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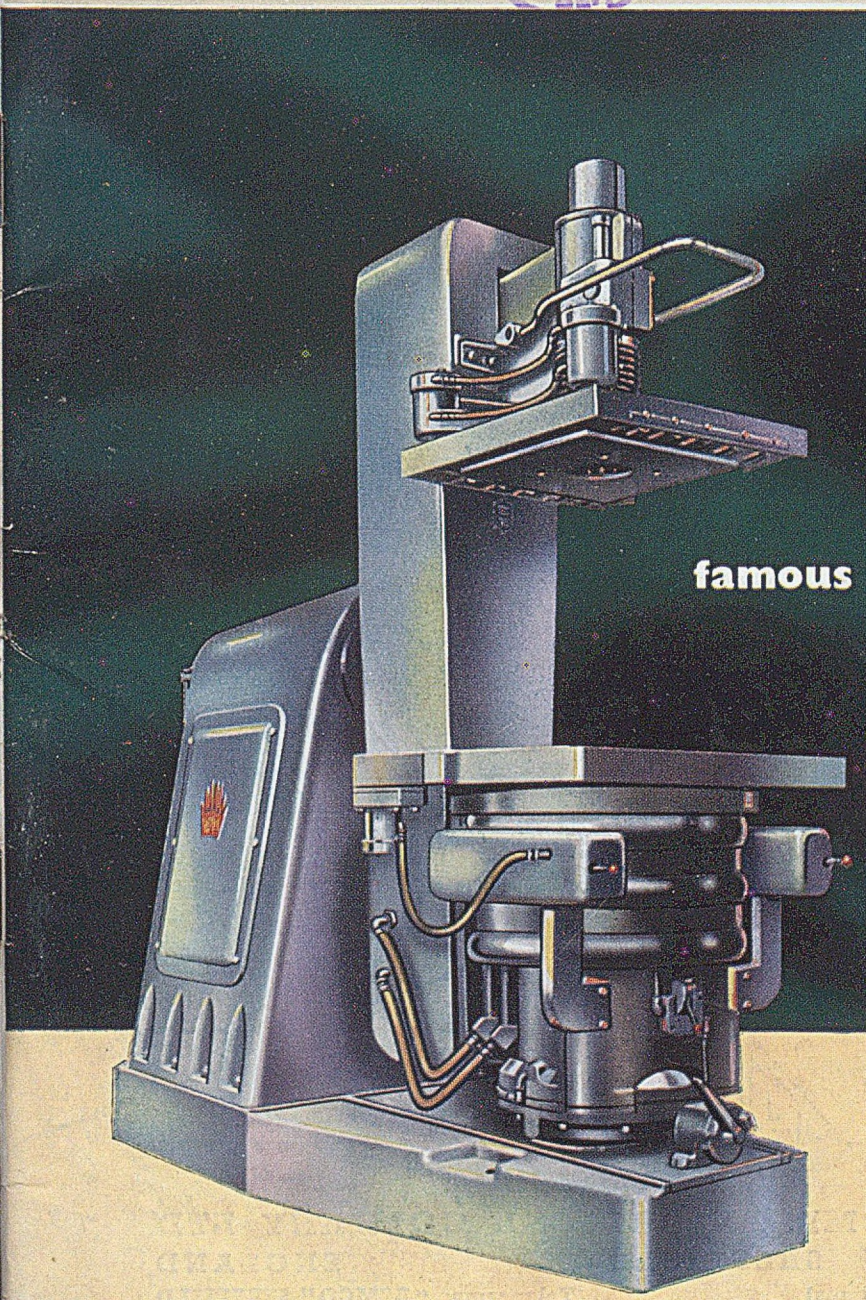

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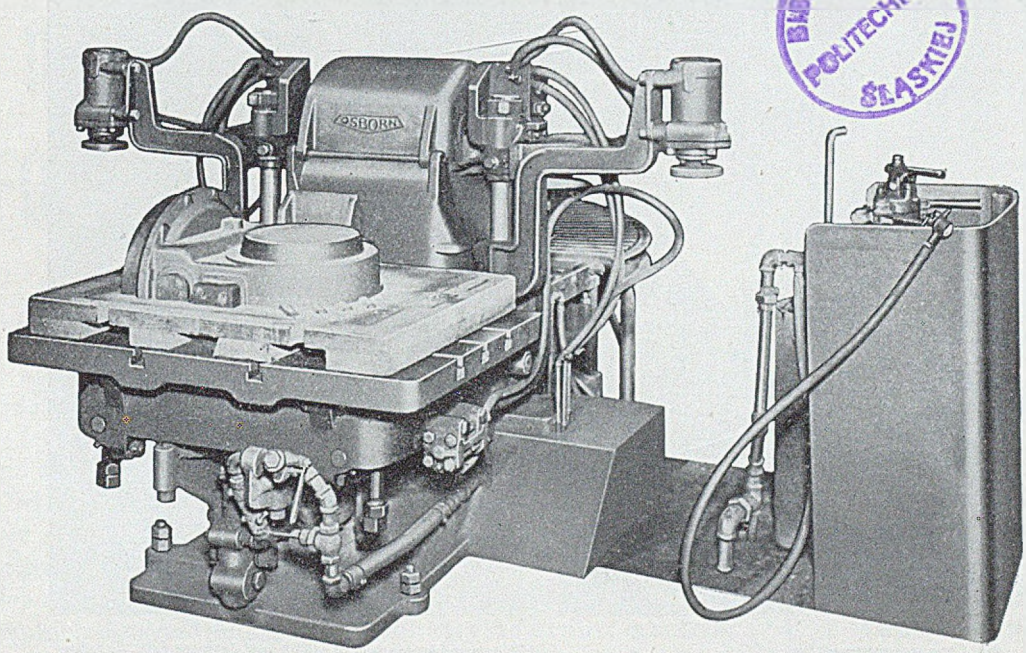

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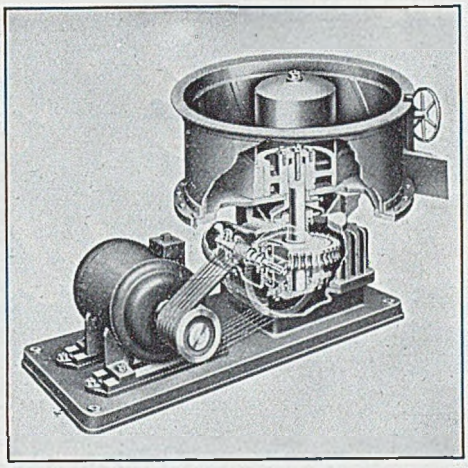
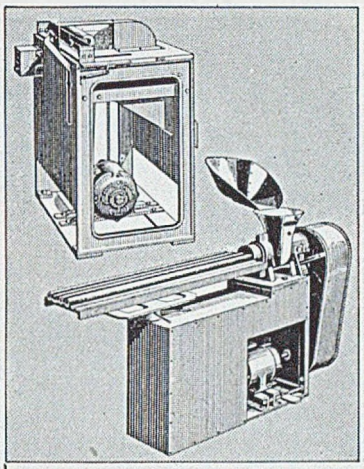
A

FORDATH MACHINES IN THE FOUNDRY





(ABOVE LEFT) FORDATH 'NEW TYPE' MIXING MACHINES *use the well known Fordath principle of rubbing and folding without crushing in each of the seven models in the range.*

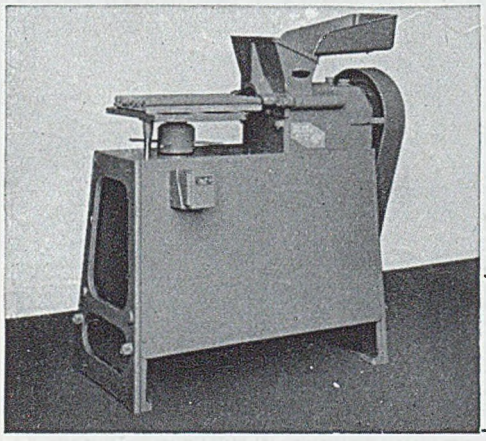
(ABOVE RIGHT) FORDATH CUT-OFF MACHINES *have many years of satisfactory service built into them.*

The FORDATH MULTIPLE ROTARY CORE MACHINE *has an enviable reputation for accurate extrusions in foundries everywhere.*

—*lower costings in the office*

Fordath 'New Type' Mixers, one for everybody, seven sizes to cope with batch capacities from 20 lbs. to 1 ton. To mix foundry silica sands with core bonding compounds *without crushing*. Stiff compounds as low as 1% can be completely dispersed through the sand, coating each grain with a film of binder. Mixing blades rotate in a horizontal plane, conveying the sand from the centre of the pan, rubbing it thoroughly against rubbing plates and tumbling it back to the centre. Two to three minutes is enough and the batch is discharged in a well aerated homogeneous mix. Gears and bearings totally enclosed.

The Fordath Multiplunger Core Machine is going to town, to the country, to export markets, wherever there are foundries. The thrust of the core sand through the multiple die is provided by plunger action instead of a rotating worm. Quality and consistency of the core sand mixture are not critical factors. Dimensionally accurate extrusions are satisfactory with sands of poor quality and even facing sand or plain red moulding sand can be extruded. With all sands, the core mix is at its best when Glyso is the bonding agent.



The FORDATH MULTIPLUNGER CORE MACHINE *admirably exemplifies the success of equipment designed by foundrymen for foundrymen.*

The Fordath Multiple Rotary Core Machine extrudes cores from $\frac{1}{8}$ inch to 6 inches. Multiple extrusion of up to ten (smallest diameter) cores simultaneously and accurately. All dies have venting device. Senior model (power driven) and Junior (power or hand operated bench model).

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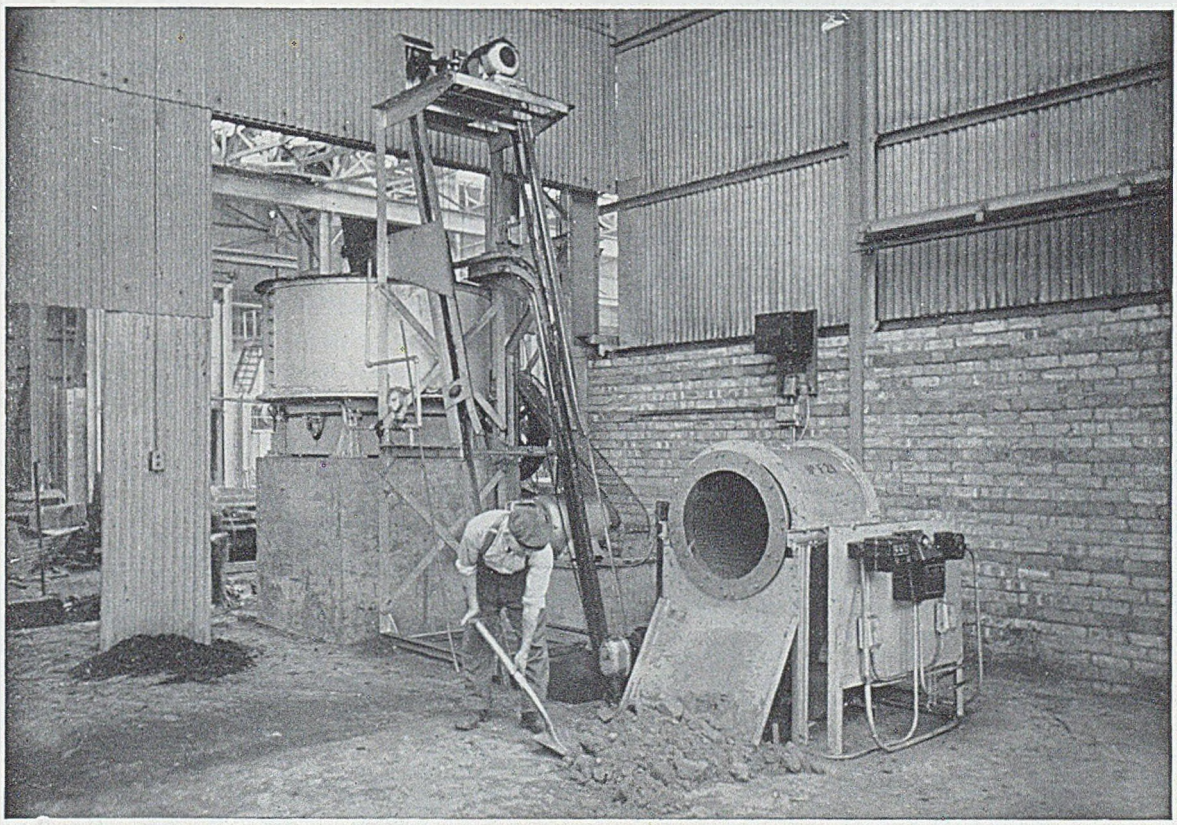

