FOUNDRY TRADE JOURNAL

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PRINCIPAL CONTENTS

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Unique Achievements

The nature and extent of the pioneering work undertaken by the Institute of British Foundrymen are not generally known. Initially, the Institute decided to preach technology where it was most needed—at the actual workshop. This has been done by the organisation of branches and sections so as to cover the needs of a very high percentage of the population engaged in foundry practice throughout the country. Other technical bodies have since followed this lead. A second unique step was the inauguration of a network of technical committees, the reports from which have greatly added to the fundamental knowledge required in day-to-day foundry operations. A further development in this direction was the provision, free of all cost to the participant, of places on these committees for approved apprentices. These fortunate students follow the work of the committee to which they are appointed right from its inception to the production of the actual Report. It is a type of education not undertaken by any other body.

Another noteworthy activity is the organisation of foremen's conferences annually at Ashorne Hill. These have been exceptionally popular, and have been a further means of inculcating technology into the actual workshops. A break in the daily routine to attend a conference or a committee is usually regarded as a nuisance by the average businessman, but for the foreman or student it is a memorable event, and adds zest to his work. The most recent development is the organisation annually of a "day of national works visits." This is a rational example of choosing what have obviously been the most popular events held during the ordinary conferences, and making them a special feature. Apart from the opportunities given to members to see, at a minimum cost, the methods and machinery used in districts other than their own, it also affords the local foundryman a chance to inspect installations, when either recent recruitment or some other reason has prevented participation in earlier visits.

Finally, in co-operation with overseas foundry technical associations, the Institute has brought to maturity, in two senses of the word, an international committee, which has successfully cemented the foundry technicians of the world into a harmonious body. We know of no other industry which for 21 years has so organised its technical activities on an international basis. There is no doubt that this pioneer development was the direct outcome of the inauguration, shortly after the 1914 war, of a system of Exchange Papers, first with the Americans and later with other countries. This again is, so far as we know, unique in the annals of technological co-operation. When the Institute was created, there were in existence the great societies serving the civil, mechanical and electrical engineering industries, and others covering mining and metallurgy. To these the Institute owes much for the lead they gave, yet by not following their traditions too closely, it has made astounding progress of which its members are, as they have every right to be, very proud. We were urged to recapitulate this, as we have just received a letter from a foundryman, saying that he could not see what value he would be getting for his membership dues if he joined the Institute. Our answer was that the return was in direct ratio to what a person put into it.

Foundry Trades' Equipment and Supplies Association

AT THE ANNUAL GENERAL MEETING of the Foundry Trades' Equipment and Supplies Association held on Tuesday of this week a report of the year's activities from which the following has been abstracted was presented to members.

Membership.
The number of members of the Association on December 31, 1950, was 49, one member having resigned during the year. The Council are of the opinion that membership can undoubtedly be increased and every effort is being made to acquaint potential members with the objects and functions of the Association.

Accounts.
The Accounts show an excess of income over expenditure of £36 2s. 4d., leaving a balance of £8 3s. 11d. to be carried forward. The administration expenses of the Association for the year amounted to £418 10s. 8d. which compares with £487 6s. 7d. in 1949.

Handbook.
During the year copies of the " British Foundry Plant and Supplies " handbook have been distributed to many interested concerns. An article appeared in the FOUNDRY TRADE JOURNAL during December, 1950, indicating that the book had originally been published for distribution in overseas markets, but as these had been satisfied copies were now available to the home market. This resulted in the distribution of 70 handbooks. The Council have agreed, in principle, that an up-to-date handbook is required and a sub-committee consisting of Mr. W. Rawlinson, Mr. V. C. Faulkner and Mr. C. Orton Foster has been formed to deal with this matter.

Exhibitions.
Arrangements were made for a Foundry Trade Section to occupy the annex at Olympia in the Engineering and Marine Exhibition.

Engineering Advisory Council.
Summaries of meetings of the Ministry of Supply Engineering Advisory Council have been circulated throughout the year to all members of the Association, from which it will be observed that particular attention has been paid to the question of rearmament and the engineering industry.

Factories Department.
The representatives of the Association on the subcommittee of the Factories Department Joint Standing Committee on Conditions in Iron Foundries have continued to attend meetings during the year. Extracts from the minutes, copies of which have been circulated to all members, indicate that constant attention is being given to the question of mould driers, ladle driers and heating.

Detection of Dust and its Directional Flow.
A pre-view of the film showing the new technique in the detection of dust and its directional flow was seen by several members of the Council and a technical report on this subject was subsequently sent to all members of the Association, followed by a private viewing of the film to interested members. The Council fully appreciate the importance of this subject and, in consequence, a sub-committee has been formed to ensure that the Association is represented on all bodies affecting the products of members in this connection.

Standardisation of Steel Grit and Shot.
Further conference meetings have been held at the offices of the British Standards Institution and the matter is still under consideration.

British Standards Institution Technical Committee MEE/22—Foundry Equipment and Foundry Patterns.
Mr. J. G. Lowe is serving as the Association's representative on this committee.

Mechanical Handling Exhibition, 1952.
The Association has indicated that it will support this exhibition, and Mr. T. A. Hammersley will act as representative.

General Activities.
All members of the Association have been kept informed throughout the year of events as developments have taken place, and assistance has been given to members wherever needed. The Council feel confident that all members will acknowledge that the Association has had an active and successful year during which many useful functions have been performed, and in concluding their report for the year under review, they wish to extend grateful acknowledgement to all those whose services have been given for the benefit of the Association, either in committee or in an individual capacity, and they feel that all members will associate themselves with the Council in recording appreciation of the valuable work performed in this way.

The report is signed by Mr. W. E. Aske, president, and Peat, Marwick, Mitchell & Co., Secretaries.

At a Council meeting of the Association held on the same afternoon, Mr. W. Aske was re-elected president and Mr. W. Rawlinson as vice-president. Mr. Frank Webster was co-opted a member of Council.

Correspondence

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

PATTERNMAKING PRODUCTIVITY TEAM?

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—Having read the three foundry productivity reports, and having made particular note of the effect that quality patterns have on production, I find no description or notes on their manufacture, or the conditions under which they are produced other than those on the match-plate.

I have also noted the recent remarks about a Patternmakers Association and would suggest a suitable first subject on the agenda to be the visit of a patternmaking team to complete the foundry reports.—Yours, etc.

J. HARVEY,
p.p HARVEY & LONGSTAFFE, LIMITED.

Latest Foundry Statistics

According to the September Bulletin of the British Iron and Steel Federation, employment in ironfoundries during the week ending August 4, at 150,088 fell by 642 against the figures for the corresponding week in July, of whom 610 were men. Similarly in the steel-foundry section, the total employment was at 19,053, 31 fewer than a month earlier, of whom 30 were men. During August, the average weekly amount of steel melted was 7,700 tons as against 8,600 in July and 7,000 tons a year earlier.

According to the Ministry of Supply, the output of light-alloy castings during August was 5,274 tons, made up of 1,467 of sand castings, 2,804 of gravity-, and 1,003 tons of pressure-die-castings. The output of magnesium castings (other than bombs) totalled 303 tons.

I.B.F. National Works Visits Day

Establishments in the London Area seen on October 12

Ford Motor Company Foundry at Dagenham.—The Dagenham, Essex, foundry of the Ford Motor Company is a highly-mechanised plant for the exclusive production of automobile components in ordinary and alloy cast iron and malleable-type iron. The principle of continuity of flow is adopted in each particular section, and close co-ordination of operations with appropriate layout is capable of producing upwards of 450 tons of fettled castings per day.

In the melting department, furnace charging is fully mechanised. The charge constituents are weighed in scale hoppers using electric overhead cranes and electro-magnets. Each charge is dropped into a cone-bottomed skip which passes under weigh hoppers for coke and limestone additions, and is then hoisted by a telpher machine running on monorails to the appropriate furnace. Grey iron is melted in three or four of seven acid-lined production cupolas of 51 to 90 in. shell diameter. All are of the continuous tapping and well-less type, and one has a conical melting zone with water cooling and operates for one week without repair. For each cupola there is a teapot ladle or gas-fired receiver located at the pouring station. Crankshaft alloy metal and malleable-type iron are melted in three electric-arc furnace units. The first consists of a 3-ton melting furnace and a 7-ton holding furnace, and in the second unit a basic-lined cupola supplies metal continuously into a 15-ton direct-arc furnace, into which steel scrap and ferro-alloys are charged intermittently, providing the required bath composition. The third unit is a 1-ton direct-arc furnace melting high-speed valve-insert metal and miscellaneous heats.

Moulding

Four individual moulding units are engaged in the manufacture of grey-iron castings, each unit incorporating a separate sand-conditioning system, moulding machines and mould conveyor, but being supplied by a common sand recovery and preparation system for knock-out sand. The mould production on each unit is determined by casting size and type. For example, heavy tractor components such as transmission housings, wheels and crankcases occupy the capacity of one moulding unit and for this purpose jolt-rollover type machines are used. Cylinder blocks are manufactured exclusively on a second unit, Sandslingers being used for cope and drag moulds producing up to 140 cylinder castings per hour. Light castings, such as cylinder-heads, gear-cases, pistons and manifolds are made on a third unit which employs two mould and cooling conveyors of the pendulum type. Jolt-squeeze and pattern-draw machines are used for this class of work, and the unit itself produces upwards of 800 complete moulds per hour. This system is duplicated for the production of such components as brake-drums, camshafts and flywheels. An inde-

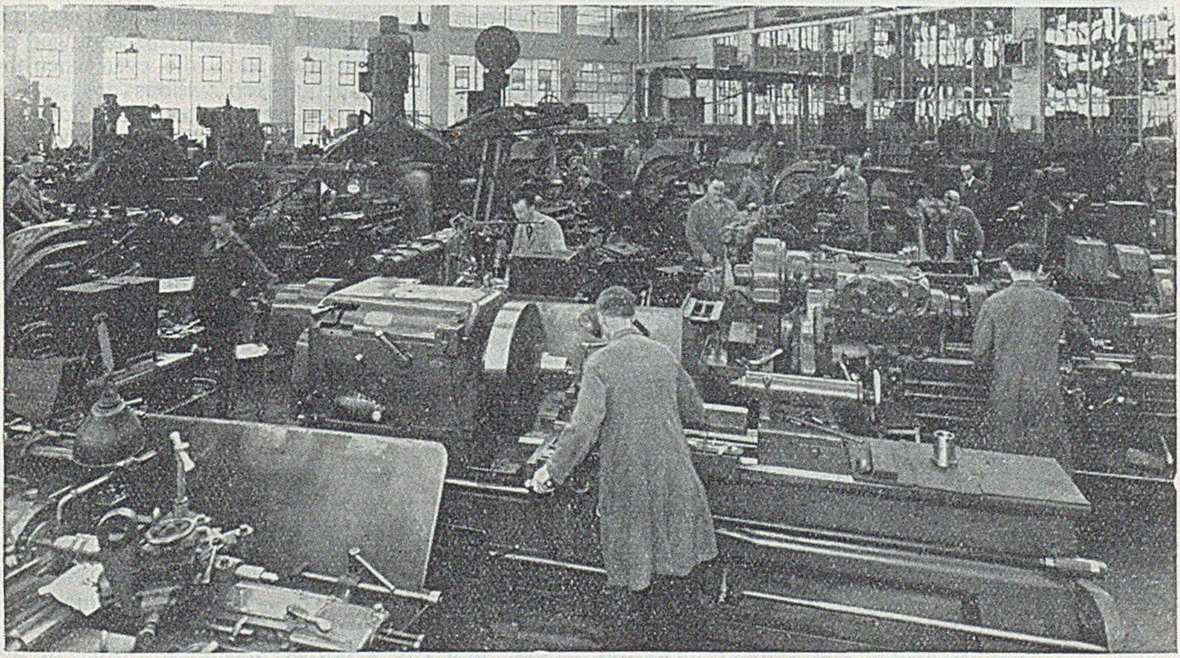


FIG. 1.—*Part of the Ford Patternshop at Dagenham.*

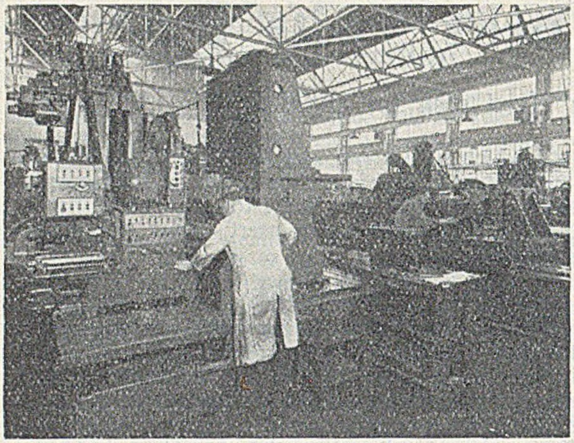


FIG. 2.—*One of the Automatic Die-sinking Machines in the Patternshop at Ford Motor Company, Limited, Dagenham.*

pendent moulding unit of similar type is engaged on alloy-iron production of crankshaft malleable-type castings (on alternate days) and uses a poured weight of 80 to 100 tons of metal per shift.

Other Departments

Modern core-making methods are extensively used in the production of up to 80,000 cores per day. Core-blowing machines of various types are employed wherever possible in addition to Sandslingers and a recently-introduced compression method for the manufacture of cylinder-barrel cores. Incoming core-sand is dried by the thermo-venturi sand-drying method utilising a vertical stream of high-velocity hot-air. The dried sand is fed into a high-efficiency cyclonic separator and automatically led into a collector vessel before being delivered to the coreship by a pneumatic conveyor, the sand being cooled *en route*. The drying and pneumatic-conveying system is entirely automatic in operation. Vertical gas-fired ovens are used for the baking of oil-sand cores and an automatic system of loading and discharging has recently been developed and installed. In this method, the core-conveyor carriers transporting the "green" cores are automatically transferred to the core oven, and after the baking operation a similar mechanical unit transfers the carriers to the baked-core conveyor.

Fettling and cleaning departments are required to accommodate over 30,000 castings per day and air-less, centrifugal cleaning machines are in general use, one such unit being capable of handling 2,500 of the heavier type castings in a single shift. Malleable castings are annealed in two batteries of three roller-hearth and pusher-type furnaces. The castings are open annealed on a 16-hour cycle, the total capacity of the furnace being 60 tons of castings per day. A double-decker gas-fired furnace is used for the annealing of crankshafts.

Ancillary departments servicing the foundry include sand and refractory and general analytical laboratories, and spacious and well-equipped wood and metal pattern-shops. The latter incorporates a drawing office responsible for the conversion of component drawings to working pattern drawings to facilitate the work of the patternmaker. Patternmaking equipment includes four Keller automatic die-sinking and profiling machines. Fig. 1 shows a view of the pattern shop, and an automatic die-sinking machine can be seen in Fig. 2. The necessary pneumatic power for the foundry is supplied from seven air compressors each with a capacity of 750 cub. ft. of free air per min. In order to keep this highly-mechanised plant in good working condition, fully co-ordinated foundry and moulding-machine maintenance departments are employed.

High Duty Alloys, Limited.—Ten years after the 1918 Armistice a group of technicians formed a company at Slough which they called High Duty Alloys, Limited, a company which associated itself with the aircraft industry through the years of rearmament, played an important part in the defence of Britain in the air during the second hostilities and entered peace-time commerce as one of the larger producers of light-alloy components, particularly of castings.

The Slough works are concerned with the manufacture of castings in "Hiduminium"—aluminium alloys—and "Magnuminium"—magnesium alloys. The works cover an area of 600,000 sq. ft., employ 1,400 and at present produce *inter alia* more than 300 tons of castings per month.

A feature of the patternshop at Slough is a special technique adopted to suit automatic moulding machines. These machines incorporate the use of self-made cods, eliminating the slow and expensive manufacture of cores. The finished pattern is sent to one of two main sand foundries, each of them with a number of modern moulding machines connected to central sand and conveyor systems. These machines and Sandslingers are arranged so as to leave a minimum of plant idle, even when the foundries are producing such various products as aircraft diffuser rings, plough yokes and "dodgem-car" bases. The weight of castings may be anything between a few ounces and 2,800 lb. Fig. 3 illustrates the dressing of a cored-up mould.

The furnaces serving the foundries cover a variety of oil-fired types, from 1,200 lb. capacity, with crane ladles in the floor-moulding section to 250-lb. Morgan bale-outs for machine moulding. The core-shop is equipped with conveyors and continuous baking ovens of the vertical type.

This in brief outline shows how a product is sand cast and what equipment is used in its manufacture. There remain still, however, the two die-casting processes.

Die-casting

The tools produced in a die tool-room either go to the gravity or the pressure die-casting foundry. The gravity foundry is arranged with four central rows of oil-fired furnaces, each supplying a line of dies on the outside. The pressure-die-casting foundry at Slough consists of a compact group of six Polak and two Edgwick machines. Most of the production of this department is connected with the textile industry, but many camera and cycle accessories, cooker and hand-tool components are turned out as well. Most components which are sand and gravity-die cast go to the heat-treatment department for the improvement of mechanical properties. There are three pit-type electric furnaces here with 5-ft. dia. capacity and a special, controlled-atmosphere plant for treating magnesium alloys. All the furnaces and low-temperature ageing ovens are controlled electrically from a recorder room.

