FOUNDRY TRADE JOURNAL

Established 1902

WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 88 Thursday, June 1, 1950 No. 1761

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

Grams : " Zacatecas, Rand, London "

'Phone : Temple Bar 3951 (Private Branch Exchange)

PUBLISHED WEEKLY : 26s. per annum (Home and Overseas)

What's in a Name

We were a little astounded to learn that a very prominent member of the ironfoundry industry questions the desirability of trade-marking brands of high-duty or other special irons. Surely, there is a much greater interest for the staff of works to promote the good name of " Smithite " than to jog along meeting the requirements of Specification No. xyz. Before standardisation got into its stride, there was great enterprise shown by the Sheffield high-speed tool steel makers to establish the good name of their brands throughout the world. When a major development came along, such as the addition of vanadium or cobalt and so forth, then, retaining the original trade mark, they just added a suitable adjective such as " superior " or " ultra." Thus, with some of the well-known foundries, as and when they go over to nodular iron, they too should label the product to something corresponding with " Smithite superior." By so doing, they will not only enhance the value of the original name, but give to the newer product the endowment of respected parentage; however, care is needed, as we will point out later.

It seems to annoy a few people that iron castings should go into the market bearing a special trade mark, yet these critics insist that nothing is as good as " Monkey Park " coke or " Milton " pig-iron. Surely they should accord the same privilege to the engineers. The worth of a trade mark is zero at birth and becomes, if the material be satisfactory, increasingly valuable with the passing of time. Specification xyz can never figure in the books of a limited-liability company as being worth a red cent, but an established trade mark is a valuable commercial asset. Again, castings made to specification xyz are in direct competition with all others complying with its clauses, but " Smithite " is regarded by buyers, though perhaps wrongly, as being something apart. There is a danger that a firm having realised the benefits to be derived from registering a trade mark for their castings, may deem it wise to acquire a whole range. This is a mistaken policy and the fewer the better—one only, if possible, is best. Hyphenating to an existing trade mark is good, so long as it does not degrade the original one. If this is to be feared then a second and distinctive trade mark should be found.

The choice of a trade mark is of great importance. The one best known in the grey-iron foundry industry has one bad drawback as printers throughout the world much prefer—not without a modicum of reason—to print, mechanite. A second trade mark just will not come to mind when required. In connection with trade marks it should be borne in mind that when choosing one, it must not be capable of being confused with an existing one in the same field. If there be one in an entirely different field it would seem possible to acquire it. For instance one finds " Compo cures colds " and " Compo—the safe washer." The Press is always worried about the use of trade-marked names, and care must be exercised when using such expressions as Thermos flask, Carborundum, and many others. Firms allowing a trade mark to be incorporated in a language lose their proprietary rights in it. For sale to the general public, an appeal to the " snob " complex has never been known to fail, whereas a democratic solicitation has rarely been successful. Cryptic ones carrying two syllables have proved their worth in the solid-fuel-fired cooker field. Without trade marks and branded goods, life would be much less interesting and progress would be retarded.

Contents

Latest Foundry Statistics

The April Bulletin of the British Iron and Steel Federation reports that there was an increase in the number of persons engaged in iron foundries on March 4 as compared with a month earlier. The gain was 651, making the total 146,871. The 651 was made up of 605 males and 46 females. The corresponding steel-foundry figures show that employment fell by 96, of whom 30 were women, and on March 4 stood at 19,187. The average weekly output of liquid steel for castings during March was 9,000 tons as against 8,800 tons in February and in March last year, representing a gain of 2·3 per cent. A distinct gain was also registered in the production of alloy steel. The average weight of finished steel castings made during March was 4,900 tons. This related to the previous month's production of liquid steel gives a yield of 56 per cent.

Dinner

Meehanite Research Institute

The eighteenth annual dinner of the Meehanite Research Institute was held last Wednesday at the Café Royal. Mr. John Cameron, J.P., presided over a company numbering over a hundred, which included many overseas members. Amongst those present were Mr. Oliver Smalley, O.B.E.; Mr. R. B. Templeton, M.I.Mech.E.; Mr. V. C. Faulkner, F.R.S.A.; Mr. W. Rennie; Dr. C. R. Austin; Mr. Carl Jensen; Mr. Wilfred Harper; Mr. J. D. Carmichael, and Mr. J. Boyd Blakeborough.

Mr. F. W. Rowe, B.S.F.A. Chairman, Mr. R. W. Casasola, Member of the Executive of the Amalgamated Union of Foundry Workers, and Mr. J. H. Wigglesworth, General Secretary of the Iron, Steel & Metal Dressers' Trade Society, at the British Steel Founders' Association "Productivity" Press Conference, held on May 17.

Notes from the Branches

Scottish

The largest and best-attended works visit ever held by the Scottish branch of the Institute of British Foundrymen was that paid to the works of Glenfield & Kennedy, Limited, Kilmarnock, on May 6. The replies to the invitation from the directors of that firm were so numerous that not a single non-member could be included in the party of visitors, and the list was finally closed with the numbers standing at 173.

Members began arriving at Glenfield's works about 9.45 a.m., and as they arrived, they were numbered off in groups of about twelve and, under the care of guides, followed a pre-determined route of inspection. Most of the visitors came by private cars, but many came by buses and not a few by train. They came from far and near, and there were few districts in industrial Scotland, except the Aberdeen and Angus districts, that were not represented. Denny was well represented by a large party which came by special bus.

Visits were paid to the heavy and light machine shops and assembly shops; to the heavy and light iron foundries; to the non-ferrous foundry and the laboratory, but there seemed to be no doubt but that the chief attraction was the new mechanised section in the iron foundry. All routes eventually led to the canteen, where, under the chairmanship of Mr. Henry Gardner, managing director, an excellent lunch was provided. A hearty vote of thanks from the members of the branch to Mr. Gardner, his co-directors and staff, was happily phrased by the branch president, Mr. R. S. M. Jeffrey, and in his acknowledgment, Mr. Gardner gave some interesting facts and figures about "Glenfield's," a firm whose name has come to typify all that is best in Scottish engineering and foundry standards.

Forty Years Ago

The Foundry Trade Journal in its issue for June, 1910, asserts in its editorial that the British Foundrymen's Association will always be linked with the reign of Edward VII—a matter which we had never thought about. Then the Editor forecasts great progress for the steel-foundry industry during the decade to follow. As this included the great war the Editor scored a winner. It is interesting to realise that, in 1910, a 12½-ton capacity electric furnace cost about £1,200. There is a short description of the new steel foundry of the Vancouver Engineering Works, complete with wash sinks and lockers. There is an interesting article describing the Verdon Cutts Hoult Electro-Bessemer Furnaces. In that article is a germ of an idea ready for re-invention. The death was announced of Mr. R. B. Tennent, of Coatbridge, who, starting as a moulder, created the great roll-making concern which still bears his name; he was 81. Edgar Allen & Company, Limited, are reported as erecting a plant at Chicago, Illinois, for the manufacture of manganese steel.

Many representatives of the overseas Press were shown over the Leeds works of Fairbairn Lawson Combe Barbour, Limited, on May 23. Representing newspapers in Norway, Latin America, United States, U.S.S.R., Palestine, Holland, Belgium, Switzerland, Germany, New Zealand, Australia and India, they were able to see the Wellington Foundry at Leeds which covers over 11 acres and employs 1,500 workers. The foundry has a capacity of over 100 tons weekly, is completely mechanised and fitted with the latest labour-saving devices.

Moulding and Testing Non-ferrous Hydraulic Castings*

By W. Thomson

It is sometimes felt that managers and foremen of small foundries, especially non-ferrous, have difficulty in obtaining sufficient information to keep them up to date with the latest tests and experiments at present being carried on in other small foundries. The Author considers that every foundryman should at least try something on his own and publish the details—if only to save anyone else from trying the same experiment with (usually) the same results. The two points which form the basis of this Paper are the investigation of various types of test-bars and experiments with a "hydraulic" mixture.

THE foundry where the tests were made is not large, but an effort has been made to make things as simple as possible for the men to work at the various types of moulding. The moulders are mobile, *i.e.*, they can switch from core-making to green-sand or dry-sand. The conditions in the shops are just about as good as in any foundry in Scotland; there is plenty of fresh air when required, and a good ventilating system has been installed. The motors and fans operating the four oil-fired tilting furnaces are placed in an outhouse at the back of the dressing shop; this takes away most of the noise when the furnaces are in operation. Fig. 1 shows the green-sand section and core bench, wherein can be seen the small sand mixer, the drying stove, the suspended middle, the turntables for casting, and the sand-blast plant.

Fig. 2 shows the centre-section of the dry-sand moulding bay. This is served by three furnaces. The drying stove is seen in the background. It is 15 ft. long by 12 ft. wide by 8 ft. high. Sand is treated in a Royer. For materials handling there are 2-ton and 3 -ton electric overhead travelling cranes.

Fig. 3 shows the moulding-machine section. It is serviced by a 2-ton electric crane; the illustration shows a small riddle in the background. The metal store leads off this section as also does a room fitted with wash-hand basins.

Fig. 4 shows the dressing shop, the equipment of which includes a band-saw, a gate cutter with carborundum blades, and grinding or buffing machines. The dust extractor for sand-blast is also housed in this shop which is serviced by a 2-ton overhead crane.

Melting Plant

For the provision of liquid metal there are 4 oil-fired tilting furnaces, 2 of 250 lb., and 2 of 400 lb., making a total of 1,300 lb. These can melt, when required, up to a total of 1,800 lb.

Fig. 5 shows a group of typical castings made by this foundry. The moulding sands used are:—

For dry-sand, Dullator yellow rock; for green-sand, Mansfield red sand. The testing apparatus available includes a Speedy moisture tester and standard permeability and compression-testing apparatus. The moisture is controlled to within 6 and 7 per cent., the permeability between 45 and 55, and the compression to within 5 and 7 lb. per sq. in. When adding new sand and to make sure of the permeability, sea sand is added, the proportions being 10 of new Mansfield to 1 of sea sand.

* A Paper read before the Scottish branch of the Institute of British Foundrymen.

The following mixture is used for oil-sand cores:—2 pails of sea sand (38 lb.); 1 pail of Dullator yellow rock (16 lb.); 1 pail of Mansfield red (16 lb.) and 2 pails of core binder (Bondex).

For black-sand cores the mixture used is:—3 pails of floor sand from the dry-sand shop (48 lb.); 1½ pails of sawdust (1 lb.); ½-lb. plumbago and 2 pails of coarse loam (28 lb.)

Both the mixtures are put through a sand mixer.

The coarse loam used is made up of 2 parts of sea sand to 1½ parts of Dullator yellow rock, and clay water is added. For fine loam the mixture is 2 parts of sea sand, 1½ parts of Mansfield red sand and 1 part of sawdust, together with some clay water. Both these mixtures are put through the pan mill.

General Castings Procedure

A high proportion of the castings are made for the general market. Those shown in Fig. 6 are known as a drum end and joint rings. These castings are for paper-making machinery, and are ordered in four different sizes of drum ends: 5 ft., 4 ft., 3 ft. and 2 ft. 8 in. They are all moulded in dry sand in the usual way. For example, the ring at the bottom is bedded into the drag box. The cope box takes in the upper portion of the ring and the supporting legs from the ring to the trunnion.

A smaller moulding box is bolted to the cope box, which takes in the trunnion. The runner gate is so placed that there is a cut-in gate at the trunnion and a drop-gate at two of the supporting legs. The weight of these castings varies from 300 to 900 lb.

Fig. 7 shows a group of aluminium castings, most of which are for machines for making plastic material. All heavy sections carry a riser or feeder, and should the heavier sections be so placed that it is impossible to get a feeder attached, then that same part must be chilled.

Fig. 8 shows two manganese-bronze spur wheels and illustrates the running system used. A transmitting cylinder is shown in Fig. 9, the pattern for which is mounted on a wooden plate 6 ft. by 2 ft. 9 in. by 2 in. thick. The corners are strengthened by ¼-in. thick mild-steel plates screwed on to the plate, whilst the pinholes on the plate are bushed. The box pins are made a fixture to the drag box, the pins being sufficiently long to go through pinholes on the plate and cope box. This means the complete pattern is enclosed in the moulding boxes before commencing to ram, *i.e.*, the moulder first rams the cope, then turns over the cope and drag box with the pattern plate between, and proceeds to ram the drag box. When ramming is complete, the moulding boxes are again turned over and the cope parted from

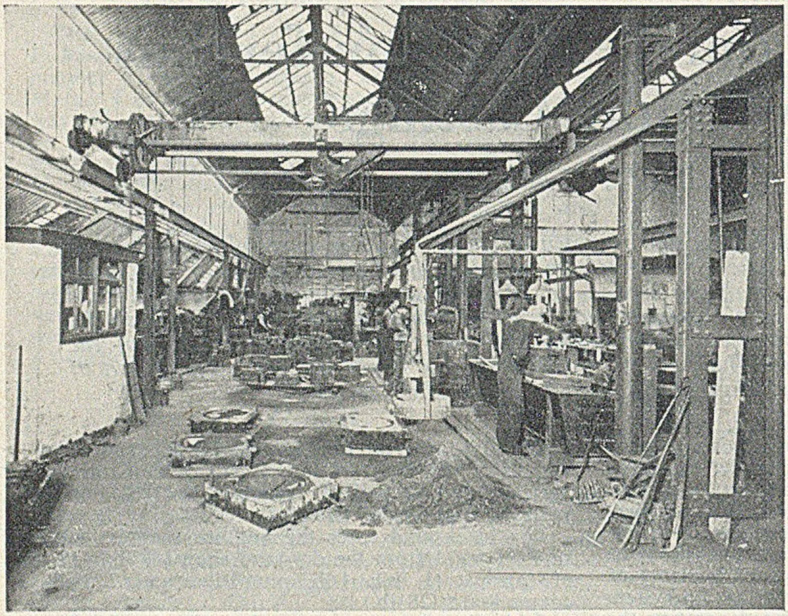


FIG. 1.—GREEN-SAND SECTION AND CORE BENCH.

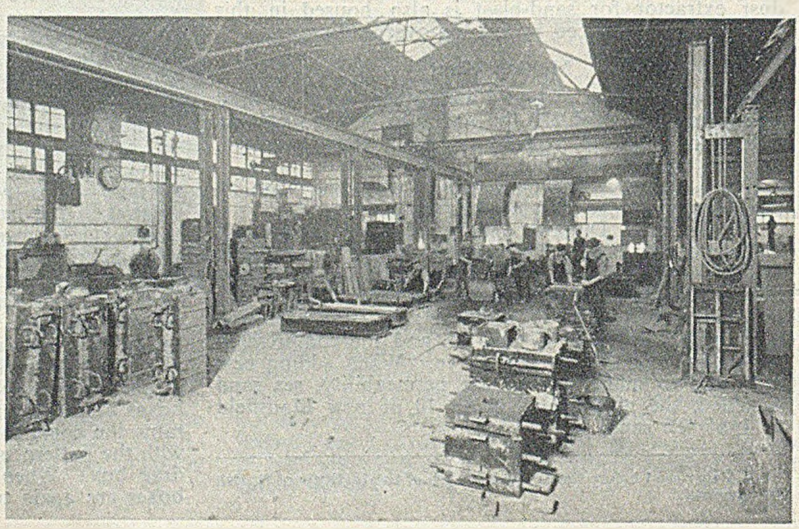
the plate. The half-pattern in the cope is loose on the pattern plate and is located by dowel pins, and wood screws are screwed on to the pattern so that it will not fall out when parting from the drag box. The drag half of the pattern is made a fixture to the pattern plate so that both are withdrawn at the one time. The box pins are also a good guide for giving a clean parting on draw from the sand.

The draw-back or block core which forms the cylinder face and part of the cylinder body is made in a core box and in halves; it is made in ordinary dry sand and placed in the mould. It is then made a fixture to the mould by inserting "L"-shaped 6-in. sprigs from the drawback to the mould "cores."

Cores for Transmitting Cylinders

The tank cores and the cores on the face of the base are made in black sand and Terracoats No. 14 is used instead of blackwash, the mixture being 4½ parts of sea sand, 1 of Dullator yellow rock sand, 1 of Mansfield, and 1 of plumbago. This takes the form of a loam mixture. It is rammed up in a metal core box, one half core box being used as a core carrier. The core is then placed in the core stove and dried in the usual way. When dried, the core is given a coating of blackwash and placed in a fire or against the flame from the gas jets and baked. The core is then given a further coating of blackwash and dried. The position of this core in the mould is such that the metal is liable to search through. Since adopting this method of making the core, there has been very little trouble in getting this core out of the casting. The byepass core is made as one core, not in halves, and as the main bore core passes through the byepass, it is necessary that both these cores are inserted into the mould at the same time. The main cores are made up in the loam mixture. Transmitting cylinders are cast in a perpendicular position with the tank at the bottom. The

FIG. 2.—DRY-SAND MOULDING BAY.



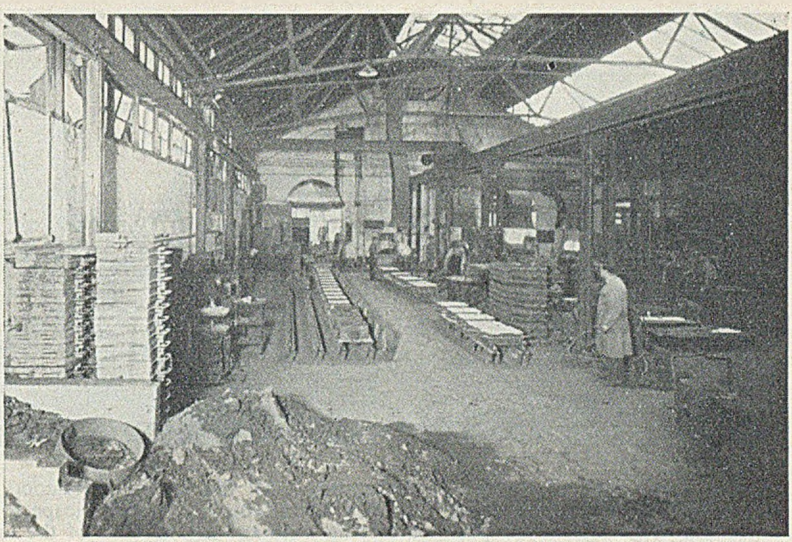


FIG. 3.—MACHINE-MOULDING SECTION.

gate runner is placed alongside the casting with cut ingates at the tank—the main body being at the cylinder face—and at the base of the cylinder, which is the top of the casting when being cast.