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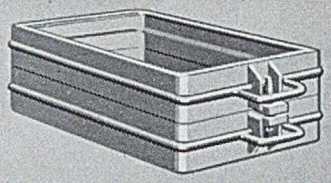
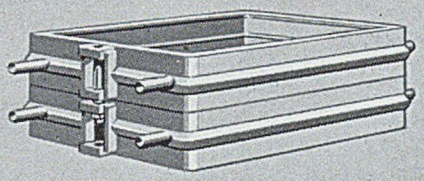
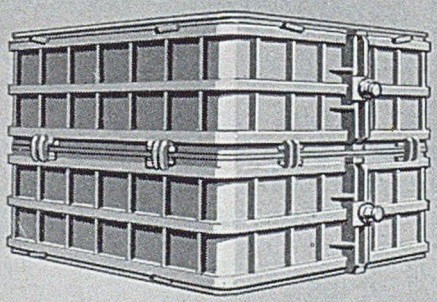


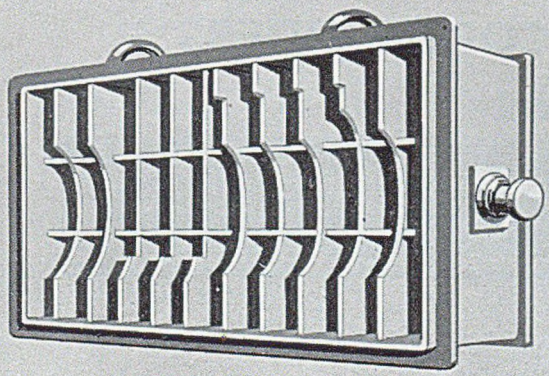
LIGHT WORK - 1 MAN LIFT



MEDIUM WORK - 2 MEN LIFT



MEDIUM WORK - CRANE LIFT



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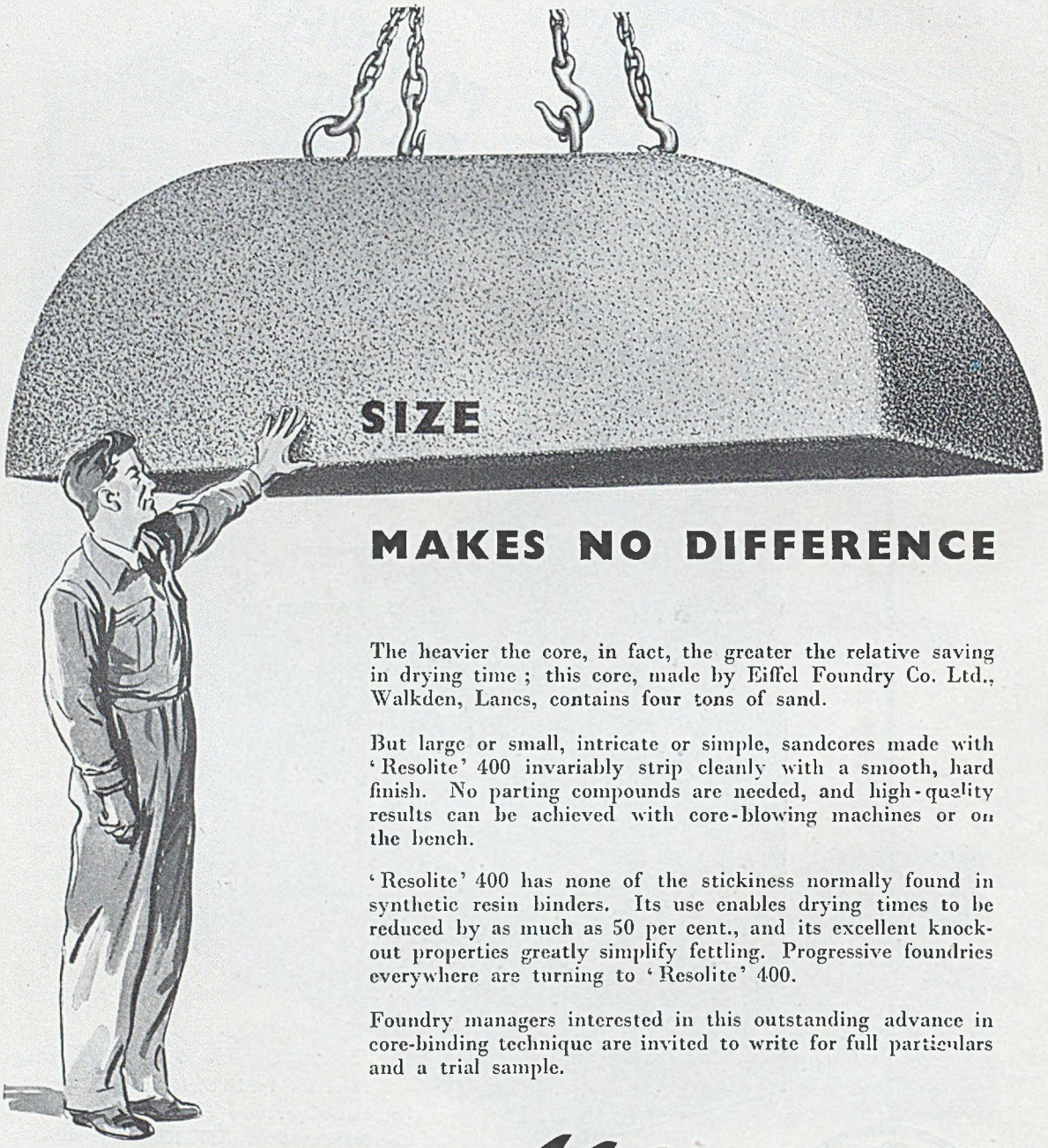

MAKES NO DIFFERENCE

The heavier the core, in fact, the greater the relative saving in drying time ; this core, made by Eiffel Foundry Co. Ltd., Walkden, Lancs, contains four tons of sand.

But large or small, intricate or simple, sandcores made with 'Resolite' 400 invariably strip cleanly with a smooth, hard finish. No parting compounds are needed, and high-quality results can be achieved with core-blowing machines or on the bench.

'Resolite' 400 has none of the stickiness normally found in synthetic resin binders. Its use enables drying times to be reduced by as much as 50 per cent., and its excellent knock-out properties greatly simplify fettling. Progressive foundries everywhere are turning to 'Resolite' 400.

Foundry managers interested in this outstanding advance in core-binding technique are invited to write for full particulars and a trial sample.

'RESOLITE' (REGD.) 400

SYNTHETIC RESIN CORE-BINDER

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Increased output now brings you 'Resolite' at reduced prices

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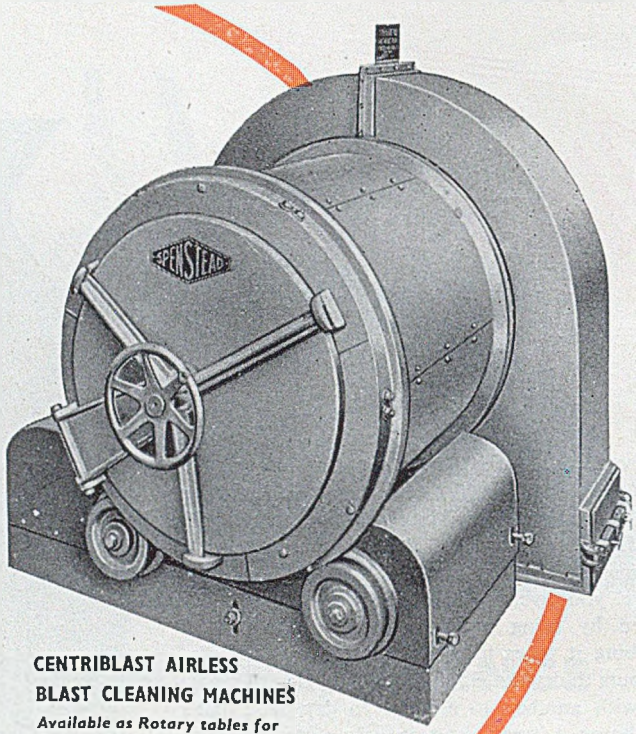

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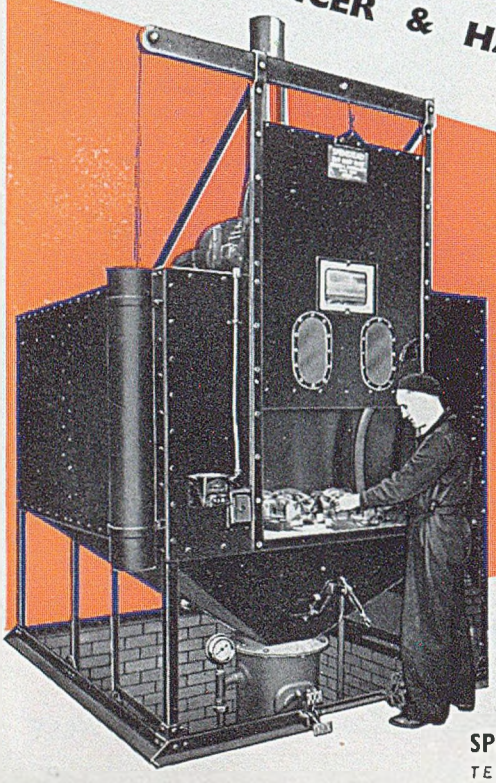

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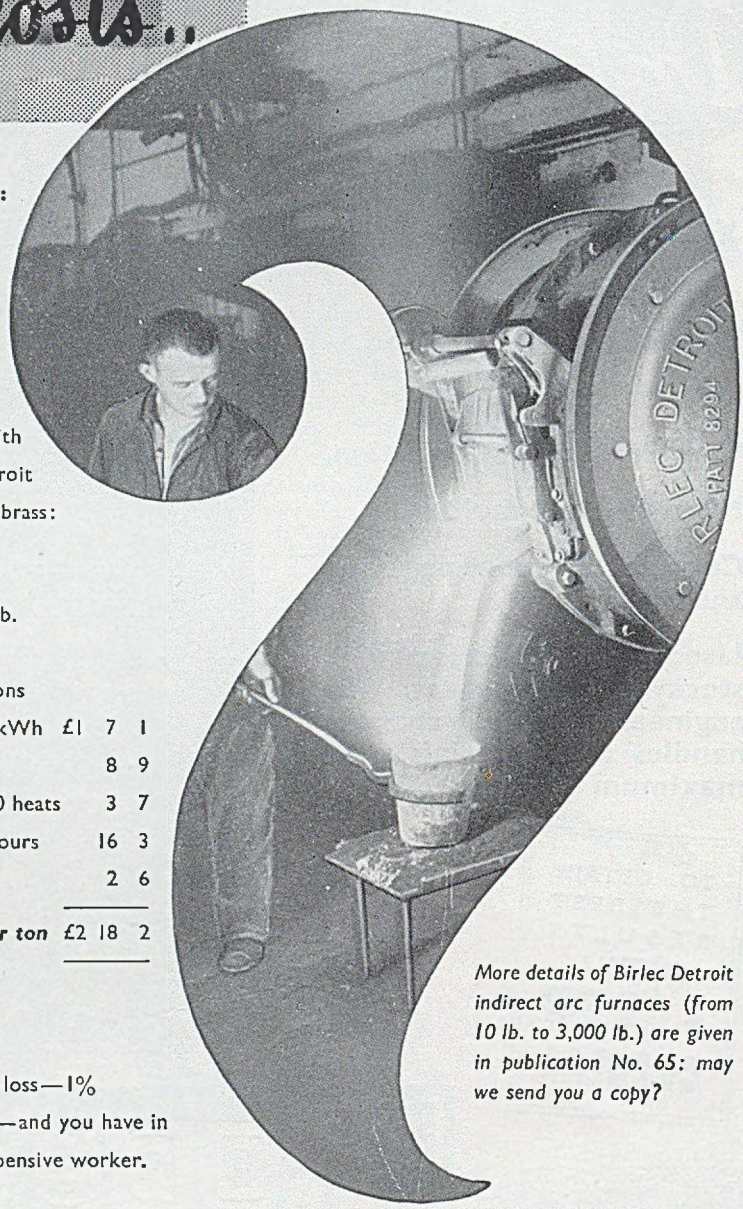
P2156

What are your melting costs..



Some metal founders never find out: too few know in advance. BIRLEC DETROITS, however, give reliable, predictable melting performances, producing sound metal at low operating costs.

Compare your present melting figures with these typical costs on a 500 lb. Birlec Detroit furnace (model LFY), working on 70/30 brass:

Average size of heat	500 lb.			
Heats per 8 hours	11			
Average output per 8 hours ...	2½ tons			
Electricity per ton @ 1d. per kWh	325 kWh	£1	7	1
Electrodes per ton @ 1/9d. per lb.	5 lb.		8	9
Refractories per ton	1,500 heats		3	7
Labour per ton @ 5/- per hour	3¼ hours		16	3
Water and miscellaneous ...			2	6
Direct operating cost per ton		**£2**	**18**	**2**

More details of Birlec Detroit indirect arc furnaces (from 10 lb. to 3,000 lb.) are given in publication No. 65: may we send you a copy?

Also reckon the advantage of low metal loss—1% can be assumed for budgeting purposes—and you have in the Birlec Detroit a hard, reliable, inexpensive worker.