Qualcast (Ealing Park), Limited.—This foundry produces between 65 and 70 tons of good castings each week from a total site area of 45,000 sq. ft. The foundrymen are not proud of the layout, but are justifiably proud of both the quality and quantity of work done in difficult circumstances. Three separate types of castings are produced, namely, crankshaft castings for a wide range of engines and compressors, jobbing castings up to 2 tons in weight, and machine-moulded items. The tonnage of each class produced is approximately the same. A high proportion of the jobbing work is for the machine-tool industry, and the machine-moulding shop is laid out to deal with medium runs.

Labour turnover is remarkably low, and it is the policy of this company to look for work which is more difficult than the average, so that continuity of experience of a highly-skilled team, and limited floor space, can both be used to the maximum advantage. Five apprentices are employed, a quite remarkable number these days when viewed in relation to the forty skilled men.

Two cupolas of 3 tons per hour are the sole means of melting, and, as would be expected, a very high degree of control of materials and melting is one of the chief secrets of the very successful operation of this foundry. The company produces most of its own patterns, and new shot-blast plant has recently been installed in the fettling shop which at the present time is being re-arranged.

Morgan Crucible Company, Limited.—Although there is a small experimental test foundry at these works, the crucible manufacturing side was the major attraction for foundrymen visitors. Naturally, furnaces and ancillary equipment produced were also inspected and added interest was provided by the making of such items as refractories, potentiometers, carbon brushes, riser discs and other carbon shapes.

British Bath Company, Limited.—As several accounts of the British Bath Company's mechanised foundry at Greenford and visits paid to it have already appeared in the JOURNAL* only brief recapitulation is germane in this context.

The company belongs to the Allied Ironfounders group and has pioneered the Sandslinger production of bath moulds, which has now reached a high degree of efficiency using mainly unskilled labour. Sand preparation and handling are both mechanised as are all operations in the dressing shop. A feature of the latter is a continuous Wheelabrator shot-blasting plant wherein the baths are carried in pendulum fashion, the capacity being 75 per hour. Patterns are set-up on the "block" system, *i.e.*, two patterns are used for each bath, and synthetic sand is employed. An iron containing a fairly high phosphorus content is used for baths, a typical composition being T.C. 3.20, Si 3.10, Mn 0.50, S 0.070 and P 1.35 per cent. It was unfortunate that at the time of the foundrymen's visit there was some labour trouble at the works and not all departments were working. In the finishing sections there is an up-to-date vitreous-enamelling shop using mainly the dry-powder process. Here the use of universal jigs for holding the castings is noteworthy. A self-contained amenities section for foundry workers has quite recently been completed.

* FOUNDRY TRADE JOURNAL, March 1, 1946 and August 5, 1948.

Belling & Company, Limited (manufacturers of electric fires and cookers).

This foundry has an area of 23,000 sq. ft. and is engaged in the production of grey-iron and aluminium castings used in the manufacture of the firm's electric cookers and fires. The layout consists of:—(*a*) A well-equipped patternshop producing plaster, wood and metal equipment; (*b*) a floor-moulding shop employing 24 moulders engaged on plate-moulding, using aluminium double-sided pattern plates. To avoid undue strain to the moulder, aluminium copes are provided to the larger box parts and additionally five snap-flask moulding machines for the production of the smaller castings. There is also a sand-blast unit and fettling shop which were inspected, as well as shower-baths and clothes-locker accommodation for the use of all foundry personnel.

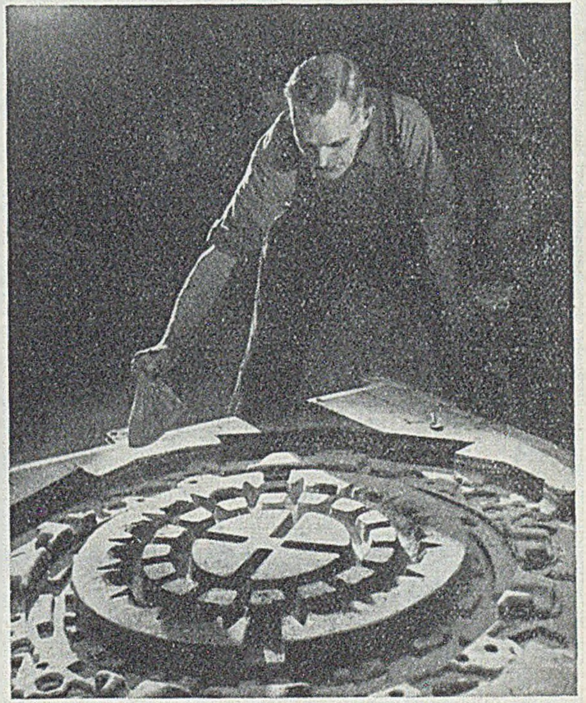


FIG. 3.—*Dressing a Cored-up Mould: Sprinkling Parting Powder over a Mould for a 108 lb. De Havilland "Goblin" Diffuser Ring in the High Duty Alloys Magnesium sand Foundry.*

I.B.F. National Works Visits Day

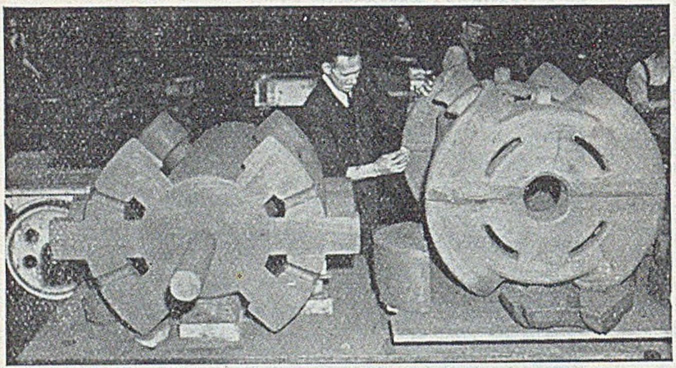
The melting units comprise two cupolas, one of 3 tons and one of 30 cwt. per hr. capacity, and two coke-fired tilting furnaces for the melting of aluminium. Very rigid control is practised in the preparation of facing sand and in cupola charging and melting to produce castings suitable in quality and finish for the application of acid-proof vitreous enamels. The success attained in that department is largely due to this initial care. An average month's output from the foundry is of the order of 40,000 iron castings weighing approximately 75 tons total and 10,000 aluminium castings making about 4 tons in all. Fig. 7 shows workmen engaged in pouring cooker castings. Patterns can be seen in the background. The machine and assembly shops of this concern were also inspected.

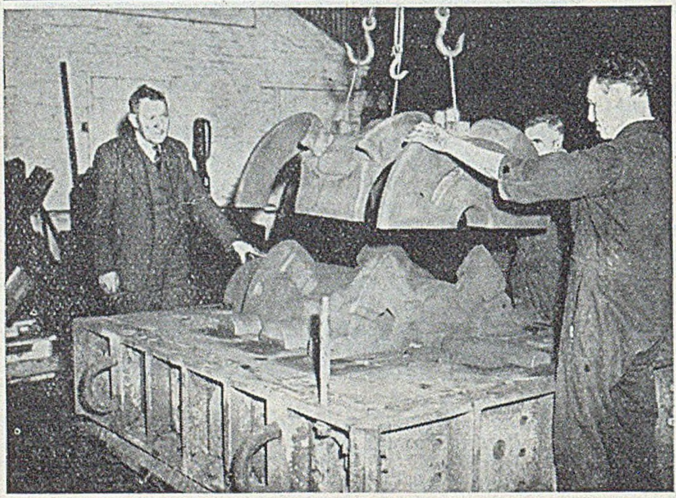
Harland & Wolff, Limited.—These foundries form part of the principal works of the London organisation of this company which, being chiefly devoted to ship-repair work, are situated on the north bank of the river Thames, adjacent to the river entrance to the King George V dock. and are served by rail, road and river transport. The foundries. which have a floor area of 45,000 sq. ft., are divided into three bays which, in the main, are allocated respectively to heavy iron castings, light iron and machine-moulded castings, and non-ferrous castings and white-metalling. These bays are served by overhead travelling cranes of 40 tons, 10 tons and 20 tons capacity respectively as well as by monorail and jib cranes, while part of the machine moulding plant is served by a roller conveyor system. There is direct road and rail access to the foundries, which also contain concrete footpaths. Modern washing and changing facilities are provided, with shower baths, as well as a canteen where hot meals are served.

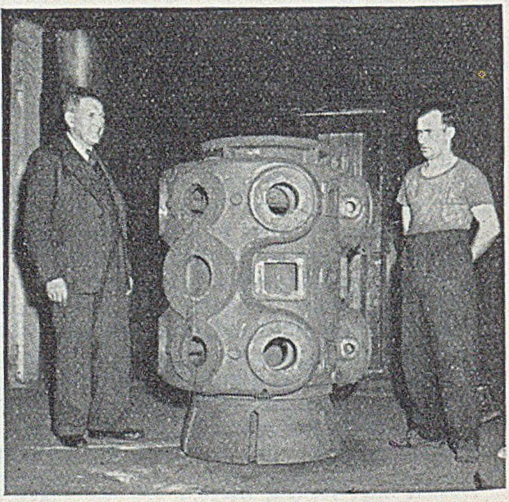
The melting and pouring capacity permits iron castings up to 15 tons to be produced and non-ferrous castings up to 5 tons. All types of castings are supplied to the ship-building, ship-repairing and general-engineering industries and a wide range of engineers' grey iron in greensand, drysand and loam, and of non-ferrous castings, is produced for various customers. Special features include mass-production of railway and other castings and the manufacture of large die blocks for the motor-body and pressed-steel industries.

J. & E. Hall, Limited—Founded in 1785, this firm now manufactures heavy industrial, marine, brewery and commercial refrigerating equipment, escalators and lifts.

Of the refrigerating equipment, typical examples of work at the present moment going through the shops are carbon-dioxide compressors giving up to 100 tons refrigeration per hr.; ammonia compressors







FIGS. 4, 5 *and* 6.—*Various stages in the Production of an Ammonia Cylinder Casting at the Foundries of J. & E. Hall Limited at Dartford, Kent; Fig. 4 shows Complicated Core Assemblies; Fig. 5 Core Placing, where the Second Core is being lowered over the First and Fig. 6 the Final Casting after Fettling has been completed.*

giving up to 300 tons refrigeration per hr., and methyl chloride and freon compressors giving up to 100 tons per hr. refrigeration. Fifty per cent. of the material required for the manufacture of these plants is grey iron. In the escalator section, examples of units similar to the one installed in the Dome of Discovery of the South Bank Exhibition were seen, with capacity to carry equivalent to 7,500 passengers per hour.

The present ironfoundry comprises two bays adjoining each other, the main bay, 240 ft. long by 40 ft. wide, and the annexe 100 ft. long by 24 ft. wide, but plans are in hand for the building of a new foundry. The patternshop is housed near the foundry in the woodworking section of the firm. In this section, the policy of the firm to make models to customers' requirements as distinct from standard designs first makes itself apparent. Everyday production in the foundry consists of cylinders, crankcases and pistons of varying size and design, as well as frames and bases for CO_2 machines. By use of the various foundry processes, *e.g.*, moulding machine, Sandslinger, loam or dry-sand moulding, the skill of the experienced craftsmen (of whom J. & E. Hall are very proud) was shown. Normally, castings ranging up to 12 tons in weight are made. Close metallurgical control is maintained and, in this connection, a well-equipped laboratory is available for mechanical testing and chemical and metallographical analyses. This control is essential, as the castings, in addition to possessing satisfactory mechanical properties, must be perfectly gas-tight up to 750 lb. hydraulic and 500 lb. air pressure. A constant check on the quality of castings is kept by regular laboratory analyses of incoming materials and finished products as well as regular trial of test-bars which are cast on all important components. Figs. 4, 5 and 6 show a typical job.

J. Stone & Company (Charlton), Limited—These foundries are concerned with the production of a wide range of cast products, including marine propellers of all types, which are supplied in the fully-finished condition; sand- and die-castings in a wide range of aluminium and magnesium alloys, and all types of non-ferrous alloys, including aluminium bronze. The works cater for machining of various types of castings, including railway bearings and the laboratories are well equipped for radiological examination and metallurgical analysis by the most modern methods.

Fraser & Chalmers Engineering Works. The foundry of the Fraser & Chalmers Engineering Works at Erith of the General Electric Company, Limited, is a general purpose iron foundry for supplying castings for the company's own manufactures. The products range from turbine-exhaust casings weighing up to 30 tons and conical-cylindrical rope drums up to 20 ft. dia., down to small parts for conveyor work weighing only a few ounces and numbering many thousands. For these latter, a small semi-mechanised portion is set aside, with a prepared sand feed to a number of Wallwork machines, operated in the main by women.

Large Pneulec jolt-ram machines take care of

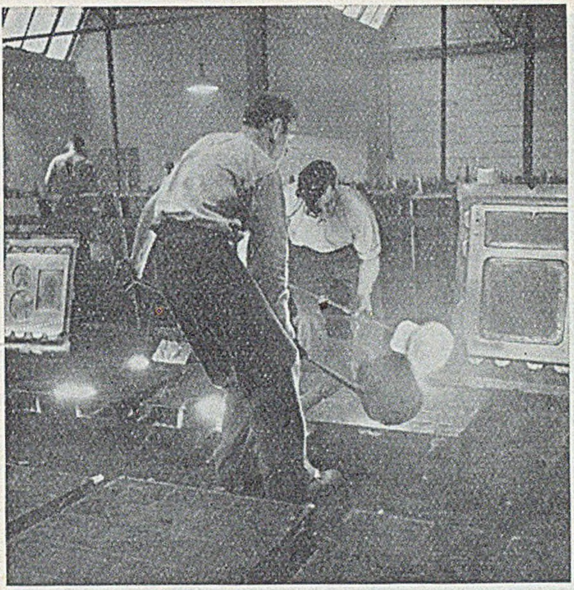


Fig. 7.—*Double Pouring of Electric-cooker Castings at the Works of Belling & Company, Limited. On the left is a Pattern for a Cooker Top Plate and on the right a Pattern for a Cooker Front.*

repetition work for screen frames and similar work and an interesting section is devoted to the semi-mechanical production of bladed cores for turbines. The core ovens are fired by the Newstead type of stove, and three cupolas yield 3, 4 and 5 tons of iron per hour, respectively. The buildings cover an area of 56,000 sq. ft. and approximately 170 men and women are employed there, among these being the gratifying number of 16 apprentices. An up-to-date clothing store and wash-room has just been completed, including the provision of warm showers. While the vast majority of castings are in grey iron, considerable tonnages of anti-abrasion and heat-resisting irons are used for the Company's mining productions.

Renshaw Foundry Company, Limited, Staines—This firm was incorporated under its present title and management in 1934, although there had earlier been a foundry which since 1880 made agricultural castings and since 1926 general iron castings. A further change was made in 1936, when high-duty and alloy iron production was introduced, along with a high degree of technical control. Over the last 15 years output has increased from 200 to 1,500 tons per annum, mainly of machine-tool, marine, and special-purpose castings. During the wartime concentration, the firm was one of the nucleus foundries of the south-eastern area. To-day the works is exceedingly well-equipped as a jobbing foundry with modern plant, including that for sand-preparation, core-drying and metal distribution.

Special Payment Scheme

On cessation of Essential Works Order in April, 1946, being still faced with a shortage of skilled

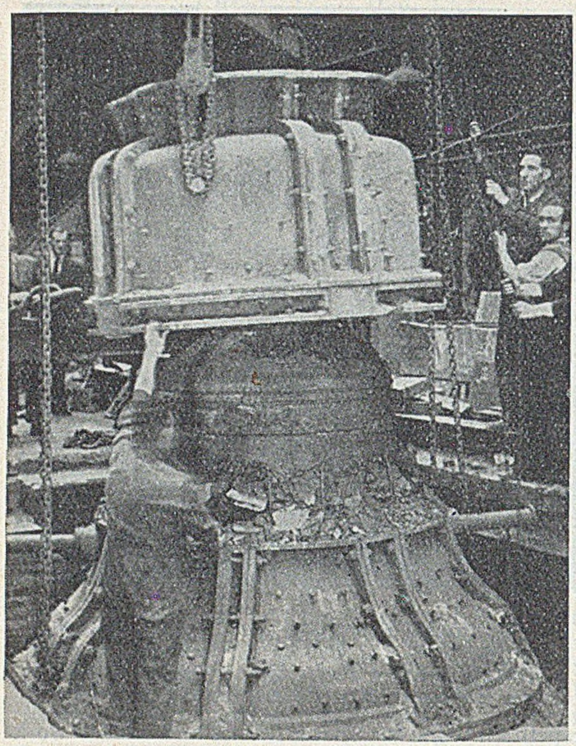


FIG. 8.—*Stripping the Mould after casting the "Freedom" Bell at the Works of Gillett & Johnston, Croydon.*

labour and likely migration of personnel, serious consideration was given by the executive to various systems of incentives to encourage the manufacture of improved castings. Various schemes of payment were considered and a choice finally made for the system which is used to-day. The system is virtually a system of piece-work in reverse, *i.e.*, standard rates were set up, based on previous piece-work histories, and converted into a flat-rate per week. This rate is paid as in normal staff arrangements, days of absence for sickness and holidays being paid for.

