes more uniform. The cure for this difficulty is to utilise a sand of variable grain size or an addition of silica flour to a sand of uniform grain size. In addition to their ameliorative action already pointed out, the fine grains act like wedges placed indiscriminately between the larger grains, which gives a certain amount of "play" to the latter.

Mixture of Sand and Metal (Core Scab)

Definition.—This refers to an intimate mixture of the metal and the sand so as to form a veritable conglomeration, very profoundly affecting the core.

Causes and Cures.—This phenomenon is possible due to one or other of the following conditions being present:—perhaps the breaking into the mass of the core by the liquid or perhaps the creation of large voids between the grains of sand. The causes of such behaviour are diverse.

Lack of Hot Strength.—If the temperatures for the breakdown of the bonding agent is sufficiently low, its premature disappearance involves that the core is eventually replaced by a mass of free sand possessing no cohesion whatever.

Creation of Large Voids

(*a*) *Combustion of Organic Matter.*—If the core making sand contains too high a proportion of organic matter (bond core gum and the like) its burning out can be associated with the formation of large voids.

(*b*) *Distortion of the Mass of the Core.*—(1) The natural expansion of the core. The influence

The "Abreuvage" Defect

of compaction to incorporate within the core a proneness to expansion has been indicated earlier. (2) Creation of an abnormal pressure between the grains of the sand when it is a question of setting cores partly surrounded by metal in a casting of heavy section, it is as well to take account of the following phenomena:—At the moment of casting, the organic constituents of the core are decomposed by the heat and immediately start to burn in the presence of oxygen supplied by the air contained in the core on coming from the mould. When the core is completely surrounded by metal, the combustible gases are forced to find a passage through the grains of sand; they deposit carbon because of the impossibility of their being burnt because of the lack of oxygen. This ever-increasing deposit exercises a pressure between the grains of sand and this phenomenon has the effect of splitting the core, following well-defined cleavage planes, into which the metal can penetrate. To cure this defect, especially in core sands containing an organic constituent, it has been thought wise to add iron oxide to the extent of one to two per cent., which furnishes sufficient oxygen to ensure the combustion of the gases set free at the moment of casting.

Examination of the Particular Case Submitted by the Founder

The details sent to the "*Centre Technique*" strongly suggested that the phenomenon encountered was "*abreuvage*." A sample of the sand used for the making of the cores was submitted and showed upon analysis the following properties:—Clay content—about 1.9 per cent.; A.F.S. Fineness Test number 38, with an adequate concentration of the grains on sieves numbered 30, 40, 50 and 70. A test showed that the softening point of the sand was higher than 1,500 deg. C. It was then possible to affirm that the sand used for the making of this class of core was certainly of too large a grain size. There also was need to use a better-quality dressing.

Conclusion

To obtain a maximum of satisfaction the following controls might usefully be established:—

Base Sand.—For those cores which will be entirely surrounded by a metal, it is suggested that a sand firmness number of A.F.S. 50 to 60 will be adequate.

Core-sand Mixture.—

Base sand, 100 parts by weight.
Silica sand, 5 to 7 parts by weight.
Linseed oil, 1.5 parts by weight.
Dextrine, 1.4 parts by weight.
Water, 1.5 to 2.0 parts by weight.

Dressing.—Any of the following mixtures—set out in order of preference—can be used:—

(1) Use specially prepared absorbent dressing, together with a top dressing of the type readily purchased; (2) use a dressing based on Italian graphite, the characteristics of which were set out in an article which was printed in *Fonderie* and translated in the FOUNDRY TRADE JOURNAL (page 160 and 161 of our issue of February 24, 1949), and (3) using a black-wash, the properties of which were set out in the October, 1947, issue of *Fonderie*.

[We regret that we have been unable to find a technical expression equivalent to the French word "*abreuvage*" and would welcome suggestions from readers.—EDITOR.]

Publications Received

Monel and Some Other High-nickel Alloys *versus* Sulphuric Acid. Published by Henry Wiggin & Company, Limited, Wiggin Street, Birmingham, 16.

The first section of this comprehensive brochure discusses the effects of temperature, aeration, agitation and acid concentration on the corrosion-resistance of Monel, nickel, Ni-Resist, Inconel and other nickel-chromium alloys, when attacked by straight sulphuric-acid solution.

The effect of reactions in which sulphuric acid is mixed in varying amounts with other chemicals is not readily predicted. Numerous corrosion tests have therefore been made in plant under actual operating conditions, and including widely varying processes.

Tube Works Gauges and Gauging Practice. Compiled by F. W. Clark. Published by Stewarts and Lloyds, Limited, Brook House, Upper Brook Street, London, W.1. Price 5s.

This book, of an elementary character, has been prepared for use by the company's trainees. Devoid of mathematical formulæ, it introduces the reader to the tools of the trade and the method of use. There are two appendices, one being a collection of definitions and the second notes on tolerances as set out in the standard specifications.

Memorandum on Faults in Arc Welds and Mild and Low-alloy Steels. Published by the British Welding Research Association, 29, Park Crescent, London, W.1. Price 2s. 6d.

In this memorandum typical faults which can occur in arc welds in mild and low-alloy structural steel construction are defined and illustrated; an outline is given of the reasons for their occurrence, and of the ways in which they may be avoided and corrected.

Reclamation of Grey-iron Castings

(*Continued from page 214*)

Molybdenum.—Like chromium, molybdenum forms an oxide which tends to hinder the formation of a satisfactory bond between the weld metal and the base casting. The amounts present in grey-iron castings are usually small, however, and the effect is not marked. Cast irons containing molybdenum are more liable to harden in the heat-affected zones than are molybdenum-free irons.

Note.—The above statements on the effects of elements on the ease of bonding during the welding operation on cast iron apply primarily to fusion welding. Some of the adverse effects can be appreciably offset by the use of a suitable flux (see paragraph X). It should also be noted that the effects of elements on the structure of the metal adjacent to the weld will be minimised by heat-treatment such as pre- or post-heating.

Carbon Control of Cupola-melted Irons*

By E. Bramble

ACCURATE CONTROL of carbon in melted cast iron is one of the greatest contributions a metallurgist can make to uniformity of casting characteristics and machinability. The principal factors affecting carbon content are:—(1) Composition and type of materials charged; (2) method of charging; (3) height of coke bed above the tuyeres; (4) amount and type of coke used between charges; (5) volume and pressure of air blown into the cupola; (6) temperature attained in the cupola; (7) slag control and disposal; and (8) type and design of cupola used.

Composition and Type of Raw Materials

Steel

This must pick up carbon, either from the excess of the hematite iron or from the carbon in the coke. It is well known that steel can only be carburised in a cupola to a definite limit. This point is reached at 2.7 to 2.9 per cent. carbon and it is highly improbable that a much higher figure could be obtained.

Hematite

This usually contains over 3.5 per cent. carbon, and due to the influence of other elements during the refining and melting in a cupola loses part of its carbon as "kish" down to a definite amount. "Kish" is the metallurgical term applied to graphite which separates out of molten iron and floats to the surface. This separation does not occur with all irons but only under certain conditions of carbon content.

Cast-iron Scrap

In its very smallest form, such as, for example, borings, it is found that under the oxidising conditions of a cupola, carbon is burnt out of it and extra carbon to replace this loss is absorbed from the coke. This phenomenon occurs to a more or less degree with all scrap.

Obviously, then, one can, for the moment, by ignoring other factors, control the amount of carbon present in the iron by varying the compositions of the materials in the charge and the quantity of elements in that charge, and it is known from practice that the lower the amount of carbon charged in the mixture the greater the amount picked up or absorbed during its passage through the cupola.

The silicon content influences carbon pick-up, the low-silicon charges absorbing more carbon than the higher-silicon charges. Other elements have little influence. High manganese, however, tends to favour carbon absorption to a small extent, due to the fact that manganese has a greater affinity for carbon than the iron. About 0.5 per cent. carbon increase is obtained for each one per cent. of manganese present.

Method of Charging the Cupola

Practical observations have shown that carbon pick-up depends on:—

(*a*) *Level and uniform charging.*—Obviously, if the coke is spread evenly over the area of the cupola and the charged materials lie evenly upon it, carbon absorption must then proceed at an even and fast rate over the whole mass. This is proved conclusively when mechanically-charged cupolas are allowed to accumulate charges in heaps down the stack. The fluctuations in the final carbon content are really violent and the final results are generally lower in carbon than they should be.