Transmitting cylinders have to withstand a hydraulic pressure of 2,000 lb. per sq. in., although the working pressure is in the region of 600 to 700 lb. per sq. in. When cast-on test-bars are required for these cylinders, it has been proved that the most satisfactory bars are obtained when it is possible to have the head or pouring basin inside the moulding box attached to the gate runner. Cast-on test-bars of the various types have been tried out on different parts of the casting, but were not up to standard, and the Author strongly recommends cast-on bars off the head inside the moulding box. Fig. 10 shows some receiving cylinders, together with other castings. The receiving cylinders are cast in much the same way, the only difference being that a tapered feeding head, the full size of the top of the casting, is recommended here to give a good sound hydraulic casting. Here again there was difficulty with cast-on bars. It has been found that the best metal for pressure castings is what is called H.4, *i.e.*, 83 per cent. copper, 7 tin, 5 zinc., 5 lead, + 1½ per cent. cupro nickel. This hydraulic mixture was founded during the war years by Mr. Frank Hudson, who spent much of his time with the Author and another well-known firm in the West, trying to find an alloy suitable to withstand as high a hydraulic pressure as A.G.M. or C. metal, *i.e.*, 88-10-2 or 86-12-2. The main purpose in carrying out these tests was to try and save tin, which was in very short supply at that time.

The foundry also casts cylinder rams of various sizes weighing from 14 lb. to 15 cwt., dressed weight. The small sizes, 1¼ in. to 2½ in. outside diameter, are cast in green sand on a bank with the runner gate at the bottom and a riser at the top. This means that the molten metal has to travel upwards; also, it saves casting in a perpendicular position when there are not available suitable boxes for casting by this method. The larger rams, 2½ in. to 12 in. outside diameter, are cast in a perpendicular position with the runner gate at the

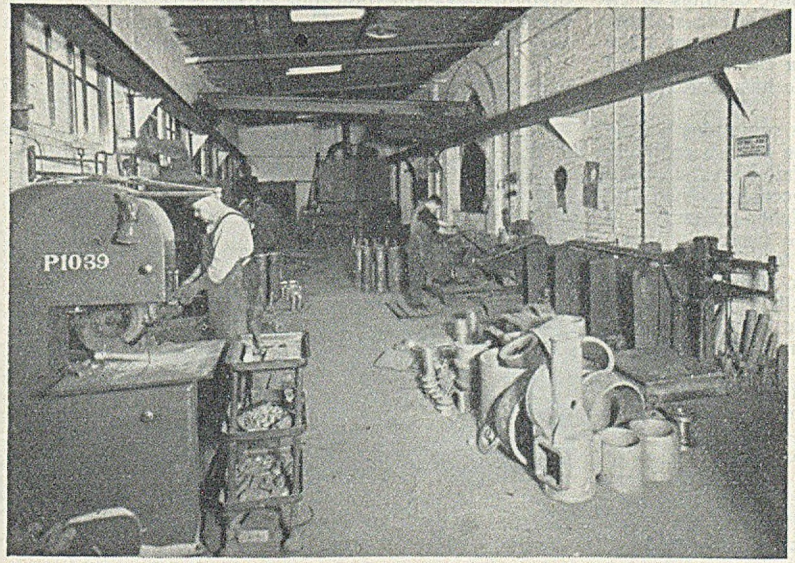


FIG. 4.—VIEW OF THE DRESSING SHOP.

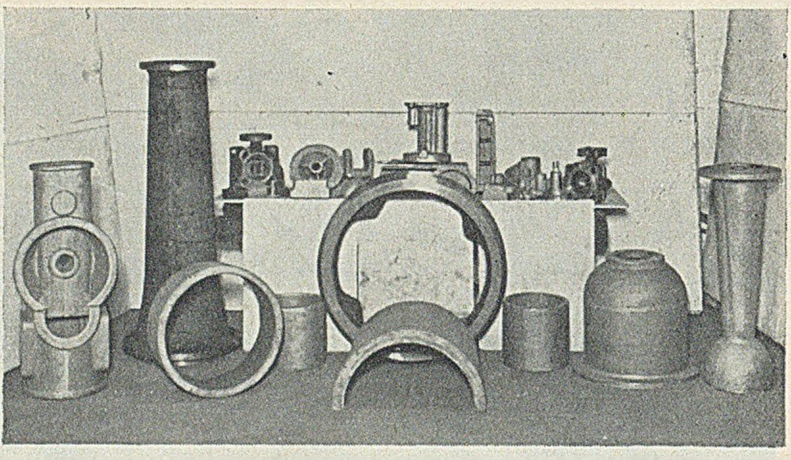


Fig. 5.—Variety of Castings made in the Author's Foundry.

bottom and a riser at the top of the casting. All the larger types of rams have about 5- to 6-in. extra length on them. This acts two ways: as a feeding head and a dirt trap. All the cylinder rams are cast in H.4 mixture and have to withstand a hydraulic pressure of 2,000 lb. per sq. in. The remainder of castings for internal use are mostly bushes in gunmetal, thrust rings in phosphor bronze and all the small fittings for the steering gear, etc.

Test-bars

Fig. 11 shows keel and shaped bars. Some time ago the Author had trouble in getting test-bars to withstand the physical tests, and at that time he made up his mind to put through a series of test-bars cast at different temperatures and with different diameters of downgate in the keel-shape of test-bar instead of, as suggested by different people of authority on test-bars, a direct pour. All these test-bars were cast off the same heat of metal, and they were cast in the hydraulic mixture H.4 (83-7-5-5 + $1\frac{1}{2}$ per cent. nickel). The results obtained showed that the best bars can be had when the metal-pouring temperature is around 1,200 deg. C.; also, that the two shaped bars in the box are most suitable at that temperature. When the temperature is lowered to below 1,100 deg. C., the open keel bar is preferable. This means that all pressure castings which require test-bars must have three separate cast bars, *i.e.*, (1) two shaped bars in box cast first at about 1,200 deg. C.; (2) the actual casting with a cast-on bar, and (3) the keel bar when the temperature has decreased to about 1,100 deg. C.

Some might imagine that there was something a little irregular in such a practice, but there have been many instances where the cast-on test-bar failed in the physical test; yet, when the casting had been machined and put through the hydraulic test at a higher pressure than was called for, it was proved to be perfectly sound. This is just another instance of a bad test-bar and a perfectly sound casting. Some time ago the foundry was making light castings in high-tensile bars for the Admiralty, and they were at that time insisting on cast-on test-bars. The casting was about 10 in. long, the body being cone shaped with about $\frac{5}{16}$ in. metal, and on one end a 5-in. dia. flange $\frac{1}{2}$ in. thick; on the other end, a box shape about 4 in. square and $\frac{1}{4}$ in. thick. Those who had experience with test-bars would know the difficulty of getting a cast-on bar from a casting of this kind. On one occasion the foundry was very successful with the castings, but some bars cast-on were attached and these failed. Also, at the same time, and with the same metal, the foundry cast separate bars, which withstood the required test quite easily. At that time the inspector was unwilling to pass the castings on account of the failure of the cast-on bars, until instructions to do so were received from a higher level. The Author understands the position is very much altered now in this respect and that it is permissible for separate bars to be cast, provided they are from the same heat of metal from which the casting has been poured.

Below are two examples of cast-on and separately cast test-bars. The requirements are:—

1st Heat.—Temperature 1,200 deg. C.

		U.T.S., tons per sq. in.	El, per cent.
Cast first.—(1) Two shaped bars in box	(a)	15.5	30
	(b)	15.5	20
(2) Cast-on bar		12.5	11
(3) Keel-shape bar		15.0	17

2nd Heat.—Temperature 1,190 deg. C.

		U.T.S., tons per sq. in.	El, per cent.
Castfirst.—(1) Two shaped bars in box	(a)	15.0	18
	(b)	15.5	17
(2) Cast-on bar		11.5	12
(3) Keel-shape bar		15.0	18

It will be noted that the cast-on test-bar in each case failed to pass the physical test in respect of tensile strength and elongation, but all the separately cast bars reached requirements. The castings used for these tests were two receiving cylinders, and both were accepted by

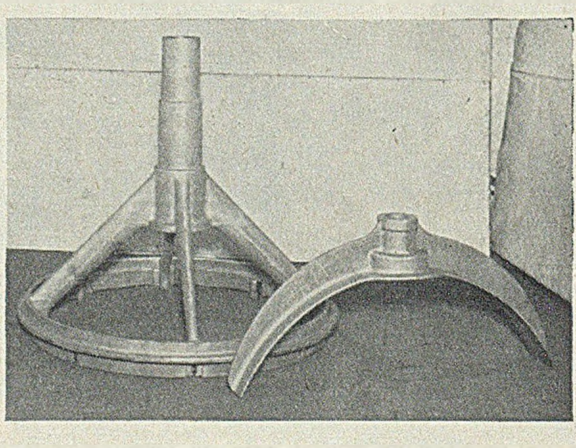


Fig. 6.—Drum End and Bridge Bracket for Paper-making Machinery.

the inspector; moreover, they passed the hydraulic tests. Before dealing with the next batch of tests, he would like to express his appreciation of the efforts made by all those people responsible for convincing the authorities that separately cast test-bars should be accepted as satisfactory.

Phosphor-bronze Test-bars

Made from 90 per cent. copper and 10 per cent. tin, the minimum tests required are 12 tons tensile and 1.5 per cent. elongation. It is worth noting that, whilst cast-on bars have passed the test, the Author prefers the three separately-cast bars in one box.

Bursting Tests

Fig. 12 shows the test-pieces used for bursting tests on gunmetal castings. The object in carrying out these tests was to find how a variation in the compositional quality of a particular grade of gunmetal affected its suitability for pressure castings. The effect was also studied of an additional percentage of cupro nickel on the value of the bursting pressure. The grade of metal used in these tests was the H.4 (83-7-5-5), with additions.

The dimensions of the test-pieces were:—Diameter of flange, 8½ in. machined; thickness of flange, 1¼ in. machined; length of body, 6¼ in. machined; thickness of body, ⅜ in. machined; internal diameter, 3 in. machined.

Each test-piece or casting had a cast-on test-bar (keel shape), and there were two test-pieces per heat. The data of specimen "A" were:—Chemical composition:—Copper, 83.6; tin, 7.28; zinc, 3.50; lead, 5.08; nickel, 0.69; iron-traces. Tensile-test result:—U.T.S., 14.5 tons per sq .in; yield point, 9.5 tons per sq. in.; elongation, 24 per cent. Load/deformation figures were taken up to the point of permanent set on one each of the two pairs of castings. Test-piece "A" casting fractured axially on length of parallel portion, the fracture extending to within 1 in. of one end and 2 in. of the other end of parallel portion.

Specimen "A."—Pressure at point of permanent set, 3,800 lb. per sq. in.; pressure at rupture point, 6,000 lb. per sq. in.

Specimen "B."—Tensile-test result:—U.T.S., 15 tons per sq. in.; yield point, 9 tons per sq. in.; elongation, 26 per cent.; pressure at point of permanent set, nil; pressure at rupture point, 7,000 lb. per sq. in.

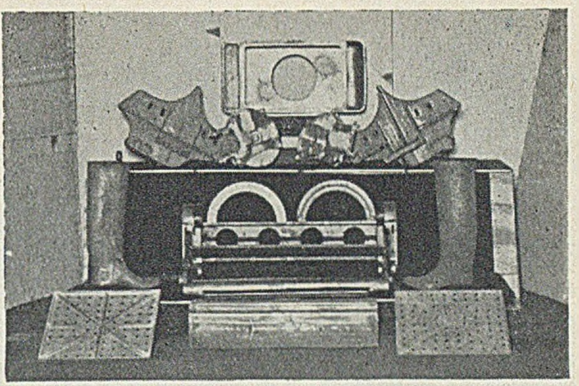


Fig. 7.—Group of Aluminium Castings, most of which are for the Plastics Industry.

Test-piece "B."—The casting fractured axially on the length of the parallel portion; the fracture measured 2 in. in length and lay midway between flanges of the test-piece.

Specimen "C" (two test-pieces per heat)

Chemical analysis:—Copper, 81.14; tin, 6.87; zinc, 3.84; lead, 4.91; nickel, 3.02; and iron, 0.16 per cent. Tensile-test result:—U.T.S., 13 tons per sq. in.; yield point, 9 tons per sq. in.; and elongation, 14 per cent.; pressure at point of permanent set, 3,600 lb. per sq. in.; pressure at rupture point, 6,000 lb. per sq. in.

The casting burst on parallel portion, and the fracture was axial along length of cylinder and extended to within 1 in. of the flanges.

Specimen "D."

Tensile-test result:—U.T.S., 12.5 tons per sq. in.; yield point, 8.5 tons per sq. in.; and elongation, 12 per cent.; pressure at point of permanent set, nil; pressure at rupture point, 6,500 lb. per sq. in.

The casting fractured axially on length of parallel portion, with the fracture extending to within 1 in. of the flange.

It should be noted that chemical composition of "C" and "D" shows an increase in the nickel content from "A" and "B," yet the tensile tests are low—in fact they are below specification. The pouring

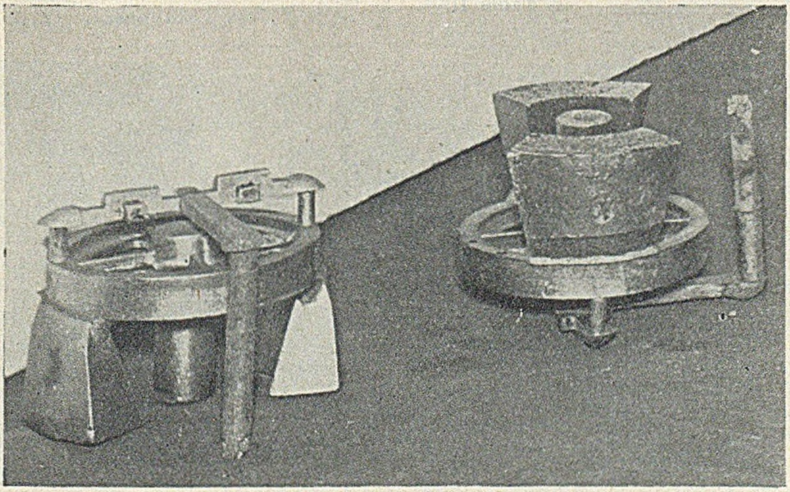


Fig. 8.—Manganese-bronze Spur Wheels, showing Running System used.

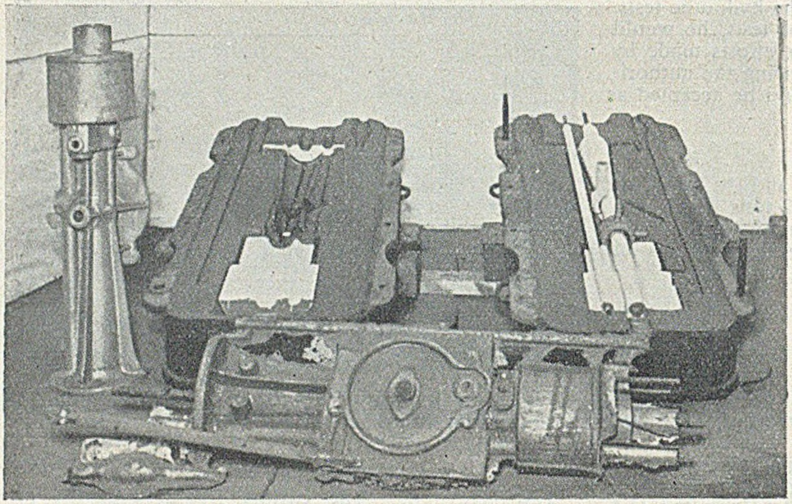


FIG. 9.—TRANSMITTING CYLINDER, SHOWING MOULD AND CORES, AND ROUGH AND DRESSED CASTINGS.

temperature of the metal in the four tests was in the region of 1,180 deg. C. to 1,200 deg. C.

Additional Test No. 4

For this, 300 lb. of H.4 (83-7-5-5 + 18 lb. cupro nickel + 6 lb. Cuprex) was used. Exactly 3 lb. of Cuprex were placed at the bottom of the crucible at the commencement of the heat, and 3 lb. were added when the metal was melted. When the metal was ready and poured into the carrying ladle the slag was skimmed off and 18 oz. of phosphor copper were added. After the metal was poured into the ladle the temperature was 1,220 deg. C. When the phosphor copper was added the temperature decreased to 1,180 deg. C. To all outward appearances the metal was sluggish in parts.

TABLE I—*Tensile-test results obtained in No. 4 test.*

	Temp., deg. C.	U.T.S., tons per sq. in.	El, per cent.
No. 1. 2 shaped bars in box ..	1,180	17.5	19
No. 2. 2 ,, ,, ,, ..	1,180	14.5	15
No. 3. Cast-on bar (keel shaped)	1,160	13.0	11
No. 4. ,, ,, ,, ,,	1,130	15.5	16
No. 5. Separate ,, ,, ,,	1,100	14.0	15

With the tensile test being so low (see Table I) and from the appearance of the molten metal when being poured, there seemed little justification in carrying out bursting tests on these castings.

No. 5 Test

This was made with two pieces having test-bars attached. For the last 300 lb. of H.4 + 18 lb. cupro nickel + 6 lb. Cuprex, was used.

Chemical composition:—Copper, 80.02; tin, 8.04; zinc, 2.84; lead, 5.19; nickel, 3.01; and Phos., 0.03. This test was carried out in a similar way to No. 4, the only difference being that when the metal was ready for pouring into the ladle only half of it was poured, then the 18 oz. of phosphor copper was added, followed by the remainder of the metal. The appearance of the metal in the ladle was much better than the previous heat, although it still had a little of the sluggish or blotchy look about it. A further addition of 4 oz. of phosphor copper was made which then gave the metal a very clean appearance. The temperature of the metal in the ladle before the extra 4 oz. of phosphor copper was added was 1,260 deg. C. After the 4 oz. of phosphor copper was thoroughly stirred in the ladle the temperature decreased to 1,200 deg. C. Tensile-test results are shown in Table II.

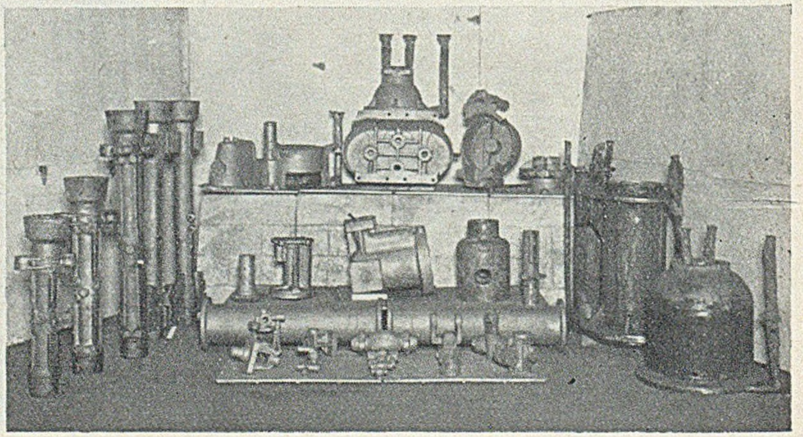


FIG. 10.—RECEIVING CYLINDERS AND SELECTION OF VARIOUS CASTINGS.