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FOUNDRY TRADE JOURNAL

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PRINCIPAL CONTENTS

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

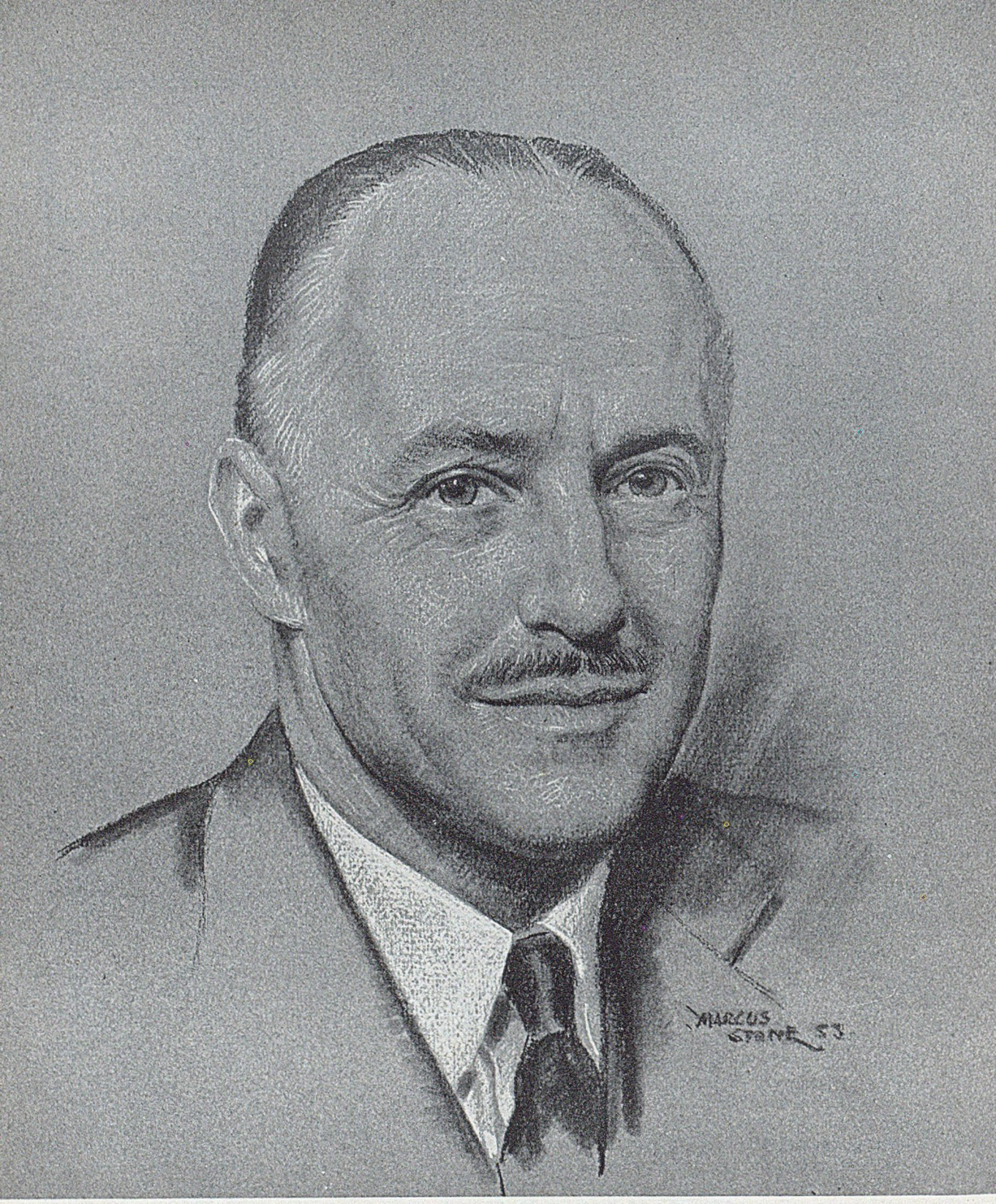
49 Wellington Street, London, W.C.2. 'Phone: Temple Bar 3951 (Private Branch Exchange) Grams: "Zacatecas, Rand, London"

Foremen's Training Conference

During our recent participation in the Foremen's Training Course organized by the Institute of British Foundrymen at Ashorne Hill, we noted that these important members of the staff were just as concerned with the state of trade as the sales director. The subject of sales was introduced by Mr. John Blakiston, who showed the trend of foundry business over a long period, with its booms and depression. At the moment there is quite a lull in the demand for castings. This was ascribed to the recent tendency of customers to accumulate stocks as being preferable to cash, as prices were always rising. Now, the economic machine has gone into reverse, but it was thought that it will not be long before there is a "boomlet." Certain of the South American buyers have been holding off the market, but the Australians, having materially improved their financial position, are likely to return.

Excellent advice was given as to how foremen can meet the buyers' market. Price cutting was deprecated, as only the first to do so benefited; those following injured both themselves and the community. In economy of working, it was pointed out that extravagance with chaplets could lose a firm ten pounds a week and so, too, with other supplies. Quality of the product was the best asset in retaining business. His every effort to-day should be to make the buyer quality rather than price conscious, and in a short personal experience we found this to be not too difficult, providing the seller appreciates to the full what the buyer most values. Another address which contained much information of general interest was by Mr. S. Leetch, who dealt with the place of the foreman in industrial organization. Obviously, he is part and parcel of management. To-day he is assisted, but should not be overridden, by such specialist departments as those for time-study, methods, costs and so forth. Much good, it was stated, could be derived from the arranging of visits to other departments so that an appreciation of the whole organization could be obtained. Other factors were the placing in the hands of the foreman as much commercial information as possible; the institution of intensive instructional courses and the use of the T.W.I. (training within industry) system. The lecturer valued highly the technical skill possessed by the foreman, as it greatly enhanced his standing with the men.

This was the fifth annual conference to take place and we received the impression that the mental calibre of the delegates and the enthusiasm for their work is progressively increasing. Especially was this to be noticed amongst those who had taken the trouble to equip themselves by attendance at evening classes and by reading both good literature and technical matter. We can assure those employers who were sufficiently enlightened as to allow their foremen to attend these courses, that they get very good value for money.



SIR CLAUDE GIBB

Chairman and Managing Director of C. A. Parsons & Company Limited.

Leaders of the Industry

SIR CLAUDE GIBB

SIR CLAUDE GIBB, C.B.E., D.SC., M.E., F.R.S., is chairman and managing director of C. A. Parsons & Company, Limited, and chairman of A. Reyrolle & Company, Limited, of Hebburn, Co. Durham He is also chairman of the Parolle Electrical Plant Company, Limited, of Newcastle-upon-Tyne, a director of the Bushing Company, Limited, of Hebburn, Pyrotenax Limited, also of Hebburn, and Savage & Parsons Limited, of Watford, Herts., and is one of the outstanding personalities in the electrical industry.

His rapid rise to his present eminence is due to his remarkable academic and technical qualities. Born in Adelaide, South Australia, in 1898, he studied at the School of Mines and the University, Adelaide, graduated as Master of Engineering, and was awarded the Angus Engineering Research Scholarship. In 1923, he came to this country and started work in the turbo-alternator erecting bays of C. A. Parsons & Company, Limited, as a fitter. Later he was transferred to the drawing office, and then to the outside staff, London district, where his outstanding qualities attracted the notice of Sir Charles Parsons. He was recalled to Heaton Works as manager of the test house, and in 1929 Sir Charles appointed him to the board of directors. In 1937, he became general manager of the company; in 1944, joint managing director with Mr. F. G. H. Bedford, and in 1945, on the retirement of the latter, chairman and managing director.

During the 1914-18 war he served as a pilot in the Australian Flying Corps and in world war II held the position of Director-General of Weapons and Instrument Production in the Ministry of Supply. In 1942 he was awarded the C.B.E., and subsequently became Director-General of Armoured Fighting Vehicles and chairman of the Tank Board.

His knighthood was conferred upon him in the 1945 Birthday Honours, and in the following year he was elected a Fellow of the Royal Society. In 1947 he received the honorary degree of Doctor of Science of Durham University, and was elected a Fellow of the Royal Society of Arts. In 1951 he received the honorary degree of Doctor of Science (Engineering) of London University.

Sir Claude is deeply interested in educational matters, and is chairman of the University of Durham Appointments Board, and a member of King's College Council, Newcastle-upon-Tyne. The apprentices' training school at Heaton Works is one of the most advanced in the country, and Sir Claude is also a strong believer in the beneficial effect on production of bright colours and congenial working conditions in the factory.

In 1946, he delivered the Edward Williams Lecture to the Institute of British Foundrymen and the address he gave on "Castings and Weldings" was truly outstanding in a brilliant series. He showed himself to be as expert in foundry practice as he is so well known to be a leading authority on electrical engineering. As a respite from work, Sir Claude enjoys a round of golf.

Correspondence

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

SAFETY MEASURE FOR ROLLOVER MACHINES

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—In the fourth paragraph on page 88 of the Annual Report of the Chief Inspector of Factories for the year 1951 there appears an account of a fatal accident which occurred whilst a man was cleaning down a rollover moulding machine.

The account bears a close resemblance to an accident which occurred in a foundry with which I was associated some years before the last war. In that case, too, the machine had been rolled over to give access whilst the man blew away the accumulated sand with a compressed air pipe. When he had finished using the air pipe the valve with which it was fitted failed to shut and so he turned off the main stop valve. After a short interval the machine rolled back, trapping him with fatal consequences.

During all this time, the control valve on the machine had not been moved and this is the point which most operators fail to appreciate; the machine only requires the air supply to be shut off for it to start rolling back—it is not necessary for the control valve to be moved to "exhaust." There is some slight delay whilst the air pressure leaks slowly away and then the machine rolls back—very quietly—of its own accord. Here the danger lies, and to ensure an avoidance of accidents of this nature it is well to provide the machine, as we did, with permanent props which can be swung into position to support the roll-over table during cleaning operations.—Yours, etc.,

"PIMPERNEL."

International Salvage Bureau

The fifth general meeting of the *Bureau International de la Recuperation* brought to Paris at the end of last month many trade associations catering for scrap and merchants dealing in waste materials. After transacting business of a formal character there were two items of interest to readers.

The president of the technical section of the iron and steel scrap branch initially stressed the opening of a mutual market for coal and steel. The annual sales of the associated merchants in six countries amounted to about 12 million tons. After several meetings, the merchants could not reconcile their views with those of the steelworks owners and the governing control. However, there is hope that following this meeting further progress will be made. With but one exception, it was agreed to press for complete liberty of action in movement and prices in the scrap trade.

The president of the non-ferrous section of the scrap trade deplored the continuation of Governmental interference in their business. Though the situation was not too promising, there was still the need for the merchants to strengthen the friendly ties which existed and to press governments to ease their restrictions so as to allow a progressive return to normal commerce so ardently desired by the B.I.R.

THE MIDLAND MOTOR CYLINDER COMPANY, LIMITED, announce the retirement from April 30 of Mr. G. S. Yorke, who has been with the company for nearly 35 years, sharing the managing directorship with Mr. A. E. Pearce during the last eight years. Mr. F. A. W. Livermore, who has had 19 years with the company, has been appointed works director.

Fuel Appliances for Inferior Coal

Modern solid fuel appliances could burn low-grade coal and coke efficiently, said Dr. Joy P. Stern, Scottish divisional analyst for the N.C.B. at the second annual conference of the Scottish Women's Advisory Committee on Solid Fuel held in Glasgow on April 28. Mrs. Willis, organizing secretary of the committee, said that advice on the appliances could be obtained from the information centre of the Coal Utilisation Council in Glasgow. A second centre would shortly be opened in Edinburgh.

Shetland crofters, it was pointed out, preferred a model with an open fire in the kitchen, and one that did not require special fuel but could burn peat. In Aberdeenshire, combination grates were popular. Dumfriesshire housewives found difficulty in securing suitable closed stoves providing good supplies of hot water. Mrs. Lonsdale said electricity had now reached its limit because of high cost for further use by housewives in urban houses, and solid-fuel appliances were becoming more attractive. She pleaded for simplicity in operation. "Some of us are not very technical," she added, "but we are very practical." "It is not possible for the woman who is out all day to use solid-fuel facilities for cooking," said Miss J. Wilson, chairman of the Scottish division of Business & Professional Women's Clubs, "but we do appreciate what can be done in the way of space-heating and hot water supply by these appliances." Miss Wilson also made a plea to "the experts" to contrive a means of conveying ashes from the ashpan without raising clouds of dust, and suggested that for safety reasons a heat-resisting ash pail would be advantageous in many cases.