(*b*) *The position of steel scrap in the cupola.*—Charging the steel scrap directly on to the coke generally results in higher carbon content than when the steel is charged last. This fact is usually taken into consideration when it is known that the type and method of operating the cupola under consideration gives high or low carbon content naturally and whether these carbons are required to be corrected.

For natural *low carbon* content the order of charging the materials into the cupola should be:—First, steel rail and spring, etc.; second, scrap; and third, pig-iron.

For medium carbons

First, half of the steel; second, pig-iron and scrap; and third, remainder of steel.

For high carbons

First, pig-iron and heavy scrap; second, light scrap; and third, light steel (*e.g.*, constructional or plate, etc.).

(c) Smaller metal charges and correspondingly smaller coke charges mean more contact of coke and metal surfaces, and consequently tend to give higher carbon irons.

(*d*) *Type of steel used.*—In using clean rail steel scrap, which has a carbon content around 0.6 per cent., obviously the charged carbon content will be higher than if steel containing 0.15 to 0.2 per cent. carbon were used. If the same amount were used in both cases, then foundrymen logically expect to obtain a higher ultimate carbon in the first case. This is what actually occurs, and so, from this it would appear to represent an economy in coke to utilise clean, high-carbon steel in the charge. In the case of rusty steel scrap, the rust (or oxide) must first be reduced to iron before the steel can be re-carburised and unless, therefore, more carbon is supplied in the form of a higher coke-to-metal ratio, the carbon content of the resultant iron will always be lower when rusty steel is used than when clean steel is used, all other factors being equal.

Height of the Coke Bed above the Tuyeres

Probably the greatest and most important factor concerned in carbon pick-up is the height of the coke bed. A reduction of the bed height due to scaffolding, excessive burning-out of the lining of the cupola, or patching collapse lowers the height of the coke bed immediately, and unless steps are taken to remedy these conditions the resultant metal tapped will be low in carbon. The addition of extra coke charges, which causes a sudden raising of the coke-bed height is not desirable, a steady increase with each successive charge being much better practice.

Type of Coke

Of equal importance to the amount of coke used in the cupola is the type which is used. Carbon pick-up is mainly influenced by:—(1) The size of coke used; and (2) the purity or composition of the coke. In general,

*An entry for a short Paper competition organised by the Lincoln branch of the Institute of British Foundrymen.

Carbon Control of Cupola-melted Irons

the smaller the coke the greater will be the surface area exposed for contact with the molten iron. However, there is obviously a limit to the smallness in size of the coke which can be used practicably. Very small coke materially alters air-blast conditions and may effect such a baffling of the blast that it may stop the blast entirely, or the coke may be blown out of the cupola stack.

Purity

In general, the higher the carbon content of the coke (provided sufficient air is supplied to the cupola to complete the gas reaction to form carbon dioxide), the hotter the melting-zone temperature and the higher the carbon absorption. Cokes having a high percentage of ash are not desirable, as they form viscous gummy slags, which cover the coke, thus reducing the reaction rate of the coke and also the rate of carbon absorption by the molten metal. Where coke carries a high percentage of ash, it will be found that if a proportion of soda ash be added to the limestone charge, a much more satisfactory performance of this type of coke is obtained. The adjustment of balance between the coke and the amount of air used is an exceedingly important point which has a bearing on carbon control. Coke in excess of the amount of air used tends to give high-carbon irons and air in excess of the amount of coke to give low-carbon irons.

Air Supply to the Cupola

The iron can pick up a high proportion of carbon in the upper section of the melting zone. High pressure of the air blast entering the cupola extends the zone of oxidation and during its passage through this zone carbon may be burnt out of the molten iron. The speed and velocity, *i.e.*, the pressure of the incoming air, if not reduced towards the end of the heat will produce low-carbon irons.

When the volume of the air blast entering the cupola is low, the temperature in the melting zone is reduced, and so a reduction in carbon pick-up is effected. When the volume is too high, free oxidation may occur in the melting zone, the time the metal remains in the melting zone is reduced and the atmosphere of combustion becomes highly oxidising, resulting in a decrease in carbon absorption.

Temperature Attained

This is a function of the efficiency of the reactions between the carbon of the coke and the oxygen of the air blast. The more completely the carbon is burned to carbon dioxide, the higher will be the temperature attained in the melting zone. The higher the temperature reached and imparted to the metal, the greater will be the carbon absorption as the molten metal falls through the interstices of the bed coke and lies in contact with it on collecting in the well.

Slag Control and Disposal

During the melting process in the cupola, oxide slags are formed by the action of the limestone added to the charge from the ash of the coke, rust, scale, dirt and sand adhering to the charged materials, as well as from the normal oxidation of silicon, manganese and iron. These slags are fairly viscous and, as has already been mentioned in this Paper, tend to stick to and cover up the surface of the coke, thereby lessening the amount of contact of the molten metal with the coke and hence reducing carbon absorption. Sufficient limestone to ensure a highly-fluid slag should therefore be used in the charge and the slag should be drawn off as formed by allowing the metal to rise to its correct level in the well of the cupola. This practice tends to keep the coke clean and hence increases carbon absorption. Another point in favour of a good fluid slag is that it protects pieces of steel from oxidation during the melting and thus assists in carbon pick-up by the steel.

Type and Design of Cupola

In comparing the melting performances of two cupolas of equal diameters, melting and being tapped at the same rate, with identical bed heights, using coke of the same quality and similar amounts between charges, and similar materials in the charge, it has often been noted that one cupola produces iron consistently softer and higher in carbon than the other. This simply means that the cupola giving high carbons is being operated under less oxidising conditions than the one producing low carbons, and conditions are more favourable to carbon pick-up.

Responsibility or the causes of this difference may be poor air distribution, high pressures and volumes of air delivered from the tuyeres or the degree of oxidation as drops of molten metal pass the tuyeres and drop to the well. Tuyeres designed in correct relation to the diameter of the cupola and of a sufficient number and so located as to ensure uniform blast distribution around the periphery have a marked influence in lessening oxidation and thereby increasing carbon pick-up.

Personal

COL. ARTHUR TERENCE MAXWELL, a director of Vickers, Limited, and the Steel Company of Wales, Limited, has been appointed as the new chairman of the Union Bank of Australia, Limited.

SIR TRISTRAM EDWARDS has been appointed a part-time member of The North-Eastern Electricity Area Board. He is chairman and joint managing director of Smith's Dock Company, Limited, North Shields, and a director of the Consett Iron Company, Limited, Consett (Co. Durham).

MR. A. J. BEELEY, a director of Plowright Bros., Limited, engineers, of Chesterfield, has been granted temporary leave to assist the Paul Weir Company, of Chicago, with a portion of their assignments as consultants to the Turkish Government. His appointment with Plowright Bros. is not in any way affected, and he will return to his normal duties in due course.

DR. F. C. LEA has resigned from the board of Edgar Allen & Company, Limited, the Sheffield steelmakers. An emeritus professor of Sheffield University, where he was Dean of the Faculty of Engineering from 1923 until 1936, Dr. Lea joined the Edgar Allen board in 1936. Previous to his appointment at Sheffield University, he was Professor of Civil Engineering at the University of Birmingham. Dr. Lea has agreed to act in a consultative and advisory capacity with the company.

DR. A. B. EVEREST is planning to attend the Italian National Foundry Congress to be held in Turin, October 13 to 15, in connection with an engineering exhibition. At that meeting he will present a Paper on "Progress in the Development of Spheroidal-graphite Cast Iron," and will also incorporate the Lloyds (Burton), Limited, film "And Now," which shows the production of this new cast iron. It is planned to repeat the lecture and film in Rome later in the month. Since the Buxton I.B.F. Conference he has also presented a lecture on cast-iron developments with special reference to spheroidal-graphite cast iron to a joint meeting of the Danish Foundrymen's Association and Institutions of Civil and Mechanical Engineers in Copenhagen.

Angle-iron Sides for Pattern Boards

By " Checker "

While in theory wooden pattern boards or plates should not require any reinforcement on their sides, it is nevertheless a fact that sometimes they receive such severe treatment on the parts which protrude beyond the outer edge of the moulding box, that additional strength has to be given to preserve them.