Records are kept to ensure that the production is maintained and the rate and the position of each operative is reviewed quarterly. Adjustments are then made, up or down, according to the performance of the individual worker. It has been found that this has engendered a co-operative spirit throughout the works and a real interest in the company on the part of the personnel. This is borne out by a particularly low rate of labour turnover, negligible when expressed as a percentage.

Gillett & Johnston, Limited.*—This concern operates a clock shop, bell foundry, non-ferrous foundry, iron foundry, erecting shops, turning and machine-tool departments. Chief interest for the visitors was centred in the brass and bell foundries where 40 are employed; these are 120 by 40 ft. and 110 by 36 ft. The bell foundry is equipped with a reverberatory furnace capable of melting up to 15 tons, also a number of "Morgan" tilting furnaces capable of melting up to 3 tons, giving capacity to cast bells up to 18 tons. There are also four "Roper" coke-fired forced-draught pit furnaces and two "Black-Seam" 100-lb. capacity forced-draught furnaces in which are melted practically every specification of non-ferrous metals, including phosphor-bronze, manganese bronze, tin bronzes, aluminium, etc. The brass foundry supplies all the castings for the firm's turret-type clock movements. Castings are also supplied to outside firms varying in weight from a few ozs. up to 2 tons. Shortly, it is hoped to increase capacity in this section to 5-ton castings.

* See JOURNAL, June 8, 1939.

Bell Founding

The bell moulds are made in special iron cases which are produced in various sizes to suit bells varying from 15 in. dia. upwards, and to allow the minimum thickness of loam say from 2 in. up to approximately 9 in. The moulds are stoved and dried and then washed with plumbago after which the inscriptions and decorations are stamped in accordance to the customer's requirements. The mould is then returned to the stove and cast the following day. Moulds are dried slowly so as to avoid any undue cracks in the moulds and cores. Fig. 8 shows the production by this firm of the "Freedom Bell" which was quite recently dedicated.

Langley Alloys, Limited,* Langley, Bucks.—The main products of this large, partially mechanised non-ferrous foundry can be classed in three groups: copper-base alloys, nickel-base alloys, and stainless steels. The foundry is divided into two main sections, one for hand moulding and one for machine moulding. Both sections are served by one core-shop and one line of melting furnaces. These consist of oil-fired furnaces for copper alloys, and a high-frequency electric furnace for nickel alloys and stainless steels; there is also a rocking-arc electric furnace.

Sand is mixed mechanically and carried by belt conveyor to the moulding machines, the operators ploughing off sand into individual hoppers as required. This system also provides sand for the hand-moulding section. The properties of the moulding and core-sand are maintained by regular laboratory control. Sand is subsequently reclaimed from the "knock-out" section by a conveyor below the grid. Castings then pass to the fettling shop, manual handling being reduced as far as possible both here and in the foundry by the use of roller conveyors.

Additional facilities include a well-equipped patternshop and drawing office. Also, as would be expected for high-quality castings, extensive chemical and metallurgical laboratories are continually checking the quality throughout the processing. Research and development are also constantly carried out on materials methods and products.

* Further details of this foundry were printed in the JOURNAL, January 15, 1948.

JOHN MORRIS (FIRESNOW), LIMITED, Johnson Street, Stockport, are planning to erect a new factory on a site at Macclesfield Industrial Estate. The premises, estimated to cover an area of over 12,000 sq. ft., will include a foundry and machine shops.

System of Studying Casting Defects*

Discussion of the Paper by G. W. Nicholls and D. T. Kershaw, B.Sc.

When this Paper was presented at the Newcastle-upon-Tyne conference of the Institute of British Foundrymen, it was expected that the account of the introduction of laboratory control of moulding operations in an essentially jobbing foundry would prove somewhat controversial. That this was indeed true in some measure has been proved by the discussion reported, but, having in mind the background of lack of skilled entrants to moulding, the Authors well justified their methods and won support from the meeting. Attempts to reconcile camber for large bed-type castings to an established formula as well as drying methods were warmly commended. Melting methods and raw material control came in for some critical comment, but on the other hand such points as effects of changed design, the value of detailed records, the necessity for supervision of the un-skilled, and attitude to the use of bought-in scrap were praised and elaborated upon.

THE CHAIRMAN, Mr. E. Longden, opening the Paper for discussion, said he thought the presentation of the Paper had been a very clear summing-up and would lead to many questions. He had noticed the mention of a camber chart which it had taken him many years to compile. He had had much satisfaction during the conference in being told by several members how nearly the chart had given the information they needed and how helpful it was in many ways. He was sure Mr. Nicholls was adding to the information, and in particular to the usual method of putting the camber in the mould.

He would like Mr. Nicholls to explain more clearly to the members why the old system of dividing the length along the bed into equal allowances for camber had to be discarded.

Setting Camber

Answering the Chairman's query, MR. NICHOLLS said the reason was that if over a 20-ft. length one wished to put in one inch of camber at a central point, the old method was at the half-way point to put in a half of an inch. However, that did not represent the true relation to one inch of camber at the centre; it was inaccurate. Mr. Kershaw and himself had worked out a simple mathematical formula. They claimed that camber at a point C, distant m from the end of a casting was roughly equal to

$$\frac{4m\,(l - m)}{l^2}\text{[max. camber]}$$

That was not really accurate either, but it was more accurate than the old method. They had altered that into the form of a chart shown in Fig. 9 on page 7 of the preprint. There was shown a casting which was approximately 40 ft. long with two side projections off-centre. There was no means of working out the camber decided on. They had to discover it by experience and by using such work as that carried out by Mr. Longden, and contained in his camber-graph.

They placed in the casting 2⅛ in. of camber one foot from the centre of the casting. It could be seen that at the half-way marks the camber was not a half of 2⅛ in. The reason for this was because they found in the old case castings which should have been straight on passing to the fettling shop, or at most might have had a slight twist in them, warped so much that they had to find the reason. Another reason was the manner in which the strickles were laid in the mould. It had been found that in laying the board down the one strickle might have been all right, but the second might not have been parallel to the first, and the result was that the casting, while being straight on one side, might have a twist on the other. They had, therefore, developed their method to make sure that all camber laid in moulds was laid by a common method.

THE CHAIRMAN remarked that in an effort to regularise the determination of camber in the same way that Mr. Nicholls and Mr. Kershaw had done, he had approached the technical colleges to provide him with a general formula suitable for any length, depth, and width of a casting. They were unable to do this. The formula about which they had now heard was near enough, but it was not accurate, and it was necessary to go into long calculations for each casting.

MR. NICHOLLS suggested the present method was more accurate than the practice which had preceded it.

MR. KERSHAW said on the question of the formula, the approximation they used to derive it was to consider that the radius of the circle of which the camber was a part compared with the maximum camber put into the bed. (Mr. Kershaw explained and amplified this by diagrams on the blackboard showing how the camber and the theoretical circle of which it was supposed to be a part compared.)

With regard to Fig. 8 on page 7 of the preprint which showed the old method of setting camber at the half-way marks along the bed, the castings often came out indicating that insufficient camber had been set. This led them to consider that the camber to be set into a mould should be fed off a circle.

Variables Affecting Camber

MR. T. B. BURROWS asked if the Author's experience had indicated that the degree of accuracy of the castings using their method of computing camber was at all affected by metal temperature at the time of pouring together with the speed at which the

* Paper published in the FOUNDRY TRADE JOURNAL on October 4 and 11, 1951.

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metal filled the mould coupled with the effect of varying metal composition.

Had they, when going into the question of camber, always taken a specific job, a specific casting temperature and time of pouring and metal composition?

MR. NICHOLLS replied that the answer to that question would take a long time. The composition of the metal and the casting temperature were noted on the record card. From their information and published sources of information they would say that wise choice of temperature had an advantageous effect on the result of camber that was put into a casting. They felt that, generally speaking, the hotter the metal the slightly less camber they would require. In other words, they felt there was a quicker heating up of the constituents of the mould, core, sand, etc., and there was a tendency for more equable cooling from heat transfer. Regarding the composition of the metal: using an iron of a higher strength would also effect the camber inasmuch as the contraction of the iron through the solid state was greater.

MR. BURROWS said he had omitted to mention that what he had had in mind was that on many occasions he had to produce a particular casting which required camber. It was a simple casting, but inaccuracies crept into the casting which were not answered by the assumption of inaccuracies in the pattern. While they aimed to keep the metal composition within reasonable limits they did find, as Mr. Nicholls had confirmed, that sometimes a slight variation in composition, or with a constant composition, sometimes a very slight variation in casting temperature or pouring speed, could upset that casting which sometimes would be straight, and on occasion might be $\frac{1}{8}$ in. out.

MR. NICHOLLS said he did not think casting temperature would affect the casting greatly. Another factor which affected the casting was the position of the riser system. Anything which affected the movement and the contraction of the casting would obviously affect the camber.

MR. KERSHAW suggested one reason why the same result was not always secured might be due to the withdrawal of the pattern. If the moulder had to finish the bottom of the mould, that might make all the difference between a straight casting and one that was slightly twisted.

Camber on Patterns

A MEMBER said camber had always struck him as being something introduced to correct a phenomenon about which they knew too little. It was a question he would like to see tackled seriously by the Institute, rather than leave every foundry to attempt to solve the problem by costly experience. He felt sure that given certain basic principles and rules to follow one could introduce camber. There were variables in design, but there were quite a number of castings that followed a similar design. If camber could be applied to patterns it would not be necessary to use separate charts to work to for camber, as it would already be established on the pattern. He could not help feeling that foundrymen were evading the issue because it was a most difficult problem, and he thought they were wasting quite a lot of money by not tackling it.

He admired Mr. Longden for trying to give them something as a guide. He had used it for establishing the camber in the pattern with a number of jobs, and had achieved remarkable success with it.

MR. NICHOLLS pointed out there was one disadvantage about incorporating camber in the pattern and doing away with the method which he used: the patterns which would have to be used would be from 20 to 40 ft. long and would not be made in one piece, but in a series of blocks. Those blocks had to be built up in the floor to follow the camber arc. Furthermore, if camber was to be incorporated in a pattern it might be generally satisfactory for the first job, but if for a running line, at the end of several weeks, unless particular attention had been paid to the construction of that pattern, the camber might very soon disappear with the amount of knocking about it would receive in the foundry.

Effect of Design on Camber

MR. H. HAYNES pointed out that there was a sketch of a horizontal boring-machine bed casting in Fig. 13 of the paper and the Authors claimed that in their class of work and experience camber was successful. Suppose they changed the design of that casting, and instead of running their brackets at right-angles they put in the centre grids, which would not need camber to the same extent. The first one was cast with camber, and then the design was changed and a star webbing was put in with no camber, but the pattern remained true and in a perfect state. Therefore he claimed that camber could not be recommended for every class of casting whatever its length might be unless they had further experience of the design of it. At Mr. Nicholls' works they had experience and could work to their formula for the camber which had proved successful. Mr. Longden's articles on camber had been of great assistance to everyone in connection with that class of work, but when one altered the design it made a lot of difference.

MR. NICHOLLS agreed that by altering design the amount of camber required could be reduced, but he still thought that on a casting 14 ft. long, irrespective of design, a small amount of camber would be required if that casting was to strip from the mould reasonably true. But it was possible that the amount of camber given a casting of that size was less than machining allowance. Only $\frac{1}{16}$ in. of camber might be required and the machining allowance on that casting might be $\frac{3}{8}$ in., so that whichever way the camber went, it would still be within the allowance and would not matter.

It had been said that camber, where it was necessary to apply it, could be estimated from certain principles, and when dealing with a casting 40 ft. long where up to $2\frac{1}{2}$ in. of camber might be required and the machining allowance was at a maximum of only $\frac{1}{2}$ to $\frac{5}{8}$ in. it was quite obvious the camber extended far beyond this allowance.

MR. KERSHAW said they saw Mr. Haynes' point about the star web. The thicker a wall section the less camber there was required, and the net effect of putting a star web into the casting was really to increase the wall section. Therefore by doing that there would be less camber required. On a length of 14 ft. very little camber would be required. An eighth to three-sixteenths was all that would be needed on that casting.

MR. HAYNES thought it was not a matter of design in that case. Experience was necessary to decide what could and what could not have camber.

Melting

MR. C. R. VAN DER BEN thought Mr. Nicholls and Mr. Kershaw were to be congratulated on a very excellent Paper, the principle of which was to study the defects in castings. In his remarks he did not propose to go into specific details.

He thought the subject had been proved by the Authors to be well worthwhile pursuing and their records, which could be detailed and were arranged to show various factors, were obviously a tremendous advantage. The list of things which could happen in a foundry owing to the many variables were legion and the mere listing of those troubles could sometimes point to a reason for a defect which in everyday foundrywork was apt sometimes to be overlooked. He thought the purpose of the Paper was to point to the need of a proper regard for difficulties and an examination of and a prevention of such occurrences.

There was one particular point with reference to melting. On page 14 of the preprint some consideration was given to what was called "oxidised metal" which could be detected by excessive sparking at the spout. Personally he thought that was to some extent dependent on the composition of the metal. With hard iron there was more sparking than with high-silicon iron. He did not think it indicated what was called oxidised metal. In the following paragraph metal which rapidly lost its "life" it was said was symptomatic of oxidised iron. He rather questioned that. There was some work in progress on gas content of iron, and iron which was "oxidised." The phenomenon of rapidly losing "life" and becoming pasty had been examined and rather surprisingly oxygen content was below normal.

MR. NICHOLLS said they knew some iron came from a furnace full of "life," but they were basing their remarks on their standard mixtures which had a certain appearance when tapped from the furnace. If there was too much sparking there was a tendency for it to have been overblown. If it was dull they called it oxidised metal. If on being tapped it lost "life," they knew it could be due to other things also. But they were a set of standards which they had attempted to construct. Their laboratory staff in their observations of tapping kept a look out for those different appearances at the tapping spout. It indicated that something was wrong and required attention. They did not say that it was definitely oxidised iron, but it could be caused by over-blowing or the use of rusty scrap. Charges out of balance could all lead to black iron which might not be as they said "oxidised iron."

MR. Nicholls further added that he agreed it was possible to run that same iron into a mould, and get a satisfactory casting. He realised that for the system to work they had to diagnose the iron so that it could be recognised at all times.

MR. BURROWS said they were all aware that wasters were made and unfortunately it was far from being an infrequent occurrence. This was a very serious problem with which they had to grapple. Everybody recognised the fact and he would like it put on record from the body of the hall that in this respect, Mr. Nicholls' and Mr. Kershaw's Paper was a valuable contribution to the excellent work which had already been done by the Institute.

Moulding Defects

Replying to a questioner, MR. NICHOLLS said the control system was not hard and fast. They could not tell a moulder that he must make a casting to certain instructions. When the work was handed out to the foreman he received the instruction sheet, and it was his duty to see that the principles were carried out. In many cases, the moulder could be trusted, but some unskilled moulders had to be watched carefully, and the instruction sheet was for the benefit of those men.

Experience showed that when a casting was made according to a particular principle; there was a 95 per cent. chance of getting a good casting, but if not, they were liable to get a defect.

The last speaker had mentioned that particular difficulty and he and his co-Author had illustrated it with a planing-machine table. The section of metal on top of the casting was roughly 5 in. thick. The bottom of the casting was the working face, so both faces were important; they had to cast one face up and one down. In this particular casting the slideways of the table were cast uppermost with 5 in. of metal section. When they tackled that job first, this mass of metal being at the top required feeding and the feeders were designed accordingly. But they found that underneath the feeders at the end of the casting there was a tendency for porosity and small blowholes to appear. But by eliminating the top feeders, putting side feeders from the waist, and bringing up an end-feeder, they had completely eliminated that defect.

Reasons for Scrap

A MEMBER said that the Paper set out details of a remarkable amount of work, but he had found it a little disappointing in the introduction. The last sentence stated: "It can be said that the amount of scrap produced in any foundry is inversely proportional to the attention paid to the problem by the management and to the efficiency of the quality-control staff." He suggested it depended also on the failure of the workmen. He would like that to be incorporated into the conclusion in some way.

He also felt that in trying to justify the introduction of a control system, one had to take notice of the fact that one moulder might produce 100 tons of good castings in a year. On examining the figures

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given for the system he did not think they had saved more than the output of one good moulder for five years, and he wondered if the cost of the system was more than the wages of a good moulder.

MR. NICHOLLS maintained that the paragraph in the introduction of the Paper still held good. If during a spell of bad work, which occasionally cropped up in a foundry, the management and staff gave it no attention at all, it would proceed to increase. If the staff was constantly on the alert watching for difficulties as they arose, and attempting to find some remedy, they would either keep their figure of scrap at a level or reduce it. For these reasons, he could not agree with the last speaker. Perhaps he might be right that it was also inversely proportional to the good work put in by moulders.

He had listened to gentlemen speaking about good craftsmen and he had heard the president speak of the falling-off of new entries to the foundry. They also had found the same thing, and the younger personnel in the foundry seemed to have lost the art of craftsmanship, and had to be watched more than the old skilled craftsmen. He maintained that if they were producing running lines of castings from a jolting or sand-slinging system, if the men were on a contract-piece-price system for the job few of them would have any thought other than producing the castings as quickly as possible so that the compensation was as high as possible. The biggest responsibility for the production of any scrap in any foundry, therefore, must be laid on the shoulders of the management and the quality-control staff.

In his firm, they were trying to build-up records of difficulties so that when these arose the cause and the most likely cure could be seen quickly.