K & L Gala Day

Thousands were the guests of K. & L. (Steelfounders and Engineers), Limited, last Saturday to share in a gala day at Letchworth to celebrate the silver jubilee of the firm's association with the 600 Group of Companies. They included employees and their families, representatives of the other companies of the group and business friends. The gala was officially opened by Mrs. Cyril Cohen at 1.45 p.m. and thereafter, in perfect weather, "all the fun of the fair" was at the disposal of the assembly. There was a circus, many sideshows, trick motor cycling and a special section for children. The star performances of the day were given by the King's Troop, Royal Horse Artillery, who gave exhibitions of formation exercises and musical drives. Most of the performances were in duplicate or triplicate and the evening concluded with a fireworks display on the field and then dancing in the works canteen. Altogether, the function was a memorable mark of progress achieved and an auspicious augury for the future.

Dinner

IRONFOUNDERS' NATIONAL CONFEDERATION

This function was held at the Grand Hotel, Scarborough, last Saturday evening and Mr. D. Graham Bisset presided. Toasts were proposed and replied to by Mr. C. Marley; Alderman J. P. Pinder; Mr. Noel P. Newman; the chairman; Mr. R. Chisholm; Mr. D. D. Walker; Dr. C. J. Dadswell; Mr. G. E. Currier; Mr. J. T. B. Swift; and Mrs. C. J. Dadswell. Mr. Oliver Gibson acted as toastmaster. Amongst the guests were Dr. J. G. Pearce; Dr. J. E. Hurst; Mr. V. C. Faulkner; Mr. Kenneth Marshall; Mr. T. Lee; most of whom were accompanied by their ladies.

Design, Installation and Operation of a Water-cooled Cupola*

By J. W. Dews

After describing the situation existing at the foundry before water-cooling of cupolas was envisaged, the Author records the reasons which led to its adoption, first experimentally, then on a routine basis for a 38-in. dia. cupola running for melts lasting about four hours. Next, experiences are given in applying the same type of water-cooling segments† to a pair of new cupolas of 24 in. i.d. running for 8-hr. melts. In this case, too, operating details and economies shown are given, as well as empiric al equations for the heat balance.

Early in 1950, due to the demands of production attention was turned to the various cupolas, which at that time were in daily use in the foundry to which the Author is attached. It was becoming increasingly necessary to increase the throughput of these cupolas, and this in turn meant bigger burn-out in the melting zone. No duplicate cupolas were available, and each cupola, therefore, had to be fettled and repaired on the same day as it was required for operation. This in itself did not help to minimize the depth of the burn-out. Accordingly attention was turned to the possibility of water-cooling the melting zone, because published information indicated that water-cooling properly applied eliminated burn-out problems. It was felt that some preliminary investigation would be useful and though these investigations would have to be carried out with the least possible interference to actual production, it was desirable that experiments should be carried out on a production cupola.

At that time, an Equiblast cupola of 38 in. lining diameter, melting an ordinary phosphoric grey iron, was being used to supply metal to a semi-mechanized plant during the morning shift, until the main melting unit for the foundry was brought into operation at lunchtime. It was necessary to get this 38-in. cupola into operation by 8.0 a.m. every morning, which, under the existing conditions and with the labour available, was always an uncertain matter. Therefore, any development which would aid the preparation and operation of this unit would be very valuable indeed. Taking into account the production demands of the entire foundry, it was felt that if any experiments with water-cooling should interfere with the melt programme, the effect on the total production would be minimized by selecting this cupola for the trials.

One factor was not covered; this cupola was only melting grey iron at the time and information was

* Paper read before the Birmingham branch of the Institute of British Foundrymen, Mr. E. Hunter presiding. The Author is chief metallurgist John Harper & Company, Limited.

† It is pointed out that the apparatus described is the subject of patent application.

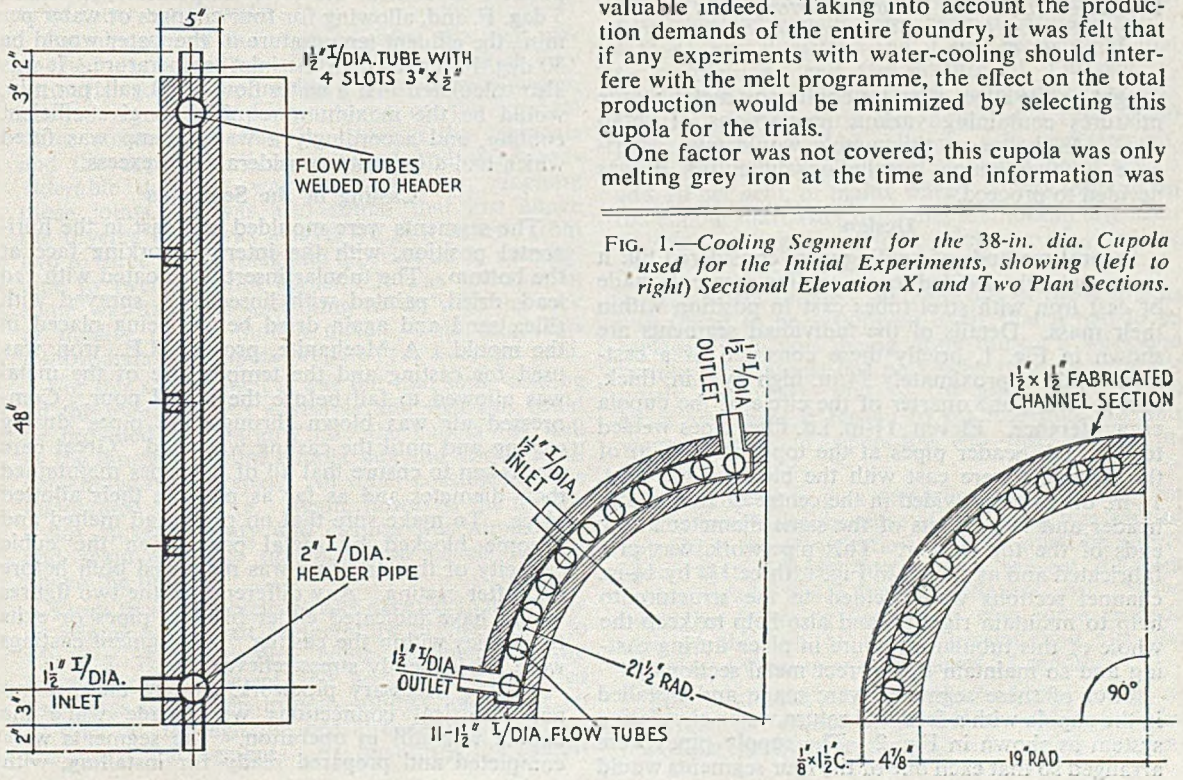


FIG. 1.—*Cooling Segment for the 38-in. dia. Cupola used for the Initial Experiments, showing (left to right) Sectional Elevation X, and Two Plan Sections.*

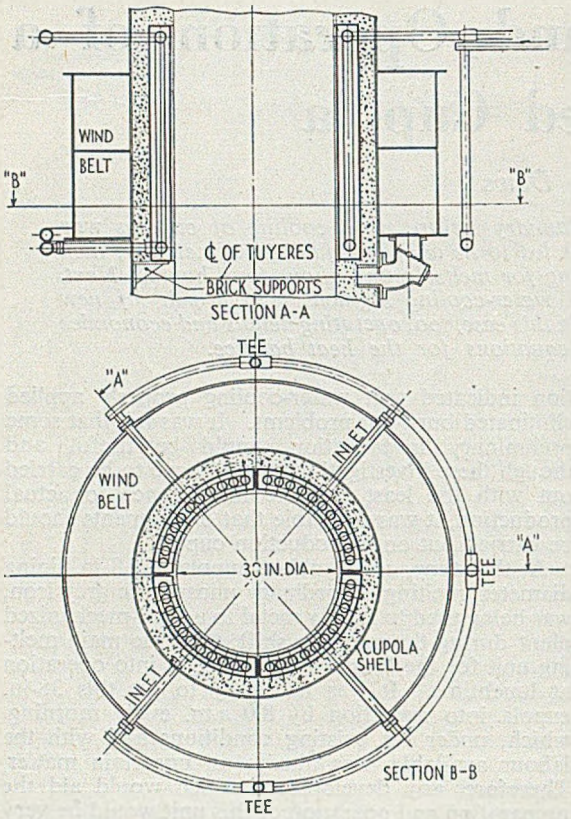


FIG. 2.—*Section and Elevation Arrangement of Feed and Return for the Water-cooling System on the 38-in. dia. Cupola.*

sought on the effect of water-cooling on metal charge mixtures containing various proportions of scrap steel. As, however, this cupola would give experience in overcoming installation difficulties it was decided to proceed.

Design

Several methods of cooling were considered but it was eventually decided to use cooling segments made of cast iron with steel tubes cast in position within their mass. Details of the individual segments are shown in Fig. 1, briefly these consisted of a cast-iron block, approximately 54 in. high by 5 in. thick, and covering one quarter of the circle of the cupola circumference. Eleven, 1½-in. i.d. flow pipes welded to 2-in. i.d. header pipes at the top and bottom of the segments were cast with the block. One inlet, 1½-in. dia., was provided in the centre of the bottom header and two outlets of the same diameter at the ends of the top header. This pipe-work was prefabricated and as shown in Fig. 1, three 1½- by 1½-in. channel sections were welded to the structure to help to maintain rigidity, and also help to keep the whole of this tubular structure in place during casting and so maintain the correct metal sections.

Four of these segments were made and installed in the cupola with a feed and return water-circulating system as shown in Fig. 2. The supply pipes were arranged so that each one of the four segments would receive an equal pressure of water from the supply pump. Likewise, the outlets were fed to the return pipe in such a way as again to maintain equal pressure. This was done in an attempt to maintain an equal flow of water through all the pipes of the segments and to prevent any short-circuiting, which would cause some portion of the cooling zone to become overheated.

A 1,300-gall. storage tank was incorporated in the circuit, and, as a precaution, mains water was connected in such a way that it could be fed either into the storage tank or directly into the circulating system. By this means, it was possible to control both the inlet and outlet temperatures of the water in the segments very closely. Also, should the pump from the storage tank fail, mains water was available to carry on with. An overflow was provided from the storage tank to look after the excess when mains water was added. This overflow was useful for measuring the amount of mains water which was being added.

It was originally intended to install these water-cooling segments and attempt to operate the cupola without putting any refractory lining whatsoever on the face of the segments. With this in mind, calculations were made to determine the size of the flow-pipes, the section of metal from the face to the flow-pipes, and the required number of water changes per unit time. These calculations were carried out by loosely applying formulæ used in boiler practice, where in essence the problem is the same, and by estimating some of the variables.

With the design, it was estimated that as it was possible to control the inlet temperature to within 5 deg. F. and, allowing for four changes of water per min., the effluent temperature of the water would be 30 deg. F. higher than the inlet temperature. It was also calculated that a water flow of 50 gall. per min. would be the maximum required to give efficient cooling, and accordingly a water pump was fitted which had a capacity considerably in excess.

Casting of the Segments

The segments were moulded and cast in the horizontal position, with the internal working face at the bottom. The tubular insert was coated with red lead, dried, painted with linseed oil, sprayed with silica sand and again dried before being placed in the mould. A Meehanite, process H.E., iron was used for casting and the temperature of the metal was allowed to fall before the actual pour. Compressed air was blown through the pipes during casting and until the casting was solid. Great care was taken to ensure that all of the pipes maintained their diameter and as far as possible their allotted place. To make sure that no pipes had melted and become blocked by metal penetration the cubic capacity of the structure was measured both before and after casting. Any difference in the two figures would have indicated either blocked pipes or exits to cavities within the casting. All segment castings were subsequently stress-relieved.

All the necessary pipework, storage tank, pump and electrical connections were made while the cupola was still in operation. The segments were completed and prepared ready for installing, with

two lifting hooks screwed into the top face, so that they could be lifted easily through the cupola shaft by overhead pulley blocks hung from the two charging-door sills. Advantage was taken of a holiday break, so that the existing brickwork was removed, the segments put in place and the water connections made with the minimum disturbance to the normal working hours of the cupola. The space between the segments and the cupola shell was filled with ganister, used as dry as possible.

Operation

As previously stated, it was desired if possible to operate this cupola without any ganister lining whatever on the face of the segments. Accordingly, the first melt was carried out on the bare face of the segments, although they were given a ganister wash. As there was no information on what sort of result could be expected, and because the material to be melted was an ordinary medium-phosphorus iron, it was decided to operate the cupola under exactly the same conditions as before the changeover.

This first melt produced iron at temperatures well above 1,400 deg. C., but which curiously lacked any noticeable degree of fluidity. In fact, its fluidity was so poor that it was difficult to pour the metal from the ladle into the pig machines. Normal casting was out of the question. The cooling system worked as expected, and there was obtained an increase of 30 deg. F. in the circulating water. It was also found that for the short duration of the heat (approximately 2 hours) it was not necessary to add any mains water.

Examination of the segments after the melt was finished revealed that all four had cracked very seriously across the middle; only one, however, showed signs of leaking. Some of the internal water connections, that is, between the segments and the cupola shell, also leaked and some considerable difficulty was experienced in reaching those joints. It was also found that just above the tuyeres there was a layer of iron pellets, from two to three inches thick and tapering off to nothing, nine to twelve inches higher. It was felt that in some way this had something to do with the lack of fluidity of the molten metal. This ridge was removed and the cupola prepared for a second melt.