Any form of protection to be used should cover both the top face and sides of the board so as to ensure its being most effective, and for this purpose ordinary angle-iron of suitable section is ideal. Often, odd length of old angle iron which are considered as scrap are available, and these can be used quite satisfactorily. A suitable section size is 1½ in. by 1½ in. and of ¼ in. thickness for boards which are 1½ in. thick or over, but other sizes can be used providing they are not too clumsy, and the pieces should be of a reasonable length to cover most of the board's side, as shown in Fig. 1 (*a*). Angle iron can be firmly secured into position by using long screws of a good strength, placed at regular intervals through both faces, which, being at right angles to each other, thus give adequate support.

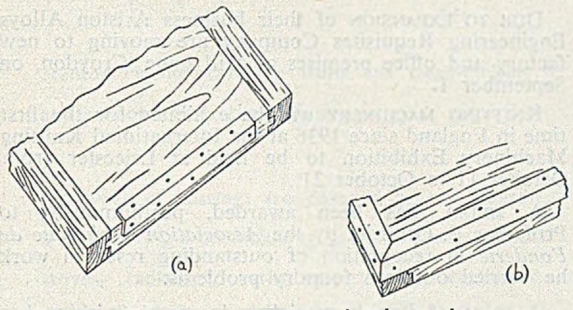


FIG. 1.—*Examples of Side and Edge-and-corner Protection of Wooden Pattern Boards*

Whenever possible, angle iron may be placed so as to stand above the surface, but where this will prevent moulding boxes being lowered to their correct position on the boards, the wood should be recessed to permit the angle iron to become level with, and form part of, the top face.

It may also on some occasions be an advantage to protect the corners of boards. This can be accomplished by using lengths of angle iron on sides and ends. A good joint is easily obtained by cutting at an angle of 45 deg. all ends which meet at the corners. thus obtaining a mitre joint, as illustrated in Fig. 1 (*b*).

F. Perkins's Australian Subsidiary

It is reported from Melbourne that F. Perkins, Limited, Diesel-engine manufacturers, of Peterborough, are considering the formation of an Australian company. At the outset, it is stated, the parent concern would provide the immediate finance required, and no public issue is intended at present. Mr. R. Perkins, son of the founder, is at present in Australia examining prospects.

THE RAILWAY EXECUTIVE have carried through a reorganisation of their district offices throughout England and Wales—Scotland was dealt with last year. Much duplication will be eliminated and a better service to the public should result.

Foundry Craft Training Centre

Mr. R. Forbes Baird has sent us a report by a layman, who was accorded permission to spend a week of his vacation in the National Foundry Craft Training Centre at West Bromwich. Omitting all the features of his report which are common knowledge in the foundry industry, there remain some of real importance. Primarily, there is adverse comment on the "unimposing" approach to the school. We agree that the school is not located in very charming surroundings. To the instructor, Mr. F. D. Roper, he accords enthusiastic approbation, alike for his teaching ability and personal charm. It is interesting to note that as an outsider, he received—very correctly—the impression that the most important factor in foundry practice is sand control. The homely confession that it took him three hours to produce one casting, of which the normal daily output expected from a 20-year-old apprentice would be twenty, emphasises just what the acquisition of skill entails. The hostel provided for the apprentices received enthusiastic comment from the visitor—management, amenities and cooking all received high commendation. This observant "holiday maker" rounded off his conclusions in the following statement:—

"The main object of investigation was to find out more of the craft from a practical angle in the foundry industry and to try and answer some of the questions regarding recruitment.

"Taking the simpler part first, the high degree of craftsmanship needed in the industry (excluding purely mechanised plants), is not understood by anyone who has not tried to do this particular craft; the work in all its phases is no dirtier than many tasks in general engineering and calls for an equal degree of skill and accuracy. The appeal of moulding, the use of sand, the production of a finished casting, have not been appreciated by the boy school-leaver. The heaviest and perhaps most dangerous part of the work is compensated by being the most glamorous—that is, the pouring of the mould—and this, of course, is not a continuous operation for the individual moulder. Summing up, the industry compares in most favourable terms with that of skilled engineering.

"The parental doubts regarding health have, of course, been answered by the medical profession, but personally it is felt the varied positions of the body in moulding would tend to improve physique rather than harm it. Increase in temperature of the work space when casting is noticeable but not intolerable, and lasts for only a short time during the day's work."

F.T.J. Prize Crossword Puzzle

The prize of two guineas for the F.T.J. crossword puzzle, printed in our issue of August 3, has been accorded to Mr. Paul M. R. Bower, of 120, Thorpe Road, Norwich, whose solution contained only two slight mistakes. He, like most others, forgot the little sequence "*bijou, caillou, chou, genou,*" etc., which the words taking *x* for the plural whereas other words, like *clou*, do not. Mr. L. W. Bolton, in a covering letter sent with his solution, suggests the clueing was too difficult. Judging by the paucity of the replies we must agree. In sending a cheque to Mr. Bower we offer him our warm congratulations.

THE MOND NICKEL COMPANY'S exhibit at the Society of British Aircraft Constructors' flying display and exhibition at Farnborough, September 5 to 10, demonstrates the use of nickel alloys in modern aircraft-engine construction.

"Manograph" Manometer

Details have been received from Fielden (Electronics), Limited, of Paston Road, Wythenshawe, Manchester, of a new type of manometer, known as the "Manograph."

For differential pressures below ¼-in. W.G., the manometer consists of two comparatively wide bore tubes. In one of the legs, there is a light metal float, which is kept away from the sides of the tube by fine ligaments. A flat electrode is mounted directly

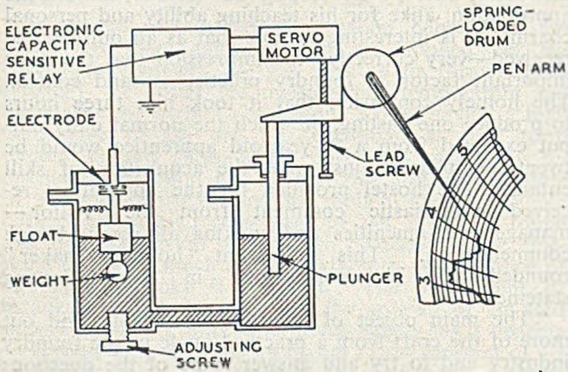


FIG. 1.—*Schematic Diagram of Manometer Recorder for small differential Pressures*

above the float and approximately 0.005 in. away from it (see Fig. 1). If the float rises or falls, the capacity between the float and the electrode is altered and the electronic circuit drives a plunger, in the other leg of the manometer, so as to restore the float to its original position. The movement of the plunger is then proportional to the change in pressure and this movement is transferred to the pen mechanism. The manometer liquid, in this case, could be water or any low-specific-gravity liquid.

It will be readily understood that if an instrument with this type of manometer is used, the differential pressure can be exceedingly small. This means that in normal flow, the pressure drop could be so low as to be almost negligible and it also makes the instrument suitable for recording low gas velocities.

The "Manograph" is housed in a cast-aluminium splash-proof case, suitable for wall mounting, and is operated from the normal 230-volts 50 cycle A.C. mains. The required pressure pipes are connected to the "Manograph" by standard pipe connections and the instrument is fitted with isolating and equalising valves.

Two other models are available for pressures up to 8 in. mercury at low, and up to 400 lb. per sq. in. pressures.

Wall Charts for Foundry Practice

The Council of Ironfoundry Associations, Crusader House, 14, Pall Mall, London, S.W.1, has in course of preparation a series of wall charts, which are designed to interest youngsters being trained in foundry practice. Sixteen are being prepared—perhaps a rather too lengthy list—and are available at the pre-publication price of £3 for member firms. The wall charts are correlated with the C.F.A. film strips.

TO ENSURE delivery before an expected rise in Italian import tariffs, the Jarrow factory of Foundry Specialities Limited, made 400 moulding boxes in ten days through the co-operation of the works consultative committee.

News in Brief

ACCORDING to Mr. P. Rigant, the cost in France of running a 20 h.p. motor is the same as the wages of one workman.

PLANS HAVE BEEN PREPARED by Densply, Limited, for the erection of a foundry shop at Coombe Road, Brighton, Sussex.