MR. TIPPER thought that the Paper was a fine one and well worth study by anyone who had the responsibility for improving output and the quality of their castings. That was a point which he thought was overlooked by the previous speaker. They might increase the labour force, but unless they were progressively studying the job and were really able to control scientifically both the work being done and the methods, then they were not going to make progress. There could be no doubt about the correctness of that method of control.

Drying of Moulds

In connection with the problem of drying moulds, there was in this section much which was well worth careful study. For example, the conclusion that one extra inch of skin depth was required to allow for " striking back " after standing a definite time was a useful constant. That was the type of information which could help a number of people making that class of mould. He also suggested that the saving in time that could result from such a study followed by the laying down of the best procedure of drying, was of considerable value.

Had anyone else found a similar relationship to that given in the Paper of one pan/hour to dry every 7.5 sq. ft. of mould surface? He agreed this figure would depend on the type of dryer and the volume of hot air put into the mould, but it was a definite figure which could be used for comparison purposes.

A matter also worth consideration was the importance of ensuring a satisfactory dried mould from the point of view of heat conductivity of the mould and its effect on the rate of cooling. They knew that, apart from the question of the type of sand used, permeability and composition, the moisture content of the mould has the greatest single effect on the conductivity or the heat absorption of the mould, and, from that point of view, accurate drying was an important factor. Could Mr. Nicholls or Mr. Kershaw say whether they had arrived at an idea of the optimum drying temperature to produce a complete drying of a standard flat surface at a certain initial moisture content without burning, *e.g.*, in the shortest time? He did not mean the temperature of the gas going into the mould, but the temperature at the surface which would become stable after a certain time.

The members of the Institute could do a great deal worse than carry out further work of this sort and report it at future meetings.

MR. NICHOLLS said it was very difficult to give the optimum temperature because it depended on the type of work being done. From their own experience, they had found that for their class of work and their casting sand and the moisture it carried, etc., the most useful temperature was round about 315 deg. C. However, they mentioned on the top of page 12 of the preprint that it was for moulds dried in static ovens, and these were purely their own findings in relation to their own processes.

Economics of Control

To go back a little further, he was sorry he had omitted to reply to a previous speaker concerning output figures shown on Table I, page 4. As a result of the system they had only shown a saving of roughly 100 tons; the equivalent of one moulder's output. What they had done was to save 100 tons of rejected castings on the difference between the output shown, which was 4,400 as against 5,000, which covered an increase of 500 tons output. In other words, they had saved 2.2 per cent. of their output and not 100 tons. It was not an accurate statement to say that there was exactly the same personnel. There were the same number of moulders, but the personnel varied each year. At the moment they had eight less than in the total works in 1943-44. In addition to that they mentioned in the Paper that the reduction in reject castings had been also brought about in face of increased inspection in the foundry and, more important still, increased inspection in the engineering works compared with the inspection or the type of casting which was allowed to be passed during the war years. It was quite true there were certain castings passed in those days which were required urgently which would not pass inspection at present. But he did not agree with the previous speaker that they had only just saved 100 tons, the equivalent of one moulder's output. They had saved more than that and, in addition, they had gained valuable experience.

A MEMBER said a previous speaker had asked for suggestions about drying of moulds. In his experience a mould which took three days to core was dried in five hours by gas. When using gas they had a small booster attached to the meter which put on five pounds pressure, and which was most effective.

MR. D. FLEMING added his congratulations to the Authors, and said he agreed with their plan of attack on the problem of scrap. Only if people tackled the question scientifically, tried to get down to fundamentals, and published their work were they likely to make any rapid progress. He endorsed Mr. van der Ben's point that it was essential to start off without being misled into a wrong conclusion through wrong premises. In that connection he suggested that the question of oxidised metal in cupolas was a case in point. The term was one which was used at the present time in an extremely loose manner. In a cupola run on coke and air, all metal was oxidised. But, to take one point of view out of many that had been put forward, the amount of oxidation varied with the height of the coke bed, whether the furnace was being over-blown or normally blown and with the coke ratio. As the degree of oxidation increased so did the normal melting losses increase. There seemed to be an increasing amount of evidence that there was no point at which a sudden change occurred and some particularly foul sort of metal came out of the cupola, the term " oxidised metal at the spout " as applied to metal unsuitable for casting was leading them into a state of confusion, in that the metal was not otherwise changed. If the properties were related to composition and temperature then the metal was quite normal. When the work to which Mr. van der Ben had referred was published he thought there would be some overwhelming evidence in that direction. The changes which have often been put down to some peculiarity in the way they had run the cupola were in fact due purely to quite normal compositional changes in the metal and not to some obscure gas phenomenon.

Effect of Cupola Bed Height

On another point he would like to ask the Authors whether it was personal experience or whether they had followed tradition and repeated the statement that " Dull iron may be caused by too low or too high a bed height. . . ." It was the " too high " to which he was referring. Could they say whether any normal upwards variation in bed height without going to ridiculous extremes had given them bad iron even at the start of a blow?

MR. NICHOLLS said that if the bed of the furnace was high they had found that the metal was dull owing to the fact that it was slow in melting. They had also found that if a mistake was made in the coke ratio and that bed height was maintained, that they tapped metal from the furnace which was at a lower temperature than normal. If they proceeded with a high bed only and continued with their normal coke charges, then they would eventually attain the normal top temperature because the excess coke on the bed had to burn away during the initial melting operation.

On two or three occasions they had found that a mistake had been made and the coke ratio was too high. During that particular melt the result was that the metal was much duller than normal—the normal temperature was 1,320-1,370 deg. C. As soon as they adjusted the coke, the next tap from the same mixture was at the correct temperature and quite normal. They had therefore assumed that if during the run they had the coke ratio too high it would slow down the melting rate and was responsible for a slight drop in temperature.

ANOTHER MEMBER said his experience had been that at the beginning of a blow if a well-established and deep bed which had not been thoroughly cleaned was being used the temperature went up and the melting rate with it. He had to confess, after carefully watching for that phenomenon, that he had never found the temperature do anything but go up in an already-established furnace with an increase of coke. If he wanted a high temperature he let his coke rise. He thought it contrary to cupola behaviour to expect cooler metal with a higher fuel ratio, unless they took it to extreme limits.

MR. NICHOLLS said that if one increased one's coke ratio to get a certain melting rate one had to increase the blast a little in order to carry out the combustion of the coke in a given time. Otherwise the melting rate would obviously be slowed down.

MR. KERSHAW added that they had noticed that when a dull iron was being melted, and the coke ratio was increased, the iron remained dull or got worse, until they dropped the coke and went back to the normal ratio.

MR. HUGHES said he had to agree that too high a bed might reduce temperature because of the time the metal was held in the well.

Methods of Scrap Checking

He hoped he might be excused for introducing a matter which had been referred to by two previous speakers; it was regarding the first paragraph in the Paper dealing with management and control staff relating to casting difficulties. It seemed to him that there were many other difficulties which should be taken into consideration if they were to make due comparisons between one place and another. In a foreign foundry, they were running an 80 per cent. scrap charge with a very inferior quality of coke but with first-class control and management; even so they got very high figures for scrap, which were to be expected under the conditions of running. Surely one could not make a direct scrap comparison between that foundry and one in which conditions and material were much better and where the type of castings did not cover such a wide range? Consideration had to be given to conditions in reading that statement.

Checking the ingredients of incoming scrap: he would like to know how that was applied and how a representative sample was secured. If they got scrap too high in silicon how did they deal with it? Did they exchange with someone who could make better use of it?

Then there was the point raised by Mr. van der Ben on the loss of " life " in iron. It had been suggested it could be rectified by reducing the blast.

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That was one of the methods; there were others. The coke ratio might be wrong; variations in the type of scrap being charged might be the means of rectifying it.

Mr. Nicholls pointed out that on page 14 they did make use of the words "may be" and, when speaking of the remedy, they said it "may be effected by . . . ." They did not say it was the remedy; they said it might be the remedy. They agreed with previous speakers regarding the possible causes of dull metal from a furnace.

Their method of keeping a check on the scrap supplied to them was to have each load dumped as it arrived and to keep it separate. It was given a load number and they obviously could tell if some of the scrap was engineers' scrap or textile scrap. Samples were checked of each type of scrap to get an idea of the silicon content. They did not claim that that was an accurate method, but it did give them a line on the average composition of the scrap. If they were attempting to produce a 20-ton casting with a silicon analysis of 1.1 per cent., their normal scrap might have a silicon content of 1.3 to 1.5 per cent. before blending with the pig-iron; they could not feed foreign scrap into that mixture and hope to have a casting with the required machining characteristics.

Mr. Nicholls' remarks were endorsed by a member present who said he had been doing similar work for the last three years. He thought Mr. Nicholls and Mr. Kershaw had been very conservative in their statements, which, however, made everyone scrap-conscious. Referring back, he wondered if any work had been done on the mechanics of camber; in putting on camber to get a casting straight, it rather struck him it would be instructive to know what it was that created the conditions that made a casting move.

Mr. Nicholls said he believed that, apart from Mr. Longden's work and one Paper by a Frenchman, there was no literature on camber over a great number of years. The causes which led to the use of camber were differences in the rate of solidification and the restrictions to movement, the design and many other variables, type of metal, type of sand, intensity of ramming, the way the casting was run (whether over dry-sand bottom or whether over chills at the bottom).

The 40-ft. castings described were run over the whole length on chills. For a dry-sand mould the amount of camber would be entirely different.

Written Contribution

Mr. H. J. Young wrote that he criticised some of the remarks which occurred in the introduction. For example, it mentioned, apparently scathingly, "the generally-accepted view that defective castings must be expected." Surely it would be folly to expect none, unless making pig-iron or the like. Moreover, the "reasonable limits" talked about there were matters requiring long and intimate experience of what one was talking about. What was "reasonable"? A hollow casting machined all over inside and outside and then parted into sections, as in the case of a piston-ring pot or quill or bush, could not be compared to a bedplate when considering what were "reasonable" losses due to rejected castings. The more searching the machining operations the severer the *post mortem*, so to speak, and the larger the number of castings in which faults were located or revealed. Castings hardly machined at all might well give negligible wastage. The amount of scrap arising from machine-moulded castings could not fairly be compared with that coming from the same castings moulded on the floor. Very heavy pieces, say, of one ton upwards, made from patterns with which the moulders were familiar might give a loss of under one per cent. An iron foundry waster-sheet which did not show both the internal (foundry) wasters and the external (machine-shop and test-bed) wasters and the precise methods of moulding, namely, floor, machine, jolter, Sandslinger, and likewise the average weight of the castings produced under each heading, was a record giving little or no information.

Laboratory Responsibility

The closing remarks of the Authors that "too many foundry laboratories were merely show-pieces" was right on the mark. Further, when a spate of bad castings came along, did the laboratory share the blame and run the risk of being supplanted by somebody more efficient; or did it just say that the iron was all right, which, incidentally, was something few laboratories really knew. The question of utterly clean iron being poured into the moulds was quite as important as anything else. The metal should be free from slag, dirt, sand and air or gas. Teapot-spout ladles delivering molten iron from the very bottom of ladle only were invaluable. The writer had something to do with perfecting the design of a ladle of this type, and models worked daily for years without any trouble other than normal daily maintenance. The time might come when one foundryman visited another and was shown the scrap-box of waster castings, and discussion would take place about this or that "devil." Piston-ring pots, impellers, partition plates, cylinder liners and all intensively-machined castings were often "devils." Moreover, it sometimes happened that just one size was far worse than any other larger or smaller. Such patterns were called "rogue patterns" in some foundries and, although one could not identify them save by their distinguishing mark or by measurement, they identified themselves when one made a thousand off and visited the machine-shop next morning.

The Paper was very welcome and he hoped it might lead one day to a much more frank disclosure of waster castings and what everyone thought was their cause.

Mr. Nicholls said that he had no comments to make on the contribution made by Mr. Young.

The Chairman, closing the session, said the Paper had disclosed an intense interest in such matters more closely connected with production than most Papers that had been presented. The Paper could be summed up in one word—"control." To enable one to do that there had to be many records and continuity.

Production and Properties of Aluminium Casting Alloys*

By F. H. Smith, A.I.M.

(*Continued from page* 450)

Melting

Many types of furnaces are used for melting aluminium alloy scrap. The selection of a suitable furnace is dependent upon a large number of considerations, the most important of which are the forms and quantities of scrap to be melted and the economics of alloy segregation and pretreatment. Furthermore, in addition to the obvious requirement of a high thermal efficiency, the furnace must be capable of melting aluminium without excessive oxidation, and should be of a design which will permit the efficient treatment of the molten alloy with solid, liquid or gaseous fluxes; alternatively the metal may be transferred to a holding furnace or bath for this treatment.

Bale-out Furnaces

In small refining units and where the economics of labour allow each piece of scrap to be detached, identified and cleaned, bale-out crucible furnaces, usually of half-ton capacity, are commonly used. Bale-out furnaces are, of course, suitable for any massive forms of clean scrap such as castings, forgings and extrusion ends and for baled sheet cuttings. Melts are usually made under a flux cover to prevent oxidation and to assist coalescence if the charge contains thin material, although the tendency to oxidation is not great since the metal is not melted in contact with the hot furnace gases. The molten charge is usually cleaned by rabbling with a flux and scrubbing with a suitable gas or gas-producing compound, which also effectively degasses the metal.

Rotary Furnaces

Rotary furnaces are widely used for the treatment of turnings and thin forms of scrap which would show high melting losses if allowed to come in contact with, or near, the furnace flame. Melting in rotaries is carried out under a thick blanket of liquid flux which shields the metal from the fierce heat of the flame and from the furnace gases. This method of melting under a complete flux cover has many advantages. Not only does it prevent oxidation of the melt, but it ensures that every particle charged into the furnace is freed of its oxide film and any surface contamination, since it is largely melted during its passage through the liquid flux cover to the melt beneath. Furthermore, the agitation of the melt produced by the rotary motion of the furnace repeatedly brings a different part of the melt under the refining influence of the liquid flux. When melting is complete, it is the usual practice to tap the melt into a holding bath or furnace in which degassing, grain refining and other treatments may effectively be carried out and the alloying contents further adjusted, if necessary. The transference of the melt to a holding bath before casting also ensures that none of the flux from the melting furnace can find its way into the final ingots. Rotary furnaces are produced with capacities up to 10 tons. Fig. 14 (*a*) shows a rotary furnace being tapped into an adjacent holding furnace.

Hearth Furnaces

Larger and heavier forms of scrap are melted in hearth-type of reverberatory furnaces. These usually have stationary hearths and may have a melting capacity from 2 to 50 tons of aluminium. Hearth furnaces are efficient and rapid melting units

* Paper presented to the Newcastle-upon-Tyne Conference of the Institute of British Foundrymen, with Mr. J. J. Sheehan in the chair. The Author is development officer, A.L.A.R., Limited (Association of Light Alloy Refiners).

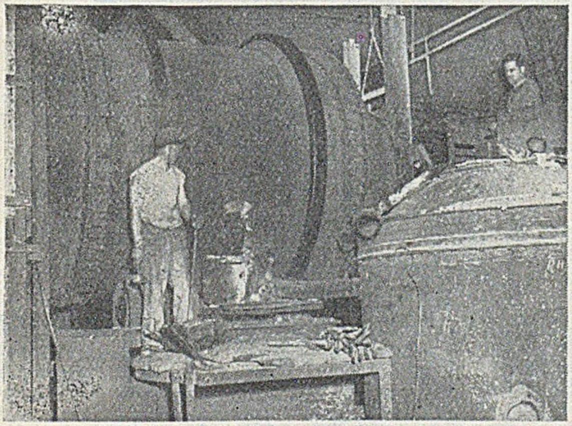

FIG. 14 (*a*).—*Rotary Furnace for Aluminium Scrap being Tapped into a Holding Furnace.*

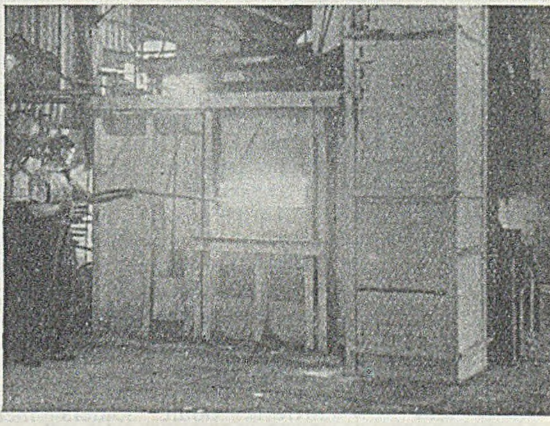

FIG. 14 (*b*).—*Treating Metal in a Small Single-chamber Reverberatory Furnace.*

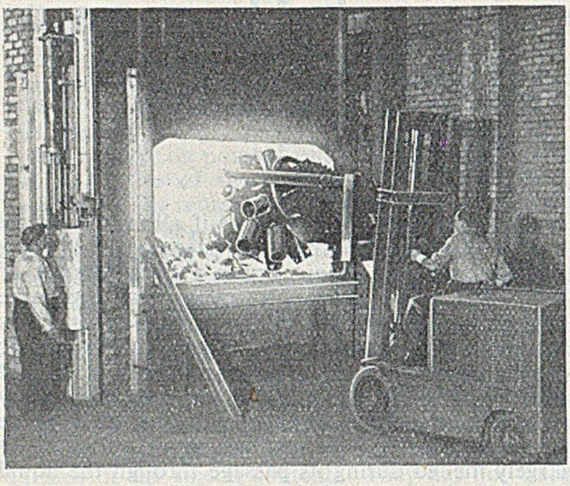

FIG. 15.—*Charging a Sloping-hearth Furnace with a Portion of Aero-engine Scrap. This Type of Furnace effects the Separation of Contaminating Metals.*

and are adaptable for many kinds of scrap. Since the burnt gases in most furnaces pass over the melt, the atmosphere is controlled as far as possible to minimise oxidation, but with the more massive forms of scrap the danger of oxidation is not great, especially as the precaution is taken of charging fresh scrap into a heel of liquid metal. The older type of furnace such as the one shown in Fig. 14 (*b*) consists of a single chamber in which melting, charging, fluxing and alloying are all carried out, but modern furnaces usually consist of two chambers, the metal after melting in the first passing to the second, which is in effect a holding well and more suitably designed for the treatment of the liquid metal. The latest type of hearth furnace has an external open well which greatly facilitates treatment of the melt and allows solid and baled scrap to be melted by direct immersion in the liquid metal in the well. The charging, puddling, fluxing and rabbling of large hearth furnaces is conducted mechanically wherever possible. Fig. 15 shows a sloping hearth furnace being charged.