For this second melt it was felt that some coating on the segments was advisable and that this could be provided by charging into the cupola (as well as the limestone) some cupola slag and also a small percentage of fluorspar. All other conditions were maintained as before. Again, however, the molten metal lacked fluidity and casting was impossible, and again a bridge of small iron pellets formed above the tuyeres.

From these two melts it was decided that in spite of allowing the exit temperature of the water to 150 deg. F., the cooling being obtained was too drastic or too efficient and was causing some of the drops of molten iron to solidify and build up as they fell through the bed and impinged against the wall of the segments. As, obviously, the coldest part of the segments was at their base, where the water entered and because this part was well below the melting zone, the build-up would be greater at this point. There were only two ways to reduce the efficiency of the cooling:

1. To apply a refractory lining for which no provision in the construction of the segments had been made, and
2. to allow the face of the segments to get hotter.

The second method was deemed hazardous, because from the very nature of the construction, leaks had developed and when the segments got hot these leaks became worse and were difficult to cope with. The only answer, then, was to line the segments with ganister. To do this, several pieces of ¼ in. dia. steel rod were bent to the circumference of the cupola and welded on to the face of the segments. These were then used to hold the ganister in place, the material being put on to just cover the rods. The cupola was again prepared in the usual way for the third melt.

Successful Melt

The third melt was a complete success. Metal temperatures were high and fluidity excellent. This heat lasted for 4 hrs. and because leakage was still a source of trouble, it was found necessary to keep the temperature of the water leaving the cupola down to 130 deg. F. After this heat, the segments had a covering of glazed slag on them which did not require any patching. Except for the original cracks, the faces of the segments were still intact and showed no traces of being burnt or melted. All subsequent melts have been of approximately 4 to 4½ hrs. duration, and it has been found that to maintain an exit temperature of 130 deg. F. maximum, re-circulation from the storage tank was sufficient for the first two hours at a rate of 40 galls. per min., *i.e.*, 10 galls. per min. per segment. After the first two hours it is found necessary to add 10 per cent. of mains water. Views looking up the cupola shaft after dropping the bottom and after re-lining with ganister to a thickness of ½ in. are shown in Figs. 3 and 4.

After approximately 50 melts one of the segments was found to be leaking so badly that it had to be replaced, the work being done during a week-end break. The cupola has now been running daily for nearly two years, that is, for approximately 470 heats and there is reason to suppose that the four segments now in operation will last almost indefinitely.

It is difficult to give any true figures on the cost of this installation because all the work was carried out within the organization. Also it must be appreciated that different installations present different problems and hence have a different cost. However, the following figures do give some realistic idea of the cost of the conversion and also the effective savings over a period of 12 months.

The total cost of conversion of the cupola as described is estimated at £450. This includes making a pattern for the segment casting, fabrica-

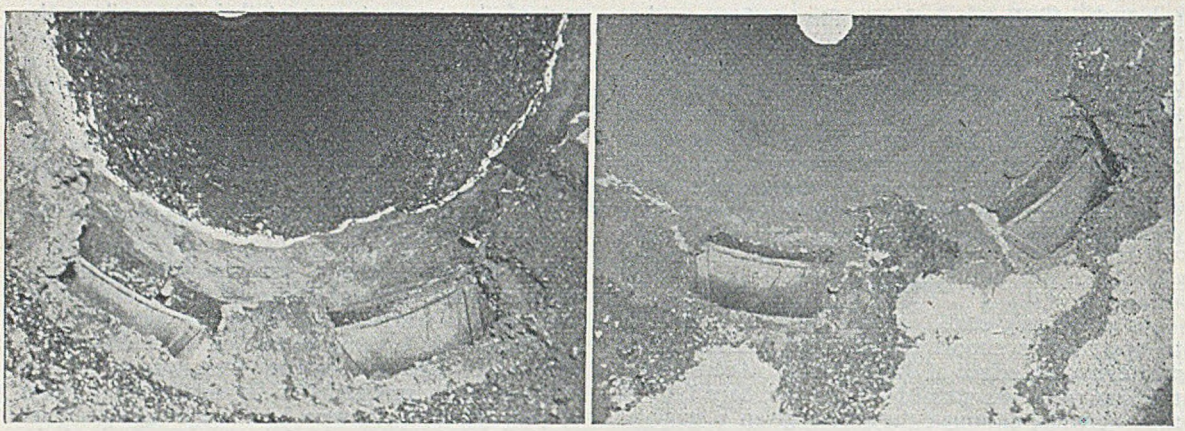


FIG. 3 (LEFT).—*View up the Cupola Shaft, showing Melting Zone after dropping the Bottom of the 38-in. Cupola.* (RIGHT).—*View from the Same Position as Fig. 9, but after Re-lining with Ganister.*

tion of the tubular structure, the cost of castings from the foundry, transport, the supply of the water pump and water storage tank, all the supply pipes, as well as labour charges for the complete installation, together with a 5 per cent. allowance for wear and tear of plant. This is simply an internal works and does not include any overheads.

Comparative Costs

Brick-lined Cupola.—Due to the exacting conditions, under which this cupola operated it was previously found necessary to reline it completely with bricks every 12 months. This operation at existing rates costs £115. Also, because of these extreme conditions, which frequently meant cooling the stack of the cupola by water quenching, daily patching requirements were heavy. It is estimated that over the period of 12 months this cost approximately £1,000; thus total maintenance for one year (materials only) cost £1,115.

Water-cooled Cupola.—It is now only necessary to keep the water-cooled zone covered with ganister to a depth of ½ in. and to repair the cupola "well" as and where necessary. Material costs for this are estimated for 12 months to be £350. The cost of water and power is estimated at £25 for 12 months; thus, in this case the total maintenance for one year is £375, representing a saving in maintenance of £740.

Maintenace on the water-cooling system is almost wholly confined to the replacement of segments, for which in nearly two years working only one replacement has been necessary and this was due to early misuse. It is clear, therefore, that even on a cupola where due to more efficient operation, maintenance costs are more normal, a considerable economy can be effected by water-cooling.

Other Operating Advantages

As previously stated, this cupola is being operated in exactly the same way as before conversion and it can be confidently stated that both metal temperatures and melting rate have been maintained, without any alteration to metal-to-coke ratio which has been maintained at 12:1. The most noticeable operating advantage has been the ease of preparation of the furnace for use. Previously, due to the time lag before the cupola was cool enough for work to be started inside, it was necessary to get cupola men to work at awkward times, *i.e.*, during the evening or at night. Neither of these times is really satisfactory and, in any case, the obtaining of hot molten metal at 8.0 a.m. was uncertain.

Since conversion, by allowing the water to continue to circulate after dropping the cupola bottom, the furnace cools much more rapidly and it is therefore possible to get inside for maintenance work much earlier. There is no chipping or fettling to be carried out and only a relatively small amount of ganister to be replaced, so the cupola can be prepared more quickly. It is now possible during normal working hours to prepare the cupola so that next morning it is necessary only for one man to come in early and light the "bed" and get ready for the heat. Since conversion, there has not been one occasion when the cupola has caused any delay. Production of slag has been reduced by 50 per cent., which means less labour is expended in its disposal, and also there is a reduction in the total heat loss from the cupola.

From this installation and operation over a period of months, three general conclusions were drawn:—

1. Sufficient experience had been gained to inspire confidence in extending the system to other cupolas.

2. The economic advantages were too outstanding to be ignored.

3. The melting zone maintained its diameter so effectively that it was obviously possible to envisage heats of up to 24-hrs. duration or even longer.

This last conclusion seemed to be of particular advantage on cupolas of small diameter, which are normally used in conjunction with mechanized moulding systems, and are required to be in operation for long periods.

(*To be continued*)

Ironfounders' National Confederation

First Annual Convention at Scarborough

The first convention of the Ironfounders' National Confederation, now a thirteen-years-old association, was held at the Grand Hotel, Scarborough, starting last Thursday and finishing on Sunday morning. It attracted about fifty members, most of whom were accompanied by their ladies. Unlike in the South of England, excellent weather was experienced for the whole period. The opening event on the Thursday afternoon was a mannequin parade at Marshall & Snelgrove's local emporium. In the evening, there was a film show opening up with the film made under the auspices of the Institute of British Foundrymen showing the way metal fills up various types of moulds, followed by films relating to oil wells and refineries. The evening finished with an exhibition game of billiards between two amateur champions.

On Friday, having dispatched the ladies on a visit to York, the day was devoted by the members to business matters. After a council meeting, a civic welcome was given by the Mayor of Scarborough (Councillor J. W. Hardcastle, J.P.).

Chairman's Address

On his withdrawal, the chairman, Mr. D. Graham Bisset, called the meeting to order and after some formal business delivered his report for the year, in the course of which he said:—

During the past year this Confederation has been exceptionally active in the interests of its members. The Council has held a number of special meetings in addition to regular quarterly meetings, to consider and decide upon the steps to be taken to give effect to members' views as expressed by the various local branch associations, and reflected by the resolutions passed at those meetings for submission to the Council. In this connection, it is encouraging to note that two local branch associations have become active and enthusiastic supporters of the Confederation during the past year. The North Western branch which had been dormant for some time has been entirely resuscitated and is now established as a live and active organization within the Confederation; and a branch association has recently been formed for the Midland members which promises to rival any of the other local branch associations in its activities.

Costing

In the early part of the year the Council considered a simplified costing system. This was published by the Confederation and first adopted by the members of the East and West Ridings Association, from which they developed a method of cost of production analysis. This has been further developed by the director to furnish a collated statement of comparative costs, as between certain agreed categories of foundries, which should prove of invaluable assistance to the members in helping them to achieve a greater efficiency of production and correspondingly increased productivity. The methods developed by the East and West Ridings Association have been considered by several of the other branch associations and it is hoped will be adopted by them as a basis for a similar method of procedure.

Prices

The cost-ascertainment committee, set up by the Council, has studied the effect on costs of the various advances in materials, wages and transport, etc., which have taken place during the year and members have been informed accordingly.

Raw Materials

In the early part of the year, the position with regard to raw materials was difficult and a number of members sought help in obtaining supplies and in this connection the Council is very grateful to the Council of Ironfoundry Associations for the prompt attention and assistance they gave. While the present position is much easier, there is still the question of coke. As a result of the target set by the steel trade, it is anticipated that there will be a greatly increased demand for coke. New coking ovens which have recently come into operation will provide for some of these requirements but it is estimated that there will be an additional demand for approximately five million tons. Members should, therefore, make sure that they avail themselves of every opportunity to increase their stocks and to obtain supplies wherever possible.

Government Proposals for Iron and Steel Industry

During the summer, the White Paper proposals for the iron and steel industry were published and at a council meeting held in September it became apparent that there was some uneasiness regarding the implications contained in the Government's proposals. On October 8, 1952, the Council was asked to attend a special meeting in London at which the position as it was known at that date was thoroughly reviewed and discussed, as a result of which the following resolution was adopted with one abstention; namely:—

> The I.N.C. Council views with alarm the proposals in the Iron and Steel Industry (White Paper, Cmd. 8619) and strongly urges the C.F.A. to make such representations as will ensure that there is no increase in the scope of public supervision of the ironfounding industry, and, in particular, to have Clause 4 of the Appendix to the White Paper deleted.

On October 20, the chairman wrote to all members outlining the position as then known and asked for an expression of opinion by vote. The Council met again on October 30 for the purpose of hearing and considering the result of the voting and at the conclusion of this meeting, the chairman

Ironfounders' National Confederation

undertook to present the views and comments of all concerned fairly and as strongly as possible at the C.F.A. meeting that afternoon.

On November 4 he again wrote to all members regarding what had transpired at the C.F.A. meeting and pointed out that he felt sure the C.F.A. would make every possible effort to safeguard the interests of all members. The matter was further discussed at special meetings of the branch associations and it became apparent that there was growing opposition to the inclusion of ironfounders in the Iron and Steel Bill. At a meeting of the I.N.C. Council held on December 10 the position was again discussed at great length, in the light of the reaction of members of the various branch associations, and as a result, the following resolution was adopted:—

> That owing to the failure of the I.N.C. resolution of October 8, 1952, to bring about the elimination of Clause 4 of the Appendix to the White Paper (Cmd. 8619) this Council of the I.N.C. is unanimous in its opinion that the best interests of the ironfounding industry, in respect to the Iron and Steel Bill, will only be served by the complete deletion of Clause 4 of the third schedule of the Iron and Steel Bill, and insists that this policy be carried out by the C.F.A.

The chairman undertook to present this resolution with as much force as possible at the C.F.A. meeting to be held on the following day. It was agreed to adjourn the I.N.C. Council meeting as he felt sure that the members of the Council would wish to be advised as soon as possible as to what transpired at the C.F.A. meeting and that, if the resolution was not acceptable to the C.F.A., they would wish to have another meeting at the earliest possible date. The I.N.C. Council meeting was resumed on December 18 and he then gave members a detailed report of what had taken place at the C.F.A. meeting and informed them that the Confederation had again been out-voted, but that he had been invited to join a deputation, composed of members of the C.F.A., which met the Minister of Supply in the afternoon of that day.