THE SHAW, SAVILLE & ALBION LINER Doric has been cleared from Middlesbrough with a consignment of nearly 6,000 tons of fabricated steel for Australia.

DOUGLAS FRASER & SONS, LIMITED, have had plans approved for additions and alterations at Westburn Foundry, Arbroath, at an estimated cost of £9,500.

DUE TO EXPANSION of their business Ariston Alloys Engineering Requisites Company are moving to new factory and office premises at Mill Lane, Croydon, on September 1.

KNITTING MACHINERY will be exhibited for the first time in England since 1936 at the International Knitting Machinery Exhibition to be held at Leicester from October 11 to October 21.

A MEDAL has been awarded, posthumously, to Professor F. Girardet by the *Association Technique de Fonderie* in recognition of outstanding research work he carried out into foundry problems.

A TEAM of British specialists in metal finishing has gone to the United States to study U.S. methods, the arrangements for the team having been made by the Anglo-American Council on Productivity.

ADPRINT, LIMITED, of Adprint House, Rathbone Place, London, W.1, have been appointed sole contractors for the sale of advertising space in all Festival of Britain official publications carrying advertisements.

DEMAG-ELEKTROSTAHL G.M.B.H. of Duisburg, Germany, have purchased from Siemens and Halske A.G. the whole of the latter's activities in the field of electric-furnace manufacture and intend to include this branch in their future manufacturing programme. The name of the firm has now been changed to Demag-Elektrometallurgie G.M.B.H.

A VANCOUVER REPORT states that a contract has been signed with Japanese steel mills for the shipment of a large tonnage of iron ore from the long-abandoned holdings on Texada Island, 50 miles north of Vancouver. The Japanese order is said to be "just an initial sale" and possibly the forerunner of a long-term contract involving the despatch of a freighter load of ore weekly.

A REPORT FROM TOKYO suggests that Japan plans to effect heavy increases in her iron and steel output as a result of the higher world demand and rising prices. following the Korean war. Next year's production targets, it is said, will be probably fixed at 2,800,000 tons of pig-iron and 3,500,000 tons of steel materials, compared with this year's targets of 1,920,000 tons and 2,500,000 tons, respectively.

BRITISH STANDARD 1589:1950, Thermal Insulating Materials (plastic composition, flexible and loose-fill) has recently been issued. It takes its place in a series for thermal insulating materials, the preparation of which was authorised by the Solid-Fuel-Industry Standards Committee on which the Institute of British Foundrymen is represented. This standard, along with B.S.1334, applies to central heating and hot- and cold-water services, both domestic and industrial. Copies may be obtained price 2s. post free from the British Standards Institution, 24-28, Victoria Street, London, S.W.1.

Recent Shipbuilding Orders

Among recent shipbuilding orders announced are the following:—

Harland & Wolff, Limited, Belfast—A cargo motorship, of about 10,000 tons dw., for the Lamport & Holt Line, Limited, Liverpool.

Harland & Wolff, Limited, Belfast—Elder Dempster Lines, Limited, Liverpool, have placed an order for two cargo motorships, of 7,500 tons dw. each.

Richard Dunston, Limited, Thorne, near Doncaster—An order for an all-welded motor tanker of 500 tons dw. has been received from the Esso Transportation Company, Limited.

Hall, Russell & Company, Limited, Aberdeen—Hvalfangerselskapet Polaris, A/S (Melsom & Melsom), Nanset, near Larvik, Norway, have placed an order for a whale-catcher, of 580 tons gross.

Grangemouth Dockyard Company, Limited—Two motorships, each of about 1,500 tons gross, for British owners, and a motor tanker lighter, of 400 tons, for the Anglo-Saxon Petroleum Company, Limited.

Lithgows, Limited, Port Glasgow—The British & Burmese Steam Navigation Company, Limited (P. Henderson & Company, managing agents) have placed an order for a cargo motorship of just over 10,000 tons dw.

Henry Robb, Limited, Leith, Edinburgh—An order from W. Holyman & Sons (Proprietary), Limited, Launceston, Tasmania, for a cargo motorship of 1,500 tons dw., for which Diesel machinery developing 1,280 brake h.p. is to be supplied by British Polar Engines, Limited, Glasgow.

Movement of Wholesale Prices

The following table, taken from the "Board of Trade Journal," shows the movement of wholesale prices of industrial and building materials, expressed as percentage increases on the average for the year 1930=100.

Group.	1949.	1950.					
	July.	Feb.	March.	April.	May.	June.	July.
Coal ..	305.3	305.3	305.3	305.3	304.7	300.7	300.7
Iron and steel	258.3	257.8	257.8	257.9	259.3	*260.7	261.3
Non-ferrous metals ..	220.2	276.8	274.3	377.6	292.2	319.1	325.8
Chemicals and oils	187.0	196.8	196.6	201.5	205.6	*207.0	211.8
Building materials	222.2	226.8	225.6	223.8	227.2	229.1	231.0

* The figure published last month has been amended. Amendments made earlier are not marked, but wherever the figures given in earlier articles differ from those above, the latter should be used.

South African Steel Output

Before July of next year South Africa would be able to rely on a million tons of steel annually from the local industry, said Mr. D. de Waal Meyer, Secretary for Commerce and Industries, when he spoke at the second annual dinner of the Steel and Engineering Industries Federation of South Africa, in Johannesburg. He said there was no reason why South Africa should not become a self-exporting country. The time was ripe to put the industry on a sound footing, and industrialists should now concentrate more on specialisation and methods of increasing productivity.

Commencing on October 3, weekly lectures on "Refractories, their Manufacture, Properties and Uses," are to be given by Mr. L. R. Barrett at the Northampton Polytechnic, London.

Infra-red Plant for Finland

An infra-red lamp plant, specially built by the General Electric Company, Limited, for the rapid stoving of paint on conduit tubing, has recently been exported to Finland for installation at the works of Finska Kabelfrabriken A.B. It has been designed to fit into a continuous production line in which the tubes are carried on a conveyor through the complete finishing process which includes automatic dipping, draining, flash-off, stoving and forced cooling. The plant comprises two opposing sections each 4 ft. wide and containing a total of 256 Osram infra-red reflector lamps, which are mounted in secondary reflectors of a special aluminium alloy to prevent loss of heat by stray radiation and to avoid the cooling effect of draughts. The work is suspended from an overhead conveyor, between the top reflectors, while inner reflecting surfaces are provided on the doors so that the plant may be used for batch production. Encased in sheet steel, each section of the plant is supported on an angle iron framework mounted on wheels to allow easy removal from the working position for cleaning and maintenance. Fume-extraction equipment is fitted in the plant. Stoving time is about 3 to 3½ min. for tubes from ½-in. to 2-in. o. dia. and up to 10 ft. long. The tubes can be passed through the plant in two or three parallel staggered rows when outputs of up to 900 lengths per hr. can be obtained. The total electrical loading plant is 64 kW., drawn from a 3-phase supply.

International Nickel's Earnings

Increased prices for refined nickel, announced by the International Nickel Company of Canada, Limited, at the beginning of June last, are reflected in the earnings of the company for the June quarter. Net profits for that quarter are given as $12,056,576 (US currency), equal to 79 cents per common share. This compares with $8,220,950, or 53 cents per share, for the corresponding quarter of last year and $8,329,015, or 54 cents per share, for the opening quarter of this year.

Net profits for the first half of this year were $20,385,591, equal to $1.33 per common share, compared with $20,983,417, or $1.37 per share, in the first six months of 1949.