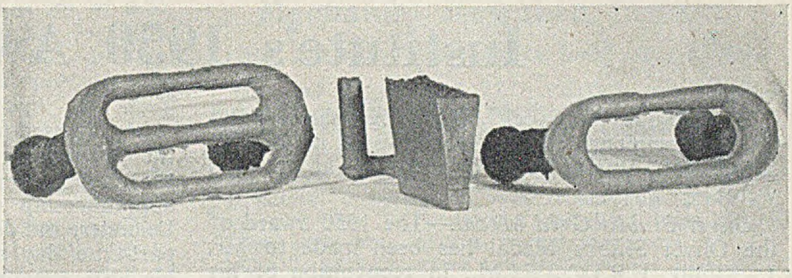


FIG. 11.—SEPARATELY-CAST TEST-BARS; THREE SHAPED BARS IN BOX, KEEL-SHAPE BAR AND TWO SHAPED BARS IN BOX.

TABLE II—*Tensile-test results obtained in No. 5 test.*

	Temp., deg. C.	U.T.S., tons per sq. in.	El, per cent.
No. 1. 2 shaped bars in box ..	1,180	17.5	16
No. 2. 2 " " " ..	1,180	16.0	16
No. 3. Cast-on bar (keel shaped)	1,160	15.0	13
No. 4. " " " "	1,140	15.5	15
No. 5. Separate cast " "	1,100	15.0	15

Bursting Test Results.

(*a*) 3. 6,944 lb. per sq. in.
(*b*) 4. 6,272 lb. per sq. in.

Both test-pieces (castings) were subjected to pressure up to the point of rupture. The fracture in each case measured approximately 3½ in. in length and showed a clean break in the wall of the test-piece.

No. 6 Test

Two test-pieces with test-bars attached were prepared from a heat of 300 lb. made up of H.4 + 18 lb. cupro nickel and introducing nitrogen gas.

Chemical composition:—Copper, 81.86; tin, 7.48; zinc, 2.97; lead, 5.25; iron, 0.36; and nickel, 2.19 per cent. The metal was raised to 1,250 deg. C. and nitrogen gas was bubbled through for five minutes before pouring. There was a distinct improvement in the tensile-test results (Table III) and the bursting-test results.

TABLE III—*Tensile-test results obtained in No. 6 test.*

	Temp., deg. C.	U.T.S., tons per sq. in.	El, per cent.
No. 1. 2 shaped bars in box ..	1,200	20	26
No. 2. 2 " " " ..	1,200	19	21
No. 3 (*a*). Cast-on bar (keel shaped)	1,180	18	26
No. 4 (*b*). " " " "	1,160	19	21
No. 5. Separately cast	1,130	14	13

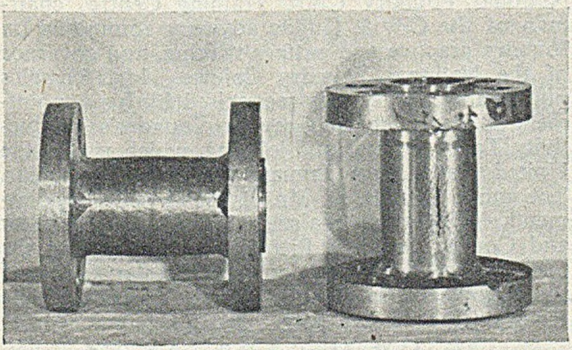


FIG. 12.—TEST-PIECES (CASTINGS) USED FOR BURSTING TESTS.

Bursting-test Results.

(*a*) Pressure at point of permanent set, 4,700 lb. per sq. in. Pressure at rupture point, 7,600 lb. per sq. in. The casting did not burst but fissured at the point of the undercut of the spot facing tool on the barrel.

(*b*) This test-piece did not burst due to repeated failure of joint, but the pressure at which the joint failed equalled 7,000 lb. per sq. in.

Some time after these tests were finished, there was a request for a casting called a valve bonnet which had to withstand a pressure of about 4,000 lb. per sq. in. The nitrogen method of casting this bonnet was used and it has proved most successful. It was tested to 4,500 lb. per sq. in.

In conclusion the Author would like to express his thanks to Mr. Frank Hudson for his helpful advice, especially on the tests involving the use of nitrogen gas; and to the directors of Brown Brothers & Company, Limited, for the opportunity to make use of information at their disposal; to their staff for their help in preparing the tables and slides; and to Mr. William Wallace, chairman and managing director of the company, without whose encouragement this Paper could not have been written.

Appendix

A transmitter is the bridge instrument of a hydraulic control gear, the principal use of this gear being: the liquid displaced on the bridge by a piston, moves the aft control instrument the requisite amount which is spring centred. To balance and replenish the system the automatic by-pass is used. This consists of an annular space, outside the pressure wall of the cylinder with two rings of holes from the pressure cylinder into the annular space. These rings are 2¼ in. apart with 20 holes $\frac{1}{16}$ in. diameter bored in each ring.

When the piston is centred, which is slightly shorter in length than the distance between the two sets of holes, the liquid in the system is all common and open for replenishing. The method of drilling the by-pass holes consists of an ordinary centre lathe with the face-plate detented and the appropriate number of holes on the circumference. A small motor with a bar mounted on the saddle, the bar carrying a pulley mounted on the drill holder. A small flexible drive from the motor to the pulley—rather like the dentist's drill—is used.

The distance from the cylinder face being marked on the bar, a sensitive handle to move the complete saddle is fitted so that the operator can get the feel of the drill breaking through. These holes are drilled before the final reamering of the cylinder is done.

MRS. WILLIAM MALONEY, wife of the secretary of the American Foundrymen's Society, arrives in London by air to-day. She is flying from America with Mr. and Mrs. Gibson and the Misses Gibson of Sydney, Australia. All are to participate in the Buxton Conference.

Institute's 1950 Awards

We include this week brief biographical notes on the recipients of the 1950 awards of the Institute of British Foundrymen. The awards were:—

Oliver Stubbs Gold Medal.—The 1950 award of the Oliver Stubbs Medal has been made to Mr. J. Arnott, F.R.I.C., F.I.M., in recognition of his outstanding services to the Institute by his work in presenting several valuable Papers of a particularly high standard and by his active participation in the work of the Technical Council and Technical Committees.

E. J. Fox Gold Medal.—On the recommendation of the assessors, Sir William Larke, K.B.E., and Dr. J. E. Hurst, the E. J. Fox Medal for 1950 has been awarded to Mr. S. H. Russell (past president) in recognition of the great contributions he has made in the technical education, research organisation, and administrative fields of the industry over a long period.

British Foundry Medal and Award.—The British Foundry Medal and Award given annually by the Institute's Council to the Author of the Paper adjudged by them to be the best presented to the Institute during the preceding year, has been awarded to Mr. A. R. Martin, B.Sc., A.R.S.M., for his Paper "Some Notable Aluminium-alloy Castings."

Meritorious Services Medals.—The Council of the Institute has awarded Meritorious Services Medals for 1950 to Mr. T. R. Walker, M.A. (Cantab.) and Mr. A. S. Wall for the outstanding services which they have rendered to the Institute as honorary secretaries respectively of the Sheffield and Wales and Monmouth branches. Mr. Wall has been honorary secretary of the Wales and Monmouth branch since 1942, while Mr. Walker has just relinquished the honorary secretaryship of the Sheffield branch after almost 23 years' service in this capacity.

Presentation of the awards will take place at the Annual General Meeting of the Institute at Buxton on June 7.

Mr. J. Arnott

Mr. Arnott is chief metallurgist of G. & J. Weir, Limited, Cathcart, Glasgow. On leaving school, he became a premium student in the laboratory of R. R. Ratlock and Thomson, City Analyst, and a student in the Royal Techncial College, Glasgow. After a short time in a consulting metallurgical laboratory, he joined, in 1913, the firm with which he is still associated. Mr. Arnott joined the Institute of British Foundrymen in 1920. He was a member of the Technical Council for many years and has taken part in several of the co-operative investigations carried out by its subcommittees. He is a member of the Council of the Institute of Metals, and a member of many other metallurgical, chemical and engineering societies.

Mr. S. H. Russell

Mr. Russell was born in 1886 and educated at the Wyggeston Grammar School, Leicester. At the age of 16 he commenced a normal foundry apprenticeship course at S. Russell & Sons, of Leicester, and during this period spent one year as a part-time day student at Birmingham University. He also attended evening classes at the Leicester College of Technology. Mr. Russell joined the Institute of British Foundrymen in 1906 and acted as secretary of the Institute Conference which was held in Leicester in 1914. He became the first honorary secretary of the Institute branch which ultimately became the East Midlands branch (Mr. Bunting being the first secretary of the re-named branch). Later he became president of the East Midlands branch and in 1928 was elected national president of the Institute. Mr. Russell was chairman of the Institute's Education Committee for

MR. J. ARNOTT

MR. S. H. RUSSELL

many years and honorary treasurer from 1937 to 1944. He is also the Oliver Stubbs Gold Medallist for the latter year.

A member of the Council of the British Cast Iron Research Association since its formation, Mr. Russell is also a past president of the National Iron Founders Employers Federation, a member of the executive of the C.F.A. since its formation, chairman of the Finance Committee of the Joint Iron Council, chairman of the Trustees of the National Foundry Craft Training Centre, chairman of the City & Guilds advisory committee on foundry practice and pattern-making, and governor of the National Foundry College. Mr. Russell's outstanding ability was recognised by his appointment as leader of the Grey Ironfounder's Productivity Team, general and jobbing, which visited the United States from January to March this year. The more notable of Mr. Russell's civic appointments include the chairmanship of the Leicester and County Accident Prevention Council and the management committee of the Leicester Guild of the Crippled. He is also a past-president of the Rotary Club of Leicester.

Mr. A. R. Martin, B.Sc., A.R.S.M.

Mr. Martin was born in 1922 and was educated at St. Albans School and the Royal School of

Mines, where he gained the qualifications of B.Sc. and A.R.S.M. In 1943 he joined the Northern Aluminium Company, Limited as assistant metallurgist and he has since been promoted by this company to the appointment of chief metallurgist.

Mr. T. R. Walker, M.A. (Cantab.)

Mr. Walker was educated at Lancaster and Cambridge where he obtained first-class honours in the Natural Science Tripos. He joined the Sheffield staff of Cammell, Laird & Company, Limited, in 1915, and in 1920 was put in charge of their chemical laboratories. In 1930, on the amalgamation of the steel interests of Cammell, Laird & Company, Limited, and Vickers-Armstrongs, Limited, to form the English Steel Corporation, Limited, he was appointed chief chemist of the new company, a position which he still holds. Mr. Walker has been honorary secretary and treasurer of the Sheffield branch since 1927, except for two years during the war when he was president.

Mr. T. R. Walker

Mr. A. S. Wall

When the City and Guilds examinations in foundry practice and science were started he was awarded the first Bronze Medal. He has published a number of Papers on foundry materials, fuel, and refractories, and a book on foundry sands. Mr. Walker is a fellow of the Royal Institute of Chemistry and of the Geological Society, and a member of the Institute of Welding and the Institute of Fuel. He is also a president of the Foundry Trades Technical Societies.

Mr. A. S. Wall

Mr. Wall served his apprenticeship at the Atlas Foundry, Cardiff, from 1901 to 1905. He subsequently gained experience with various firms in the Midlands and West Wales areas, including Pembroke dockyard. In 1916, he returned to Cardiff to take up a position with the Tubal Cain Foundry, and stayed there until 1922 when he took up a sales appointment for foundry equipment and material. In 1935 he jointed the Stanton Iron Works Company as pig-iron representative for South Wales and the West of England, a post which he still holds. Mr. Wall joined the Institute in 1929 as an associate member, and was elected to the branch Council in 1930.

Meehanite Research Institute

18th Annual Conference held in London

On May 23, 24, and 25 more than one hundred European representatives of the forty-six Meehanite licensees from Sweden, Norway, Denmark, Holland, Belgium, France, Italy and Great Britain met at the Café Royal, London, for a conference on technical, production, management and marketing problems. Representatives of associated licensees from South Africa, India and America were also present.

Reports were presented and discussed on: Economics of management; advertising in relation to profit; foundry maintenance; sand control: "ventability" and "bondability"; effect of mechanical ramming; effect of various ingredients in oil sand; metal penetration in small cores; use of oxygen for enrichment of cupola blast; effect of burn-out on melting conditions and the water-cooled cupola; practical ideas in the foundry; Sandslinger practice; moulding problems; large-scale torsional fatigue testing; machineability and tool wear; practice in runner basins, gating and risering; calculations of pouring speeds; pattern-making economies; uses of Meehanite in the pulp and paper industry; physical properties after heat-treatment; casting design as influenced by foundry practice and a symposium on the production of nodular-graphite irons.

The Conference was opened by the president, Mr. Oliver Smalley, O.B.E., and supported at later sessions by Mr. Henry Gardner, Dr. N. E. Rambush and Mr. G. B. Taylor (directors of the Institute) who were chairmen of the management and metallurgical sessions, respectively, on the third day. The secretary of the Institute, Mr. E. M. Currie, reported on the continuing and increasing progress in all the activities of the Research Institute and on the continuous demand for licences in all parts of Europe, Asia and other continents.

In the afternoon of the third day the delegates went on works visits to Qualcast (Ealing Park), Limited, and Winget, Limited; the thanks of the visitors being expressed to the directors of these works at the conclusion for their invitation and the arrangements made.

I.B.F. Golfing Society

It was unanimously decided at the last golf meeting of the Institute of British Foundrymen that an I.B.F. Golfing Society should be formed and that Mr. R. B. Templeton should be its first president. The object of the Society is to organise the Annual Golf Meeting without cost to the Institute itself. The subscription is to be 5s. per annum. Members of the Institute wishing to receive an entry form for this year's meeting, should send the subscription to Mr. F. Arnold Wilson, c/o William Jacks & Company, Limited, Winchester House, Old Broad Street, London, E.C.2, who has provisionally undertaken the duties of honorary secretary.

The committee of the I.B.F. Golfing Society this year consists of Mr. E. Arthur Phillips, Mr. James Bell and Mr. F. Arnold Wilson, and it is already arranged for the next Golf Meeting to be held on September 23 and 24 (Saturday and Sunday) at Woodhall Spa, a venue which proved so popular last year, and competitors and spectators will stay at the Golf Hotel on special terms. It is hoped that all those interested in golf will join the I.B.F. Golfing Society, whether they can compete this year or not.

The Bradley & Foster Annual Golf Competition, which has been interrupted by the war years, has now been revived and will take place this year at the Whittington Barracks Golf Club, Lichfield, Staffs, on June 16.

New Personal Income-tax Rates

By F. J. Tebbutt

Now that the Ways and Means (Budget) Resolutions have been through Parliament, a few figures concerning income tax, after the Finance Act, 1950, may be germane. For schedule D (business profits: persons on own account) the new tax poundages and provisions will apply against income in year ending April 5, 1950 (or earlier date according to the financial-year-ending date of the taxpayer concerned (*e.g.* December 31, 1949)—tax arising from assessments made being payable in two equal instalments on January 1 and July 1, 1951. For schedule E (employments: pay as you earn) they will apply against current earnings from April 6, 1950, but the new tax tables with adjustments made will apply on the first pay day after June 8.

From what is written and stated at various times, the assumption is often made that everyone pays tax at standard rate (9s.), but that is not so, there are three different tax poundages which operate on a sliding scale, one applying to taxable income (N.B., taxable income is the total income less personal allowances—see later) up to £50, another to the next £200, and then only does standard rate apply, that is it applies to all taxable income over £250. The poundages have until this 1950 Budget been 3s., 6s. and then the standard rate 9s; now they are 2s. 6d. for the first £50, then for the next £200, 5s., and then the 9s. poundage becomes applicable.

The "personal allowances" are:—earned-income allowance of one fifth (applies up to £2,000 p.a., that is the maximum deduction is £400), for each individual £110, for wife £70, and £60 for each child.

Marginal Figures and Exemptions

Every person is exempted from paying income tax unless his total income (from investments or earned) exceeds £135 p.a. Furthermore, if the income is all earned income, tax is not payable by a single person unless the total income exceeds £137 10s.; by a man with a wife £225; by a man, wife and one child £300; a man, wife and two children £375; and a man with a wife and three children £450; the deduction of the relevant personal allowance in these cases leaves taxable income "nil."

As regards standard tax paying, still taking income as all earned, if the total income of a single person is not above £450 (or a man and wife £537 10s.; man, wife and one child £612 10s.; or with two children £687 10s.; or three children £762 10s.) then the deduction of the appropriate personal allowances leaves a taxable income of £250, and so standard rate does not apply to such taxpayers. For these incomes of giving taxable incomes of £250, the actual tax payable by each taxpayer is £56 5s. (£50 at 2s. 6d., £200 at 5s.), instead of, as previously, £67 10s. If the total incomes of the five classes of taxpayers as above, do not exceed £200, £287 10s., £362 10s., £437 10s., and £512 10s. respectively, only the 2s. 6d. tax poundage would apply, incomes of these figures giving just £50 taxable income with the personal allowances deducted, so a tax payment of £6 5s. would be required (£50 at 2s. 6d.) instead of formerly £7 10s.

It should be noted that in working out the figures above, only the personal allowances mentioned earlier have been taken into account; if any others apply, then the figures may be different. There are also "wear and tear" allowances, although these deductions apply after income has been returned.

(*Continued at foot of next column.*)

Incorrect Diagnosis

By "Coroner"

The correct diagnosis of the cause of a waster is usually a straightforward matter but occasions arise when it becomes more difficult and the first impressions are misleading. A case is recalled by the writer of a particular type of water-jacketed cylinder head, which exhibited a "blown"-top face and which on closer examination was found to have metal in the core vents suggesting that the moulder had not correctly sealed

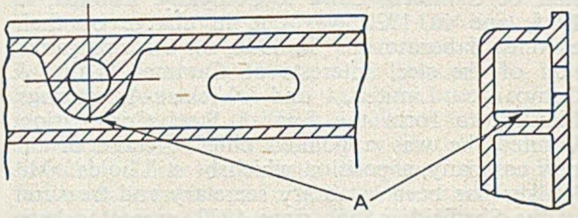


Fig. 1.—Portion of Water-jacketed Cylinder-head Casting showing how Metal penetrated to a Core Vent.

these vents and that the gas from the core consequently endeavoured to escape through the metal and caused the defect reported.

The moulder was duly notified of this waster and the reason assigned for its cause, together with the admonition to be more careful in sealing his vents in future. Being a careful workman, who never took any risks with vents, he was rather surprised at this diagnosis and suggested that the reason should be sought elsewhere.