At the outset of this meeting, the Minister was emphatic that the Government was adamant in its determination to include ironfounders within the ambit of the Iron and Steel Bill. In the light of this information the matter was again reviewed, in great detail, and finally, the following resolution was unanimously adopted by the Confederation:—

> This Council, while still adhering to its previous unanimous resolution to press the C.F.A. to secure entire deletion of Clause 4 of the Bill, having heard the statement of its chairman following the C.F.A. deputation to the Minister last week, unanimously press the C.F.A. to secure further amendments in the form of the deletion of clause 3, page 3, of the Bill insofar as it affects the ironfounding industry.

The chairman undertook to put this forward at the next C.F.A. meeting.

The Iron and Steel Bill has now passed the committee stage of the House of Commons but it is not the Iron and Steel Bill that was originally proposed by the Government. As a result of representations for which the Confederation had been largely responsible, the C.F.A. entered into negotiations with the Minister and now, apart from the actual withdrawal of ironfounders from the Bill, which could not be achieved because of the Government's attitude, ironfounders have very little to fear and it is hoped, a great deal to gain by the setting up of the proposed Iron and Steel Board.

Draft Statutory Regulations

In the middle of December, it was learned that the Government had accepted the private member's Bill in connection with the health and safety of foundry workers. On the face of it, the Bill appeared so onerous that the director of the C.F.A. took immediate steps to protest against it and all C.F.A. constituent associations were advised of what he had done. All associations, including the I.N.C., called special meetings at which the contents of the Bill were considered and a number of amendments discussed and agreed. Mr. C. J. Grazebrook, president of the newly-formed Midlands Association was asked to represent the Confederation on the C.F.A. *ad hoc* committee which was set up to deal with this matter. As a result of the representations, the proposed Bill was withdrawn on the understanding that it would be replaced by Statutory Regulations. Subsequently the draft regulations have been reviewed and amended in accordance with the many recommendations which were put before the C.F.A. and these are now in the hands of the Minister.

Revision of Constitution

Arising out of the foregoing events, the Council has decided to review and revise the Confederation constitution and local branch constitution. At the last Council meeting an *ad hoc* sub-committee was appointed to consider both these documents in detail. This sub-committee has met twice with the result that a draft of the completely revised constitution is now being considered by the Council and will be circulated to the members for further comments and criticism in the near future.

This brings the Report up to the present time and the present convention—the East and West Ridings Branch Association have been responsible for the idea of making the annual general meeting the occasion for a social as well as a business gathering and the Council felt that such an event would give members an opportunity of getting to know one another, which is a most important asset to the strength and usefulness of any organization.

Election of Officers

In proposing the re-election of Mr. D. Graham Bisset as chairman, it was stated that he had been president for seven years and that he had spent no fewer than fifty days during the past year on Confederation business. The resolution was enthusiastically adopted. The two vice-chairmen Mr. R. Chisholm and Mr. J. T. B. Swift were also

(*Continued on page* 31 (*Advert. section*))

Steel Castings and their Application*

By Frank Rowe, B.Sc., F.I.I.A.

A steel casting is the strongest and toughest of all the cast products. Additionally, by varying the composition or the heat-treatment, a very wide range of mechanical properties can be obtained in a steel casting—much wider than in any other cast material.

One of the most valuable properties of a steel casting—and one which is often overlooked—is its freedom from directional properties. One is apt to forget that the mechanical properties to be associated with rolled or forged steel are those which the material possesses along the directions of the flow lines only. When tested at right angles to the flow lines, the toughness and ductility are usually very low compared with those obtaining in every direction in a steel casting. In Tables I and II are reproduced the data from a series of tests† designed to compare the properties of wrought and cast steels. Thus a sound, properly heat-treated, steel casting is the strongest and toughest form in which steel can be produced.

Casting steel in refractory moulds is the most direct method of producing a steel structure in its final form, and there are fewer limitations than in any other steel-forming process to placing the metal where it is most needed for maximum strength and thus securing the minimum weight without excessive and expensive machining operations. In other words, a steel casting requires less machining than a forged or wrought product because it can be cast nearer to its final shape.

Unfortunately, to realize to the maximum the whole of the possibilities of a steel casting requires great skill, both on the part of the designer and the founder, due to the fundamental and unalterable behaviour of steel when cooling from the liquid to the solid state. It is the most difficult of all materials the founder has to handle. Even with a casting of perfect design—of which there are not many, nor can there be—there are three major factors which make the material more difficult to cast than any other.

The first of these factors is the large amount of shrinkage which takes place while the liquid steel is cooling down and also whilst it is changing to the solid state. The total volume change from molten steel in the ladle to the final cold casting is over 11 per cent. The second is the low strength and ductility of cast steel at temperatures immediately below the freezing point, *i.e.*, around 1,480 deg. C. Hence any stress put on the castings immediately after solidification, due to temperature differences within the castings or by restricting the free solid contraction of the casting, may cause "hot-tears." Hot-tears are one of the major bugbears of the steelfounder, and most careful design, as well as most knowledgeable foundry practice, is needed to avoid them. The third important disadvantageous factor is the high melting point, and, therefore, high casting temperature—1,540 to 1,600 deg. C.—of steel. Moulds and cores must be constructed of a material sufficiently refractory to avoid "burning on" or sintering of the mould and corefaces, strong enough to withstand the pressure and wash of molten steel flowing on to and over them, and yet elastic and compressible enought not to hinder seriously the contraction of the steel after freezing, particularly in its "tender" range, which is just below the freezing point.

To these three factors can be attributed most of the difficulties of the steelfounder. The basic fundamental necessities to secure a sound casting are well known and appreciated by steelfounders and their technical and metallurgical staffs. But, in many cases, designers and users expect a higher degree of freedom from shrinkage and other defects in their castings than they have a right to expect from the designs they put out.

* A paper read before the Customer/Founder Convention organized by the British Steel Founders' Association. The Author is managing director of K & L (Steelfounders and Engineers) Limited.

† For wrought steels, all test-pieces were cut from 6 in. dia. bars, except for 0.40/0.45 per cent. carbon steel in the heat-treated condition, and the Mn/Mo steel in the 55/65 tons per sq. in. condition. These were treated in the sections specified in B.S. 970 for the stated condition, namely 2 in. section and 2½ in. section respectively, although cut from 6 in. dia. stock. For cast steels, all test-pieces were cut from clover-leaf bars.

TABLE I.—*Chemical Composition of Samples Tested in the Wrought and Cast Conditions.*

—	C	Mn	Si	S	P	Ni	Cr	Mo
0.20 *per cent. carbon steel*								
Wrought EN.3A.. ..	0.22	0.81	0.20	0.010	0.040	0.16	tr.	tr.
Cast KL.201 ..	0.21	0.80	0.40	0.014	0.031	—	—	—
0.40 to 0.45 *per cent. carbon steel*								
Wrought EN.8	0.41	0.74	0.28	0.033	0.035	0.16	tr.	tr.
Cast KL.501 ..	0.42	0.69	0.40	0.019	0.023	—	—	—
Low-alloy Mn/Mo steel								
Wrought EN.16 ..	0.38	1.53	0.12	0.017	0.030	0.10	tr.	0.16
Cast KL.111 ..	0.34	1.35	0.40	0.027	0.033	0.70	0.55	0.31
1½ *per cent. Ni/Cr/Mo steel*								
Wrought EN.24	0.39	0.84	0.28	0.010	0.025	1.38	1.04	0.28
Cast —	0.38	0.62	0.39	0.020	0.028	1.57	0.74	0.35

Steel Castings and their Application

Models Preferable

Steelfounders would be helped immeasurably, and the use of steel castings increased considerably, if all designers of steel castings regarded as a necessity the need for them to understand why shrinkage spots, hot tears, and sand inclusions occurred in the steel castings they had designed. It is not sufficient for a designer to submit a finished two-dimensional drawing to the steelfounder and ask for his comments. It is up to the designer to know the nature and properties of the material he proposes to use before he puts pencil to paper, so that the whole conception, from the start, is based on accurate fundamental knowledge.

It must be remembered, also, that a two-dimensional drawing is often little guide to where dangerous "hot spots" (the main cause of shrinkage defects) will occur in a casting. Where maximum soundness is a prime desideratum, and particularly where a casting is to be repetitive, the making and section of a full-size or scale model in wood will nearly always show where improvements in design (with the object of securing a sounder casting) can be made.

In designing a casting for weak metals like cast iron or non-ferrous alloys, little other consideration need be paid by the designer than fairly simple basic questions like "Is it mouldable?" or "Can the cores be got out?" But, with steel castings of any appreciable size or weight, other and more difficult considerations are involved. High liquid shrinkage has to be compensated for by large feeding heads. The average yield of a good steel foundry is 50 per cent. That means 100 tons of molten steel is needed to produce 50 tons of castings. The other 50 tons go largely in feeding heads. Additionally, a steelfounder has to try to arrange his moulding and casting methods so that the casting solidifies progressively and evenly from bottom to top. Where this cannot be achieved, "hot spots," causing shrinkage cavities, occur.

Feeding heads can only be effective within certain limits. It is axiomatic that a thick section in the casting cannot be "fed" through a thin section. The thin section freezes too quickly to be of value as a channel to compensate for liquid shrinkage in a thick section. The founder then has to try to get a feeding head direct on to the thicker section or promote even solidification by means of metal chills in the mould. A designer should try to get a uniform thickness of metal in a steel casting, but, as is well known, in most designs this is impossible. But it is often possible to change the metal thickness gradually to avoid abrupt changes of section and sharp corners. Abrupt changes of section and sharp corners are a prevalent source of "hot-tears."

Another frequent cause of dissatisfaction in steel castings is sand inclusions. Many of these arise from the founder failing to hit exactly that nice balance between a sufficiently rigid and strong mould or core so as to resist pressure and wash of the metal and one which will permit the casting to contract freely while cooling down. They may also be caused by wrong positioning of the orifices by which the molten steel enters the mould. But they are often also caused by unnecessarily difficult designs. Small or thin core or mould projections must, of necessity, be weak, and the flow of steel through complicated mould passages may result in portions of the mould or cores being broken off, resulting in sand being entrapped in the casting.

In a short Paper such as this it is impossible to do more than skim over the outstanding features, nor is it suggested that any or all steelfounders know all the answers to the many difficult problems both in design and manufacture. There are hundreds of research and process metallurgists, as well as foundry technicians, at work on them in research establishments and steel foundries throughout the world, and there is not merely regular, but constant, interchange of ideas and experience between the 200 or 300 major steel foundries that there are in the world.

The steel casting is a most important component of engineering construction. As temperatures, pressures, and stresses rise—as they do and will continue to do—so the standards of soundness and severity of inspection will rise, and it is becoming increasingly important that more than lip service is paid to the ideal of co-operation between the designer and the maker of steel castings.

Road to Improvement

It would be an important step forward if chief engineers of companies who rely on steel castings for the excellence of their finished products would arrange for the draughtsmen and designers who design those castings to spend a few days or a few weeks in one or other of the steel foundries making a speciality of those castings in which they are interested. Time spent by them in the methods department of the radiographic laboratories, and the inspection departments of such foundries would give them a real insight into the problems involved. Some of these—often nearly insoluble—are unwittingly and perhaps needlessly created by the designer himself. Design staff would be most welcome, and, with their greater knowledge of what can and what cannot be done in a design, and what working stresses are involved, there is every likelihood that they might remove some of the troubles which they are all unconsciously causing.