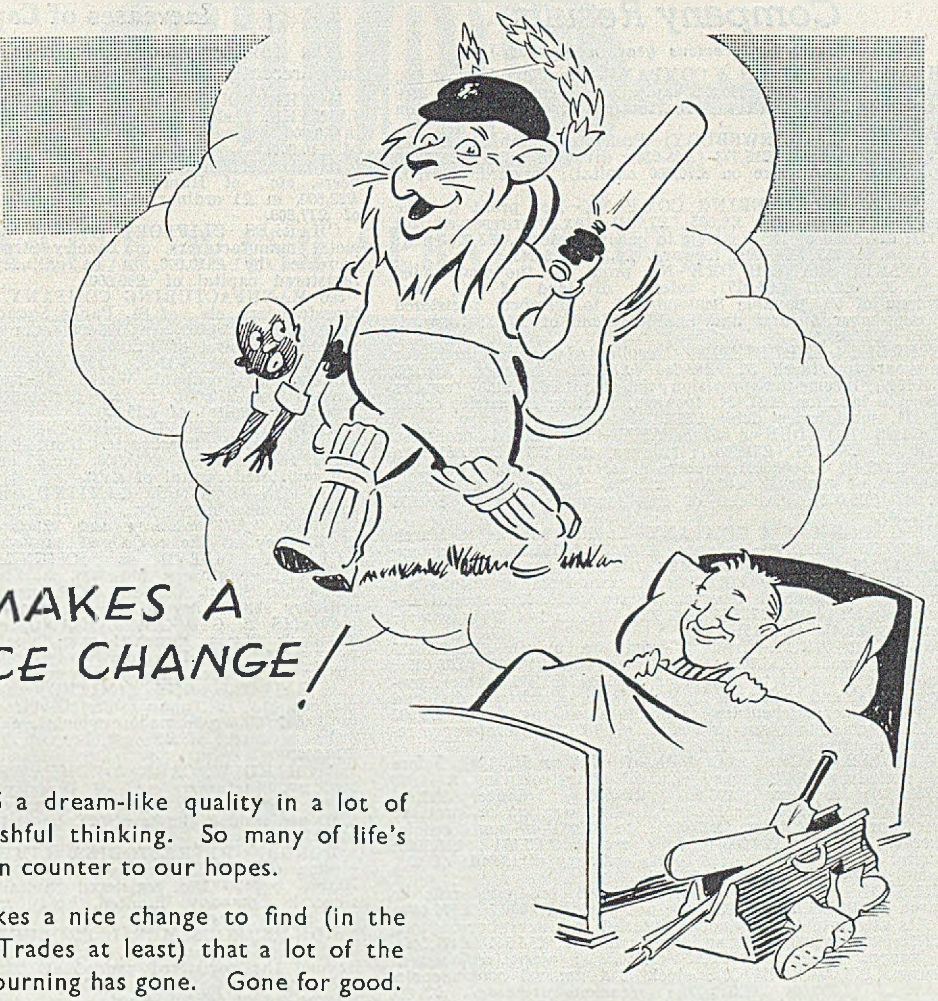
Net sales in the first half of 1950 amounted to $106,125,254, against $99,703,773 in the first half of last year. Costs and expenses were $69,439,775, compared with $62,805,118.

Secondary Aluminium

Experts from Austria, Belgium, the Netherlands, France, the Irish Republic, Norway, the United Kingdom, and Germany, have gone to the United States to study the recovery and use of secondary aluminium. Arrangements for the mission have been effected by O.E.E.C. The experts will study the segregation, collection, and grading of aluminium scrap; the analysis, remelting, and refining of such scrap; and the use of scrap and of remelted secondary metal in the manufacture of cast products and of rolled, extruded, and forged products.

The mission will spend about five weeks on the other side of the Atlantic.

A school for apprentices was opened last week at Crowanbank Foundry, Falkirk, one of the Allied group of foundries. It is provisionally intended to cater for about a dozen boys.



IT MAKES A NICE CHANGE!

THERE'S a dream-like quality in a lot of our wishful thinking. So many of life's events run counter to our hopes.

So it makes a nice change to find (in the Foundry Trades at least) that a lot of the old heartburning has gone. Gone for good. Modern mechanised aids have simplified age-long handling problems. They are increasing output; lowering overheads; producing far better castings at far less cost.

It is a line of thought that will interest all who are concerned with efficiency in Foundry Management. And August's consultants are at their free disposal—anywhere, at any time.

Sole Licencees and Manufacturers for British Empire (excluding Canada) of the Simpson Sand Mixer.

SPECIALISTS IN FOUNDRY MECHANISATION
HALIFAX · ENGLAND
Telephone: Halifax 61247/8 Telegrams: Augusts, Halifax

August's LIMITED

Company Results

(Figures for previous year in brackets.)

HEAD, WRIGHTSON & COMPANY—Final dividend of 6%, making 10%, on the £590,625 capital, as increased by a 25% free bonus issue. (Total distribution of 10% payable on £472,500.)

SENTINEL (SHREWSBURY)—Profit to March 31, £93,383 (£206,790); balance, £15,778 (£65,036); dividend nil on £910,000 capital (6d. per share on £70,000 capital); forward, £157,413 (£144,605).

LINLEY ENGINEERING COMPANY—Net profit for the year ended March 31, £9,003 (£7,704); tax over-reserved, nil (£17); dividend of 10% (same); to general reserve, £3,000 (nil); taxation, £4,733 (£4,100); forward, £8,876 (£8,843).

CONSETT SPANISH ORE—Net profit for the year ended June 30, £2,677 (£3,917); interim dividend of 5%; final dividend of 5% payable September 7 to members registered on September 5 (first and final dividend of 10%); forward, £6,180 (£5,526).

STERLING INDUSTRIES—Consolidated trading profit for the year to March 31, £83,750 (£61,552); balance, £60,233 (£38,758); income-tax provision not required, £169 (repairs £250); to taxation, £31,554; forward, Sterling Industries credit £18,111, subsidiaries' debit £584.

JAMES HOWDEN & COMPANY—Consolidated profit to April 30, £382,603 (£316,591); balance, £324,333 (£278,851); to tax, £175,447 (£142,858); general reserve, £40,000 (£65,000); reduction of goodwill, £40,000 (£15,000); reduction of patents, £20,000 (£5,000); dividend of 30% (same); forward, £49,675 (£45,834).

W. H. DORMAN & COMPANY—Trading surplus to March 31, £136,697 (£188,799); balance, £106,355 (£151,354); to income tax, £27,545 (£64,500); profits tax, £14,000 (£20,500); net profit, £64,810 (£66,354, plus £50,888 withdrawn from provisions not required); to general reserve, £30,000 (£60,000); special depreciation on plant, £21,644 (£42,000); dividend of 37½% (same); forward, £9,434 (£9,915).

WALKER BROS.—Trading profit to March 31, £43,473 (£39,301); profit, £33,209 (£33,094); to tax, £18,525 (£18,695); preference dividend to December 31, 1949, £1,445 (same); preference dividend to March 31, £482 (same); ordinary dividend of 7% (same); debenture redemption sinking fund, £2,502 (£2,388); obsolete plant provision, nil (£9,314); preference redemption sinking fund, £9,485 (nil).

WILLIAM JACKS & COMPANY—Net profit, 1949, before tax, excluding £1,675 earned by a subsidiary company, £301,055 (£250,792); to tax, £203,650 (£150,000); balance, £97,405 (£100,792); provision for further Indian taxation on previous year's profits, £17,000 (£13,000); to taxation contingencies reserve, £22,000 (£24,000); stock reserve, £7,571 (£15,700); general reserve, £20,089 (£20,000); ordinary dividends of 25% (same); forward, £34,911 (£30,387).

RUSTON & HORNSBY—Consolidated trading profit to March 31, £1,746,125 (£1,938,989); net profit, £844,017 (£976,643); profits attributable to minority interest in a subsidiary, £1,696 (£292); sundry provisions no longer required, £16,540 (£121,045); to general reserve, £268,000 (£254,313); plant replacement reserve, £75,000 (£220,000); stock and general contingencies reserve, £250,000 (£310,000); pensions reserve, £79,800 (£150,000); dividend of 7½% on doubled capital, £169,125 (12½%, £140,937); forward, £179,092 (£175,081).

MIRRLEES WATSON COMPANY—Consolidated balance from trading account for the year ended March 31, after charging administrative expenses and directors' emoluments, £215,423 (£268,710); consolidated net profit, £98,859 (£111,553); tax provision no longer required, £1,000 (£15,784); doubtful debts, nil (£2,869); to subsidiary companies' general reserve, £30,000 (£50,000); holding company general reserve, £45,000 (£50,000); ordinary dividend reserve, nil (£20,000); dividend of 8% (same); forward, £20,750 (£18,543).