The next casting also proved to be a waster, in fact this was known during pouring as the mould began to "blow" violently. On examination this, too, had metal in the vents, but as the moulder pointed out it was not due to his vents being inefficiently sealed, for in that case there would be a metal flash over the vent, but the actual casting was free from any flash and the top of the metal in the vents was rounded off suggesting that the metal was in the core and seeking an outlet through the vent. Breaking the casting showed this to be the correct assumption, the sand forming the core between a bolt hole boss was very narrow (shown at A, Fig. 1), and the metal penetrated this and flowed through the passage made by means of a wax vent, thus causing the blowing. This discovery exonerated the moulder from responsibility for the waster and steps were then taken to ensure that the core did not fail at this point again.

An assessment of the husband's income, usually includes that of the wife's income, the incomes being aggregated, but as regards any earned income of the wife, it should be noted that the one-fifth earned-income allowance applies to that as to the husbands, and there is also a special allowance of four fifths of the wife's earned income subject however to a maximum of £110, these allowances being in addition to the ordinary personal allowance to the husband of £70 for the wife. As regards the different rate poundages, the assessment machinery is such that the reduced rates can apply equally to the earnings of the wife as to the income of the husband.

Institute of British Foundrymen *London Branch*

Modernising an Iron Foundry*

Discussion of a Paper by Mr. L. W. Bolton and Mr. W. D. Ford

At the conclusion of the Annnal General Meeting of the London branch of the Institute of British Foundrymen, Mr. L. W. Bolton and Mr. W. D. Ford presented their Paper entitled "Modernising an Iron Foundry." The chairman, Mr. F. Arnold Wilson, briefly introducing the Authors, said Mr. L. W. Bolton had spent 20 years with the British Cast Iron Research Association. During the war, he had been on the staff of John Gardom and Company and was responsible there for putting new mechanised plants into operation. In 1947 he joined Morris Motors, Limited, Engines Branch, as manager of their Wellingborough foundry, which position he still held.

Mr. W. D. Ford, foundry engineer of Morris Motors, Wellingborough, first became interested in foundrywork when serving his apprenticeship with the Ford Motor Company at Dagenham. He had taken up service with Morris Motors, Limited, following a period of war service with the R.E.M.E.

In his opening remarks, MR. L. W. BOLTON referred to his colleague Mr. Ford, and stressed the importance of the foundry engineer in a modern foundry. He felt a certain amount of diffidence in addressing the London branch, because he was conscious that it was the largest and most powerful branch of the Institute. After listening to the lively and somewhat lengthy Annual General Meeting he felt it also must be the toughest branch in that so many members remained to hear their Paper.

[The Paper was then read by Mr. Bolton.]

Core-bonding Materials

MR. W. WILSON congratulated the Authors on their Paper and asked whether in using reclaimed core sand they had encountered trouble from water-proofing with the oil content of the sand. His own firm, in using this type of sand had had considerable difficulty. Perhaps Mr. Bolton had had some experience in the use of detergents for this purpose, and if so some information on the point would be very welcome.

MR. BOLTON said they had experienced no trouble from water-proofing arising from residual oil in the moulding sand. The only problem encountered had been the high plasticity of the sand resulting from unburnt organic material. There had been no difficulty at all in moistening the sand and therefore there had been no need to examine the power of detergents.

MR. B. LEVY remarked that in examining a specimen synthetic-resin sand core it was noticeable that it was extremely hard, and he would like to know whether any difficulty was experienced in extracting a core from a thin casting. It had occurred to him that damage might be caused to the wall of the casting through the hardness of the core.

MR. BOLTON observed that the hard skin on the resin core was produced by spraying the cores with water before they were put into the stove. Slow heating of resin-bonded cores to the baking temperature, as was usual in a continuous stove, tended to give a friable surface, but this trouble could be obviated by water spraying. The cores were, however, rapidly broken down by the heat of the metal and there was not the slightest difficulty in removing them from the castings. Little difference was found between the properties of oil-bonded and resin-bonded cores in this respect.

MR. J. P. P. JONES raised a point on resin- or oil-bonded cores. He said that he understood that the Authors had expressed a preference for cores bonded with resin, why then did they not use resin exclusively for cores instead of making two thirds of the cores with oil-bonded sand. Perhaps Mr. Bolton could also say what the effect was of the used core sand when used as a moulding sand, having regard to the fact that the cores were made with two different types of binders, did they mix well together as a moulding sand or was there a reaction?

Remarking that he had rather expected this question, MR. BOLTON said he had also been wondering what the reply would be. As he had said earlier, the main reason for adopting the resin-bonded core-sand in their own particular case, had been to enable them to dry the largest cores in a single trip through the stove. If all the cores were made in the resin mixture it would be necessary, in order to avoid burning the smallest cores, to reduce the baking cycle and they would then be faced again with the necessity for circulating the large cores twice. This was very undesirable, as the return of cores for re-drying had to be done manually.

As far as the moulding sand was concerned, no appreciable difference in properties had been noticed since the introduction of the resin-bonded core sand. Some difficulties had arisen in the past with high plasticity, which was believed to be due to the presence of unburnt dextrine which entered the system from the oil-bonded core mixture. Since changing the large cores to the resin-starch mixture, there appeared to have been rather less trouble from this source. He thought that dextrine had a more drastic effect than starch on the plasticity or mouldability of moulding sand, or perhaps the starch was broken down more completely in the cores by the action of the heat from the molten metal.

Block Feeders

MR. RHODES had been struck by the remarkable example of feeding with only a very thin gate and he was anxious to learn whether the same amount of feed could be obtained with non-ferrous alloys.

MR. BOLTON replied that the Authors' experience of the block runner had been limited to high-duty iron castings. These contained only 0.2 per cent. phosphorus and with such metal it had been found most effective in giving a sound casting. They had no experience of its use with non-ferrous alloys.

MR. MORRIS was very interested in the lecturer's remarks on block-feeders. His firm had used them for 25 years, but it was found that when they tried to use them on gunmetal they sometimes got a very rough edge. Had Mr. Bolton found in his experience that if they were not used properly one occasionally got pin holes in the edge of a casting?

* Paper printed in last week's issue.

Modernising an Iron Foundry—*Discussion*

Mr. Bolton, replying, said it was true that the size of the block-feeders used had been determined by trial and error. They had so far been unable to evolve any formula to give the correct size of block for a casting of a given size or weight. Where a block was not exactly right there was a danger of a rough porous edge where the runner joined the casting. One theory was that this was due to contraction in the mould, breaking the joint between the block and the casting before feeding was complete. By experiment, they had been able to overcome the trouble where the feeder was used on quantity production castings, but the danger of pin-holing at the joint still remained on one-off jobs.

Mr. H. J. V. Williams was interested in the amount of silicon and carbon in the metal as it seemed to bear some relation to the amount of control which could be exercised in using the block-type of runner. He also asked Mr. Bolton for some information on the size of the fan in the exhaust cabins used in the fettling shop, which had been shown in the illustration.

Mr. Bolton said the carbon content of the metal used was 3.35 to 3.45 per cent. and silicon 1.75 to 1.85 per cent. The fans used on the dust exhaust cabins in the fettling shop were driven by 2-h.p. motors and had a capacity of 4,000 cub. ft. per min. at about 1 in. water gauge pressure.

Transitions of Product

Dr. A. B. Everest, observing that he had thoroughly enjoyed the lecture, said the Authors had not dealt with the subject in the way in which he had expected. The foundry was the old foundry of Thomas Butlin, which he had passed hundreds of times on the railway. It had been famed in the past for making tubbing as used on the London underground railways. It was a very long cry from tubbing to tractor frames. Could the Authors say, when the firm went into the present line of production, if a completely fresh start was made, from the foundry point of view, and the foundry was re-equipped and new workers trained, or were the plant, equipment and personnel adapted to this new production. It was difficult to visualise that men who had spent a lifetime in a tubbing foundry could be trained to forget all they had learned and start afresh in a mechanised foundry for tractor castings. It was this aspect in which he was most interested—the transformation from old to new—and he had no doubt that many other members present were thinking along the same lines.

Mr. Bolton revealed that he had been afraid that some reference to tubbing would crop up. When the Thomas Butlin plant was taken over by the Nuffield organisation, "tubbing," or to be more correct, tunnel segments were being hand-moulded in the foundry which had been described. During the war, however, this shop had been used for the mass-production of a casting in black-heart malleable iron and for that work some mechanised equipment had been installed. Use had been made of that equipment in the layout for tractor castings production.

The first stage in the changeover was the introduction of metal of controlled composition, melted and poured at a higher temperature than was previously the practice in the foundry. The decision having been taken to use a synthetic sand, this was introduced for machine and floor moulding. As would be expected, some teething troubles were met before a suitable degree of control was established over sand and metal, but by the time the first castings had to be made to a high-duty specification, considerable experience of the new materials had been built up.

As contracts for tunnel segments and similar castings came to an end, the workers were transferred to operate the new equipment which was being brought into use. The staff and a nucleus of skilled moulders and core-makers were invaluable in solving the many foundry problems which arose and in training other operatives in the new methods. Foundrymen are very adaptable and there had generally been a keen interest in the new methods of operation and a desire to secure the best results from them. As an example, a moulder previously in charge of a gang producing tunnel segments was now a keen and efficient charge-hand over moulding machines.

The President, Mr. F. Arnold Wilson, in closing the meeting, paid a tribute to the very fine slides used to illustrate Mr. Bolton's lecture. He felt that of all the excellent slides they had seen during the current session now closing they had been of the best. He also felt that Mr. Bolton's effort in delivering his lucid address following the rather lengthy general meeting was worthy of the highest praise, and he himself had not noticed anything essential being sacrificed to brevity. Taken all round, he was of opinion that this Paper was a very fine achievement, worthy of the highest praise and he called upon members to signify their approval in the usual way.

Vote of Thanks

Moving the vote of thanks, Mr. L. G. Beresford disclosed that he had sought the honour of proposing it formally before he had heard the lecture, the reason being that he had known Mr. Bolton for a very long time. He had told him to-night that it was 30 years. At the beginning of the friendship, Mr. Bolton had been his student in metallurgy, so he felt that to a certain extent he could claim some credit for all they had heard. He also owed is first introduction to the Institute to Mr. Bolton, who, as they all knew, was a past-president of the Birmingham branch, so they would all understand that it was with the very greatest pleasure he moved the vote of thanks.

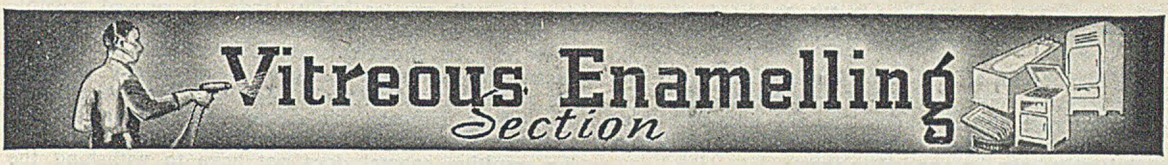
There was a final point he would like to raise *à propos* of the Paper, and that was that at one foundry he had visited not long ago he understood steps were being taken to employ the heat extracted from the foundry and elsewhere to raise steam for heating the office buildings, which were situated not far away, and it was hoped to get some very efficient shop and office heating in that way. Perhaps Mr. Bolton could tell them whether he had any experience in that direction.

Seconding the vote of thanks, Mr. F. Tibbenham, president-elect, commented on the most interesting lecture they had heard, and agreed with the president on the excellence of the slides they had seen. He felt they had shown such high quality that members would want to visit the foundry at an early date, and he hoped an opportunity could be provided for them to do so.

Replying to the vote of thanks, Mr. Bolton expressed his appreciation of the kind remarks made. Mr. Beresford had been his first lecturer in metallurgy and if any credit was due he certainly agreed that Mr. Beresford should share in it.

On the point of raising steam from foundry heat, he could only say that in the foundry described, efforts had been made to dissipate heat to avoid raising the temperature of the shop unduly, but at present this heat was allowed to escape to atmosphere.

Richardson Engineering (Birmingham), Limited, Singleton Works, 329-333, Icknield Port Road, Birmingham, 16, have the sole British Sales agency for the Hundt and Weber centrifugal casting machines.



Vitreous Enamelling of Light Alloys*

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Recent technical developments are reviewed culminating in the formulation initially of leaded and finally of leadless vitreous enamels for aluminium and aluminium alloys, both cast and wrought. There is a necessity for close control in firing temperature, but in this respect a continuous furnace in a pilot plant has given complete satisfaction. A wide range of test results is quoted to show that the leadless enamels, whilst not attaining the properties of the best acid- and alkali-resistant enamels for iron and steel, are comparable with a number of commercial enamels used for the high-melting-point metals. In some respects, for example in resistance to thermal shock, the aluminium enamels are superior. Indications are given of the fields of application and the direction to be taken by future research.

SINCE 1935, when production throughout the world amounted to some 3,000 tons per annum. the growth of the aluminium industry has been remarkable. Statistics for the year 1948 show that world production in that year amounted to 1,250,000 tons in round figures, divided up as shown in Table I.

TABLE I.—*World Production of Aluminium.*

Total production, 1948	1,250,000 tons
United States	46 per cent.
Canada	27 „
U.S.S.R.	10 „
France	5 „
Great Britain	2 „
Other countries	9 „

TABLE II.—*World Consumption of Aluminium.*

	Tons.
United States	640,500
Great Britain	246,000
France	90,500
Italy	33,000
Canada	30,000
Switzerland	28,000
Holland	12,600
Belgium	9,300
U.S.S.R. and other countries	160,000

Because aluminium possesses two outstandingly attractive characteristics, its light weight and the fact that it does not rust, its use has been, and still is, steadily increasing for a wide variety of domestic and other articles in general use. It is now used for components of a very extensive range of manufactured products and in certain very large industrial fields such as the building, mechanical transport and shipping industries.

During the past few years, the industry has become acutely conscious of the need for a hard, durable and decorative finish superior to those hitherto available. The best finishes at present in use include various types of synthetic stoving enamels and anodic oxide coatings. The former are available in a full range of attractive colours, but are relatively soft and will not withstand heat. Anodic finishes, although intensely hard, are very thin and easily scratched. They have a more limited colour range and, while the coating itself will withstand high temperature, the dyes used in colouring will not. Existing finishes, therefore, have fallen short of the requirement, particularly with regard to resistance to heat and durability and also, in many cases, with respect to adhesion.

Expansion of the use of aluminium has been retarded in certain fields by the lack of a superior finish and it is certain that the development of such a finish will accelerate this expansion and thus create new markets for the finish itself. An analysis is given in Table II of statistics for the consumption of aluminium, as distinct from its production, in the principal countries of the world. A further analysis of the breakdown of the use of aluminium in Great Britain leads us to estimate that 20 per cent., *i.e.*, 50,000 tons, of that used requires some kind of surface finish. This is divided roughly in the proportion of two to one between wrought products and castings. One ton of 16-g. sheet aluminium, if finished on one side only, would require about 4 cwt. of vitreous-enamel frit. Similarly, 1 ton of cast aluminium ¼-in. thick would require about 1 cwt. of frit. Assuming that only 10,000 tons of aluminium is finished in this way annually, it follows that the market for a vitreous enamel for aluminium already exists to the extent of between 1,000 and 2,000 tons per annum. It has become apparent, therefore, that there is an extensive world market for an improved finish for aluminium and the Authors' research work on this problem led them to believe that a solution could be found in the development of a vitreous type of enamel.

Another important class of light alloys now in use is that based on magnesium. These alloys are even lighter than those of aluminium. They are very liable to atmospheric corrosion; so much so that the use of covering or finish of some kind is obligatory. While work has been chiefly directed towards the development of a vitreous enamel for aluminium, the Authors have also produced forms of enamel which can be applied

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to the magnesium alloys. Opinion is widely held that in the years to come the use of magnesium alloys will greatly increase and it follows that the time will come when there will be a substantial demand for a vitreous enamel which can be applied to them.

Problem of Application

The problem of producing a vitreous enamel for aluminium consists in finding suitable formulations for a glass capable of being bonded to aluminium and its alloys, and having a much lower melting point and higher thermal expansion than those normally manufactured for iron and steel.

The melting point of pure aluminium is 659 deg. C., and that of the commercially pure aluminium sheet commonly used in industry is about 658 deg. C. While this material is used extensively for the production of pressings and fabricated parts, a very large number of articles, loosely referred to as aluminium, are in fact aluminium alloys, and practically all castings are alloys. These alloys may contain silicon, magnesium, copper, etc., and have melting points below that of aluminium. Thus a 3 per cent. copper alloy has a melting point of 600 deg. C. while the commonly used Alpax casting alloy—which corresponds to the aluminium-silicon eutectic—has a melting point of 570 deg. C. The annealing temperature for most of these alloys is about 350 deg. C. In contrast, the melting point of mild steel is about 1,300 deg. C., and of cast iron 1,130 to 1,200 deg. C., while the annealing point for a plain carbon steel is about 800 deg. C. Vitreous enamels for iron and steel are at present normally fired at temperatures between 700 and 1,000 deg. C. Consideration of these figures shows that a vitreous enamel for aluminium and its alloys must have a melting point below 550 deg. C., and preferably as low at 500 deg. C. Even at this figure, the margin between the firing temperature and the melting point of the metal will be only a fraction of that existing in the case of cast iron and steel.

The coefficients of linear expansion of vitreous enamels for iron and steel normally lie between 7.7 and 11×10^{-6} per deg. C., while the expansion of iron and steel is between 10 and 16×10^{-6} per deg. C., depending upon the temperature range. The slight difference between the expansion of an enamel and the metal is relatively unimportant as the forces involved are not sufficient to cause any breakdown of the bond. Aluminium, however, has a coefficient of linear expansion of 20 to 24×10^{-6} per deg. C. and, therefore, before successful application can be accomplished a great increase in the expansion of an enamel is needed.

While vitreous enamels for iron are generally applied in several separate coats, the advantages have long been appreciated in the industry for a finishing-coat enamel which could be applied directly to the metal so as to produce a finished article in one coat. Development along these lines has been actively pursued, especially in the United States. Enamels of this character which have at present been developed are only suitable for application to a limited range of steels and are not yet in common use.

It seems that the need for a special grip coat in the case of iron and steel arises from the fact that the oxide coat so readily formed on the metal is non-adherent. On the other hand, the aluminium oxide coat adheres very strongly to the metal. It would appear that this bond could, therefore, be used to form the basis of the bond to the vitreous enamel, and gives some hope of producing a one-coat enamel for aluminium with greater facility than has proved possible in the case of iron and steel.

It may be thought that the problem of vitreous enamelling aluminium might be solved by studying the methods used in producing the decorative enamels applied to copper and silver. Enamelling of this character is primarily for decorative jewellery work, and the resulting enamel does not have to withstand the same severe conditions of use as those for iron and steel. The need for the enamel for aluminium is, primarily, a utility one and the product will be used in much the same way as enamelled iron. Because of this, it has not been possible to obtain much help from the technique of the jewellery enamels which, by reason of their purpose, have been able to avoid some of the chemical limitations which have to be faced.

The foregoing presents the problems confronting those who wish to enamel aluminium. Table III summarises the properties required in relation to the existing enamels and the metals concerned.