There is also another point on which the steelfounder is sometimes ignorant—perhaps through his own fault. That is the degree of absolute soundness which is really essential in any particular casting. Absolute soundness—*i.e.*, grade A radiographic soundness—is expensive to secure. It is essential for such castings as those for aircraft, for high temperature and pressure valves, and turbine castings. The steelfounder has to live in a competitive world, and he is sometimes ground between the upper millstone of the exacting requirements of the designer and the nether millstone of the natural proclivities of the designer's colleague—the buyer. A steelfounder may sometimes hesitate to put forward what he really needs, both in time and cost, if the designer's requirements are to be met in full, lest the orders should go elsewhere. Here, again,

TABLE II.—*Comparison of Mechanical Properties of Equivalent Wrought and Cast Steels.*

Type of steel and condition.	Wrought steels.										Cast steels.				
	In direction of rolling.					At 90 deg. to direction of rolling.									
	Yield strength, tons per sq. in.	Tensile strength, tons per sq. in.	Elong. per cent. on 2 in.	Red. of area, per cent.	Izod value, ft.-lb.	Yield strength, tons per sq. in.	Tensile strength, tons per sq. in.	Elong. per cent. on 2 in.	Red. of area, per cent.	Izod value, ft.-lb.	Yield strength, tons per sq. in.	Tensile strength, tons per sq. in.	Elong. per cent. on 2 in.	Red. of area, per cent.	Izod value ft.-lb.
Plain carbon steel (0.20 per cent.-carbon steel, normalized) ..	18.0	32.4	20.0	46.0	40	17.6	31.2	15.0	12.0	11	17.8	31.6	30.0	44.7	35
0.40 to 0.45 *per cent. carbon steel*: (normalized) ..	21.2	39.2	20.0	36.5	21	20.8	37.2	10.0	10.3	10	23.2	40.0	24.0	33.0	18
(quenched and tempered to 40 tons per sq. in.) ..	—	47.6	23.0	44.7	41	—	48.4	17.0	23.2	12	—	48.6	22.0	40.0	35
Low-alloy Mn/Mo steel, (quenched and tempered to 45 to 55 tons per sq. in.) ..	—	48.0	24.0	52.3	79	—	48.0	16.0	29.3	9	35.5	49.6	23.0	43.4	56
(quenched and tempered to 55 to 65 tons per sq. in.) ..	—	59.6	21.0	50.9	57	—	57.6	10.0	23.5	12	54.0	61.6	17.0	32.0	44
1¼ *per cent. Ni/Cr/Mo steel* (quenched and tempered to 55 to 65 tons per sq. in.)	—	60.8	19.0	49.8	72	—	56.0	5.0	6.9	29	53.7	60.4	16.0	35.0	45

greater co-operation, and perhaps greater appreciation of what is involved would help. There has been, particularly in recent years, a fair degree of rationalization in steel foundries. There has been an increasing tendency for steel foundries to limit the range of work which they will tackle to enable them to concentrate their metallurgical and technical staffs over a narrower range of problems. Obviously this has been of benefit both to the founder and the customer. Particularly in notably difficult and complex castings is this to be applauded.

No-one wants to limit competition unduly or prevent the entry of a newcomer to a field where he feels he can do a good job. On the other hand, a feeling that expensively-acquired experience might be wasted and methods which, while ensuring greater soundness, would raise seriously the cost, would not be appreciated or recompensed, is not the best atmosphere in which to secure concentration on the highest possible quality.

Recent Progress

Because this Paper is largely devoted to the difficulties between designer and founder, as is proper to a Convention of this kind, it should not be assumed that great progress has not been made in the last 10 or 15 years. The advent of industrial radiography in the steel foundry has enabled great strides to be made in foundry techniques, both with properly and improperly designed castings. The first plant to be installed in any foundry was put in in 1935, and, since then, every foundry dealing with high strength and high pressure castings has increasingly used radiography—both X- and gamma-rays—to help with the problems. A wealth of research work on all the problems has been done, sponsored both by individual steel foundries and associations of steelfounders both in this country and elsewhere. This has led to a greater understanding of the somewhat complex phenomena of steel casting solidification and other steelfoundry problems, and has led to vast improvements in steelfoundry techniques with a resultant greater degree of soundness and freedom from defects.

Despite the rise in consumption of steel castings in this country in recent years, there is still a great deal of room for a wider use in all branches of engineering products. As an example, the experience of the U.S.A. can be quoted. Not only is the consumption of wrought steel twice as high per head of the population as in this country, but so is the consumption of steel castings.

It is on this basis of an ever-increasing and widening field for the use of steel castings that the B.S.F.A. is formulating its plans and particularly those for the extension of its co-operative research work in the British Steel Castings Research Association.

A free interchange of views and experience, such as is provided by this Convention, can only lead to a greater understanding of the problems which exist and a greater realization of the need for designers and founders to attack them jointly. Much remains to be done, but there is little doubt that it will be done because when there is a material and a method of forming it which gives the strongest possible structure known to metallurgical science, steelfounders must pursue their aim to make the best possible use of it.

Book Review

Fatigue of Metals, by R. Cazaud, translated by A. J. Fenner. Published by Chapman & Hall, Limited, 37, Essex Street, London, W.C.2. Price 60s. net.

A successful modern novel and its film version, have recently popularized the problem of fatigue in metals, yet it is more than a hundred years since this distinctive type of failure was first studied by engineers. We have now nearly forgotten the unfortunate primitive explanation of the fractures as being due to "crystallization," and by the use of the microscope and the X-ray spectrometer research workers have noted the changes which actually occur within the original crystals of a fatigued metal. Theories of fatigue were discussed in Gough's book of 1926, and in more recent years the importance of concentrations of alternating stresses at surface discontinuities in metallic structures has become increasingly apparent in connection with these failures. In 1937, the first French edition of Dr. Cazaud's book was printed and much of its appeal lay in its emphasis on this latter aspect of the problem. Thus the publicity given to German work on the behaviour of welded joints, especially in unmachined metal, impressed the reader with the weakening effects of notches and bad surface finish.

Foundrymen may not look upon weld beads as being essentially castings, but, they do appreciate the pros and cons of good surface finish, and will be sympathetic with Dr. Cazaud's outlook. The third edition of his book appeared in 1948 and five years later this English translation by Mr. Fenner has been published. Five years involve quite a time lag, but the translator has taken the opportunity of mentioning some further research work which has been completed since 1948. Even this hardly brings the book up to date, though the index may be at fault in prompting such a conclusion. The well-known name of Almen is not listed, though his work on shot-peening is mentioned on page 315. Ageing effects in steels are not indexed, but they are discussed on page 144. The recent work done at Cambridge by Weck and others on the fatigue resistance of welded structures does not appear to receive attention.

Those of us who are interested in castings are referred to pages 100 and 106 for cast iron, but only the last page gives results. Fatigue values for a few alloy cast irons are listed in an indifferent way, and one is chiefly impressed by the good results of a single malleable iron (not indexed) the analysis of which is not given. Nodular iron does not come into the picture, but iron crankshafts receive a good deal of notice in connection with design. If one is involved in the production of cast details with good surface finish, using perhaps the lost-wax process of "shell moulding," then the many references to surface roughness and its effect on fatigue will be of interest. Several results are given for cast light alloys, and whilst the fatigue limit for wrought aluminium-bronze may be as high as ± 25 kg. per sq. mm. this is reduced to about ± 15 kg. per sq. mm. for the cast alloy "owing to casting defects such as inclusions, blow-holes and microscopic cavities." The author seems to assume that all metals have a definite fatigue limit except in the case of cast white metals for bearings, but this is not a universal belief.

The book reads easily, but here and there the English terms are unusual, and all values are given in the metric system. A tool steel on page 100 contains "pearlite granules" and rails are called "railway lines," whilst on page 116 the microstructure of a 16 per cent. Cr steel is given as ferrite. These details do not condemn the perspective of a work the publication of which is described by Dr. Gough in a Foreword as "a notable event."

H. O'N.

American Contracts for Sheffield Castings

It is reported that English Steel Corporation, Limited, of Sheffield, have recently received orders for a number of large steel castings intended for plant to be built in the United States in connection with the defence programme. The American authorities have only just agreed to the release of this information although some of the castings have already been produced and are to be despatched this month. According to a statement by the firm, these orders are important not only because of dollar earning, but also because they call for steel castings of greater size than any previously produced in this country, the heaviest weighing approximately 170 tons and requiring about 210 tons of liquid steel in its production. Patterns as large as a normal prefabricated house have been used for this work. In addition a specially-constructed vehicle is being built to transport the castings from Sheffield to the port of despatch, and the combined gross weight of vehicle and castings will be about 230 tons.

It is also reported that an important agreement has recently been concluded between the General Steel Castings Corporation, of Granite City, U.S.A., and the English Steel Corporation, Limited, of Sheffield, two of the largest producers of special castings in the two countries. The American company is among the foremost producers in the world of special castings for locomotives, carriages and wagons, and under the agreement the English Steel Corporation will produce in quantity special railway castings which they have already been developing. An interchange of information on design and foundry technique is also envisaged.

Losses on South African Contract

A loss of more than £250,000 on a contract for South African Railways is shown by the North British Locomotive Company, Limited, Glasgow, Britain's biggest private builders of locomotives, in its accounts for last year. Further heavy losses on the same contract are expected this year and next. In a preliminary announcement on the accounts for the year to December 31, 1952, the company stated: "The trading results shown have been seriously affected by the substantial loss amounting to £261,000, mainly incurred on a contract for electric locomotives of an exceptional type for the South African Railways, placed with the company in 1948. "It is expected that during the next two years further losses on the same contract, amounting to £175,000, will be incurred." Despite these losses, however, the directors are of the opinion that the financial position remains sound and accordingly, besides paying the final dividend of 2½ per cent. on the Preference stock, it is proposed that the Ordinary dividend be maintained at 5 per cent.

I.V.E. Section Notes

At the annual general meeting of the Institute of Vitreous Enamellers, Midland section, held last month, the following officers were elected or re-elected for the next session:—As *chairman:* Mr. A. W. Murdoch; as *vice-chairman:* Mr. A. G. Read; as *committee:* Mr. Baldwin, Mr. Bayliss and Mr. Legg; as *hon. secretary:* Mr. D. Sleath and as *hon. lanternist:* Mr. Rodway. Mr. Williams then gave a paper on "Development of Castings for Vitreous Enamelling" and a lively discussion ensued. At the conclusion, a vote of thanks was proposed to the retiring president.

Association of Bronze and Brass Founders

Annual Survey and Technical Report

A general meeting and the annual meeting of the Association of Bronze and Brass Founders were held on Wednesday of last week at the Connaught Rooms, London. Mr. W. R. Marsland presided over both.

The following firms were elected to membership:—Richard Thomas & Baldwins, Limited, Swansea; J. Blakeborough & Sons, Limited, Brighouse; British Engines, Limited, Newcastle-upon-Tyne; Bowen & Company, Limited, London, and David Flanagan, Limited, Ayr.

President's Report

The president then delivered the Annual Report in the course of which he said:—

The past year had been a very important one for the Association, one in which notable work had been done and one in which the name of the Association had been kept well in the news. Notable was, of course, the productivity conference held at Harrogate in June and many expressions of appreciation of the worth of this conference had been received. He believed the stimulus to thought which it provided as well as the practical application of processes and techniques which were described were leading to improvements and economies in the foundry generally and were revitalizing the atmosphere in which members worked. As time went by, they would yield increasing benefits to all. Unfortunately, this conference, undertaken for the benefit of the whole industry, involved the Association in a loss of £173. The "Proceedings" of this conference, which had been widely distributed, was an attractive publication. The Association was indebted to the proprietors of FOUNDRY TRADE JOURNAL for the very great help which they gave with this volume.

An International Foundry Conference had been held in Paris under the auspices of the Organization for European Economic Co-operation. The president had attended, supported by members of the Brassfoundry Productivity Team. In addition, the president had accepted an invitation to attend a conference on technical matters organized by the British Steel Founders' Association at Ashorne Hill and had also attended, with the secretaries, a meeting of the British Productivity Council in London during March. This co-operation with other associations was of benefit to members of the Bronze and Brass Founders' Association.

The chairman of the Association's technical committee would later present a report, but he stressed how greatly he esteemed the work that the committee was doing and again pointed out that it was for the benefit of the whole brassfoundry industry in the country. The president thought that the sub-committee which had drafted the Joint Services Code of Inspection Procedure should be particularly congratulated on the work carried out in this direction.

The Council had watched the interests of members with continued vigilance. They supported the successful appeal which ensured that the supply of Mansfield sands would not be restricted by building encroachment and had also represented to the Ministry of Supply that other important sand deposits should be safeguarded in the same way to ensure adequate supplies for industry in the future.

The Council had kept under review the metal position which had changed so greatly in the past twelve months, and had supported, through its representative on the scrap advisory committee, the relaxing of controls, at the same time advocating that metal, which could be used here, should not be exported, so ensuring ample supplies in this country at competitive prices.

The Association had maintained good relations with the Ministry of Supply and Ministry of Materials and also with allied trade associations. It had had helpful informal conversations with representatives of the British Bronze and Brass Ingot Manufacturers' Association on ways and means of providing funds for research and other developments of importance to the bronze and brass foundry industry. This would be discussed later.

Local Meetings

Meetings had been held in the various areas and, being informal, continued to provide a valuable means for the exchange of views and information. The president had attended meetings in each area, with the exception of Yorkshire, and he apologized to the Yorkshire members for the circumstances which made it impossible for him to be present. He particularly thanked the Scottish members for organizing at short notice such a well-attended and successful meeting in Glasgow last month. In the London area, the meetings were now preceded by a short talk on some matter of current interest. Members in other areas might well consider whether this arrangement would not be of value to them.

The annual theatre party on the evening preceding the annual meeting continued to grow in popularity and this also was valuable in promoting friendship between members. The Association was very grateful for the valuable publicity which the Press gave to the Association by publishing notices and reports on meetings and on their general activities.

The fact that the work which was done was of benefit to all brass founders was a very good reason why more of them should lend their support. Membership had increased slightly during the last year and was now 101, but it was hoped that the good work which the Association was doing would be brought to the attention of non-members and that there would be an increase in membership in the coming year. The president was very grateful for the support he had received from the vice-president, members of the Council, the technical committee, the Editor of the "Bulletin" and the many other

Association of Bronze and Brass Founders

members who had contributed to the work of the Association. On some occasions, it had been difficult to come to a decision on delicate problems, but when such an occasion had arisen there had always been some member of the Council or the Association to whom he had been able to appeal for advice.