Liquation Furnaces

A special type of hearth furnace, known as a sloping hearth or liquation furnace, was developed to deal with multimetal assemblies, and enables the costly and difficult hand separation of the aluminium components to be avoided. The liquation furnace, of which there are many versions, is essentially a reverberatory furnace with an inclined hearth. Fig. 16 is a diagram showing the principle of a stack furnace (Gittins[5]). Scrap such as the obsolete aircraft wing section shown in Fig. 9, or the engine in Fig. 15, is fed into the furnace at the highest level and advantage is taken of the difference in melting temperatures of the metals comprising the assembly.

Lead and low melting point solders melt and drop from the assembly at an early stage in its passage down the hearth and are caught and conveyed away by suitably arranged channels in the floor. As the structure passes into the hotter portion of the furnace, the aluminium melts away and flows down the hearth into a holding bath at the side of the main stack. The remaining steel, brass and other metal parts of the original structure are raked out at the front of the furnace. For the efficient melting of scrap in this type of furnace, the hearth temperature and atmosphere must be carefully controlled in order to minimise the loss of aluminium by oxidation and to prevent the solution of other metals in the aluminium.

One of the advantages of the hearth type furnaces is that they can be constructed with very large capacity wells or holding baths into which the metal flows from the continuously operated hearth. It is consequently possible, without loss of melting time, to analyse chemically the melt while it is in the furnace and make the necessary additions to bring the composition to the desired limits.

Metal Treatment

Reference has been made in the above brief description of furnaces and their operation to fluxing and degassing treatment. It is not intended to discuss these subjects in detail, but merely to enlarge a little on what has already been said.

Flux compositions depend, of course, upon the nature of the scrap and the type of furnace with

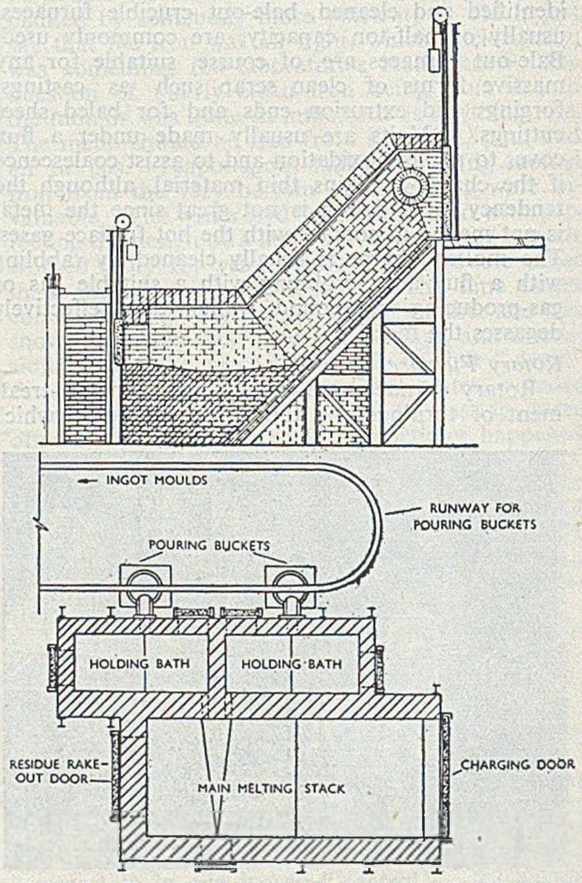

FIG. 16.—*Diagram showing the Principle of a Stack Furnace for Melting Aluminium for Ingots (Gittins[5]).*

which they are to be used. Most refiners use flux compositions of their own compounding but the majority of fluxes are essentially binary or ternary mixtures of salts of which sodium chloride is the main constituent. The other salts are commonly chlorides and fluorides, and their purpose is to improve the cleansing characteristics of the flux and to lower the melting temperature of the main constituent. Whether the flux mixture is liquid at the temperature at which it is used, as in the rotary furnace, or merely pasty or powdery as in the bale-out, its main purposes are to protect the metal from oxidation, and to refine the melt by removing all traces of oxides, nitrides, carbides and other non-metallic impurities. To ensure that the metal is completely refined, great care is taken to bring the whole of a melt into intimate contact with the flux. The liquid metal is also subjected, usually in a holding furnace or well, to the scavenging action of a gas, such as chlorine or nitrogen, which is bubbled through the melt in such a way that any non-metallic particles remaining at this stage are washed to the surface to be removed together with the spent flux by skimming, or sink to the bottom of the melt. By this treatment alloys completely free from non-metallic impurities are produced. The scavenging action of the gas further ensures that the metal is adequately degassed. A special rotary furnace designed for gaseous treatment of the melt is shown in Fig. 17.

Magnesium Removal

It was explained earlier that desired alloy compositions are obtained by blending and alloying and not by the removal of unwanted alloying elements from the raw materials. Only one element—magnesium—is usually deliberately and quantitatively removed. This is effected either by treating the melt with an active gas which removes the element as the chloride or by the application of an aluminium fluoride-based flux. The gaseous treatment is mainly used, in this country, for relatively small melts and is operated on a time or quantity basis, whilst the fluoride treatment is applied to the large reverberatory furnace melts where chemical analyses may be made throughout the melting cycle in much the same way as carbon is controlled in melting steel. Considerable amounts of magnesium are readily removed by these methods, but the complete removal of magnesium is a very lengthy and uneconomical operation. Fortunately in many alloys the increased strength and hardness resulting from the presence of a small amount of magnesium is an advantage, and it is seldom necessary to reduce the magnesium content to much below 0.1 per cent. Other treatments such as modification and grain refining, which are applied to certain alloys, are carried out immediately before the metal is cast into ingots.

Casting

Although fully automatic casting is practised in some very large refineries, most alloy producers employ only a semi-automatic system, and in the smallest refineries melts are cast by hand. Whether the metal is tapped from the holding furnace along an inclined launder and through an adjustable feeding head into the ingot moulds or whether the moulds are simply filled manually from hand ladles, the same care is taken to minimise turbulence which might produce dross and give rise to inclusions in the ingots. To guard against possible mistakes in the identification of batches of ingots, the melt or batch number is always stamped on each ingot *before* it is removed from the mould.

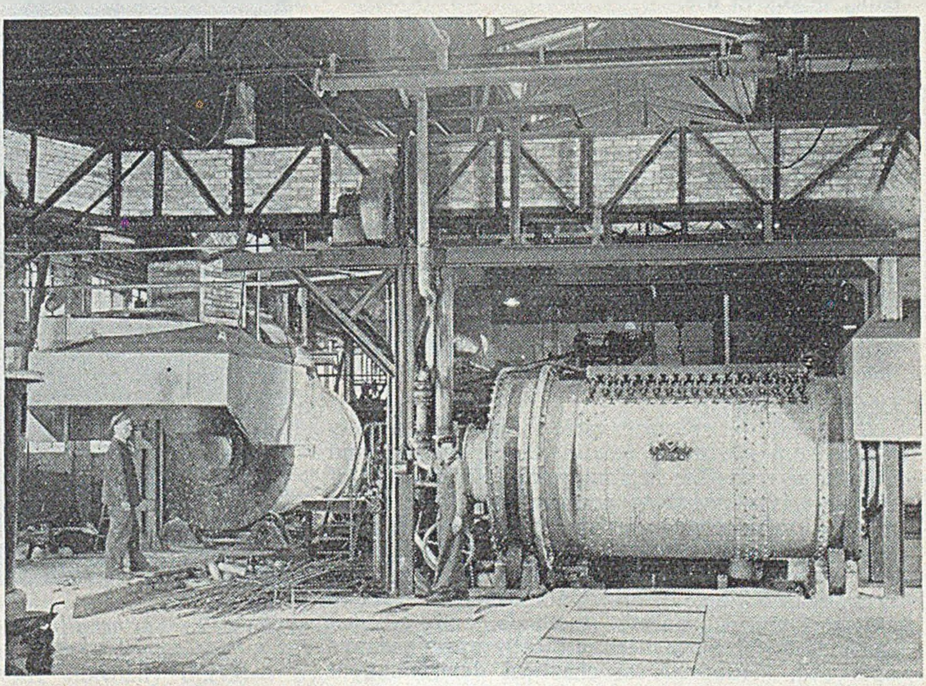

FIG. 17.—*Rotary Furnace with Tuyeres for Chlorine and Nitrogen Treatment.*

[*Courtesy of Metall Verlag G.m.b.H.*

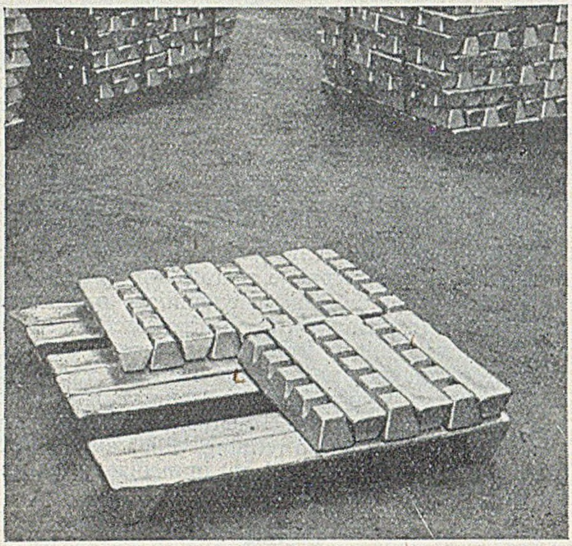

FIG. 18.—*Stacking Aluminium Ingots with the Use of Special Pallet Ingots at the Base.*

Very many different shapes and sizes of ingots are used in this country, each alloy producer having his own individual preferences. A special purpose ingot, based on an American development, has recently been introduced into this country. In the refineries and large foundries, batches of ingots are transported and stacked using fork lift trucks. To avoid the use of separate pallets or base boards for each bundle of ingots, specially shaped ingots are cast which form the base on which the normal type ingots are stacked. Figs. 18 and 19 show these pallet ingots in use.

Inspection

In the modern refinery very great emphasis is laid upon inspection to ensure that the alloys will meet not only the requirements of the specification. but also those of the founder. Every melt is, of course, chemically analysed to make sure that the composition falls not merely within the specification, but within those limits which foundry practice has shown to give the most desired characteristics. In addition to the normal chemical analysis each melt is checked spectrographically to see that it does not contain any impurity element which is not named in the specification and which would not be detected by routine chemical methods.

Chemical Analysis

Chemical and spectrographic samples are usually taken from the metal stream during casting, and with large melts the beginning, middle and end of the heat is sampled to confirm that there is no segregation or change of composition during the casting period. Among the refiners with whom the Author is associated there is continual and organised exchange of information on chemical and spectrochemical analysis methods and all use methods which have been critically examined and approved. Hundreds of chemical determinations have to be made daily in a refinery, not only to analyse the alloys made but to determine the compositions of raw materials and to control production processes. The need for quicker and more accurate analysis methods[9] has led, during recent years, to the adoption of physico-chemical techniques, and today most elements are determined absorptiometrically or polarographically. Many specifications demand very low limits for a number of elements, and analysis methods must be of a high order of accuracy in order to make certain that these limits are not exceeded. Methods of the type referred to are not only more accurate but are quicker and require less space than the older classical methods. Rapid methods which can be used to control furnace charge compositions during melting are essential to the producer of alloys from secondary materials. The spectrograph is, of course, also used for this purpose and in the United States has been developed to such a degree in the form of the " Quantometer " that in the large refineries this instrument is used for all routine analysis. The Quantometer is a spectrographic apparatus which determines automatically from the arced or sparked samples the amounts of each of the more common elements which are present. It supplies the complete analysis results in a few minutes. Fig. 20 shows a portion of a chemical laboratory attached to an aluminium refinery.

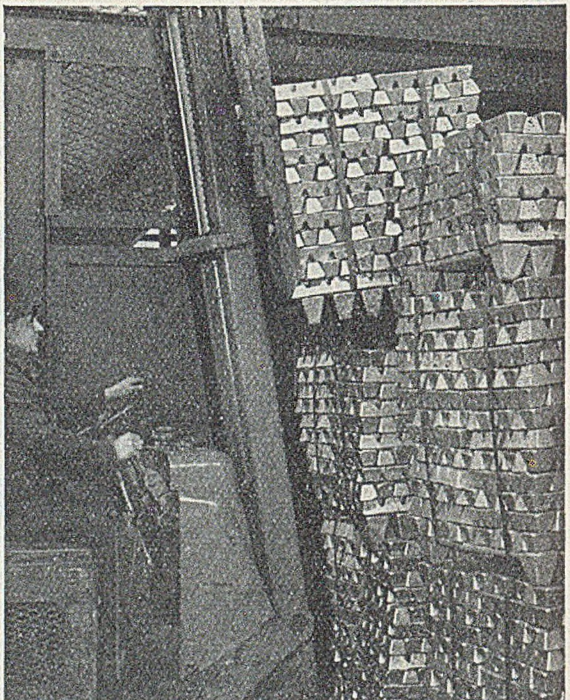

FIG. 19.—*Further Illustration of Stacking Ingots; in this Case a Fork-lift Truck is being used to Stack Batches of Ingots made up as shown in Fig. 18.*

Fig. 20.—*Corner of a Chemical Laboratory attached to an Aluminium Refinery.*

Mechanical Testing

Although mechanical tests made on specimens cast by the alloy producer do not necessarily guarantee that the founder will obtain the same results, they do demonstrate that the metal, if melted and cast under suitable conditions, will have the mechanical properties demanded by the specification. Furthermore, they are evidence that the refiners' alloy is adequately gas-free and does not contain harmful non-metallic inclusions. For this reason the mechanical testing of every melt is routine practice in all progressive refineries. Mechanical test results not only serve as an additional check on production technique, but, when collected over a long period, provide useful data for the statistical examination of the relationship between composition and mechanical properties which can be of considerable assistance in establishing specification limits.

Freedom from Gas

The optimum gas content of aluminium alloys which are to be remelted for the production of castings depends on the practice of the founder and the type of castings to be made. The refiner obviously cannot supply metal which would be equally suitable for every casting and every foundry, but he does endeavour to produce ingotted alloys which are either "gas-free" or contain a small but consistent gas content. The uniformity of gas content is controlled by many refiners by the Straube-Pfeiffer vacuum freezing test of samples taken from the melt before casting, and the founder is thus assured, if his melting and casting are properly controlled, of uniformity of casting characteristics from one batch of metal to another.

Although in peaceful times the greater part of the output of casting alloys is used for castings for other than military applications, the stringent inspection and testing procedures demanded by A.I.D. for aircraft materials are normally operated by progressive refiners in the production of all alloys irrespective of their ultimate application.

Development

In addition to the search for new and better production and testing methods, which goes on continuously, the laboratories of the ingot producers are engaged in the development of new and improved alloys, and investigations into the effect of alloying and impurity elements on the many different properties and characteristics of the casting alloys. A recent example of some preliminary experiments to assess the defect known as "local shrinkage," in terms of the gas content and composition of an alloy, has been described by Scheuer and his colleagues[10]. Fig. 21 shows an experimental foundry in which this kind of work is carried out.

Secondary Aluminium Industry

The first part of this Paper, which of necessity has been brief and lacking in detail, will nevertheless have given the reader some idea of the methods employed in the production of casting alloys from secondary raw materials and the way in which difficulties which arise from some of the characteristics of aluminium are overcome. The practice described is the result of very many years of progress—secondary aluminium alloys have not always had the excellent reputation which they enjoy to-day, and during their earlier history standards were very much lower

Inevitably as the use of aluminium and its alloys increased, the cheap and readily available process scrap and obsolete products provided an attractive raw material which could apparently be remelted without difficulty and in very simple equipment. Equally inevitably, the alloys produced were frequently of quite unsuitable composition because scrap was melted with little or no sorting; the solution of other metals in the melt, iron and brass bolts and bushes for example, produced alloys with

Production and Properties of Aluminium Alloys

excessive metallic impurity contents, and the absence of a proper refining technique together with the effects of overheating ensured that the metal, when ingotted, contained large amounts of non-metallic inclusions. The fact that there were at this time very few official specifications for aluminium casting alloys—all for alloys made from primary aluminium—made the task for those who saw the real potentialities of alloys produced from scrap, all the more difficult.