Enamels Containing Lead

It is now possible to consider some solutions to the problems outlined above.

The first line of attack which all workers have followed is to introduce lead oxide into the enamel. Lead oxide has long been known to reduce the melting point of glazes and enamels without much effect on the expansion. The alkalis (No_2O, K_2O and Li_2O) increase the expansion and also lower the melting point. Mixtures of lead oxide and an alkali are known to give a great reduction in melting point, combined with increased expansion—just those properties required for a vitreous enamel suitable for aluminium.

TABLE III.—*Physical Properties of Metals and Corresponding Enamels.*

Material.	Coefficient of thermal expansion, per deg. C.	Melting point, deg. C.	Annealing temperature, deg. C.
Iron or steel	11 to 16×10^{-6} (0 to 600 deg. C.)	1,130 to 1,300	800 to 900
Enamel for application to iron and steel ..	7.7 to 11×10^{-6}	700 to 1,000	—
Copper	16×10^{-6} (0 to 600 deg. C.)	1,083	—
Enamel for application to copper	10 to 14×10^{-6}	570 to 640	—
Silver	18×10^{-6} (at 620 deg. C.)	961	—
Enamel for application to silver	—	—	—
Aluminium and alloys	24 to 28×10^{-6}	570 to 660	350 to 600
Properties for enamel suitable for use on aluminium	18 to 22 × 500 to 550 10-6		—

A considerable amount of information on the melting points of various interesting compounds and eutectics is already available, particularly from work done in the U.S.A.[1] and some of the more relevant figures are included in Table IV. The work has been extended somewhat in the Authors' laboratories, particularly in relation to mixtures of lead borate and silicate. A graph showing the melting point of mixtures of these is given in Fig. 1.

The search for a solution to the problem, by combining lead oxide with alkalis in suitable glasses, proceeded along parallel lines on both sides of the Atlantic, but there were some interesting differences in the results obtained. The American workers produced enamels containing titanium and antimony oxide, combined with a fairly high proportion of lithium as flux-

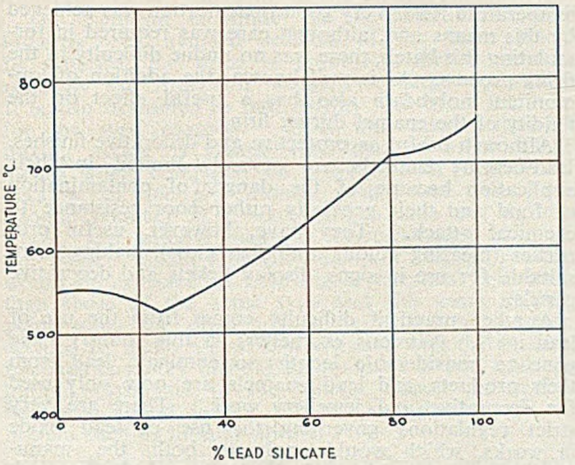


FIG. 1.—MELTING POINTS OF LEAD SILICATE/BORATE MIXTURES.

ing agent and no boron.[2] In spite of its lead content, the product exhibited good resistance to attack by moisture and acid. It could, however, be applied to only a limited range of aluminium alloys, and, even then, involved the use of special surface treatments. British workers, on the other hand, have had to avoid the use of titanium because of patent protection and the use of large proportions of lithium, because of expense.

The first range of Aluglas* enamels produced (Aluglas A) avoided the use of lithium entirely, but did contain a higher percentage of lead. These enamels were available on a wide range of colours. Application was particularly easy and involved no surface treatment other than a very simple cleaning process. Little trouble was experienced with any of the cast or wrought alloys, except those using very high percentages of magnesium. This series of enamels, however, was not sufficiently resistant to chemical attack, particularly with regard to alkalis and humidity; severe loss of gloss resulting from exposure to 100 per cent. humidity for six days.

To overcome this difficulty two further series of enamels were developed, known as "Aluglas B" and "Aluglas B1." In these enamels the lead content was reduced and the melting point allowed to rise somewhat. The resulting products were much harder and their resistance to chemical attack was improved to a level where they were comparable to the American product, without any serious increase in complexity of the application process.

Table V indicates the approximate molecular formula of some of the various lead-bearing enamels developed in this country and America. It is difficult to express the composition of these enamels in a way in which their relations can be easily appreciated. In analysing the results, a form of graphical chart has been found helpful and two of these charts are illustrated in Figs. 2 and 3. On these charts, the mole-

* "Aluglas" is the name adopted by the Amalgamated Research and Development Company, Limited, as the trade mark for their frit.

TABLE IV.—*Eutectics Useful in Compounding Low-melting-point Vitreous Enamels.*

$PbO—SiO_2$

$2PbO . SiO_2$: 746 deg. C.
$3PbO . 2SiO_2$: 715 deg. C.
$PbO . SiO_2$: 766 deg. C.

$PbO—B_2O_3$

$PbO . 2B_2O_3$: 768 deg. C.
$5PbO . 4B_2O_3$: 548 deg. C.
$2PbO . B_2O_3$: 493 deg. C.

$K_2O—SiO_2$

$K_2O . SiO_2$ } $K_2O . 2SiO_2$: 780 deg. C.
$K_2O . 2SiO_2$ } $K_2O . 4SiO_2$: 750 deg. C.

$Na_2O—SiO_2$

$2Na_2O . SiO_2$ } $Na_2O . SiO_2$: 1,020 deg. C.
$Na_2O . SiO_2$ } $Na_2O . 2SiO_2$: 830 deg. C.
$Na_2O . 2SiO_2$ } SiO_2 : 790 deg. C.

$Li_2O—SiO_2$

$Li_2O . SiO_2$ } $2Li_2O . SiO_2$: 1,024 deg. C.
$Li_2O . SiO_2$ } $Li_2O . 2SiO_2$: 1,033 deg. C.

$K_2O . SiO_2 - Na_2O . SiO_2$	Eutectics	745	deg. C.
$K_2O . 2SiO_2 - Na_2O . 2SiO_2$	,,	705	,,
$Na_2O . 2SiO_2 - Li_2O . 2SiO_2$	,,	637	,,
$Li_2O . B_2O_3 - Na_2O . B_2O_3$	,,	650	,,
$K_2O . PbO . 4SiO_2$	,,	757	,,
$PbO . Na_2O . SiO_2$	,,	620	,,
$PbO . Na_2O . SiO_2 - PbO . SiO_3$	,,	590	,,
$PbO . Na_2O . SiO_2 - Na_2O . SiO_2$	,,	580	,,
$3PbO . SiO_2 - Na_2O . SiO_2$	,,	620	,,
$3PbO . 2SiO_2 - Na_2O . SiO_2$	,,	590	,,
$2PbO . SiO_2 - PbO . 2B_2O_3$	,,	525	,,

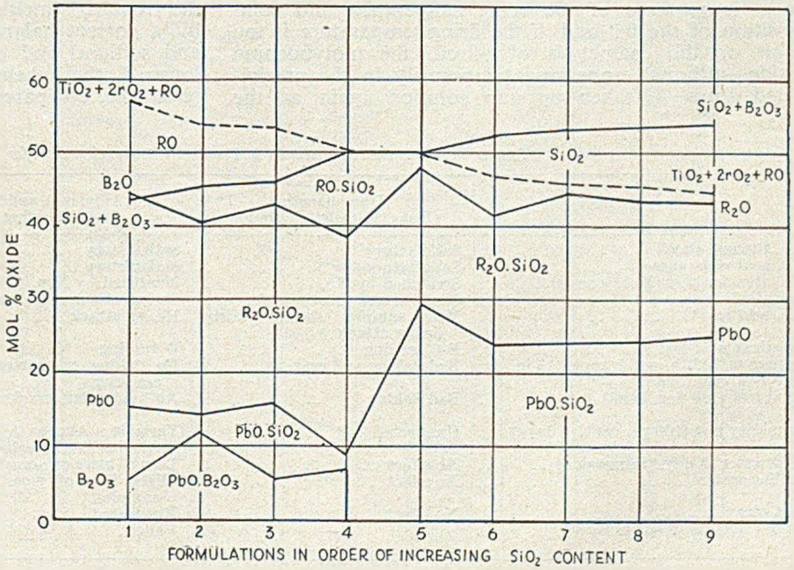


FIG. 2.—COMPOSITION OF AMERICAN FRITS.

Vitreous Enamelling of Light Alloys

cular percentage of the various acidic and basic oxides in the enamels are plotted as ordinates and the various enamel compositions are arranged along the abscissæ in order of increasing acidity or SiO_2 content. By dividing the oxides into "acidic" and "basic" groups and plotting the percentages of each group additively (*i.e.*, PbO, $PbO + R_2O$, $PbO + R_2O + RO$ for the basic oxides, and SiO_2 and $SiO_2 + R_2O_3$ for the acidic oxides), the acidic and basic oxides can be balanced and any excess of one or the other readily observed. These charts have proved useful in deciding on lines of attack and for fitting results into one coherent scheme. But an analysis on this basis cannot be carried too far.

Some difficulty was experienced in finding a suitable opacifier for the lead-bearing Aluglas. The common opacifiers themselves are not very suitable. Titanium tends to give a yellowish colour, although this can be counteracted by combining it with antimony. The method had some disadvantages. however, and was, in any case, covered by previous patent specifications.

TABLE V.—*Approximate Molecular Percentage of Lead-bearing Enamel Suitable for Application to Aluminium.*

	Dupont (2) formulation.	Aluglas (4).		
		A	B	B.1
Lead oxide, PbO	10 to 18	40 to 50	25 to 35	10 to 20
Silica, SiO_2	38 to 65	20 to 30	30 to 40	40 to 50
Lithium oxide, Li_2O ..	5 to 12	0 to 1	0 to 3	0 to 3
Other alkalis, R_2O ..	0 to 42	5 to 7	9 to 12	12 to 16
Titanium oxide, TiO_2 ..	0 to 11	—	—	—
Boric oxide, B_2O_3 ..	—	15 to 20	10 to 15	8 to 10
Alumina Al_2O_3	—	1 to 3	1 to 3	2 to 4

The problem was eventually solved by the use of molybdenum compounds. A molybdenum compound (normally ammonium molybdate) was incorporated in the batch, and further additions of ammonium, sodium or calcium molybdate were added in the mill. Zircon added as a mill addition assists the process.[5] The opacification depends upon the precipitation of one of the many oxides of molybdenum (probably MoO_3) during the final firing of the enamel. Careful adjustment is required of the firing temperature and composition of the frit and, if the firing temperature is too high or the enamel is over-fired, the molybdenum oxide—although appearing temporarily in the precipitated form—is taken up into solution again as the temperature rises. Very good opacification was achieved by this means and, although care was required in formulating this batch, there was no undue difficulty in the firing process. As is well known, the addition of ammonium molybdate also has a useful effect on the fluidity of the enamel during firing.

Although useful as protective and decorative finishes, lead-bearing enamels are severely limited in their application because of the danger of contamination of food and their generally rather poor resistance to chemical attack. They have, however, useful properties (pleasing colour and high gloss), making them suitable for use in signs, display tickets and decorative panels.

Another practical difficulty comes from the use of lead itself. Vitreous enamellers in this country have gone to considerable lengths to eliminate lead from their products, and lead enamels are now only used for decorative and jewellery work. There are very strict regulations governing the use of lead oxide in works, which would apply to both the manufacturers of the frit and the users of the enamel. It is true that provided the quantity of lead in the frit is reduced so that the insoluble lead bi-silicate can be used, there is some relief from these regulations, but it has been the Authors' experience that vitreous enamellers as a whole have, so far, been unwilling to introduce lead enamels into their works in any form.

Leadless Enamels

Because of the difficulties in the commercial exploitation of a suitable lead-bearing enamel, the Amalgamated Research & Development Company decided. two years ago, that a solution of the problem along the lines of a leadless enamel must be found. Accordingly the whole of the company's research efforts was applied to this problem.

The melting points of the Aluglas B and B1 enamels had already been allowed to rise above 500 deg. C. (which was the limit initially imposed), and it had been proved that enamels with melting points in the region of 530 deg. C. were quite practicable, providing they were handled with correct equipment. Nevertheless, melting points were required very much lower than those of existing enamels.

A series of frits was prepared using the alkaline-earth group of oxides in place of lead and obtaining the required melting point and expansion coefficient by a correct balance of the alkali metals (potassium and sodium) and boron. These were found to have lowered the chemical resistance, particularly acid resistance, compared with the Aluglas B enamels.

TABLE VI.—*Summarised Results of Tests on Vitreous Enamels for Aluminium.*

Test.	Iron enamel. (Not acid-resisting grade.)	Aluglas A and B. (Lead-bearing.)	Leadless Aluglas D.
B.S. thermal shock	Satisfactory	Satisfactory	Satisfactory
B.S. heat resistance	Satisfactory	Satisfactory	Satisfactory
B.S. abrasion test (Mohr's scale)	Scratched by No. 7	Scratched by Nos. 4-5	Scratched by No. 6
B.S. alkali test	Slight attack most samples ..	Severe attack most samples ..	Fair attack
B.S. acid test	Most samples showed fairly heavy attack	Heavy attack	Heavy attack
American acid test	B-C grading	D grading	C-D grading
Impact test (2-lb. wt. dropped 15 in. on to 1-in. diam. ball)	Bad flaking and crazing ..	No flaking or crazing; slight cracking	No flaking, only slight cracking
Bend test (180 deg. bend)	Bad flaking	No flaking but cracks appear ..	No flaking but cracks appear at bend
Humidity test (100 per cent., 6 days) ..	Unaffected	Variable: Aluglas A lost gloss. Aluglas B unaffected	Unaffected
Cold water (6 days' immersion)	No effect	Loss of gloss on some samples ..	No effect
Boiling water	No effect	Slight loss of gloss on some samples	No effect
Salt spray	No effect	Not tested	No effect
Home Office lead solubility	—	Failed	—

The inclusion of lithium in the formulations had hitherto been avoided because of its high price. In America, the price is lower and this element is used by the American workers in large quantities. It is also beginning to find its way into batch formulæ for the steel enamels. It is well known that its fluxing action is greater than that of other alkali metals when compared on a weight per cent. basis because of its low atomic weight (At. Wt. 7.94. Atomic Number 3). Since lithium salts are, on the whole, less soluble than the corresponding salts of the other alkali metals, enamels using lithium would be expected to have higher chemical resistance than those of the same type and the same melting point using the other alkalis. Accordingly, it was decided to make use of this element, and the present formulations may include up to about 8 per cent. of lithium carbonate in the batch. Some advantage has been found in the use of heat-stable salts of lithium such as lithium silicate.

This stage of the work involved the preparation of several hundred enamels in which an exploration was made of the effects of various elements on the viscosity characteristics, gloss, opacification and colour. Continued development on these lines led to a gradual improvement in the physical and chemical properties of the enamel, without undue increase in the melting point, and to the production of a range of formulæ for both opacified and clear enamels capable of being produced in a range of colours.

Of necessity, all these formulæ contained a much higher proportion of alkali metals than is common in iron and steel enamels. By a proper balance of the various ingredients it was possible to avoid the depreciation in properties which would normally have accompanied such an increase. This fact is well brought out by an examination of the ratio of the "acidic" and "basic" oxides. Vitreous enamels for iron and steel and glazes for ceramic ware have a ratio $\frac{RO_2 + R_2O_3}{R_2O + RO}$ (where RO_2, etc., are the molecular fractions of the various oxides in the enamel), varying from 1.5 to 12.0, the higher figures being associated with the more acid-resisting enamels firing at a high temperature. Compositions having a ratio of less than 1.5 have been considered commercially useless hitherto because of their softness and solubility. For a comparatively new series of low-melting-point glazes and fluxes for the decoration of glass and ceramic ware, this ratio varies from 1.2 to 4.5 but in this case the B_2O_3 and Al_2O_3 content is high.[3] In the Aluglas leadless enamels (Aluglas D)[6] the ratio seldom exceeds 1.5 and, in the final series of formulations, lies between 0.3 and 1.40. In spite of this, the hardness of these enamels is in the region of 6 on Mohr's scale. They are, consequently, more chemically resistant than the lead enamels approaching the normal grades of vitreous enamel on iron and steel commonly available in this country.

During the latter stages of the work reported in this article, close collaboration has been maintained with the Aluminium Development Association and the British Non-Ferrous Metals Research Association. Several series of physical tests have been carried out in the laboratories of the latter Association on enamels for aluminium, including Aluglas. These tests include those specified in BSS 1344 (1947) "Methods of Testing Vitreous Finishes," and others devised by the Research Association to stimulate the effect of the prolonged use of enamel in domestic and industrial situations. The result of these, and other tests, are summarised in Table VI. It will be seen from this table that the new leadless Aluglas has properties intermediate between the lead-bearing aluminium enamels and the normal grades of vitreous enamels for iron and steel. Further details of the tests and the general results obtained are given in Appendix I.

The various types of Aluglas D frit[6] now available have melting points up to about 530 deg. C. when ready for spraying. It has been an aim of this work to produce enamels with a melting point not exceeding 500 deg. C. and the choice of this temperature as a useful maximum agrees with other workers in this field. It has not yet been found possible, however, to produce a leadless enamel with adequate chemical resistance firing below 500 deg. C., although development along these lines is continuing. It will be appreciated that these temperatures are the firing temperatures of the finished enamel. The base glass itself may have a melting point appreciably lower, but mill additions and opacifiers are always responsible for some increase.

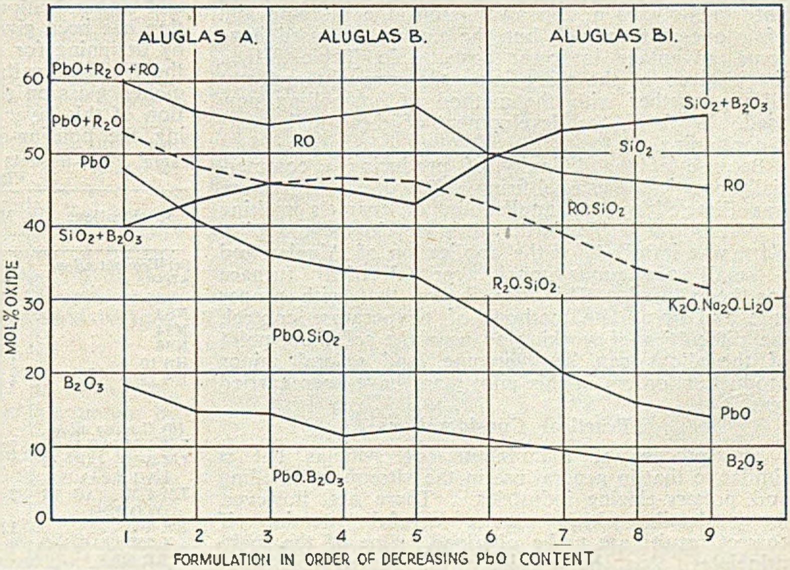


FIG. 3.—COMPOSITION OF "ALUGLAS" FRITS.