GEORGE COHEN SONS & COMPANY—Group profits, after all charges, including tax, for the year to March 31, including £13,757 (nil) profits relating to previous year, £129,369 (£216,158); tax charged, £223,229 (£335,239); attributable to holding company, £128,823 (£213,392); to dividend on the 4½% preference shares, £37,125 (£29,906); ordinary dividend of 20% (same); written off special expenditure in connection with recent litigation, £19,291 (nil); written off new issue expenses, nil (£13,730); balance of profit retained, £6,407 (£103,756).

IRON TRADES EMPLOYERS' INSURANCE ASSOCIATION—Premium income for 1949, less re-insurances and transfer to catastrophe fund, £1,877,301 (£2,949,238); dividends and interest, £117,581 (£116,487); to payments under policies, including expenses, £2,309,739 (£2,810,989); commissions, £32,533 (£36,649); management expenses, £169,419 (£153,981); directors' fees, £6,600 (same); to profit and loss, £481,516 (£1,002,549); fund, £3,461,183 (£4,456,008); transferred from revenue account, £481,516 (£1,002,549); to premium return fund, £310,000 (£626,000); bonus fund, £117,681 (£116,487); staff trust fund, £28,000 (£20,000); written off furniture and fittings, £5,398 (£11,384); off freeholds and leaseholds, £13,800 (£21,250); general reserve, nil (£175,000); forward, £111,808 (£105,068). Directors recommend a return of 17½% of employers' liability, third party, and personal accident premiums paid for 1949, together with bonus of 6% on which income tax has already been paid, making a total return of 23½% (28.4% gross, against 28.3% gross last year).

Increases of Capital

The following companies are among those which have recently increased their capital:—

MOTHERWELL MACHINE & SCRAP COMPANY, LIMITED, Inshaw Works, Motherwell, increased by £20,000, in 20,000 ordinary £1 shares, beyond the registered capital of £10,000.

HUGH SMITH & COMPANY (POSSIL), LIMITED, engineers, etc., of Hamiltonhill Road, Glasgow, increased by £22,500, in £1 ordinary shares, beyond the registered capital of £17,500.

CHARLES CLIFFORD & SON, LIMITED, non-ferrous metal manufacturers, of Fazeley Street Mills, Birmingham, increased by £110,000, in £1 ordinary shares, beyond the registered capital of £90,000.

505 MANUFACTURING COMPANY, LIMITED, engineers, brassfounders, etc., of St. Paul's Square, Birmingham, 3, increased by £24,000, in 240,000 shares of 2s., beyond the registered capital of £1,000.

J. BISSET & SONS, LIMITED, agricultural implement makers, of Greenbank Works, Blairgowrie (Perthshire), increased by £10,000, in £1 preference shares, beyond the registered capital of £15,000.

MIDLAND METAL SPINNING COMPANY, LIMITED (formerly M.M. Purchasers, Limited), Bishopsgate, London, E.C.2, increased by £449,900, in £1 ordinary shares, beyond the registered capital of £100.

RUSTON-BUCYRUS, LIMITED, manufacturers of excavating machinery, etc., of Lincoln, increased by £150,000, in 75,000 "A" ordinary and 75,000 "B" ordinary shares of £1, beyond the registered capital of £1,600,000.

CROSBY VALVE & ENGINEERING COMPANY, LIMITED, engineers, founders, smiths and machinists, etc., of Cannon Street, London, E.C.4, increased by £75,000, in £1 ordinary shares, beyond the registered capital of £25,000.

ADAMS & GIBBON, LIMITED, engineers, etc., of St. Thomas's Street, Newcastle-upon-Tyne, increased by £38,000, in 15,000 5% second cumulative preference and 23,000 ordinary shares of £1 each, beyond the registered capital of £22,000.

A. BAIRD & SONS, LIMITED, machinery and implement makers, etc., of Annan (Dumfriesshire), increased by £40,000, in 10,000 6% redeemable cumulative preference and 30,000 ordinary shares of £1 each, beyond the registered capital of £10,000.

RICHARD W. CARR & COMPANY, LIMITED, steel and tool manufacturers, etc., of Wadsley Bridge, Sheffield, increased by £20,000, in 10,000 ordinary, 5,000 preference, and 5,000 unclassified shares of £1, beyond the registered capital of £30,000.

MORGAN REFRACTORIES, LIMITED, Liverpool Road, Neston (Cheshire), increased by £500,000, in £1 unclassified shares, beyond the registered capital of £500,000. Morgan Crucible Company, Limited, hold practically the whole of the issued shares.

NON-FERROUS METAL PRODUCTS, LIMITED, Basinghall Street, London, E.C.2, increased by £418,000, in 1s. shares, beyond the registered capital of £32,000. At February 14, 1950, the Imperial Smelting Corporation, Limited, held 639,820 shares out of 640,000 issued.

BENJAMIN PRIEST & SONS, LIMITED, manufacturers of bolts and nuts, etc., of Old Hill (Staffs), increased by £50,000, in 200,000 ordinary shares of 5s., beyond the registered capital of £15,000. Each of the existing ordinary shares of £1 have been sub-divided into 4 shares of 5s. Final dividend of 10%, making 20% (same).

New Companies

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

C. MORRELL (ENGINEERS), Audley Street Works, Blackburn (Lancs)—£3,000. C. and J. Morrell.

BRIDGE FOUNDRY (WORDSLEY), High Street, Wordsley, Stourbridge—£10,000. J. and H. V. Mole.

AMALGAMATED LIMESTONE CORPORATION, 60, Buckingham Palace Road, London, S.W.1—£100.

STANHOPE FOUNDRY COMPANY, Moseley Street, Wolverhampton—£20,000. B. and W. L. Stanton.

DIECASTINGS OF HASTING, Silverlands Road, St. Leonards-on-Sea—£1,000. V. D. and G. N. Sinden.

SINCLAIR & CLARKE (ENGINEERS), 10, Sackville Street, London, W.1—£3,000. W. Clarke and M. Holland.

J. W. RAYLOR & COMPANY (ENGINEERS), Bankfield Lane, Crossens, Southport—£10,000. J. W. Raylor.

JOSHUA GREAVES & SONS, Atlas Works, Ramsbottom (Lancs)—Engineers. £4,000. J. R. and E. Greaves.

WILLIAM WRIGLEY, Southgate Works, Southgate Street, Oldham—Textile engineers. £3,000. W. and E. Wrigley.

K. POHORILLE, Northall Street, Kettering—Toolmakers, die casters and sinkers, etc. £3,000. K. and S. Pohorille.

CHAS. S. BEARD (DIE CASTERS), 22, Green Terrace, Rosebery Avenue, London, E.C.1—£100. C. S. Beard and A. T. Ford.

Raw Material Markets

Iron and Steel

Foundries producing castings for the motor, general engineering, and textile trades are very busy in home and export orders. They are large users of hematite and low- and medium-phosphorus irons, supplies of which are becoming somewhat restricted, particularly the low-phosphorus grades. Matters have not been helped by a furnace in South Wales breaking down, and supplies from this source will not be possible for some weeks. Refined pig-iron, fortunately, is in fairly good supply.

Conditions vary among the light foundries, and there is no difficulty in supplying their requirements of Northamptonshire high-phosphorus iron, although Derbyshire iron is still tight.

Re-rollers are well supplied with steel billets, except, possibly, the 2-in. section, and some small sizes of flat billets for strip rolling. For some time re-rollers of bars have not been very busy, because there has been a restricted demand in the home trade, and export orders have been difficult to secure because of Continental competition. There are signs of definite improvement in home requirements, and during the last fortnight more business has been secured for small bars and light angles from foreign customers, owing to the fact that Continental prices have increased considerably, and delivery times are very much extended. British prices of bars are now competitive, so that more export business should accrue.

The sheet rollers are still exceptionally busy and are requiring the maximum deliveries of sheet bars. They have many months' work ahead of them, and it is only with difficulty that new business for sheets can be placed.

More orders have been coming in for heavy joists, angles, channels, etc.

Non-ferrous Metals

Last week saw the publication of the July copper statistics by the Copper Institute in New York and, judging from the figures, activity in the United States last month suffered something of a setback. It must not be forgotten, however, that holidays were in progress and many plants closed in consequence. The figures are shown in short tons of 2,000 lb. Production of crude copper was 85,315 tons, compared with 96,754 tons (a revised figure) in June. The output of refined copper in July was 96,734 tons, against 113,961 tons in June, a somewhat spectacular drop. Stocks of refined copper in producers' hands at July 31 were at 48,266 tons, compared with 50,327 tons at the end of June. There was a very sharp fall in deliveries to consumers, the July figure of 95,983 tons comparing with 126,047 tons in June.