Adoption by Foundry Industry

As is to be expected in the circumstances, the reputation of the poorly-produced alloys—lack of ductility, low mechanical strength and corrosion resistance and non-uniformity—was reflected upon the products of those refiners who were operating metallurgically controlled processes. Because of this background it was many years before most founders came to see that the alloys produced from secondary material were reliable engineering materials and had economic advantages. The use of secondary aluminium, even as late as the beginning of 1939, was still excluded from specifications for aircraft and from the few British Standards engineering specifications. Consequently much of the alloy produced was made to the refiners' own specifications which, in time, became recognised in the foundry industry. Considerable quantities of other alloys, equivalent to official specification compositions, were also made for founders and were used in castings for which aircraft or British Standards specifications were not demanded. These alloys proved to be completely satisfactory, which indeed was to be expected as, apart from the fact that they were not made from primary aluminium, they conformed to all the requirements of the official specifications.

Wartime Arrangements

It was at the time when "secondary" casting alloys were beginning to be seen in a new light that this slow evolutionary process was accelerated by the urgent demands of rearmament. Relaxations were accepted for most of the more commonly used aircraft casting alloys permitting them to be made partly or wholly from secondary materials. At the same time, a number of alloys, which had been produced by the refiner for several years for commercial applications, were given official recognition, one as a D.T.D. specification and three by the Light Alloy Control. The now familiar alloy to D.T.D. specification 424 was introduced at about the same period as a casting composition which could readily be produced by the conversion of Duralumin-type wrought alloys.

This official recognition of the secondary aluminium industry was fully justified by the results. Despite the exacting demands made on all components by the Services, no casting failures are known to the Author which could justly be attributed to the use of secondary alloys, although some resulted from the choice of unsuitable alloys. The contribution of the secondary aluminium industry to the war effort is seen in Fig. 2 by the peak production of 1944, which approaches 100,000 tons.

The performance of casting alloys during the war years has clearly shown—what the refiners have always claimed—that the properties of an alloy do not depend on the history of the raw materials from which it is made, but on the final composition of the alloy and the manufacturing methods by which the alloy is produced. That this is also recognised by aircraft inspection authorities is shown by the fact that, when the aircraft specifications for casting alloys were recently revised, the wartime relaxations were embodied in the new requirements, and primary aluminium was demanded solely for certain alloys which can only be made with selected primary pig of especially high purity.

Casting Alloy Specifications

B.S. 1490 *General Engineering Series*

The importance of material specifications will be readily understood both by the founder and the user of castings. As the growth of the aluminium industry has been to a large degree associated with the use of aluminium alloys for aircraft, most of the official specifications have been drawn up to meet the special requirements of aircraft applications and have been prepared by departments of the appropriate Ministry. Up to the year 1949, only five casting alloys used for general engineering purposes were the subject of British Standards Institution specifications and three of these specifications were 20 years old. This meant that some of the casting alloys in popular use were not governed by officially recognised standards; others were subject to specifications which were out of date, and others to specifications framed to meet

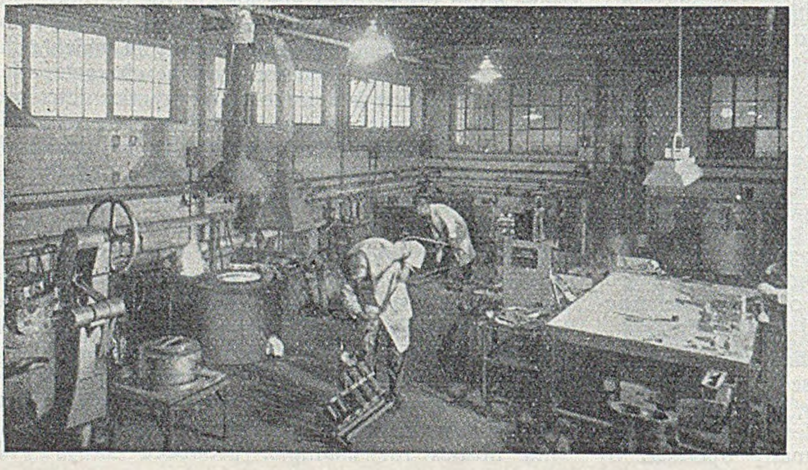

FIG. 21.—*Typical Experimental Foundry where Aluminium Casting Alloys are Tested under Controlled Conditions.*

the particular conditions of aircraft use. There was, therefore, a need for a series of British standards for aluminium alloys and castings which would be nationally and internationally accepted, and in 1949 the British Standards Institution published, as the product of a Committee consisting of alloy manufacturers, founders and users of castings, the first comprehensive standard for "Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes"—B.S. 1490.

The British Standards Institution Committee, profiting by the experience gained during the previous ten or so years, placed no restrictions whatsoever on the raw materials to be used in making the alloys, but confined their requirements to the chemical composition and minimum mechanical properties limits. They were satisfied that, if these were met, the user would be adequately safeguarded.

Maintenance of Standards

The introduction of B.S. 1490 was a step of considerable significance in the advancement of aluminium casting alloys, for it implied recognition of the claim that the alloys were suitable and established materials for general engineering applications. The specifications are not only a guarantee of composition and properties to the founder and user of castings, but they are an important factor in the maintenance of high standards by industry as a whole. If every engineer and designer would insist on castings to B.S. 1490 (or, where this is not possible, to other accepted specifications), there would be no sale in the industry for the unspecified alloys and castings of doubtful quality which in earlier years threatened to bring into disrepute the good name of all aluminium alloys. It is particularly necessary at the present time, when the demand for many nonferrous metals exceeds the supply that users and producers of aluminium alloys should understand that the maintenance of the reputation which the alloys have attained is their responsibility and must not be endangered by use of unsuitable makeshift materials.

Although B.S. 1490 was published only comparatively recently, it has already been adopted by the alloy producers and by large sections of the foundry and engineering industries. To those who are reluctant to abandon old and familiar alloy designations or have difficulty in remembering the new numbers, the Related Specifications Table given in Appendix II should prove helpful.

(*To be continued*)

Colvilles to Extend Dalzell Works

Colvilles, Limited, are to carry out alterations to buildings in Meadow Road, Motherwell, to be used as a bar mill for the Dalzell works. The probable cost is £33,000. The company also has had plans approved for the erection of buildings in Park Street, Motherwell, as an extension to a department of the Dalzell works, at an estimated cost of £27,500.

In addition, plans have been approved for a plate-extension bay at the works in Park Street costing £15,000. Buildings are to be altered in Crosshill Street, Motherwell, to be used as a boundary wall by the company.

Building Steel Allocation Scheme

As already announced, the allocation of steel, which was freed from control in May, 1950, is to be reintroduced as from December 3. In general, the scheme will be the same as that which was then in force, except that alloy steel will be controlled under a separate scheme and cast iron will not be included in the allocation arrangements.

A notice has been sent to all registered building and civil engineering contractors telling them how to apply for steel authorisations for licensed building work; this includes steel for which the preferential treatment certificate or D.O. symbol has been awarded. For this purpose M.O.W. form 2065 is to be used and one form submitted for each job. Additional copies of the form are available at Ministry of Works' licensing offices. Henceforth all applications for new building licences should state the requirements of steel for delivery after December 2.

Builders engaged in contracts for Government departments, local authorities, and nationalised undertakings, where the work is not subject to licence, should look to the department or authority for whom they are working to ensure that steel authorisations are issued before December 3, to cover all their needs after that date. This applies both to new work and to work in progress. A special arrangement is being made for conduit and other steel required for electrical installation work. Small quantities of steel (*e.g.*, 1 ton of heavy plates, sections, or forgings, 10 cwt. of medium plates, sheets, or strip, 5 cwt. of wire) may be bought in any one month without an authorisation, on submission of a certificate made out in a form to be specified in the Order to be made by the Ministry of Supply. The purchase of manufactured fitments, such as steel windows, cookers, meters, etc., will not require an authorisation. For sheet steel the present arrangements will continue.

Export Licensing Control

The Board of Trade has issued a further amendment to the Export of Goods (Control) Order, 1951. Among the principal changes, which became operative on October 22, are the following:—

Licences are now required for all destinations for iridium, osmium, palladium, rhodium, and ruthenium, their compounds, and alloys containing such metals, platinum compounds, paints containing zinc oxide (including leaded zinc oxide).

Licences are now required for aluminium strip, certain types of air-conditioning machines, specified oil-well drilling apparatus and tools and oil-well logging and exploration apparatus, plant of the kind used for automatic continuous electrolytic tinning of steel strip, certain types of turbines and electrical machinery, leak-detecting instruments, and strain gauging equipment and parts, for all destinations other than those specified in Part II of the third schedule, excluding Hong Kong.

Enquiries regarding this amendment should be made to the Export Licensing Branch of the Board of Trade, Atlantic House, Holborn Viaduct, London, E.C.1 (telephone: CITY 5733).

IT IS A FITTING coincidence that the Royal School of Mines, London, is celebrating its centenary in the year of the Festival of Britain. The college can claim to be the oldest metallurgical college in the country, and its establishment was closely connected with the Great Exhibition of 1851, from which it drew considerable financial backing.

Obituary

Mr. John Ernest Iveson, formerly secretary of the Wharton Crane & Hoist Company, Limited, Reddish (Ches), has died at the age of 62.

Mr. William Reah, for many years cashier with Swan, Hunter & Wigham Richardson, Limited, shipbuilders, of Wallsend (Northumberland), has died at the age of 61.

Mr. Esmond Henry Wiley, deputy chairman of the Pyrene Company, Limited, fire extinguisher manufacturers, etc., of Brentford (Middx), died on October 15. He was 78.

Major R. D. K. Curling, chairman of the Associated Automatic Machine Corporation, Limited, and the British Automatic Company, Limited, until his retirement owing to ill-health last year, died on October 15, at the age of 65.

The death has occurred at the age of 76 of Mr. Charles H. Westmoreland, who was with Dorman, Long & Company, Limited, constructional engineers, etc., of Middlesbrough, for 40 years, during which time he travelled abroad extensively on the company's business.

Mr. Charles Percy Newman has died at the age of 84. He was chairman of Newman, Hender & Company, Limited, iron and non-ferrous founders, etc., of Woodchester (Glos), N. H. Engineering, Limited, Le Grand, Sutcliff & Gell, Limited, well drillers and pump makers, of Southall (Middx), and a director of S. Smith & Sons (England), Limited. He was vice-president of the Institution of Works Managers. His son, Mr. N. P. Newman, J.P., was president of the Institute of British Foundrymen, 1949/50.

We regret to record the death of Mr. W. B. Parker, who until his retirement in 1943 was chief chemist and metallurgist to the British Thompson-Houston Company, Limited, at Rugby. He received his early technical education by attending evening classes at the Birmingham Central Municipal Technical College. Then in 1897 he won a Priestley Scholarship to Mason's College (later the University of Birmingham), where he continued his studies. He was awarded honorary membership in the Institute of British Foundrymen in 1945, having joined the British Foundrymen's Association in 1905—one year after its foundation. Immediately on the formation of the British Cast Iron Research Association, he joined its council and remained an active member for about 20 years. In addition he often served on British Standards Institution Committees and held membership in a number of technical institutes.

Metal Experts to Tour U.S.

Eighty specialists, divided into three missions, have left for the United States under the Organisation for European Economic Co-operation technical assistance scheme, where they will study galvanising techniques, non-ferrous heavy metal fabrication, and smelting and refining of non-ferrous metals, respectively. On completion of a six-weeks' tour of research centres and industrial undertakings, the experts will return to Paris to draw up their reports for the 18 O.E.E.C. member countries. These three missions bring up to 60 the number of technical assistance projects already carried into effect. Nearly 1,000 European and American specialists have already taken part in this scheme to promote productivity in the industrial, agricultural, and scientific fields by the exchange of technical knowledge and experience, and a large number of further projects is under consideration by the O.E.E.C.

Personal

Mr. A. G. Findlay has resigned his appointment as chief of the special products division of Head Wrightson Processes, Limited, to join Monsanto Chemicals, Limited.

After 38 years' service with the British Aluminium Company, Limited, Mr. W. C. Kennedy has retired from the position of assistant manager and chief engineer at the Kinlochleven (Argyllshire) works of the company.

Col. F. A. Neill, in recognition of his 21 years service as chairman and managing director of James Neill & Company (Sheffield), Limited, steel and tool manufacturers, has been presented with an inscribed silver salver on behalf of the staff and workers.

A foreman, who has completed 55 years' service with Lockwood & Carlisle, Limited, piston ring manufacturers, of Sheffield, Mr. W. Astwood, and Mr. D. Ferguson, for 50 years the company's agent in Glasgow, received gold watches at a recent presentation ceremony.

The National Federation of Engineers' Tool Manufacturers has elected Mr. R. A. Balfour, managing director of Arthur Balfour & Company, Limited, Sheffield, as president at its annual meeting. Mr. S. J. Harley (Coventry Gauge & Tool Company, Limited) and Col. F. A. Neill (James Neill & Company (Sheffield), Limited) have been elected vice-presidents, Mr. T. P. Chew (Richard Lloyd, Limited, Birmingham), hon. treasurer, and Major-General E. P. Readman (English Steel Corporation, Limited, Sheffield) has been appointed hon. auditor.

The highest honour given by the Franklin Institute, Philadelphia, the Franklin medal, has been awarded to Sir James Chadwick, master of Gonville and Caius College, Cambridge, for his outstanding work in nuclear physics. In January, 1950, Sir James was awarded the Faraday medal by the Institution of Electrical Engineers for his work in this field, and for his contributions to science generally. Formerly Britain's scientific adviser on the United Nations Atomic Energy Commission, he was awarded the Nobel Prize for Physics in 1935, and received the United States Medal of Merit for his work during the war on nuclear energy.

Nickel and Cobalt Allocations

The International Materials Conference announced in Washington on October 10 that the governments of the countries represented on the manganese-nickel-cobalt committee have accepted the committee's recommendation that plans of distribution of nickel and cobalt for the fourth quarter of the year be put into operation at once. The plans of allocation have been forwarded to all interested governments for immediate implementation.

In order to ensure that countries normally importing semi-manufactured products will continue to receive sufficient supplies of these products for essential end uses, the committee has recommended that exporting countries maintain their exports in accordance with normal patterns of trade and at a level commensurate with their allocation. All countries have been urged to adopt measures to eliminate non-essential uses of these metals and to encourage, where possible, their substitution by metals more readily available.

The United States is to receive the largest allocation for the fourth quarter with 19,690 tons of nickel and 1,212.4 tons of cobalt, while the United Kingdom, which is second in order of priority, is to get 5,088 tons and 329.1 tons, respectively.

Platinum/Rhodium Thermocouples and their Industrial Applications*

Written Comment on the Paper by Marcel Chaussain

MR. R. C. JEWELL, metallurgical director, and MR. E. G. KNOWLES, physicist, Sheffield Smelting Company, Limited, wrote, as producers of thermocouple wire, that they were interested to read M. Chaussain's Paper, but were very sorry to see that he apparently based all his work on thermocouple wire of American origin and made no mention whatsoever of any from European sources. Further, he said: " The most important researches and developments have originated in the United States," and again: " At the present time, all thermo-electric pyrometry is based on these standards," and later refers to the N.B.S. International Standards. (Surely they were not international, and very definitely everybody did not use them?) They agreed with M. Chaussain that resistance tests were not so useful as e.m.f. data, and in any case were much more difficult to make with the same degree of accuracy.

Sources of Error

The writers had been using the differential method of testing thermocouple wire for more than 15 years in order to effect control of their production, and felt that there were a few useful comments they could add. There was no necessity for ice to be used at the cold junction, since the e.m.f. being measured was small, and any e.m.f. variation due to temperature change of cold junctions was negligible. This had been proved by repeated tests. They did find, however, that whether the cold junctions were immersed in ice or not, an erratic error independent of the e.m.f. being measured and of the order of 0 to 1 micro-volt, positive or negative, was developed at the cold junction. Occasionally this erratic e.m.f. was of the order ± 2 micro-volts, so that if values of the differential e.m.f., Δe, were required to 0.5 micro-volts or less, it was essential to correct for this erratic error; this was always done. Furthermore, unless the cold junction was very carefully made, erratic errors much greater than the above were experienced when it was placed in ice. M. Chaussain made no mention of any such corrections, and this may be the explanation of the rather large experimental errors indicated in Figs. 9, 10, etc.

It was personal experience that, except in the case of platinum, the Δe-temperature curve was not in general a straight line, as found by M. Chaussain; it would be interesting to know if this phenomenon was a feature of wire from American sources. In obtaining the figures of Table I, how many runs did M. Chaussain perform?

* Paper presented to the Newcastle-upon-Tyne Conference of the Institute of British Foundrymen and printed in the JOURNAL August 9 and 16.

Wire Purity

In his remarks on the homogeneity, he said:— " The purity · and homogeneity is determined for each temperature of the hot-joint," but the writers were not clear how an e.m.f. determination at one point determined the homogeneity. Further, it was stated that all platinum would be positive to N.B.S. platinum 27. Had wire of greater purity not been obtained since this particular wire was produced about 20 years ago? Referring to Fig. 4, it was stated that platinum-type G.32 was sub-standard in purity. Had the purity been tested? Variations of the type shown could quite well be produced by strain, or incomplete annealing. In Table II, on homogeneity tests, were the figures Δe microvolts always positive and were the tests made on new wire or used wire?