FIG. 4.—TYPICAL VITREOUS - ENAMELLED KITCHEN WARE.

Aluglas D can now be applied directly to commercially-pure aluminium sheet and a number of the more important wrought and cast alloys (Figs. 4 and 5), but difficulties are still experienced with its direct application to alloys containing fairly large percentages of copper or magnesium. To overcome these difficulties, a series of tests were made in conjunction with the Aluminium Development Association, with special surface treatments for the metal as a preparation for enamelling. Most of these treatments consist in producing phosphate, chromate, or aluminium-oxide coats. Although it has been shown that some of these treatments do not prevent the application of the enamel, none has been effective in promoting the adhesion of the enamel to materials which could not be handled normally. Some treatments completely prevent the formation of the bond, and this is particularly true of the chromate coatings of the type which have been used in this connection by the American workers in the field with lead enamels.

The Authors' approach to this problem has been a different one and has consisted in the provision of a special undercoat for use on certain alloys. This, unfortunately, is a step away from the ultimate aim of a one-coat enamel, but the undercoats used have some advantage in lower costs. In Table VII a list is given of the more important wrought and cast alloys, together with the method of enamelling now used. Work on the development of these undercoats is continuing.

Because of the difficulty of producing a commercially practicable enamel firing at 500 deg. C., attention was directed to the application of enamels melting at 530 deg. C. To further this development a pilot plant was installed for the application of Aluglas and a small continuous-tunnel type electrical furnace has been used. This has shown that with proper care and up-to-date methods of temperature control, the difficulties of working so near the softening point of the alloys can be overcome, and several minor production orders in this pilot plant have been carried out.

Practical Considerations

The process of manufacture of Aluglas frit is similar to that in general use in the vitreous-enamelling and pottery-glazing industries. There are, however, many details which require careful attention if correct results are to be obtained. One of the main principles that has guided the development of Aluglas is that of making use of a combination of eutectics in order to attain the lowest possible melting point consistent with suitable physical characteristics. Batches have to be more thoroughly mixed, therefore, and the firing more carefully controlled to obtain the correct sequence of chemical reactions. While, for experimental purposes, pure chemicals are generally used, suitable commercial production batches can only be obtained economically by the use of felspars and other chemical compounds of commercial grade. These have to be carefully chosen if the advantages derived from the eutectics above mentioned are to be maintained. It is for this reason that contamination from the crucibles or walls of the furnace must be reduced to a minimum and the condition of the atmosphere controlled within close limits.

Recently, improved results have been obtained by the use of tank-type furnaces with pre-combustion chambers arranged so that the temperature and condition of the combustion products can be carefully controlled and adjusted before they enter the melting furnace itself. In this type of furnace, the melt in contact with the furnace walls is the coldest part so that slagging and contamination of the batch is relieved. Consideration has been given to taking further advantage of this by designing for a relatively high loss of heat through the furnace walls, so as to maintain a layer of unmelted glass on the inside of the furnace. The formation of this layer could be further assisted by positioning the pouring-off hole a short distance above the

TABLE VII.—*Wrought and Cast Aluminium Alloys and Method of Vitreous Enamelling Developed.*

Specification.	Main alloying elements.	Enamelling treatment.
(a) Wrought alloys.		
SIC	Comml. pure sheet (99 per cent. Al)	Aluglas direct.
NS3	1 per cent. Mn	Aluglas direct.
NS4	2 per cent. Mg	Special undercoat.
NS6	5 per cent. Mg	Special undercoat.
HS 10	1 per cent. Mg, 1 per cent. Si	Special undercoat.
HS 15	4 per cent. Cu, 0.6 per cent. Mg, 1.5 per cent. Si, 1.2 per cent. Mn	Special undercoat.
(b) Casting alloys.		
LM-1-M (AC 1) ..	7 per cent. Cu, 3 per cent. Si	—
LM-2-M (AC 2 LAC 112A)	1.5 per cent. Cu, 10 per cent. Si	Aluglas direct.
LM-4-M (AC 4 DTD 424)	3 per cent. Cu, 5 per cent. Si	Special undercoat.
LM-6-M	12 per cent. Si	Aluglas direct.
LM-7M (AC 7 RR 50)	2 per cent. Cu, 2.5 per cent. Si, 1 per cent. Ni	Special undercoat.

floor of the furnace, so that the lower layer of glass is never disturbed.

Preparation of Frit and Slip

This follows on similar lines to the methods at present used in the industry. The mill additions normally used to obtain opacification, suspension and setting characteristics, are not suitable for this type of enamel where it is essential to keep the melting point as low as possible and maintain the maximum fluidity during the firing process. A new technique and range of mill additions have been developed to obtain the best results.

Preparation of the Metal

The fact that aluminium is a non-rusting metal simplifies its preparation for enamelling. Clean castings direct from the foundry can be enamelled without further treatment. Wrought products (and. generally, castings also) require some form of degreasing treatment. Solvents and alkaline degreasing washes may be used, or the grease may be burnt off by pre-firing. If the surface of the material is in bad condition, shot blasting proves a useful preparation for enamelling.

Enamel Application

Most of the Authors' work has been with sprayed coatings, where the technique is exactly similar to that now in use. The most reliable results are obtained if the first coat is applied very lightly in a fairly dry condition. After firing, this thin coat forms the bond to the aluminium and gives a good foundation for the second or cover coat. Normally, two coats of the same slip are used, but experiments have recently been conducted with special undercoats for use on certain alloys.

Muffle furnaces are the most convenient for general experimental works, but special care is required to ensure that the temperature is even throughout the furnace. In the pilot plant, a continuous furnace has been installed in which the enamelled articles are carried through a 5-ft. long heating zone on a moving belt. With this type of furnace it is much easier to control the operating temperature, and to ensure that each article passes through a zone of controlled temperature without overheating. The articles may be brought up to the required temperature in a preheating zone and the firing operation completed in a relatively short zone at carefully controlled temperature.

This problem of even temperature distribution within the furnace has already been met in connection with the heat-treatment of alloys. In this case, ordinary muffle furnaces were found inadequate, but the difficulties have been overcome by the introduction of air-circulation furnaces, in which a fan circulates air at a fairly high speed within the furnace itself. The lack of heat transfer by radiation is made up by increased convection. If this type of furnace is used, trouble may arise due to deposition of dust on the enamelled surface. If a method were found to overcome this, this type of furnace should be most useful.

Summary

There have been several attempts to solve the problem of the vitreous enamelling of aluminium by the use of a lead-bearing enamel. For reasons already outlined the conclusion was reached that such a solution would not be satisfactory and, accordingly, attention was given to the production of a leadless enamel.

Although leadless "Aluglas" is the equal in appearance and chemical resistance of most of the vitreous-enamelled ware obtainable on the market, the best acid-resisting finish which can be obtained on iron and steel is not yet achieved with aluminium. Aluminium enamels have, however, some advantages over the iron and steel enamels, particularly with regard to their flexibility, while they are hard enough to withstand hard wear. Aluglas is unquestionably an improvement in many important respects over the finishes previously available for aluminium.

In manufacture and use, Aluglas is not essentially different from the existing vitreous enamels, and companies equipped for producing one should be readily able to adapt themselves to carry out the other. The major difference is in the temperature concerned, and it is unlikely that either melting or firing furnaces now in use for vitreous enamel could be used for Aluglas without modification. It is believed that the industry now has considerable experience in overcoming such special problems as may arise from the use of these enamels.

Although it is considered that the stage has been reached when these frits can be marketed, the Authors are well aware of the necessity for further development and are continuously working to produce improvement, particularly by reduction in melting point and reduction in cost. A reduction of melting point would materially assist in simplifying the application process, and continued research along the lines which led to the present developments should tend in this direction.

Another aspect of the problem which is receiving attention is the question of the application of Aluglas to various aluminium alloys. The original Aluglas A series presented no difficulties in this direction, but the leadless Aluglas D was at first only found suitable for direct application to commercially pure aluminium and the casting alloy L.33. Recent developments permit its application to most of the more important wrought and cast alloys. Experimental work is proceeding on the combination of the enamelling process with the heat-treatment process. In this connection, the ability of Aluglas to withstand severe

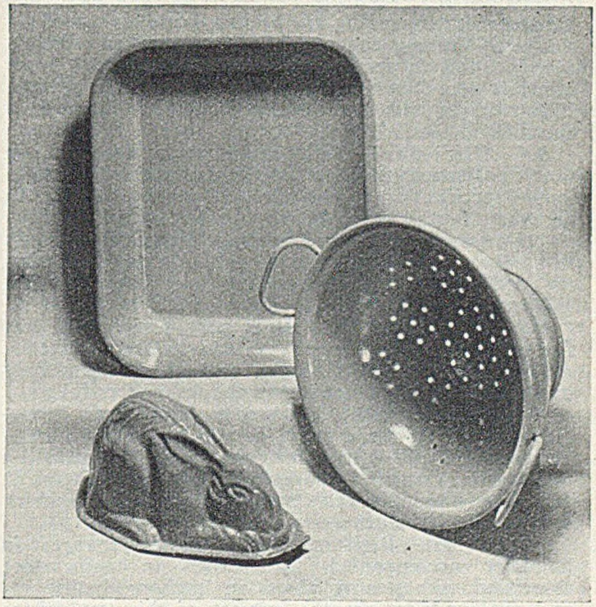


FIG. 5.—THE ABILITY OF THE LEAD-FREE VITREOUS ENAMEL TO SEAL AND ADHERE TO THE SURFACE OF PIERCED AND FORMED COMPONENTS IS DEMONSTRATED.

Vitreous Enamelling of Light Alloys

temperature shock is invaluable and allows of articles being quenched in water direct from the enamelling furnace. Just as aluminium has already replaced steel for many purposes where its inherent advantages have offset its greater cost, so, it is believed, will vitreous-enamelled aluminium replace enamelled steel in the near future to an appreciable extent.

The Authors express their thanks to Dr. A. G. Quarrell, late of the British Non-Ferrous Metals Research Association, and to Miss M. E. Whitaker, who has conducted a large number of tests on the enamels, to Dr. E. G. West and his staff of the Aluminium Development Association, for their continued encouragement, and the directors of the Amalgamated Research and Development Company, Limited, for their permission to publish this work.

REFERENCES

1 *Journal of The American Ceramic Society*, 1947, November.
2 British Patent No. 580,688, 1943; British Patent No. 634,055, 1945, Dupont.
3 U.S. Patent Spec. No. 2,352,425, A. J. Deyrup, Du Pont de Nemours.
4 British Application No. 37,078, 1946.
5 British Application No. 14,774, 1948.
6 British Application No. 14,743, 1948.

APPENDIX

Tests Applied to Vitreous-enamelled Samples

B.S. Thermal Shock Test.—The test as applied to these samples was not quite as severe as intended in the B.S. Specification, since smaller samples (12 sq. in.) were used throughout. Also, all the test-pieces were enamelled on one side only.

Modified B.S. Heat-resistance Test.—The temperature indicated in the B.S. test was somewhat high for alloys of aluminium. B.N.F.M.R.A., who carried out this test, modified it by heating the sample to 340 deg. C. and allowing it to cool. The test was repeated three times as specified.

Modified B.S. Abrasion Test.—Minerals of increasing hardness corresponding to Mohr's scale are used in this test. Vitreous-enamelled iron passes when minerals below 7 fail to scratch the surface. Lumps of the minerals were drawn across the enamel surface; whereas light rubbing with the powders to 60 to 72 mesh is specified in the B.S. test.

B.S. Alkali Test.—Slight modification was made in that the temperature was more rigidly controlled than in the specification, for it was held at 80 ± 1 deg. C. for the 20-min. duration of this test. All but one or two samples of lead-bearing enamel failed this test. Several leadless have passed. A number of tests on ordinary vitreous-enamelled iron show several failures.

B.S. Acid Test.—The test is very severe and very few samples of vitreous-enamelled iron are unaffected. All samples of leadless Aluglas were affected, and only one lead-bearing enamel passed the test successfully.

American Institute of Vitreous Enamellers Test.—A test with 10 per cent. citric acid is applied over a period of 15 min. after which the enamel is graded by the degree of attack. Grades are: AA, A, B, C and D and depend on light reflection and the ease with which soft pencil marks are removed.

Steam Test.—Resistance to frequent changes in humidity accompanied by changes in temperature associated with steamy places in kitchens, bathrooms and in laundries, are the subject of this test, where steam at 50 deg. C. impinges on the enamelled surface for ten 2-min. periods with intervals of 2 min. Samples of enamelled iron and leadless Aluglas passed without any noticeable effect. Samples of all lead enamels tested showed some signs of damage—in some cases removable by rubbing, but in others, generally pigmented varieties, permanent damage resulted.

Humidity Test.—For six days the samples are left undisturbed over distilled water in an airtight container, with the aim of showing the effect of humidity with condensation. Iron/steel vitreous enamels and leadless Aluglas were unaffected. Lead-bearing enamels were affected to some extent—shown by marks on the surface and excessive condensation. Only in a few cases was damage permanent.

Resistance to Cold Water.—Immersion in cold water (room temperature) for six days cause spalling in some lead glazes. Others passed. Leadless enamels and iron enamels all passed.

Salt-spray Test.—Specimens in this test were sprayed twice daily with a 3 per cent. solution of sodium chloride. Iron and leadless aluminium enamels all passed while only one failure resulted with lead-bearing enamels.

Spalling Test.—The spalling test was mentioned by Du Pont as a quick method of determining the resistance of enamels to weathering. A sample bearing an exposed metal/enamel interface is immersed in 5 per cent. ammonium-chloride solution for periods up to 96 hrs. and should show no signs of flaking (spalling) after this period. Results seem a little erratic and the Authors consider this test to be of only limited value.

Action of Various Fruit Juices.—Citrus fruits attack Aluglas, both lead-bearing and leadless, to an appreciable extent. Milk, beer, sanitary cleaners and many common reagents are without action on the leadless enamel although several, especially sanitary cleaners containing chlorine, fiercely attack the lead-bearing enamels.

Metal Degreasing

A simple method for making and using two-phase metal cleaners is described in a leaflet from Glyco Products Company, Incorporated, 26, Court Street, Brooklyn 2, N.Y. It is based on having a system in which the water and solvent remain as separate layers. The solvent consists of a chlorinated solvent such as trichlorethylene to which is added mineral spirits to give a final specific gravity greater than the water layer which remains on top of the solvent. Phosphates are frequently added to the water to help remove water-soluble dirt from the metals. The efficiency of this system depends on the addition of polyethylene glycol 400 (di tri) ricinoleate S-556U, about ½ per cent., to the solvent. The S-556U material acts as an organic solvent wetting agent and emulsifier for the metals, helping to remove grease and oils rapidly.

Cleaning by this two-phase system is effected simply by dipping the metal parts through the water layer into the solvent and then within a short time bringing them up through the water layer with a minimum of agitation or other mechanical cleaning methods. The system is not heated, and thus avoids difficulties with toxic fumes, fire hazard, loss of solvent and change in composition of the two phases.

THE SOUTHERN SECTION of the Institute of Vitreous Enamellers has arranged a social evening to take place in London on June 14. A visit to "Latin Quarter" at the London Casino will be followed by the section dinner at the Horse Shoe Hotel, Tottenham Court Road.

Personal

Mr. W. Pym, of J. C. Pym & Company, brassfounders, Willesden, a member of the London branch of the Institute of British Foundrymen, was last Monday elected president of the Willesden West Rotary Club.

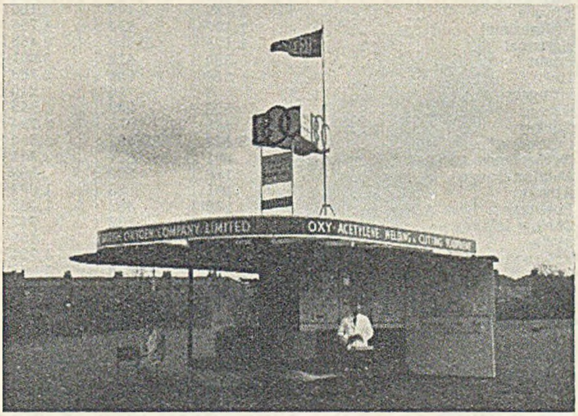
Mr. Edwin Tattersfield is going to Australia as the engineering representative of E. Green & Son, Limited, ironfounders and fuel-economiser manufacturers, of Wakefield (Yorks).

Mr. H. A. Godwin, foundries and patternshop manager of the African foundries, which are connected with the First Electric Corporation of South Africa (associated firm of the Associated Electrical Industries), is paying a visit to this country, where he will be engaged in studying mechanisation and in viewing various foundries, particularly Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester. He will be participating in the Buxton Conference of the Institute of British Foundrymen.

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.			
	April.	Nov.	Dec.	Jan.	Feb.	Mar.	April.
Coal ..	301.7	305.3	305.3	305.3	305.3	305.3	305.3
Iron and steel	259.0	258.1	257.8	257.8	257.8	257.8	257.9
Non-ferrous metals	263.4	283.3	277.2	277.4	276.8	274.3	277.6
Chemicals and oils	191.0	196.3	196.5	196.6	196.8	196.6	201.5
Building materials	226.0	225.9	225.2	226.2	226.8	225.6	223.8



The British Oxygen Company has Designed a Mobile Display Unit for Exhibiting its Products at Agricultural Shows, etc., in Britain. The Van may be Transferred into an Efficient Demonstration Stand in Two Hours. It was Exhibiting Quasi-Arc Products and Techniques at the Shropshire and West Midland Show last week, and may be seen at the Bath and West Show from May 31 to June 3, at Braintree (Essex) on June 7 and 8, at Leicester from June 13 to 15, and Paisley from June 20 to 23.

News in Brief

A new moulding shop is planned for erection at Sheepwash Lane, West Bromwich, by Great Bridge Foundry, Limited.

As from to-day, the address of Gas Chambers & Coke Ovens, Limited, will be Chandos House, Buckingham Gate, London, S.W.1.

A booklet has been received from Croda, Limited, of Goole, makers of protective finishes, detergents, etc., commemorating their 25th anniversary.

Archibald McMillan & Company, Limited, of Shrub Place Lane, Edinburgh, are to demolish and reconstruct their foundry at a cost of £8,000.

Ashmore, Benson, Pease & Company, Limited, have had plans approved for their new works, foundries and extensions to existing premises at Stockton-on-Tees.

Sulzer Bros. (London), Limited, have appointed Marine & Industrial Power Company, Pty., Limited, 205, Latrobe Street, Melbourne, as their representative and agent for all stationary Diesel-engine business throughout Australia.

Scottish Cables, Limited, have announced that their offer to acquire the Pietermaritzburg works of Rhodesian Cables, Limited, has been accepted. A new South African company, Scottish Cables (South Africa), Limited, will be formed with an authorised capital of £800,000 in 5s. shares.