It must not be deduced from the above statistics that the supply position in America is any easier. On the contrary, the retention for a period beyond all expectation of the 2 cents import duty is making things very difficult for consumers in the States, and on the Commodity Exchange copper futures are offered at 23.70 cents. This suggests an advance of at least 3 cents in the price of electrolytic copper.

On Tuesday the Ministry of Supply announced that the price of electrolytic copper had been increased from £186 to £202 per ton delivered consumers' works. The Ministry also raised its buying price for rough copper in 2-cwt. to 3-cwt. slabs from £144 to £156 per ton, discounts, premiums, and charges for forward delivery remaining unchanged. The new prices have been introduced to safeguard the Ministry's position in view of the increase made by United States producers in the price of copper and pending discussion with the Northern Rhodesian producers on the basis of the agreement reached with them in July last that they would not wish to take advantage in their pricing arrangements with the Ministry of Supply of any increase in the American prices due to the imposition of the United States import duty.

Zinc futures in the United States have been strong, the quotation of 18.75 cents comparing with the producers' price of 15 cents. But fears of the application of ceiling prices are tending to keep current values in check. However, lead was lifted by 1 cent per lb. last week to 13 cents, and the U.K. quotation went up by £8 to £104. The Ministry of Supply's lead price went up by a further £8 per ton on Tuesday of this week.

Following a bout of profit taking in the East last week, the London tin market collapsed on Thursday last, the fall amounting to over £100 per ton for the official quotations. A fair amount of cash tin was sold, the sales being, it is believed, on behalf of a producer. Some recovery was seen on the following day and the week closed at £773 settlement. The American quotation, after advancing to 108 cents, fell back to 101 cents and finished the week at 102 cents.

Metal Exchange official tin quotations were as follow:—

Cash—Thursday, £743 to £745; Friday, £776 to £777; Monday, £814 to £815; Tuesday, £829 to £831; Wednesday, £788 to £790.

Three Months—Thursday, £743 to £745; Friday, £776 to £777; Monday, £814 to £815; Tuesday, £829 to £831; Wednesday, £788 to £790.

Business in non-ferrous semis has been fairly brisk, for buyers have taken the view that, even though no increase occurred, the chances of a fall at present were remote. Scrap values have shown a tendency to harden, for holders believe that the margin between new metals and old is likely to become narrower as the months go by. In the United States copper scrap is very firm and not too plentiful. Fabricators are believed to have purchased secondary copper for conversion to electro on a toll basis.

Nimonic 90

The Mond Nickel Company, Limited, announce the addition of Nimonic 90 to the published Nimonic series of alloys. Although this superior material has already been installed on many gas turbines, its use has been restricted and details of its properties have not so far been available for publication owing to the fact that it has been under a security ban.

Nimonic 90 results from extensive research in the company's laboratories, combined with long production experience in the rolling mills of Henry Wiggin & Company, Limited. Many service trials in gas turbines have demonstrated its superiority as the material for gas-turbine blades. At 750 deg. C. it is 10 per cent. better than Nimonic 80A under all conditions. At 815 deg. C. and even at 870 deg. C. it has shown high load-carrying capacity for long periods. Nimonic 90 is available in bar, sections, forgings, sheet strip, and wire.

Sheffield Steel Output

The output of steel ingots and castings in the Sheffield area during July averaged 41,000 tons a week, compared with 35,400, 32,400, and 28,900 tons a week in the corresponding months of 1949, 1948, and 1947.

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

(Delivered, unless otherwise stated)

August 23, 1950

PIG-IRON

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

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

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

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

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

Cold Blast.—South Staffs, £16 3s. 3d.

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

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

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

FERRO-ALLOYS

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

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

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

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

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

Ferro-tungsten.—80/85 per cent., 11s. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 6d. per lb. of W.

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

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

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

Ferro-manganese (blast-furnace). — 78 per cent. £28 3s. 3d.

Metallic Manganese.—96/98 per cent., carbon-free, 1s. 7d. to 1s. 8d. per lb.

SEMI-FINISHED STEEL

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

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

Sheet and Tinplate Bars.—£16 16s. 6d.

FINISHED STEEL

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

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

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

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

NON-FERROUS METALS

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

Tin.—Cash, £788 to £790; three months, £788 to £790; settlement, £790.

Zinc.—G.O.B. (foreign) (duty paid), £127 10s.; ditto (domestic), £127 10s.; "Prime Western," £127 10s.; electrolytic, £132; not less than 99.99 per cent., £138.

Lead.—Good soft pig-lead (foreign) (duty paid), £112; ditto (Empire and domestic), £112; "English," £113 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, all English destinations, £146 5s.; rolled zinc (boiler plates), all English destinations, £144 5s.; zinc oxide (Red Seal), d/d buyers' premises, £119.

Other Metals.—Aluminium, ingots, £112; antimony, English, 99 per cent., £160; quicksilver, ex warehouse, £20 10s. to £21; nickel, £386.

Brass.—Solid-drawn tubes, 19¾d. per lb.; rods, drawn, 25½d.; sheets to 10 w.g., 24d.; wire, 24½d.; rolled metal, 22¾d.

Copper Tubes, etc.—Solid-drawn tubes, 21½d. per lb.; wire, 209s. per cwt. basis; 20 s.w.g., 217s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £135 to £153; BS. 1400—LG3—1 (86/7/5/2), £143 to £160; BS. 1400—G1—1 (88/10/2), £195 to £260; Admiralty GM (88/10/2), virgin quality, £200 to £256, per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £214-£260; L.P.Bl, £148-£173 per ton.

Phosphor Bronze.—Strip, 32½d. per lb.; sheets to 10 w.g., 34½d.; wire, 34d½.; rods, 32d.; tubes, 37½d.; chill cast bars: solids, 33d., cored, 34d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 2s. 2d. per lb. (7%) to 3s. 1½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 2s. 8d. (7%) to 3s. 7½d. (30%); to 12 in. wide × .056, 2s. 8½d. to 3s. 7½d.; to 25 in. wide × .056, 2s. 10½d. to 3s. 9½d. Spoon and fork metal, unsheared, 2s. 5d. to 3s. 4½d. Wire, 10g., in coils, 3s. 1½d. (10%) to 4s. 0½d.; (30%). Special quality turning rod, 10%, 3s. 0½d.; 15%, 3s. 5½d.; 18%, 3s. 9¾d.

Obituary

J. J. McCLELLAND

It is with great regret that we announce the death of Mr. J. J. McClelland, a prominent member of the Institute of British Foundrymen who died at Newport at the age of 85. For many years Mr. McClelland was in business in London and was a prominent member of the London branch of the Institute and was a member of the London County Council. Some 26 years ago he removed to Cardiff and established himself in the foundry-supplies business. Along with a few other enthusiasts, he established there the Wales and Monmouth branch. For many years he was the secretary of this branch and by much hard work and exercise of his charming personality did much to extend the knowledge of foundry technique in South Wales. He is survived by Mrs. McClelland and his daughter, Mrs. Rawden, who is also well-known in industrial circles in South Wales.

MR. HERBERT CAUKWELL, formerly a director of Rawlinsons, Limited, lift and hoist makers, of Leeds, died on August 9.

MR. MILLAR DAW DOUGLAS, the 72-year-old proprietor of Hugh Douglas, Limited, ship repairers and engineers, of Liverpool, has died after a long illness. He was actively connected with the firm for 50 years.

MR. SLATER WILLIS, chairman and managing director of the Tinsley Rolling Mills Company, Limited, Tinsley, Sheffield, died recently. He was 76. Mr. Willis was a former president of the Sheffield Chamber of Commerce.

MRS. EMMA JANE WALTON, wife of Mr. Sydney Walton, who was for many years a director of Industrial Newspapers, Limited, proprietors of the FOUNDRY TRADE JOURNAL, died in hospital at Harrow on August 16. She was 69.

MR. R. RICHARDSON, who was the oldest member of the original firm of Leeds locomotive-manufacturing pioneers—Kitson and Company, of Airedale Foundry, Hunslet, now J. and H. McLaren, Limited, diesel engine manufacturers—has died at the age of 84.