The experiments showing the effect of heating in SiO_2, Al_2O_3, etc., might give the effect of these substances alone in producing contamination, but hardly reproduced the conditions in practice where two wires, one alloy and the other pure platinum, were adjacent and probably placed in a furnace containing a reducing atmosphere. Furthermore, was the contaminant necessarily Si, Al, etc.? Had M. Chaussain verified this by, say, a comparison of the spectrographic examination of the wire and also the powders? It might be some contaminant in the powders which produced the effect and not necessarily the main constituent of the powders.

The life of the thermocouples used by M. Chaussain did not appear to be any greater than that obtained in this country. The writers understood that the practice in steelworks here was after 15 to 20 immersions of 20 secs. each, to cut back and remake the hot-junction. The total time was, therefore, 5 to 7 min. The couple was not necessarily defective after this time, but the users preferred to err on the side of safety.

Author's Reply

MR. MARCEL CHAUSSAIN wrote in reply that for his researches he had used wire junctions of American origin, but others examined were of French make. The Author's work on thermo-electrical matters dated from 1947. At this time, he had knowledge of the work published in " Industrial and Engineering Chemistry " by Dr. Bert Bremmer and he had adopted the standard N.B.S. He was aware to-day that a wire of greater purity than Pt 27 had been produced, but he believed that this Pt 27 ought, in spite of everything, to remain the standard junction; he had, however, no official information on this subject. In France at the present time, the standard N.B.S. of 1933 was still in current use. So far as the differential method was concerned, he could state that its precision was distinctly superior to that of other methods. However, he had not

Platinum/Rhodium Thermocouples

the years of experience possessed by Mr. Jewell and Mr. Knowles and he considered their remarks to be extremely judicious.

Alloy Wire

As for platinum/rhodium, he had obtained data as for platinum, tests being carried out both during reheating and furnace cooling. It was important that the platinum/rhodium wires should be well annealed at a temperature of 1,200 deg. C. as counselled by Dr. Bremmer.

In principle, each point of a test for homogeneity equally takes into consideration a test for purity at 1,200 deg. C. Several points taken at different temperatures allow of the correction of experimental errors, but platinum 932 he had only tested at 1,200 deg. C . This platinum of somewhat ancient vintage had also intentionally been investigated for its fine quality as against platinum of normal 548 type.

Important Objective

From the experiment on heating wires in refractory oxides, it was obviously impossible, no matter what precaution be taken, to set forth the individual substances which caused contamination. However, it could be seen that the effects were clearly different from one substance to another—which did indicate that the substance was reactive. In his researches, oriented towards an industrial end, it was important to state effects, he had no spectroscope available and thus had been unable to determine absolute causes.

When it was necessary to determine the temperatures of baths of liquid steel, he believed that precision was the first consideration and would not hesitate to shorten the wire by a few centimetres even if they were not entirely defective. The object of his Paper was to ensure precision rather than economy.

Production Control Technique

The Anglo-American Council on Productivity, with E.C.A. technical assistance, is sending a specialist team to the U.S.A. under the sponsorship of the Institution of Works Managers, the Institution of Production Engineers, the Purchasing Officers' Association, and the Federation of British Industries, to investigate the administrative processes of production control from finality of design to despatch. It is the team's mission, while touring widely diverse establishments in the Eastern States, to study among other things the procurement of raw materials, and components, the control and reclamation of scrap material, the planning and scheduling of output, and material supplies and machine loading.

It will also investigate new developments in American practice, particularly such as are likely to have a bearing on the problem of limiting the volume of "paper work," inevitably involved in production control —a problem of serious concern for the very numerous small manufacturers representing the bulk of British industry.

New Catalogues

Foundry Dust Control. It is very opportune that Air Control Installations Limited of Ruislip, Middlesex, should have issued a 4-page leaflet at this time, as this subject is very much to the fore in foundry circles. The leaflet describes and illustrates four special-duty machines of quite different types for various applications in foundries. All are furnished with either hydrostatic or dynamic precipitators. It is available to our readers on application to the issuing company at Ruislip.

Man-cooling Fans. An eight-page illustrated catalogue received from Keith Blackman Limited, Mill Mead Road, London, N.17, describes a range of man-cooling fans. The sizes available range from 15 to 36 in. diameter. Some interesting diagrams are printed showing air velocities at distances ranging from 10 to 50 ft. away from the fan. With a 36-in. dia. fan, a starting velocity of 550 ft. per min. will still be 100 ft. per min. at 50 ft. distance. Obviously, there are numerous applications for such fans. The brochure is available to our readers on writing to Mill Mead Road.

Refractories. The Morgan Crucible Company, Limited, of Battersea Church Road, London, S.W.11, have devoted a leaflet to detailing the properties of a new refractory M.R.1. It contains 52 to 53 per cent. of silica and 43 to 44 per cent. of alumina and has a refractoriness of Cone 35. Softening starts at between 1,600 and 1,650 deg. C., which is, in the reviewer's experience, very high for this class of brick. The front page carries five pictures, which possibly detract from the main feature—" The New Refractory," which should obviously be outstanding because of its news value.

Cupola Control. The new book of the Metronic Instrument Company, Limited, of Ettingshall, Wolverhampton, on " How to Read the Cupola Meter " is as good a piece of publicity as has passed through our hands for a long time. Unless one knows all about meters, they are the most uninteresting objects to be encountered either on a cupola or under the stairs. In the plainest language, illustrated by funny yet telling sketches, a story is unfolded, not how the instruments work, but of the benefits—and they are considerable—to be derived from interpreting the results they indicate. Many of our readers have acquired a working knowledge of their cupolas, yet a study of this very interesting booklet will, it is thought, be helpful in simplifying the whole subject of control. It is available to our readers on application to the works at Ettingshall.

Training for the Engineering and Metal Industries. Birmid Industries, Limited, of Birmid Works, Smethwick, 40, Staffs, have issued a new edition of their booklet on the youth-training facilities they have had in being for the last seven years. An excellent scheme has been devised, but the reviewer was sorry to see the latest bit of Whitehall jargon has crept in. One does not train boys to a " level," but to a " standard." The underlying principle of the training given is to match it with a boy's ability and, if he shows aptitude—as no fewer than 125 have done since the inception of the scheme—then they go forward to the acquisition of the national certificates in the various phases of engineering and metallurgy. This is sufficient evidence to show that a sound system has been inaugurated.

News in Brief

AN ORDER for a 10,000-ton d.w. cargo liner has been placed with John Readhead & Sons, Limited, South Shields, by the Strick Line.

J. T. PRICE & COMPANY (Brass & Aluminium Founders), Limited, have changed their telephone number to Newcastle-under-Lyme 68011 (3 lines).

THE VERNON ENGINEERING COMPANY, LIMITED, has moved into larger premises at Waterloo Buildings, 10, Piccadilly, Manchester, 1, (telephone: CENtral 3539).

THE INSTALLATION of an experimental gas turbine in the 12,000-ton tanker Auris has been completed by R. & W. Hawthorn, Leslie & Company, Limited, Newcastle-upon-Tyne.

BURNSIDE WORKS of Hillside Foundry & Engineering Company (Cupar), Limited, are to have a new second storey added to the building to provide additional office accommodation, retaining the ground floor as a pattern store.

A NOTE accompanying a comprehensive programme of meetings arranged by the Beeston Boiler Foremen's Association stresses the indebtedness of the members to the lecturers who have given so freely of their time and experience.

THE 60 LOCOMOTIVES to be built by the North British Locomotive Company, Limited, Glasgow, for service in South Africa, will be completely equipped with tapered roller bearings, etc., manufactured by British Timken, Limited, Birmingham.

A 12,000-TON TURBINE CARGO STEAMER has been ordered from Charles Connell & Company, Limited, Glasgow, by Ben Line Steamers, Limited. The propelling machinery will be supplied by David Rowan & Company, Limited, Glasgow.

A FOUR-DAY WEEK came into operation on October 15 for 640 workers at the malleable-iron works of Harrison & Company (Lincoln) because of a shortage of pig-iron supplies. It is expected that there will be a reduction in production of 20 per cent.

THIRTY-EIGHT EMPLOYEES of A. Reyrolle & Company, Limited, manufacturing electrical engineers, of Hebburn (Co. Durham), who had completed 40 years in the company's service, received presentations of gold watches on October 10, when nearly 500 of the company's staff with 25 years' service or more were entertained at dinner by the directors.

A GENERAL MEETING of the Institute of Metals will be held at The University, Edgbaston, Birmingham 15, at 2.30 p.m. on January 3, 1952, when there will be an informal discussion on "Tool and Die Materials for the Extrusion of Non-ferrous Metals and Alloys." The Chair will be taken by Mr. Christopher Smith, chairman of the metallurgical engineering committee.

MR. J. BAMFORD, principal of the National Foundry College, Wolverhampton, spoke on "Training for the Foundry Industry" at the first of a series of six lectures at the Chesterfield Technical College last week. There were 100 people present, including works managers from all the steel firms in the district. Alderman H. Cropper, Chairman of the Governors of the College, presided.

GUEST KEEN BALDWINS IRON & STEEL COMPANY, LIMITED, Cardiff, announce that Mr. H. W. A. Waring, C.M.G., A.C.A., is relinquishing the appointment which he has held for the last four years as secretary of the company and its subsidiaries in order to take up an appointment as director of the Power and Steel Division of the secretariat of the United Nations Economic Commission for Europe in Geneva. Mr. L. R. P. Pugh, A.C.A., has been appointed to succeed him.

B.S.F.A. Productivity Increases

Supplementing the information published last week, the British Steel Founders' Association have issued from the reports of their members the following excerpts listing progress in productivity since the report of the team visiting America was issued.

Case A—By means of specialisation and a selective sales policy, this steel foundry has increased its output by 50 per cent., while the number of its customers has been reduced by a like percentage. This has resulted in productive efficiency being increased and rising costs of raw materials and wages have been largely absorbed.

Case B—In this foundry the output per man/hour in its moulding shops has been increased by 41 per cent. and in its dressing shops by 32 per cent. during the last two years.

Case C—Another foundry reports that during the last two years its output has increased by 14.77 per cent. Wages costs per ton have been reduced by 4.75 per cent.

Case D—A large steel foundry reports that over the last three years, by introducing a new plant and by improving the layout of various departments of the foundry, the following percentage reductions in man/hours per ton have taken place:—Sandslinging, 14 per cent.; machine moulding, 47 per cent.; and dressing, 51 per cent.

Case E—A small steel foundry reports the following increases in output both in total tonnage and in output per man/hour:—

Average Monthly Figures.

—	Tons despatched.	No. of castings.	Average weight of castings.
1948 ..	158·5	2,874	125 lb.
1951 ..	206	4,243	108 lb.
Increase ..	30 per cent.	47.6 per cent.	—
Decrease ..	—	—	13·6 per cent.

Increased output per man/hour (all employees), 20 per cent.

Case F—A large steel foundry reports that it has succeeded in reducing the tap-to-tap cycle on one of its furnaces from 2 hrs. 55 min. to 1 hr. 45 min. This represents a reduction of 60 per cent. in the time cycle; the number of heats per week has been increased from 42 to 72 and the production of steel from 120 tons to 216 tons.

Case G—Large numbers of grinding machines are used in steel-foundry dressing-shops. As a result of research, a large steel foundry has found it possible to reduce the cost of grinding wheels per ton of castings by 40 per cent.

Case H—As a result of methods study, yield has been increased by 3 per cent. and scrap reduced from 7 per cent. to 5 per cent. in a medium-size steel foundry.

Case I—During the last three years a medium-size steel foundry has reduced the cost of refractories by no less than 50 per cent.

Case J—It is reported from another steel foundry that the number of man/hours required to produce a ton of castings has been reduced during the last two years from 185 to 167.

BETTER EDUCATIONAL TRAINING FACILITIES for prospective managers were advocated by Sir Harold West, managing director of Newton Chambers & Company, Limited, Sheffield, and chairman of the Institute of Industrial Administration, speaking at a meeting of the Tees-side group of the institute at Middlesbrough. In the U.S.A. there were 600 educational institutions which awarded degrees to students specialising in business or commerce, but there were only 60 in Britain, he said.

Raw Material Markets

Iron and Steel

The recent increase in deliveries of iron ore have been maintained and, although pig-iron output has improved, the shortage of blast-furnace coke seems likely to preclude the blowing-in of additional furnaces. The general engineering, speciality, and textile foundries have benefited to some extent from the improvement in pig-iron supplies. Hematite supplies have been coming forward more regularly, although the tonnages received are not equal to present needs and are not likely to be from the furnaces now in blast, as these have to cope with the requirements of both the steelmakers and the foundries. While coke supplies are the chief factor mitigating against a further expansion in pig-iron production, shortage of suitable manpower is also a difficulty.

The shortage of pig-iron is applicable to all grades and is retarding production at foundries generally. Refined-iron makers report reduced outputs on account of shortages of their base materials, and the low- and medium-phosphorus iron producers would also be able to improve on present outputs if they had all the raw materials they require. Users of high-phosphorus pig-iron, which include light and jobbing foundries, textile and some of the engineering foundries, are finding it increasingly difficult to obtain this grade. Since the changeover of some furnaces from the production of foundry iron to basic-steel making pig-iron, outputs of foundry irons have been on a much-reduced scale, and the subsequent blowing-out of furnaces for repairs, coupled with production difficulties, has caused further depletion in supplies. Many foundries are endeavouring to find alternative sources of supply, but that is no easy task.

There is an insistent demand for suitable cupola scrap in both cast iron and steel. Stocks at the foundries are low, and suppliers are unable to satisfy all demands, particularly for heavy cast-iron scrap. Regular deliveries of foundry coke and furnace coke for core ovens and heating purposes are forthcoming, but stocks are low and the future is by no means free from anxiety. Ganister, limestone, and firebricks are coming forward satisfactorily, while ferro-alloys are generally available without delay, although some grades present difficulty.

Re-rollers continue to be seriously affected by the shortage of steel semis, and outputs of all sizes of sections, bars, and strip are on a much reduced scale. The quantity of steel semis from home steelworks shows no improvement and the moderate consignments from oversea only relieve the position slightly. Many of the re-rolling mills continue to operate on a short-time basis, and are likely to continue to do so unless much larger tonnages of steel are received from Continental sources. The sheet re-rollers are also in need of larger quantities of sheet bars. Any suitable re-rolling material is readily accepted, including defectives and crops, but the tonnages available are inadequate.

Non-ferrous Metals

After a very steady week, values on the tin market eased off on Friday but have since hardened. It would seem that there is no underlying weakness in the market. Negotiations between the Bolvian producers and the Reconstruction Finance Corporation are, it is reported, suspended indefinitely, but it is difficult to believe that the two sides will not come together again before long. Bolivia must export her tin, and although the United States is not at the moment hard driven for supplies, the time will come when it is necessary for purchases to be made. There has been some talk of possible releases of tin from the stockpile, but confirmation is lacking, and it seems hardly likely that the rumour has, in fact, much foundation. World production is well maintained and there can be little doubt that America's abstention from buying is operating to allow many countries on the Continent to obtain supplies.

Opinion appears to be hardening in favour of £1,000 per ton being a reasonable price for the metal today, but in the United States sales are still being made at 103 cents, which is equal to no more than £824 per ton. While the short-term contract for Bolivian concentrates was arranged on the basis of 112 cents, it does not follow that the Americans are prepared to pay that price elsewhere. And 112 cents is less than £900.

Copper figures for September have been published by the Copper Institute, New York, and output of blister copper, in short tons of 2,000 lb., in the States during September was 73,148 tons, about unchanged from August, while in refined there was a drop in production of about 5,500 tons at 74,104 tons. Domestic deliveries rose sharply to 121,629 tons from the August level of 104,938 tons. Stocks of refined copper in producers' hands fell from the August figure of 70,937 tons to 62,093 tons at September 30. Outside the United States blister output was 113,424 tons, about 650 tons lower than in August, while refined copper production at 101,133 tons compared with 105,907 tons. Deliveries to consumers were 9,500 tons down at 74,131 tons, but stocks of refined went up by 2,000 tons to 163,538 tons.

London Metal Exchange official tin quotations were as follow:—

Cash—Thursday, £1,030 to £1,035; Friday, £1,005 to £1,010; Monday, £1,020 to £1,030; Tuesday, £1,025 to £1,030; Wednesday, £1,027 10s. to £1,030.

Three Months—Thursday, £975 to £980; Friday, £952 10s. to £955; Monday, £972 10s. to £975; Tuesday, £985 to £987 10s.; Wednesday, £985 to £990.

Welding Health Hazards

An investigation into the possibility of ill-health arising from the welding process has been carried out by the Factory Department of the Ministry of Labour and National Service and the results have been published in a book entitled "The Health of Welders."* The investigation consisted of a survey of the various types of welding followed by clinical examination of some 250 welders in different industries, supplemented in many cases by special examinations such as radiological examination of the chest and blood examinations. Literature on the subject, particularly that published during the past 15 years, has also been reviewed. The main conclusions are that welders do not suffer from any specific disease that could be described as "welders' disease" nor does occupational dermatitis appear to be a frequent or serious cause of disability. Electric welders may suffer from "arc eyes" but this has no permanent effect on the vision. Electric welders also suffer to a greater extent than other workers from a slight superficial inflammation of the eyelids. Amongst welders exposed to high concentrations of fumes, slight irritation of the throat is not uncommon but no serious effects on the throat or nose were observed.