A cargo of 6,800 tons of scrap metal from Hamburg recently arrived at Montreal. It was the first shipment of scrap metal to go to Canada directly from Germany. It is expected that shipments will reach 100,000 tons this year. Most of the metal is being transhipped to mills at Hamilton, Ontario, and Toronto.

Another of the tanker contracts being negotiated with Clyde firms has now been placed. William Hamilton & Company are to build a tanker of 16,500 tons dw. for the Blue Star Line. Propelling machinery will be of the Rowan-Doxford type, supplied by David Rowan & Company, Limited, Glasgow.

A new company, Aiton Africa (Proprietary), Limited, is being formed in South Africa by Aiton & Company, Limited, pipework specialists and ironfounders, of Derby. Wing-Commander J. M. Aiton, chairman and managing director, visited South Africa recently and viewed new power stations which are being equipped with Aiton's pipes. The company is also going to open a new works at Southwick, Sunderland.

The Eighth Regional laboratory operated by the *Centre Technique des Industries de la Fonderie* is situated at Rennes. It contains chemical analysis and sand testing laboratories, mechanical testing and machine shops. The opening ceremony was attended by Mr. Oliver and Mr. Richard. Two lectures were delivered by Mr. Chatelin and Mr. Bigard. Mr. Tigiot, the president of the local employers association, gave the opening address.

W. H. Dorman & Company, Limited, report a visit from Mr. J. J. Fowler, managing director of Equipment Distributors Pty., Limited, and Marine & Industrial Power Company Pty., Limited, of Melbourne and Sydney, who are their agents in Australia. Mr. Fowler is on a six months' visit to this country and during this time hopes to meet personally the principals of the numerous companies which his company represent in Australia. On arrival, Mr. Fowler was able to hand over to the company an order for twenty high-speed marine engines to be used by the Australian Civil Aviation Department. Other important visitors to the works recently have included M. Paul Bernard and staff of *Etablissements Paul Bernard & Cie*, the company's French agents.

Imports and Exports of Iron and Steel

Board of Trade Returns for April

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

Total Imports of Iron and Steel

From	Month ended April 30. 1949.	Month ended April 30. 1950.	Four months ended April 30. 1950.
	Tons.	Tons.	Tons.
Australia	5	6	15
Canada	5,372	3,214	13,056
Other Commonwealth countries and Irish Republic	2,038	103	23,635
Sweden	1,123	1,134	4,385
Norway	2,833	4,334	15,140
Germany	445	9,754	32,064
Netherlands	12,073	4,377	21,805
Belgium	42,429	8,429	31,455
Luxemburg	26,402	3,846	12,186
France	14,004	21,637	74,319
Austria	1,750	1,294	2,255
USA	7,933	3,760	23,830
Other foreign countries	246	810	2,640
TOTAL	116,653	62,698	256,785
Iron ore and concentrates—			
Manganiferous	—	1	10,901
Other sorts	696,562	587,658	2,735,911
Iron and steel scrap and waste, fit only for the recovery of metal	144,272	204,193	801,927

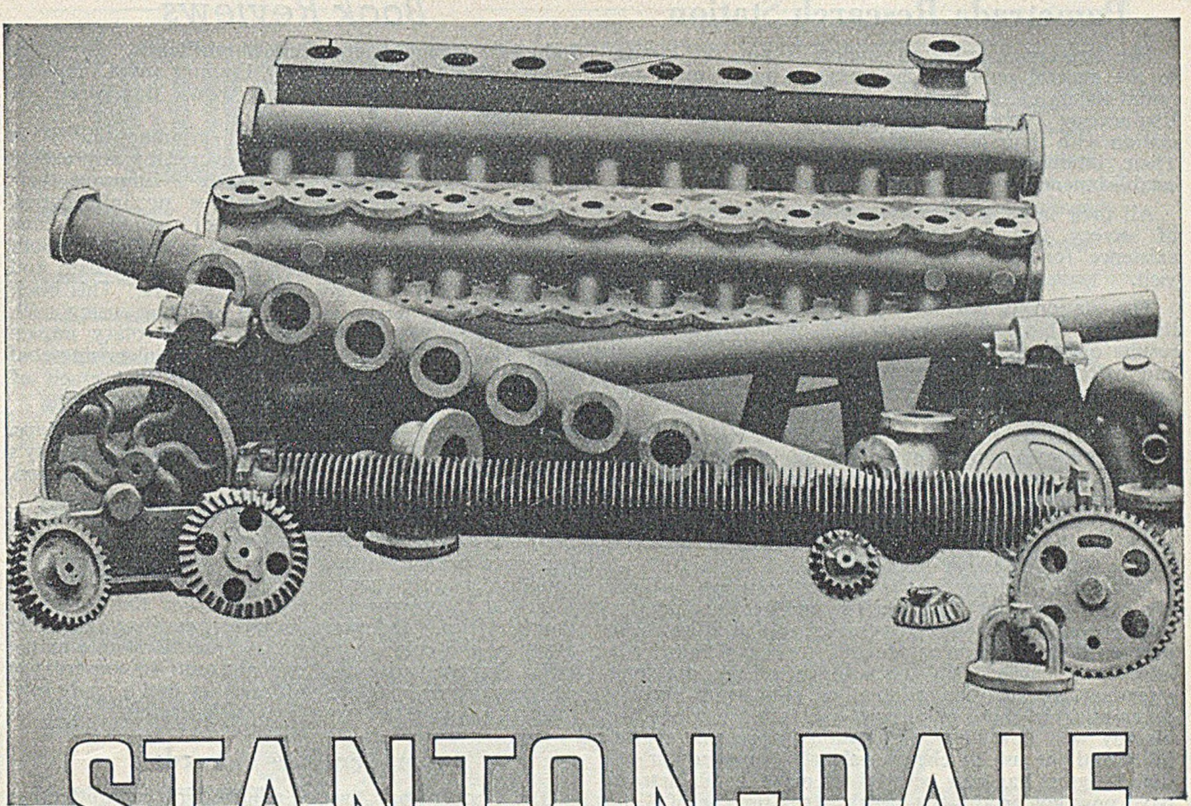
Exports of Iron and Steel by Products

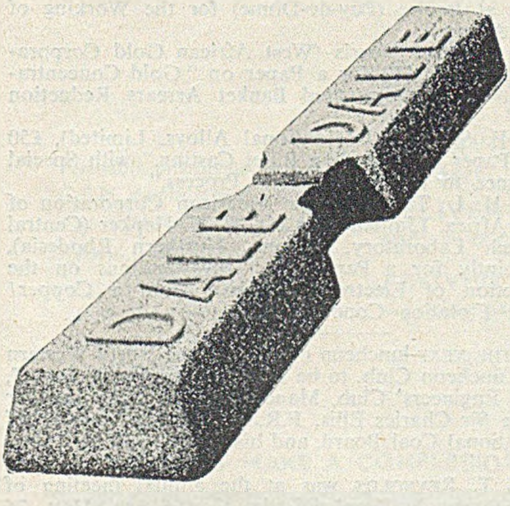
Product.	Month ended April 30. 1949.	Month ended April 30. 1950.	Four months ended April 30. 1950.
	Tons.	Tons.	Tons.
Pig-iron	279	4,040	10,070
Ferro-alloys, etc.—			
Ferro-tungsten	28	137	401
Spiegeleisen, ferro-manganese	605	118	834
All other descriptions	145	90	601
Ingots, blooms, billets, and slabs	131	795	1,416
Iron bars and rods	400	430	1,772
Sheet and tinplate bars, wire rods	186	217	1,163
Bright steel bars	2,023	3,054	13,457
Other steel bars and rods	17,057	14,797	77,639
Special steel	1,032	973	4,835
Angles, shapes, and sections	9,968	10,801	48,461
Castings and forgings	650	805	3,198
Girders, beams, joists, and pillars	2,668	5,858	20,185
Hoop and strip	3,024	7,200	20,199
Iron plate	225	187	902
Tinplates	18,118	16,915	77,033
Tinned sheets	335	165	931
Terneplates, decor. tinplates	—	29	112
Other steel plate (min. ⅛ in. thick)	18,463	20,920	93,714
Galvanised sheets	8,072	9,050	38,190
Black sheets	12,964	12,663	43,454
Other coated plates	849	960	3,925
Cast-iron pipes, up to 6-in. dia.	7,003	6,677	25,049
Do., over 6-in. dia.	5,286	7,391	28,602
Wrought-iron tubes	30,271	26,923	115,914
Railway material	14,180	24,150	88,807
Wire	3,770	4,868	21,782
Cable and rope	2,357	2,391	11,350
Netting, fencing, and mesh	1,600	1,078	5,998
Other wire manufactures	755	1,715	6,982
Nails, tacks, etc.	570	373	1,655
Rivets and washers	766	398	2,396
Wood screws	275	283	1,121
Bolts, nuts, and metal screws	1,749	1,901	9,964
Stoves, grates, etc. (excl. gas)	797	615	3,360
Do., gas	206	194	857
Baths	819	851	4,315
Anchors, etc.	783	483	2,949
Chains, etc.	737	807	3,239
Springs	748	885	3,264
Hollow-ware	5,651	5,527	31,091
All other manufactures	17,476	18,791	81,062
TOTAL	193,021	216,511	921,849

Total Exports of Iron and Steel

Destination.	Month ended April 30. 1949.	Month ended April 30. 1950.	Four months ended April 30. 1950.
	Tons.	Tons.	Tons.
Channel Islands	1,227	519	2,822
Gibraltar	84	168	615
Malta and Gozo	315	611	1,973
Cyprus	502	709	2,763
British West Africa	7,025	7,140	31,409
Union of South Africa	16,348	15,920	52,504
Northern Rhodesia	1,274	1,814	9,289
Southern Rhodesia	2,927	6,154	25,326
British East Africa	6,207	6,256	31,452
Mauritius	326	508	3,081
Bahrein, Koweit, Qatar, and Trucial Oman	1,804	504	2,328
India	6,692	6,792	27,380
Pakistan	2,875	8,018	23,715
Malaya	3,085	6,335	25,905
Ceylon	1,262	3,082	12,632
North Borneo	688	346	2,555
Sarawak	48	20	645
Hongkong	3,714	4,413	18,204
Australia	16,327	16,489	96,688
New Zealand	8,691	11,134	55,104
Canada	8,942	15,522	35,397
British West Indies	6,665	6,259	23,314
British Guiana	294	503	2,546
Anglo-Egyptian Sudan	877	1,189	6,013
Other Commonwealth countries	630	964	4,439
Irish Republic	5,697	7,924	29,628
Russia	1,227	45	295
Finland	6,101	2,965	20,253
Sweden	4,735	8,176	29,689
Norway	5,941	7,213	25,956
Iceland	451	254	1,610
Denmark	6,830	13,490	53,764
Poland	55	114	616
Germany	23	20	151
Netherlands	10,742	6,484	27,217
Belgium	701	860	5,027
Luxemburg	503	—	253
France	1,129	1,448	8,103
Switzerland	1,137	819	4,705
Portugal	1,174	2,099	6,458
Spain	580	413	3,361
Italy	210	536	2,768
Hungary	6	16	215
Greece	527	933	2,545
Turkey	839	878	3,794
Indonesia*	2,413	2,557	6,669
Netherlands Antilles	691	824	3,941
Belgian Congo	186	120	509
Angola	161	55	1,094
Portuguese East Africa	189	332	1,463
Canary Islands	194	102	747
Syria	61	236	455
Lebanon	4,648	2,110	4,724
Israel	1,844	936	5,695
Egypt	4,393	5,170	24,714
Morocco	104	3	217
Saudi Arabia	187	58	948
Iraq	6,434	982	15,364
Persia	10,617	5,356	39,235
Burma	723	984	3,588
Thailand	275	323	2,459
China	242	29	600
Philippine Islands	277	394	4,975
USA	326	1,407	4,486
Cuba	62	30	441
Colombia	605	442	2,010
Venezuela	5,991	4,029	14,184
Ecuador	551	56	961
Peru	608	311	2,865
Chile	1,008	2,721	6,215
Brazil	1,407	1,881	10,714
Uruguay	283	1,099	3,212
Argentine	324	5,978	25,126
Other foreign countries	690	1,921	9,671
TOTAL	193,021	216,511	921,849

* Includes Netherlands New Guinea in 1949.

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Pametrada Research Station

The Pametrada research station is not well-known to the general public. The name is made up of the initial letters of the council of the Parsons and Marine Engineering Turbine Research and Development Association with their laboratories and works at Wallsend. Their labours receive the support of neighbouring establishments in the Tyneside area.

All their investigations are conducted under the seal of secrecy and, although the station has been in existence for six years, May 26 was the first Press visit.

The station is not merely a testing establishment; its main object is research and application of the results obtained therefrom. The buildings are modern and extensions are in progress. The equipment of apparatus in the physics, chemical and metallurgical laboratories is elaborate and efficiently operated.

Most comprehensive running tests are being carried out with a steam turbine for the Admiralty, including assessment of torque on the shafts; measurement of pressure drop in steam piping; casing temperatures; turbine distortion, etc. Observations on the noise level in the fan flats and boiler room have been leading to progressive improvements.

While major departures in designs of steam turbines for ships may not be expected, another medium for ship propulsion to which engineers and scientists have turned their attention is the gas turbine. Pametrada have been engaged on the solution of the problems attendant on such an adaptation, which are entirely different from those of aircraft gas turbines which are already well developed. Variation in speeds, reversability and the use of cheap fuel are demanded for sea use. Progress has now been so far made that Pametrada have now got on the test bench a gas turbine of 3,500 h.p. designed for use in a ship and to drive the propeller directly. "Lloyd's" have passed all the plans, and when the extensive tests they carry out at Pametrada are passed as satisfactory, the machinery will be installed in a merchant ship. The tests will continue for a considerable time. For instance, at present, diesel oil is being used, but, after testing out the lighter types of boiler fuel oil, it is hoped that ultimately the gas turbine will be able to operate on heavy fuels oils—hence the concentration of one section of the research staff on methods of elimination of vanadium compounds or their neutralisation in fuel oils where they have a deleterious effect on the blades in these high-temperature gas turbines.

Pametrada have still other progressive ideas and have been working on a water-cooled gas turbine. This machine will run at temperatures up to 2,200 deg. F.; yet the metal surfaces will be at a lower temperature than in the present turbine.

T. W. Ward's New Offices

Mr. George Wood, chairman of Thos. W. Ward, Limited, Mr. Ashley S. Ward, president of the company, and Mrs. W. R. S. Stephenson, Mistress Cutler of Sheffield, took part in a ceremony which marked the opening of the company's new offices and canteen at their Inverkeithing yard on May 16. The Ward house flag was unfurled by Mrs. Stephenson, and Mr. A. S. Ward opened the door of the new building with a silver key suitably inscribed. Entrance to the new premises is lined with ships' panels, on which are named naval and mercantile ships which have been broken up at Inverkeithing, while above the panels are three 16-inch gun tampions from H.M.S. Rodney.

Book Reviews

Industrial Grinding and Reduction Plant. By C. S. Darling. Published by Emmott & Company, Limited, 31, King Street West, Manchester, 3. Price 3s.

There are so many phases of grinding that it is necessary to know just what is covered by any article or text book. Foundrymen seeking to improve their fettling-shop practice would receive no information from a study of this book, nor would vitreous enamellers find much to help them in their mill-room practice, though a perusal of Chapter VI—Steam and Fluid Grinding—may give useful pointers. This book deals with the larger aspects of grinding, using such apparatus as ball mills, ring roll, and rotary impact mills, and those foundries grinding and pulverising coal for use within furnaces will no doubt find much of interest.

Belgian Congo—Review of Commercial Conditions. Published for the Board of Trade by His Majesty's Stationery Office, York House, Kingsway, London, W.C.2. Price 1s.

The importance of the Belgian Congo was materially increased during the war and its commercial position has since been enhanced. The only direct interest the foundry industry has is in the supply of hardware. Much at the moment is supplied from the Union of South Africa. Indirectly, however, castings enter into many of the colony's imports. There is a note to the effect that the native market is not quite so conservative as most people imagine, and novelties find a ready sale. This is as near the truth as can be stated.

Capper Pass Awards

The Capper Pass Awards adjudicating committee has made the following awards for 1949, on behalf of the Councils of the Institution of Mining and Metallurgy and of the Institute of Metals:—

Mr. Jean Matter and Mr. Marcel Lamourdedieu (*Société Centrale des Alliages Légers, Issoire* (Puy-de-Dôme), France), £50 jointly for a Paper on "The New Factory of the *Société Centrale des Alliages Légers* at Issoire (Puy-de-Dôme) for the Working of Light Alloys."

Mr. G. Chad Norris (West African Gold Corporation, Limited), £50 for a Paper on "Gold Concentration at the Amalgamated Banket Arrears Reduction Plant."

Dr. E. Scheuer (International Alloys, Limited), £50 for a Paper on "Modern Billet Casting," with Special Reference to the Solidification Process."

Mr. H. L. Talbot (Anglo-American Corporation of South Africa, Limited) and Mr. H. N. Hepker (Central Research Laboratory, N'Kana, Northern Rhodesia), £50 jointly for a Paper on "Investigations on the Production of Electrolytic Cobalt from a Copper/Cobalt Flotation Concentrate."

At the next luncheon meeting of the North Western Fuel Luncheon Club, to be held on Wednesday, June 7, in the Engineers' Club, Manchester, the guest speaker will be Sir Charles Ellis, F.R.S., Scientific Member of the National Coal Board, and his subject will be "Coal versus Oil."

Mr. T. Reynolds was at the annual meeting of Wellingborough Rural District Council on May 26 unanimously elected chairman for the coming year. Mr. Reynolds has for a number of years been principal of T. Reynolds & Son, ironfounders, Little Harrowden, Northants, and is a member of the Institute of British Foundrymen.

Raw Material Markets

Iron and Steel

Supplies of most grades of pig-iron are still rather tight, and, consequently, the various advances in the maximum permitted prices, which range from 4s. to 8s. 6d. per ton, according to grade and delivery points, have not led to any visible shrinkage in the demand. The call for high-phosphorus iron is less insistent owing to quiet conditions in the light-castings trade, but the unabated activity of the engineering and jobbing foundries assures the immediate absorption of the current output of hematite and low- and medium-phosphorus grades.

British prices of semi-finished steel have not been changed and the severe curtailment of imports has reduced the burden of high-cost foreign material which is borne by the steelmakers. Deliveries of all classes of semis are on a satisfactory scale, with the sole exception of squares and flats. The smaller sizes are scarce and in active demand.

Confidence in the continuance of full employment in the steel industry is reinforced by the news that American production is running at a rate slightly in excess of maximum rated capacity. British shipbuilders, too, have recently improved their bookings, while substantial specifications are coming to hand from power-plant, wagon and locomotive builders, constructional and marine engineers, and home and foreign railways. Only a spectacular expansion of production, which must await the completion of new mills now in course of construction, will enable the sheet trade to overtake the enormous home and oversea demand which seems to have been entirely unaffected by the further rise of 15s. in the price of galvanised sheets now quoted at £40 1s. 6d. per ton for 4-ton lots.