MR. MALCOLM MCALLISTER, a director of John G. Kincaid & Company, Limited, marine engineers, of Greenock, died last Monday after a short illness. Mr. McAllister, who was made a director two years ago, had been associated with the company for over 40 years.

COL. SIR WILLIAM CHARLES WRIGHT, BT., died last Monday at the age of 74. He was a former chairman and managing director of Guest, Keen Baldwins Iron & Steel Company, Limited, and was on the board of Richard Thomas & Baldwins, Limited. The modern steelworks completed in 1936 at Cardiff was primarily conceived by Sir Charles. During both of the world wars he was Controller of Iron and Steel Production. He was president of the Iron and Steel Institute from 1931 until 1933 and was the British Iron and Steel Federation's president for the year 1937-38.

MR. GERALD ALLOTT, who was a technical adviser to the managing director of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield, until his retirement last year, died recently at the age of 66. Mr. Allott had nearly completed 50 years' service with the company, which he joined as a boy in the drawing office, later becoming general sales manager of the ironworks department. He was a former president of the East and West Ridings branch of the Ironfounders' National Federation and was a member of the main committee of the British Chemical Plant Manufacturers' Association. Mr. Allott was also an executive member of the British Ironfounders' Association and of the National Light Castings Ironfounders' Association.

CLASSIFIED ADVERTISEMENTS

PREPAID RATES : Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Numbers. 2s. extra (including postage of replies).

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

SITUATIONS WANTED

FOUNDRY MANAGER (40), non-ferrous, seeks position in South of England. Mechanised or jobbing shop. Good organiser and disciplinarian. M.I.B.F.—Box 894, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER / SUPERINTENDENT (age 45), 20 years' executive experience, open for engagement with established concern. Specialist in light alloys and mechanisation. Technical and practical qualifications first class. Fully conversant with modern foundry practices.—Box 876, FOUNDRY TRADE JOURNAL.

GENERAL MANAGER desires change; present position, General Manager of large foundry producing high duty iron castings in wide variety ranging from machine moulded items to loam and dry sand, work up to 35 tons each in weight. Thoroughly experienced in all branches of the foundry trade, control of pattern shop, and knowledge of machine shop practice.—Full control commercial, practical and technical. Strict confidence observed.—Box 882, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (31), fully trained, practically and theoretically, experienced in all aspects of the trade, wishes to take up progressive permanent position. Accommodation essential.—Box 896, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN, with first-class experience of large fully mechanised plants, medium jobbing work, desires progressive post with go-ahead firm. Very keen, tactical, age 40, A.M.I.B.F.—Box 902, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN (28) desires progressive position. Experienced cupola and sand control, grey and high duty irons. Modern mechanised plant. Able to train green labour. Good disciplinarian.—Box 900, FOUNDRY TRADE JOURNAL.

METALLURGIST (25), Hons. Graduate, Diploma National Foundry College, 3 years' industrial experience in cast steel, iron, bronzes and malleable, seeks responsible technical or semi-technical post with foundry.—Box 862, FOUNDRY TRADE JOURNAL.

WORKS MANAGER, 25 years' experience aluminium die-casting and melting, gravity, pressure, and sand casting, good disciplinarian, designer, excellent engineering knowledge, requires executive or similar position.—Box 892, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

ENGINEERING Firm requires skilled UNIVERSAL MILLERS, TURRET LATHE SETTER OPERATORS, TURNERS, PLANERS, ENGINEERS' FITTERS, SHEET METAL WORKERS and WELDERS.—Apply PLANT MACHINERY & ACCESSORIES, LTD., 136-140, Bramley Road, W.10. Ladbroke 3692.

SITUATIONS VACANT—*Contd.*

A VACANCY exists in the laboratories of Ferranti, Ltd., Edinburgh, for a man with metallurgical training and experience in microphotography to be directly responsible to the Chief Chemist, Edinburgh. Opportunity to acquire experience of modern metallurgical, physico-chemical and spectro-chemical instruments. Initial salary according to experience and qualifications.—Apply, stating full details of training, qualifications and experience in chronological order, to the PERSONNEL OFFICER, Ferranti, Ltd., Ferry Road, Edinburgh.

A VACANCY occurs for a SENIOR FOUNDRY FOREMAN in a Company in East Anglia. High grade iron and non-ferrous castings for the firm's own product with a labour force of about 50. Applicants should have a good knowledge of both ferrous and non-ferrous moulding practice, possess the quality of leadership, together with experience in administration.—Replies, giving full particulars of career to date and salary required, to Box 866, FOUNDRY TRADE JOURNAL.

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

ASSISTANT PLANT MAINTENANCE FOREMAN.—Take charge of running and maintenance of heavy industrial plant in Coventry. Must have good mechanical experience and ability to control maintenance gang. Permanent position with good prospects for hard worker with ability to produce results.—Box 5222, SCOTTS, 9, Arundel Street, London, W.C.2.

FOUNDRY MANAGER.—Salary £1,000-£2,000 offered by Messrs. Robert Cort & Son, Ltd., Reading, to a thoroughly experienced practical Foundry Manager, to take charge of their new semi-mechanised and jobbing foundry (no accounts or office work involved). Capacity 40/50 tons per week of valve castings and general jobbing work up to 5 tons. Experience of valve production preferred, but not essential. Motive type sand-slinger moulding machines. Modern sand handling plant, etc. Must hold similar position earning not less than £800 p.a. Age 35-50 years.—All replies must state age and present salary, and be addressed to the MANAGING DIRECTOR, Robert Cort & Son, Ltd., Reading Bridge, Reading.

SALES OFFICE.—Man with initiative required for responsible position by William Mills, Limited, Aluminium Founders, Friar Park Road, Wednesbury. Experienced in statistical work, office routine, record keeping, and accustomed to responsibility. Age 25/35.—Application in writing to THE GENERAL MANAGER.

SITUATIONS VACANT—*Contd.*

ENAMEL DEPARTMENT CONTROLLER.—Experienced Vitreous Enameller required by an important Midland Manufacturer of cooking appliances. Applicants should be strict disciplinarians, technically sound and capable of taking full charge of Mill Room, Laboratory, Cast Iron and Sheet Steel Enamel Shops, and able to organise full production. Continuous furnace experience would be an advantage. A good salary will be paid to an energetic production organiser.—Apply (quoting Ref. WMP.3), giving full details of age, education, experience, and salary required, to Box 864, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN, aged about 30 to 40, required for fully mechanised foundry near South Coast producing up to 75 tons of small grey iron engineering castings per week. Applicants must have had previous experience of foundry mass-production and also should be capable of price and rate fixing. Successful applicants would be required to commence in September. Salary £650 per annum.—R. G. LEACH, Receiver and Manager, John Every (Lewes), Limited, Phoenix Iron Works, Lewes, Sussex.

FOUNDRY FOREMAN.—A really first-class reliable, experienced, and energetic man required for large Steel Foundry (Manchester-Salford area). Adequate salary, staff conditions, and pension scheme operating. This post offers scope for advancement to suitable applicant.—Full details to Box 886, FOUNDRY TRADE JOURNAL.

METALLURGIST required for Malleable Iron Foundry—White Heart. Age 30/40.—Apply, stating qualifications, experience, and salary required, to Box 880, FOUNDRY TRADE JOURNAL.

METALLURGIST required, to take over new Laboratory, and be responsible for metallurgical and sand control of iron foundry producing wide range of high duty iron castings—Glasgow area. —Reply, stating age, experience and salary required, Box 878, FOUNDRY TRADE JOURNAL.

NIGHT FOREMAN wanted by Birmingham non-ferrous metal ingot foundry. Wages £10 10s. weekly.—Reply, stating previous experience, Box 888, FOUNDRY TRADE JOURNAL.

REPRESENTATIVE required by London Non-ferrous Foundry. Applicant must have some technical knowledge of non-ferrous founding.—Apply in first instance to Box 860, FOUNDRY TRADE JOURNAL.

PARTNERSHIP

WORKING PARTNER for small Non-ferrous Foundry, South Coast; good prospects. £500. Would consider selling. Long lease.—Box 890, FOUNDRY TRADE JOURNAL.