* "The Health of Welders" by A. T. Doig, M.D., D.P.H., H.M. Medical Inspector of Factories, and L. N. Duguid, B.Sc., A.M.I.(Mech.)E., M.I.W. Obtainable from H.M. Stationery Office or through any bookseller price 3s. net, post free.

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

(Delivered, unless otherwise stated)

October 24, 1951

PIG-IRON

Foundry Iron.—No. 3 Iron, Class 2:—Middlesbrough, £11 10s.; Birmingham, £11 4s. 6d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 0s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £13 12s. 3d.

Scotch Iron.—No. 3 foundry, £13 1s., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £15 7s.; South Zone, £15 9s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £15 17s.; South Zone, £15 19s. 6d.

Cold Blast.—South Staffs, £17 5s. 6d.

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 17s.; Scotland (Scotch iron), £13 3s. 6d.; Sheffield, £13 13s. 6d.; Birmingham, £14 0s. 6d.; Wales (Welsh iron), £13 3s. 6d.

Spiegeleisen.—20 per cent. Mn, £18 15s. 9d.

Basic Pig-iron.—£11 15s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £40 15s., basis 45% Si, scale 15s. 6d. per unit; 70/84 per cent., £56 2s. 6d., basis 75% Si, scale 16s. per unit.

Silicon Briquettes (5-ton lots and over).—2lb. Si, £48 5s.; 1lb. Si, £49 5s.

Ferro-vanadium.—50/60 per cent., 15s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 9s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £175; ditto, copper-free, £190.

Ferro-tungsten.—80/85 per cent., 33s. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 35s. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent C, £74, basis 60% Cr, scale 24s. 6d. per unit; 6/8 per cent. C, £70, basis 60% Cr, scale 23s. 3d per unit; max. 2 per cent. C, 1s. 8¼d. per lb. Cr; max. 1 per cent. C, 1s. 8¾d. per lb. Cr; max. 0.15 per cent. C, 1s. 9½d. per lb. Cr.; max. 0.10 per cent. C, 1s. 9¾d. per lb. Cr.

Chromium Briquettes (5-ton lots and over).—1 lb. Cr, £78 9s.

Cobalt.—98/99 per cent., 17s. 6d. per lb.

Metallic Chromium.—98/99 per cent., 5s. 11d. per lb.

Ferro manganese (blast-furnace).—78 per cent., £40 8s. 9d.

Manganese Briquettes (5-ton lots and over).—2lb. Mn, £50 6s. 6d.

Metallic Manganese.—96/98 per cent., carbon-free, £215 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—Basic: Soft, u.t., £21 11s. 6d.; tested, 0 08 to 0.25 per cent. C (100-ton lots), £22 1s. 6d.; hard (0.42 to 0.60 per cent. C), £23 19s.; silico-manganese, £29 15s.; free-cutting, £24 15s. 6d. Siemens Martin Acid: Up to 0.25 per cent. C, £27 16s.; case-hardening, £28 4s.; silico-manganese, £30 16s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £25 15s.; basic, hard, over 0 41 up to 0.60 per cent. C, £26 15s.; acid, up to 0.25 per cent. C, £28 4s.

Sheet and Tinplate Bars.—£21 16s.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £25 6s. 6d.; boiler plates (N.-E. Coast), £26 14s.; chequer plates (N.-E. Coast), £26 15s. 6d.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £23 15s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £27 11s.; flats, 5 in. wide and under, £27 11s.; hoop and strip, £28 6s.; black sheets, 17/20 g., £35 15s. 6d.; galvanised corrugated sheets, 17/20 g., £49 18s. 6d.

Alloy Steel Bars.—1-in. dia. and up: Nickel, £44 17s. 3d.; nickel-chrome, £65 2s. 9d.; nickel-chrome-molybdenum, £72 10s. 3d.

Tinplates.—52s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £227; high-grade fire-refined, £226 10s.; fire-refined of not less than 99.7 per cent., £226; ditto, 99.2 per cent., £225 10s.; black hot-rolled wire rods, £236 12s. 6d.

Tin.—Cash, £1,027 10s. to £1030; three months, £985 to £990; settlement, £1,030

Zinc.—G.O.B. (foreign) (duty paid), £190; ditto (domestic), £190; "Prime Western," £190; electrolytic, £194; not less than 99.99 per cent., £196.

Lead.—Good soft pig-lead (foreign) (duty paid), £175; ditto (Empire and domestic), £175; "English," £176 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £210 10s.; rolled zinc (boiler plates), all English destinations, £208 10s.; zinc oxide (Red Seal), d/d buyers' premises, £205.

Other Metals.—Aluminium, ingots, £124; antimony, English, 99 per cent., £390; quicksilver, ex warehouse, £73 5s. to £73 15s.; nickel, £454.

Brass.—Solid-drawn tubes, 25d. per lb.; rods, drawn, 32¾d.; sheets to 10 w.g., 29⅜d.; wire, 31¼d., rolled metal, 28⅜d.

Copper Tubes, etc.—Solid-drawn tubes, 26d. per lb.; wire, 254s. 9d. per cwt. basis; 20 s.w.g., 281s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £255 to £280; BS. 1400—LG3—1 (86/7/5/2), £275 to £300: BS. 1400—G1—1 (88/10/2), £330 to £360; Admiralty GM (88/10/2), virgin quality, £330 to £360 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £340 to £370; L.P.Bl, £295 to £315 per ton.

Phosphor Bronze.—Strip, 38¼d. per lb.; sheets to 10 w.g., 40⅜d.; wire, 42¾d.; rods, 38d.; tubes, 36¼d.; chill cast bars: solids 4s., cored 4s. 6d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 2s. 7d. per lb. (7%) to 3s. 6¾d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 1d. (7%) to 4s. 0¾d. (30%); to 12 in. wide × .056, 3s. 1¼d. to 4s. 1d.; to 25 in. wide × .056, 3s. 3¼d. to 4s. 3d. Spoon and fork metal, unsheared, 2s. 10d. to 3s. 9¾d. Wire, 10g., in coils, 3s. 6¾d. (10%) to 4s. 6½d. (30%). Special quality turning rod, 10%, 3s. 5¾d.; 15%, 3s. 10½d.; 18%, 4s. 2¾d. All prices are net.

Forthcoming Events

OCTOBER 30

Sheffield Metallurgical Association

"Some Impressions of a Visit to the U.S.A., by Dr. D. F. Marshall, 7 p.m., at the Grand Hotel, Sheffield.

Institution of Mechanical Engineers

Midland branch:—Chairman's address by Prof. G. F. Mucklow, 6 p.m., in the James Watt Memorial Institute, Great Charles Street, Birmingham.

OCTOBER 31

Institute of Welding

Discussion to be opened by Dr. H. G. Taylor on the report of the Anglo-American Productivity Team, 2.30 p.m. Presidential Address by H. J. Thompson, 6.30 p.m. Both meetings will take place at the Institution of Civil Engineers, Great George Street, London, S.W.1.

Institute of British Foundrymen

Lincolnshire branch:—Joint meeting with the Lincoln section of the Institution of Production Engineers. (Further details from the Secretary.)

London branch:—"Some Present-day Practices in Patternmaking," by B. Levy, 7.30 p.m., at the Waldorf Hotel, London, W.C.2.

NOVEMBER 1

Institute of Vitreous Enamellers

Midland section:—"Control Methods," by H. Laithwaite, 7.15 p.m., at the Imperial Hotel, Temple Street, Birmingham.

Leeds Metallurgical Society

"Some Structural Aspects of Recrystallisation," by R. Eborall, 7 p.m., in the Chemistry Department, Leeds University.

Purchasing Officers Association

Glasgow branch:—Works visit: "The Manufacture of Electric Motors," Hoover, Limited, Cambuslang. (Further details from the Secretary.)

NOVEMBER 2

Institution of Mechanical Engineers

Industrial Administration and Engineering Production Group:—"Some Factors Affecting Wear on Cemented Carbide Tools," by Dr. E. M. Trent.

Institution of Works Managers.

Annual general meeting, 7 p.m., at the Waldorf Hotel, London, W.C.2.

Institute of British Foundrymen

West Wales section:—"Intricate Castings from Durable Loam Moulds," by J. Currie. (Further details from the Secretary.)

NOVEMBER 3

Institute of British Foundrymen

Wales and Monmouth branch:—"Intricate Castings from Durable Loam Moulds," by J. Currie, 6 p.m., at the Engineers' Institute, Cardiff.

Beeston Boiler Foremen's Association

Works visit to the Derby Locomotive Works. Members to be at the works by 9.30 a.m.

More Art Foundry Practice

Mr. A. L. Parrott, of the Morris Singer Company, has pointed out that in the article printed last week under the above title there were some inaccuracies and omissions. The designer of the medallions was Mr. A. Stanley Young and not Mr. A. J. Young; the statue of Bishop Yeatman Biggs was first cast in 1925 (not 1924), and it should have been added that the group showing St. Nicholas with three children the work of Gilbert Ledward, R.A. is for delivery to the Hospital for Sick Children. Our apologies are tendered to all who have been inconvenienced.

NOTICE

Replies to Box Numbers to be addressed to "Foundry Trade Journal," 49, Wellington Street, London, W.C.2.

SITUATIONS WANTED

FOREMAN PATTERNMAKER, age 48, desires position. Sound knowledge of modern patternmaking, for machine and floor moulding. Costing and estimating.—Box 1321, FOUNDRY TRADE JOURNAL.

FOUNDRY MAINTENANCE ENGINEER (36), desiring change, seeks position in the Midlands. Fully conversant with all Foundry plants. Ten years of executive experience. Present employed as Works Engineer.—Box 1336, FOUNDRY TRADE JOURNAL.

RATEFIXER (44), 20 years' practical, 10 years' ratefixing experience, Iron, Steel and Non-ferrous, requires situation. A.M.I.B.F. Keen and energetic. Own house.—Box 1335, FOUNDRY TRADE JOURNAL.

IRON MOULDER, age 37, seeking position as Foundry Foreman, experienced in all classes of foundry work, also control of labour.—Box 1339, FOUNDRY TRADE JOURNAL.

MANAGER (aged 45) desires change. Present position full control of heavy jobbing and repetition foundries. Practical training, fully experienced costing, estimating, and sales. Accustomed to complete control. Must be progressive post. —Box 1317, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

MOULDERS.—Jobbing Moulders required for Iron Foundry; rate 3s. 6d. per hour, plus £2 week bonus, plus merit bonus. Also, all classes of Foundry labour.—P.M.A., 136, Bramley Road, W.10. LAD. 3692.

YOUNG METALLURGIST required by large engineering company situated in the Eastern Counties, for metallography of ferrous and non-ferrous materials, special analysis, etc. Progressive position for successful applicant showing initiative and willingness to work with minimum supervision. Please state age, experience and qualification.—Box 1301, FOUNDRY TRADE JOURNAL.

OPPORTUNITY for fully qualified Foundry Manager to take complete control of small jobbing Iron Foundry in the Midlands. This is a genuine opening for a conscientious man to acquire a share in profits and a Directorship in firm—upon proved results. Fullest particulars of experience, etc., in the strictest confidence. —Box 1289, FOUNDRY TRADE JOURNAL.

WORKS MANAGER required for Australian light casting engineering and sheet metal fabricating works. 2,000 hands. Salary £3,000 Australian per annum plus first class passages. Applicant must have had previous works managerial experience. Apply giving full details of experience and position held which will be treated in the strictest confidence to Box 1328, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

LONDON Iron and Non-ferrous Foundry requires REPRESENTATIVE for medium and heavy weight castings.—Apply Box 1330, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN wanted for small Jobbing Foundry in Leigh area. Green sand and dry sand moulding. Piecework bonus system in operation. State experience and qualifications, etc. Permanent position.—Box 1306, FOUNDRY TRADE JOURNAL.

STEEL FOUNDRY in Lancashire requires the services of METALLURGIST, age 21-28, for metal control work on their steel plant. Write stating age, training, experience and salary required to Box 1295, FOUNDRY TRADE JOURNAL.

METALLURGIST for Senior post in West Riding Engineering Firm, with own Cast Iron Foundries. Wide experience in chemical, physical and micro work, also in supervision. Excellent prospects. Give full career, age (about 35), and salary required.—Box 1313, FOUNDRY TRADE JOURNAL.

FOREMAN for Mechanised Foundry in East Suffolk, making Castings on various types of Moulding Machines. Experience of mass production, ability to maintain high production good quality work and discipline is essential. Superannuation Scheme operative, good canteen and transport facilities available.—Give details of age, technical and practical training, and operating experience to Box 1318, FOUNDRY TRADE JOURNAL.

THE EAST SUSSEX ENGINEERING CO. requires a Chief Estimator for the foundry. Applications will be considered only from men holding a similar position, experienced in estimating for high-quality soft grey iron castings up to 4 tons weight for the Machine Tool Trade and for mechanised plant. Write in first instance giving comprehensive details of past experience, positions held, age, and salary required, to the Phoenix Iron Works, Lewes, Sussex.

WANTED.—SENIOR DRAUGHTSMAN for mechanical work on large Foundry project in Monmouthshire. Good salary, 5-day week, canteen, etc.—Apply, giving full details of experience, etc., to Box 1323, FOUNDRY TRADE JOURNAL.

METALLURGIST required to assist Foundry Manager in general administration of modern iron foundry. Must have sound practical experience of all aspects of foundry work. Salary £700-£800. —ROBERT CORT & SON, LTD., Reading Bridge Ironworks, Reading.

SHIFT CHEMIST required for Steel Foundry operating two basic electric furnaces, on plain carbon and low alloy steel. State age, experience, and wages expected to Box 1327, FOUNDRY TRADE JOURNAL.

SKILLED MOULDERS, PLATERS, TURNERS, BORERS, etc., required by Distington Engineering Co., Ltd., Workington, Cumberland.—For further details apply to the LABOUR MANAGER.

FOUNDRY MANAGER — controlling 1,000 staff and works—mechanised foundry, core and fettling shop, producing Cylinder Blocks, Heads, and similar automobile castings. Must have practical knowledge of such work, and held similar or assistant's position. Salary in accordance with the responsibility outlined above, coupled with age and experience. Superannuated post. All replies treated in in strict confidence.—Box No. 6514, 9, Arundel Street, London, W.C.2.

SITUATIONS VACANT—*Contd.*

FOUNDRY MANAGER for small Essex Foundry. Grey iron and non-ferrous; floor and machine moulding.—State experience, age, salary required, to Box 1340, FOUNDRY TRADE JOURNAL.

ENAMEL PLANT SUPERINTENDENT of proved efficiency and skill required. Sheet and cast iron. Progressive position and excellent prospects. Starting salary £1,000 for right man. Present staff aware of this vacancy.—Box 1334, FOUNDRY TRADE JOURNAL.

WORKS CHEMIST.—Engineering Firm in the East of Scotland invite applications for METALLURGIST. Capable of controlling analysis of ferrous and non-ferrous castings, also all classes of steel supply.—Apply, giving particulars of qualifications and salary desired, to Box 1333, FOUNDRY TRADE JOURNAL.

ALUMINIUM DIECASTING FOREMAN required, Lancashire. Fully experienced man, able to take charge of department and secure high grade production from trainee and semi-skilled labour. Interview London or Lancs. Remuneration £600/£750, according to results.—Box 1337, FOUNDRY TRADE JOURNAL.

METROPOLITAN BOROUGH OF STEPNEY.

PUBLIC CLEANSING DEPARTMENT.

APPOINTMENT OF WORKSHOPS FOREMAN (MECHANICAL TRANSPORT).

APPLICATIONS are invited for the above position in the Council's permanent establishment, at a weekly wage of £9, rising by two annual increments of 5s. to £9 10s. for an average of 44 hours (based on 88 hours in a fortnight).

Applicants should be capable of undertaking, under the supervision of the Public Cleansing Officer, responsibility for the maintenance of the Council's Mechanical Transport, including supervision of labour.

Applicants must have served a fully indentured apprenticeship with a firm of heavy vehicle manufacturers or in the workshop of a large undertaking dealing with heavy vehicles of all descriptions. Experience in the maintenance of Municipal vehicles and appliances will be an advantage.

The appointment will be subject to the provisions of the Council's Bye-laws, the Stepney Borough Council (Superannuation) Acts, 1905/31, and to proof of age and constitutional fitness.

The successful applicant will be required to work at the Council's Central Garage, 430/32, The Highway, E.1, to the hours of 8 a.m. to 5.30 p.m. Monday to Thursday; 8 a.m. to 5 p.m. Friday; and in alternate weeks, 8 a.m. to 12 noon Saturday, and during such other hours, and undertake such other duties as may from time to time be prescribed.

Applications should be made, on a form obtainable from the undermentioned address, and forwarded so as to reach me not later than Monday, 19th November, 1951.

Canvassing, directly or indirectly, will disqualify.

J. E. ARNOLD JAMES.
Town Clerk.

Municipal Offices,
London Fruit Exchange,
Duval Street, E.1.