Non-ferrous Metals

Trading this week has been rather light owing to the onset of the Whitsun holiday which resulted in many factories being closed for both Monday and Tuesday. Prior to the holiday a fair volume of business was passing, for buyers considered that the rise in virgin metals in the United States had not spent itself and they were, therefore, inclined to put something on their books in case any change occurred over the holiday period here. Zinc has been outstandingly strong and advanced last week to 12½ cents East St. Louis for the producers' price, while on the Commodity Exchange 13.55 cents was bid at the end of the week. In London the Ministry of Supply increased its selling limit by £4 to £107 10s.—the highest price seen for this metal since 1915. On Tuesday there was a further rise of £4 in zinc, bringing the current price up to £111 10s. per ton. Since the beginning of the year the price of zinc has been increased by £24 per ton.

Lead has been steady and unchanged both in the United Kingdom and in New York, but the US price of aluminium was marked up by 50 points to 17½ cents. No change was made in the sterling price, which remains at £112. In the early part of last week tin showed considerable strength and moved ahead rapidly, but the market closed below the best of £601 5s. for sellers of cash and £602 15s. for three months. It was reported that little or no metal was sold by the Government broker. In spite of keen anticipation that copper would go up again there was no change from the 20½ cent. level in New York. Futures were quoted at 18.50 cents or thereabouts. The undertone is very firm.

Metal Exchange tin quotations were as follow:—

Cash—Thursday, £602 10s. to £602 15s.; Friday, £601 to £601 5s.; Tuesday, £601 5s. to £601 10s.; Wednesday, £602 to £602 15s.

Three Months—Thursday, £603 15s. to £604; Friday, £602 10s. to £602 15s.; Tuesday, £602 5s. to £602 10s.; Wednesday, £603 to £603 5s.

No let-up was seen in the prices of scrap in spite of quieter conditions owing to the holiday, for holders seemed to take the view that even higher prices are in store and they took action, or rather, did not take action, accordingly. There has certainly been a very considerable rise in the values of secondary metal during the past few weeks, and at a guess one would venture the opinion that in the case of a number of grades record high levels have been established. Brass swarf, for example, at £100, which is now about the market level, must be higher than ever before in the history of the trade. High-grade brass prices are not easy to determine, but QF cases deprimered are probably around £140 and may go higher in the near future.

Aluminium in New Guinea

NEW PROSPECTING COMPANY

The Government of the Commonwealth of Australia has decided to form, in conjunction with the British Aluminium Company, Limited, a company to be known as the New Guinea Prospecting Company, Mr. Casey, the Development Minister, announced in Canberra.

The company will have a capital of £100,000, of which the Commonwealth holding will be 51 per cent. and the British Aluminium Company and associates 49 per cent. Mr. Casey said the Commonwealth will have the controlling interest on the board of five directors through its nomination of the chairman and two other directors. The main object of the company, he added, would be the location and development of large-capacity hydro-electric power schemes suitable for use in industries, particularly aluminium, where a low cost of power is essential.

Prospecting surveys would also embrace searches for bauxite and other minerals related to aluminium production. If exploratory work proved successful, Australia and other British countries would not have to buy aluminium from dollar sources.

Special Fittings on Yacht

Mr. John M. Jackson, managing director of Jackson, Elphick & Company, Limited, ironfounders, Larkhall, has had some unique pieces of equipment fitted aboard his new 37-ton motor yacht, the Jaqmarie, which was launched on May 16 from the Rosneath yard of James A. Silver, Limited.

A selenium photo-electric cell brings a relay circuit into operation when darkness falls and switches on the vessel's riding light fitted on the deckhouse roof; wardrobe and locker doors are held shut by permanent magnets, and high-tensile phosphor-bronze ribbon is used on ship-type davits for hoisting inboard a 12 ft. sailing dinghy.

Jaqmarie, which was designed by Mr. John Bain, of Silvers, is 57 ft. overall, with a beam of 14 ft. 8 in., and is driven at a speed of 10 knots by twin Gray petrol engines, each of 85 h.p. A feature is the labour-saving galley, which extends the full width of the craft, and is tiled in cream and green. The stove, which burns ¼ lb. of solid fuel an hour, was designed at the owner's foundry.

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

(Delivered, unless otherwise stated)

May 31, 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, £109 per ton.

Ferro-tungsten.—80/85 per cent., 7s. 3d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 8s. 3d. 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., 13s. 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. 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.—Plates, ship (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, £36 8s. ; nickel-chrome, £52 16s. 6d. ; nickel-chrome-molybdenum, £59 9s. 6d.

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

NON-FERROUS METALS

Copper.—Electrolytic, £170 ; high-grade fire-refined, £169 10s. ; fire-refined of not less than 99.7 per cent., £168 ; ditto, 99.2 per cent., £168 10s. ; black hot-rolled wire rods, £179 12s. 6d.

Tin.—Cash, £602 to £602 15s. ; three months, £603 to £603 5s. ; settlement, £602 5s.

Zinc.—G.O.B. (foreign) (duty paid), £111 10s. ; ditto (domestic), £111 10s.; "Prime Western," £111 10s.; electrolytic, £112 5s. ; not less than 99.99 per cent., £113 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £96 ; ditto (Empire and domestic), £96 ; "English," £97 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, all English destinations, —— ; rolled zinc (boiler plates), all English destinations, —— ; zinc oxide (Red Seal), d/d buyers' premises, £105.

Other Metals.—Aluminium, ingots, £112 ; antimony, English, 99 per cent., £160 ; quicksilver, ex warehouse, £17 5s. ; nickel, £321 10s.

Brass.—Solid-drawn tubes, 17⅝d. per lb. ; rods, drawn, 23⅜d. ; sheets to 10 w.g., 21⅝d. ; wire, 22¼d. ; rolled metal, 20⅜d.

Copper Tubes, etc.—Solid-drawn tubes, 17¾d. per lb.; wire, 191s. 3d. per cwt. basis ; 20 s.w.g., 217s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £110 to £127 ; BS. 1400—L.G.3—1 (86/7/5/2), £120 to £138 ; BS. 1400—Gl—1 (88/10/2), £158 to £200 ; Admiralty GM. (88/10/2), virgin quality, £185 to £223, per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £180-£220 ; L.P.Bl, £130-£138 per ton.

Phosphor Bronze.—Strip, 29½d. per lb. ; sheets to 10 w.g., 31⅜d. ; wire, 31⅛d. ; rods, 29d. ; tubes, 32¼d. ; chill cast bars : solids, 29¼d., cored, 30¼d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 1s. 11¼d. per lb. (7%) to 2s. 9¼d. (30%) ; rolled metal, 3 in. to 9 in. wide × .056, 2s. 5¼d. (7%) to 3s. 3¼d. (30%) ; to 12 in. wide, × .056, 2s. 5½d. to 3s. 3½d. ; to 25 in. wide × .056, 2s. 7½d. to 3s. 5½d. Spoon and fork metal, unsheared, 2s. 3¾d. to 3s. 1¾d. Wire, 10g., in coils, 2s. 10½d. (10%) to 3s. 8¾d.; (30%). Special quality turning rod, 10% 2s. 9½d.; 15%, 3s. 2d. ; 18%, 3s. 6¼d.

Obituary

MR. HYLA FREDERIC ROSE, iron and steel merchant, of Darlaston, Wednesbury (Staffs), has died at the age of 67.

MR. DAVID WILSON, late of Babcock & Wilcox, Limited, and International Combustion, Limited, died recently.

MR. HENRY JOHN CHESNEY JOHNSTON, chairman of Leeds Fireclay Company, Limited, died suddenly on May 11 at the age of 74.

MR. DUNCAN K. MACL. WREN, for many years with Stewarts and Lloyds, Limited, Oswald Street, Glasgow, C.1, died in hospital on May 17.

MR. J. T. GRATTON, a director and secretary of D. T. Gratton & Sons, Limited, agricultural engineers, of Boston (Lincs), died suddenly on May 8. He was 54.

MR. CHARLES JAMES BAKER, for many years associated with, and a director of, Ricardo & Company Engineers (1927), Limited, Pall Mall, London, S.W.1, died last Friday.

The Australian Press reports the death of MR. F. S. GRIMWADE, managing director of Grimwade Castings Pty., Limited, of Melbourne. Mr. Grimwade was an enthusiastic supporter of the Meehanite Research Institute of Australasia, his firm having been one of the first licensees in the Southern Hemisphere for the manufacture of Meehanite.

SIR ALEXANDER WALKER, director of Glenfield & Kennedy, Limited, Kilmarnock, died at his home, Piersland, Troon, last Saturday, at the age of 81. His public benefactions totalled about £100,000. During the first world war, his services were enlisted by the Government for the Ministry of Munitions and other Departments, and later for the disposal of surplus Government material.

Wills

CARLAW, R. H., chairman of David Carlaw (engineers), Limited, Glasgow £119,266

SANDERS, T. D., joint managing director of Thomas Sanders, Limited, brassfounders, Birmingham... £8,415

WILSON, C. A., a director of Wilsons & Mathiesons, Limited, ironfounders, etc., of Armley, Leeds, 12 £71,125

HARTLEY, ARNOLD, managing director and founder of Hartley's Malleable Fittings Company, Limited, Halifax £11,768

BRIDGEWATER, JOHN, for over 50 years connected with Kirkpatrick, Limited, malleable-iron founders, of Walsall £4,602

REES, G. P., formerly for many years blast-furnace manager of the Lilleshall Company, Limited, Shifnal (Shrops) £5,155

HIND, MRS. A. A., chairman and managing director of William Rowland, Limited, non-ferrous metal stockholders, of Meadow Street, Sheffield, 3 ... £60,644

WOLSTENHOLME, J. P., late deputy chairman and joint managing director of Walmsleys (Bury), Limited, paper-making machinery manufacturers, etc. ... £108,978

YOUNG, J. J. B., a director of the Carlton Main Colliery Company, Limited, William Heaton & Company, Limited, ironfounders, of Rotherham £26,357

LOVING, H. C., a former chief engineer of Cammell Laird & Company, Limited, at Sheffield, and the first chief engineer of the English Steel Corporation, Limited, on its formation £9,910

MUSCROFT, E. B., who was formerly in control of the scrap iron and steel interests in South Wales of Thos. W. Ward, Limited, and latterly with the British Iron & Steel Corporation, Limited £7,984

TURNER, JOHN, vice-chairman and a director of Turner, Atherton & Company, Limited, hatters' machinists and foundrymen, of Denton (Lancs), and chairman of Manchester and District Ironfounders' Employers' Association £4,576

STEWART, SIR FREDERICK C., chairman of the North British Locomotive Company, Limited, Kelvin & Hughes, Limited, Kelvin, Bottomley & Baird, Limited, Thermotank, Limited, Thermotank Engineering Company, Limited, and a director of other companies, a former president of the Institution of Engineers and Shipbuilders ... £645,310

CLASSIFIED ADVERTISEMENTS

SITUATIONS WANTED

FOUNDRY MANAGER (age 35) desires change; 12 years' experience of repetition castings, including motor car cylinders, heads, etc., and general engineering castings in high duty and grey iron; capable of full sand and metal control, and training of unskilled labour.—Box 520, FOUNDRY TRADE JOURNAL.

FIRST-CLASS FOUNDRYMAN (age 36), foremanship experience, seeks progressive post; ferrous and non-ferrous, mechanised, and loose pattern work.—Box 544, FOUNDRY TRADE JOURNAL.

METALLURGIST, Cambridge graduate, seeks position in foundry to gain experience.—Box 550, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

A VACANCY exists with a large modern fully Mechanised Foundry in the South Wales area for an experienced FOUNDRYMAN, to investigate and effect a remedy to prevent faulty castings occurring during production. Applicants should have thorough practical experience in foundry technique, as applied to machine and sand slinger moulding and core making.—Applications in confidence, giving full particulars of age, experience and salary required, to Box 526, FOUNDRY TRADE JOURNAL.

A VACANCY will occur in the East Midlands area for a first-class SALESMAN, with extensive knowledge of the foundry trade, to represent well-known manufacturers of Foundry Materials. Replies invited, stating full details of past experience, etc.—Box 530, FOUNDRY TRADE JOURNAL.

ASSISTANT to Foundry Manager wanted for Iron Foundry producing 250 tons mixed make weekly. Floor, piecework, and semi-mechanised productions. Must be conversant with pricing, Union negotiations, estimating and general organising. House can be provided. Good opening with old-established company. Give fullest particulars in confidence.—Box 552, FOUNDRY TRADE JOURNAL.

BLACKHEART Malleable Foundry requires a METALLURGIST, to take complete charge of a melting, annealing and sand control;. State experience and salary required. Yorkshire district.—Box 536, FOUNDRY TRADE JOURNAL.

FOREMAN PATTERNMAKER for small shop in Midlands making wood and metal patterns, attached to Jobbing and Mechanised Foundries. State full particulars of experience, age, and salary required.—Box 558, FOUNDRY TRADE JOURNAL.

SALES ENGINEER required, with comprehensive knowledge of modern furnace, boiler and incinerator construction and application, to handle the sale of refractories, mainly in Central and East Africa and the Middle East. The successful applicant must possess sound technical qualifications, including at least Associate Membership of appropriate technical Associations. The job entails considerable travelling, from the Headquarters in East Africa. A four figure salary will apply, together with the usual privileges of overseas employment. Interviews in London. Applications will be treated in confidence and should be as complete as possible.—Write Box L.L.A., c/o 95, Bishopsgate, London, E.C.2.

SITUATIONS VACANT—*Contd.*

CYLINDER PATTERNMAKER. — A first-class man, fully experienced in cylinder patternmaking, is required for a new foundry in Wellingborough.—Apply in writing, giving age, details of experience, wages required, etc., to MORRIS MOTORS, LTD., Wellingborough, Northants.

FOUNDRY FOREMAN required for Grey Iron Foundry, West of England; general engineering castings, 20-25 tons per week; high class jobbing work, with small machine moulding section; knowledge of cupola control and machine practice necessary; good prospects for the right man; house provided.—Applicants, who should be between 35 and 45, should state qualifications, experience, and salary required, Box 494, FOUNDRY TRADE JOURNAL.

FOUNDRY SUPERINTENDENT, South Lancs. area. "Loam," "dry" and "green" sand. Jobbing Iron foundry, weekly average 40 tons, 90 employees. Able to produce 15-ton castings to close analysis. To be responsible to the Managing Director for Foundry and Pattern Shop. Preference to M.I.B.F. State salary required.—Box 512, FOUNDRY TRADE JOURNAL.

MODERN Factory requires SUPERINTENDENT, who must have thorough technical and practical knowledge of vitreous enamelling, spray painting, and electroplating, and must have wide experience in control of male and female labour. Assistance with housing accommodation if necessary.—Applications should state age, experience, and salary required, to Box 562, FOUNDRY TRADE JOURNAL.

MOULDERS required, first-class men only. Vacancies occur in iron and non-ferrous departments for floor and bench moulders. Piece work with time rates guaranteed.—MOYLE, Kingston-on-Thames.

METALLURGIST required to organise and develop Phosphor Bronze Chill Bar Foundry, including Continuous Casting Machine; state age, experience, and salary expected.—Box 508, FOUNDRY TRADE JOURNAL.

PATTERNMAKERS required for Wood and Metal patterns by highly mechanised Foundry in Doncaster area, producing castings for agriculture, textile, and mining machinery. Top rates of pay. Good prospects for young and ambitious men.—JOHN FOWLER & CO. (LEEDS), LTD., Sprotborough Works, Doncaster.

REQUIRED.—Experienced and energetic FOUNDRY FOREMAN, for West Riding Foundry, producing High Class Machine Tool and Engineering Castings, with an optimum output of 2,500 tons per annum; applicants must be capable of efficiently supervising Moulders in green and dry sand and loam, coremaking, and final dressing, and fully conversant with modern methods of production by hand or machine and accustomed to piecework; a strict disciplinarian and used to control; applications are invited only from persons who have satisfactorily held a similar post and who are requiring a permanent position; an adequate salary will be paid to a first-class applicant; house available.—Apply, stating age and previous experience, to Box 486, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

METALLURGICAL CHEMIST required to take charge of Chemical Laboratory at Non-ferrous Metal Works situated West of London. Good experience in the analysis of Non-ferrous Alloys and Alloy Steels essential. Knowledge of Spectrograph Analysis and corrosion testing an advantage.—Write, giving full details of qualifications, experience, age and salary required, to Box S.763, WILLINGS, 362, Grays Inn Road, W.C.1.

RATEFIXER required for general Foundry in Lancashire. Must be competent to estimate and negotiate suitable time standards with operators on moulding and coremaking for mixed castings up to 25 tons individual weights. A man of adequate education and suitable personality with practical experience needed.—Reply, giving full particulars, to Box 548, FOUNDRY TRADE JOURNAL.

WANTED FOR INDIA.—An experienced FOUNDRY FOREMAN for a large Steel Foundry in Calcutta producing a large variety of Steel Castings from a few lbs. up to 5 tons in weight, chiefly Railway Rolling Stock Components; candidates must have had at least 10 years' experience in such a foundry, 5 years in sole charge; experience in the working of a fully mechanised foundry is desirable; appointment is for 3 years, with free passage out and home; salary at the rate of Rs. 1,300 per month (rupee=1s. 6d.), with free furnished quarters.—Applications, with full details of experience and copies of recent testimonials, to Box 498, FOUNDRY TRADE JOURNAL.

UNIVERSITY OF BIRMINGHAM.

DEPARTMENT OF INDUSTRIAL METALLURGY.

APPLICATIONS are invited for the post of RESEARCH FELLOW in Industrial Metallurgy, to work in the field of melting and casting of metals. Candidates should possess adequate and suitable academic qualifications and experience in research. Salary £450 per annum.

Applications should be sent within a fortnight of the appearance of this advertisement to the undersigned.

C. G. BURTON,
Secretary.

The University, Birmingham, 3.
May, 1950.

BUSINESSES FOR SALE

BUSINESS FOR SALE.—Small established iron and non-ferrous foundry company, with modern foundry premises adjacent to railway station 35 miles from London. Premises owned on 99 year lease, and equipment, stocks and goodwill included. Very reasonable price and substantial mortgage if required.—Box 538, FOUNDRY TRADE JOURNAL.

SMALL complete Iron and Brass Foundry for Sale, with Pattern and Machine Shops, within 10 miles of Manchester. Buildings and land included.—Box 524, FOUNDRY TRADE JOURNAL.

BUSINESS OPPORTUNITIES

INDUSTRIAL Engineering Syndicate, with substantial financial resources, desire to acquire whole or part interest in an engineering concern or allied industry. A transaction involving from £50/£200,000 is envisaged.—Write PRINCIPAL, Box 514, FOUNDRY TRADE JOURNAL.