Technical Committee

The report of the Association's technical committee was presented by its chairman, Mr. Lancaster, who said four normal quarterly meetings had been held, as well as a special meeting to consider the draft Code of Inspection Procedure. All had been well attended. The committee had had two main activities, one the preparation of the draft Joint Services Code of Procedure for the Inspection of Copper-base Alloy Castings and secondly consideration of amendments which might be desirable to specification B.S. 1400—1948, with which were allied proposals for encouraging the greater use of alloys in this British Standard.

Proposals for the Code of Inspection Procedure were a logical sequence to the report of the committee for the standardization of engineering products (the Lemon Committee) and the call for economy and efficiency in industry. About 18 months ago the Association submitted an outline of their proposals on this matter to the co-ordinating committee, but it was then realized by them that the general subject was under consideration with the Federation of British Industries which it was thought precluded them from dealing with the matter. However, the Association's committee had reiterated their views on the desirability of action in this matter, with the result that in July last representatives met the Admiralty working party on inspection procedure, and shortly afterwards delegates of the Ministry of Supply. As a result, the Association undertook to prepare a Code for the consideration of the Admiralty and Ministry of Supply.

Inspection Code and B.S. 1400 Revision

Mr. B. R. Higgins had drafted a code which was considered at a special meeting of the technical committee on December 18; it was approved after agreement on certain amendments. Copies of this proposed code were handed over to representatives of the Admiralty and Ministry of Supply on Janrary 13 of this year.

The technical committee had tried to produce a single document which would comprise details of all tests which might be required for copper-base alloy castings, stating a scale of tests for each category, the records to be kept and for what period and the procedure for release of castings. It was hoped that the authorities would adopt a common procedure and that delegation of authority would be practised widely.

British Standard 1400 had been in existence for five years and was due for review; the technical committee had anticipated this by sounding opinions on the subject. It appeared that for those alloys particularly susceptible to zinc and phosphorus loss in melting, the ingot should have a higher content of these elements than the casting specification. This would be proposed for alloys LG1, LG2, PB1, PB2, PB3 and LPB1. It was also thought that three alloys which were little used, G2, LG1 and SB1, might, without detriment, be omitted from the schedule and members' views were requested upon this and the proposals for adding a limited number of new alloys.

Following a suggestion of the British Bronze and Brass Ingot Manufacturers' Association, it had been agreed in principle that the technical committees of the two associations should form a joint sub-committee to review and form agreed recommendations for amendments to the present standard. The main aim was to promote the use of B.S. 1400 specifications to the gradual exclusion of many others now in use. To achieve this B.S. 1400 must be reasonably comprehensive but not overburdened by a number of alloys closely resembling each other.

The Association was very pleased that the British Non-Ferrous Metals Research Association had agreed to do some work on the creep properties of gunmetals and also on rapid methods for analysis.

It was with great regret that the Committee lost during the year the services of Mr. P. D. Crowther who had been a valuable member for some six years, and who had presided with such distinction. They welcomed to the Committee Mr. A. L. Wakeling, of Bull's Metal & Marine, Limited.

Continuing the proceedings, a minor amendment to the constitution concerning representation of the industry as a collective body in dealing with Government Departments was approved. In response to the appeal issued by the National Foundry College to help in furnishing the model foundry in the new buildings now being erected, it was decided to grant a token payment from the Association and recommend members individually to contribute as desired.

Annual Meeting

The tenth annual business meeting then followed and routine matters—apologies for absence, minutes, and accounts were dealt with. It was then proposed, seconded and resolved that Mr. W. R. Marsland should be president of the Association for the ensuing year and Mr. G. A. Woodruff, vice-president. To fill five vacancies on the Council Mr. E. J. Brooke (Aluminium Bronze Company, Limited), Mr. A. J. N. Brown (Steven & Struthers Limited), Mr. F. G. Burrell (Shipham & Company, Limited), Mr. G. H. Charsley (Trent Foundries Limited), and Mr. P. B. Higgins (Yorkshire Engineering Supplies Limited) were elected. The technical committee was re-appointed *en bloc* and Mr. E. J. Brooke was elected to fill the vacancy on the Publicity Committee, due to the resignation of Mr. W. B. Leigh. Representatives to serve on kindred bodies and committees were re-elected, except that Mr. A. F. Raynor of Anti-Attrition Metal Company, Limited, was elected to serve on the City and Guilds of London Institute Committee. Finally, it was proposed and resolved that Heatcote & Coleman, chartered accountants be appointed secretaries to the Association for the ensuing year and thanks were accorded for their valuable services in the past.

Evolution of Vitreous-enamel Formulæ*

By A. W. Murdoch

(*Continued from page* 392)

Period 1925 to Present-day

The period 1925 to the present day has seen several developments of great importance to the enamelling industry, and it may be well at this point to consider the main enamel groups or types separately as:—(1) dry-process enamels for cast iron; (2) wet-process enamels for cast iron and (3) wet process enamels for sheet steel.

Dry-process Enamels for Cast Iron

In this field, progress has not generally been so marked as with wet-process enamels. Ground-coat compositions, basically of borax, felspar and quartz, have altered little in character during the period. The high lead-content, once considered essential, has gradually decreased from around 20 per cent. PbO to as low as 2 per cent. PbO. This has necessitated alterations to the K_2O, Na_2O, B_2O_3 and silica in order to obtain a mechanically strong coating. The Author cannot, in this context, refer in detail to the uses and the functions of the different enamels, but it should be understood that this type of ground-coat, particularly, must have distinct mechanical, as well as chemical, properties. Lead-less, dry-process ground-coat enamels have also been developed, which are proving increasingly popular, and although nothing particularly striking has taken place with these ground-coats, it is noteworthy that they are increasingly used even amongst the "old school" of enamellers. Typical formulæ are shown in Table IX.

TABLE IX.—*Typical Dry-process Ground-coats Enamels for Cast Iron, 1925 to Present-day (compositions per cent.).*

Constituent.	A.	B.	C.
Silica (SiO_2)	50	55	60
Boric oxide (B_2O_3)	8	12	14
Sodium oxide (Na_2O)	5	7	10
Potassium oxide (K_2O)	7	10	8
Alumina (Al_2O_3)	10	14	8
Lead oxide (PbO)	20	2	—
Classification :	High lead.	Low lead.	Lead-less.

It will be noticed that as the lead content decreases, the silica and boric oxide contents increase. (The silica and alumina give the mechanical strength, while the Na_2O, K_2O, B_2O_3 act as fluxes, replacing the lead. Some of these ground-coats, particularly the lead-less type, contain small amounts of cobalt or manganese oxides, which are considered to improve the adherence. Ground-coats comprised of well-mixed raw materials have also been used during this period.

Dry-process, white cover-coat enamels, during the last 25 years, show a changeover almost completely from those containing lead to lead-less types. Although lead-less, dry-process cover-coats were manufactured earlier, their use was limited owing to the ease of application of leaded enamels, and only fairly recently have the lead-less frits superseded those containing lead. The use of tin oxide as a melted-in opacifier has now been replaced by antimony oxide, and although this is to-day the most popular type of dry-process, white cover-coat, recent developments have produced a much more dense white enamel by zirconium opacification. Enamels of the antimony type can also be acid-resisting, where this quality is desirable. Typical formulæ showing the evolution of dry-process white cover-coats are given in Table X. There is no real demarcation as to when one type of dry-process enamel was superseded by another, in fact, all the classes mentioned were being used during the same period. However, to-day frits containing lead are obsolete, even if only because of the high quality of lead-less types.

TABLE X.—*Typical Dry-process White Cover-coats for Cast Iron (Composition per cent.)*

Constituent.	Lead/Tin.	Lead/ Antimony.	Lead-less Antimony.
SiO_2	25	25	25
PbO	10	10	—
SnO_2	10	—	—
Sb_2O_3	—	6	8
ZnO	10	10	14
Na_2O	10	12	14
B_2O_3	10	10	12
K_2O	8	8	8
Al_2O_3	7	7	7
BaO	—	6	6
CaF_2	10	6	6

Arsenic oxide was occasionally added, in amounts varying from ½ to 1 per cent. in order to increase the density of either the tin- or antimony-opacified enamels.

Wet-process Enamels for Cast Iron

These enamels have made distinct progress during the last 25 years, again, the distinctive feature being the elimination of lead from the formulæ (see Table XI). Ground-coats for cast iron depend to a large extent upon mechanical as well as chemical properties to promote adherence, so that frequently their composition may bear close resemblance to that of the cover-coats, although opacification, if present, is derived by different means. Lead-bearing ground-coats were used in the 1930's, but the most popular of this period were the matte-surface ground-coats. These were very high in refractories and very open in structure, and often they were compounded by mixing a very refractory frit in varying percentages at the mill with refractory raw materials. The sintered ground-coat was also in use, and these last two were lead free. Raw ground-coats, again free from lead, were also in use, as were the not-so-popular glossy-surface type.

All these, except the lead-bearing enamels, have survived to-day, when the use of ground-coats on

* Paper presented to the Midland section of the Institute of Vitreous Enamellers, Mr. Ball presiding. The Author is superintendent, Ferro Enamels Limited.

TABLE XI.—*Wet-process Ground-coats for Cast Iron.*

	1.	2.	3.
SiO_2	60	56	38
Na_2O ..	14	14	7.5
K_2O	3	7	2.0
Al_2O_3 ..	5	0.5	2.0
B_2O_3 ..	8	15.5	18
CaF_2 ..	10	—	19
CoO	—	0.3	—
MnO_2 ..	—	0.7	—
BaO	—	—	3.5
ZnO	—	—	10

Description: (1) Very refractory type used with mill addition of 10 per cent. clay and 25 per cent. quartz; (2) non-glossy sinter type, 100 per cent. frit, 6 per cent. clay at mill; and (3) glossy type, clay added at mill.

cast iron has become necessary in many instances where direct-on cover-coat enamels could be used a few years ago. With the lead-bearing cover-coats for cast iron of 25 years ago, the lead content varied from 10 to 30 per cent., and the ease of application, combined with low firing temperature and the ability to flow, ensured their popularity. They were gradually superseded by the lead-less type, where barium carbonate and zinc oxide replaced the lead content in the formula. The main opacification was derived from antimony oxide in the melt in practically all cases. The lead-less enamels also widened the range of colours which could be obtained, and thus increased the popularity of the vitreous-enamel finish. Direct-on cover-coat enamels for cast iron were developed by the use of formulæ which embodied the necessary fluidity, workability and coefficient of expansion. The use of barium carbonate and zinc oxide increased the fusibility of the lead-less enamels, dehydrated borax was incorporated into many formulæ, and this class of enamels improved in covering power and density, although the type remained the same—still deriving its opacity mainly from antimony oxide.

Recently-developed enamels for cast iron, coincident with the adoption of titanium enamels for steel, are not yet in general production and use, but the laboratory stage is passed. Acid resistance had been obtained by employing a high silica content, but, in the early 1930's, the use of titanium dioxide as a partial substitute for silica in the formula gave rise to the introduction of more workable enamels in this class.

Table XII shows typical examples of the range of formulæ used to-day, compared with the leaded enamels of 25 yrs. ago.

TABLE XII.—*Wet-process Cover-coat Formulæ for Cast Iron (parts by weight).*

	1925–1930.	In current use.	
	Lead-bearing.	Lead-less	A.R. Lead-less.
SiO_2	20–25	25–30	30–40
Na_2O ..	10–20	15–20	15–20
B_2O_3 ..	3–6	8–12	6–8
PbO	10–30	—	—
Sb_2O_3 ..	0–5	0–5	0–5
ZnO	0–2	8–12	0–10
K_2O	1–4	3–6	0–6
Al_2O_3 ..	3–5	2–5	0–5
BaO	—	5–8	0–8
CaF_2 ..	2–5	5–10	2–3
TiO_2 ..	—	—	5–10

Fundamentally, therefore, in the late 1930's, the use of acid-resisting enamels for cast iron was very much on the increase, particularly in the cooker industry, and the demand has been even greater since 1945. Black enamels for cast iron have always found a ready market and, here again, lead-less types have become established. Cobalt, manganese, iron and chromium oxides are usually employed to obtain a good black colour, but occasionally copper, iron or nickel oxides are added as well. Formulæ modifications for this type have been directed during this period mainly to increasing the workability and acid-resistance, and here again titanium dioxide has proved its usefulness in replacing some of the silica.

Wet-process Enamels for Sheet Steel

Twenty-five to 30 years ago, it was considered that ground-coat enamels for sheet steel should be fired at temperatures of around 900 deg. C. The formulæ in use, therefore, contained a high percentage of refractory, the silica content frequently being more than 50 per cent. of the total batch. The quartz and felspar contributed approximately equal proportions (of the silica) while the borax was usually one-third of the total material weight. Compositions were fairly simple and might contain only sodium carbonate, sodium nitrate and fluorspar together with those materials already mentioned, and the oxides of cobalt, nickel and manganese. The high percentages of cobalt were evidenced by the distinct blue coloration present in the fired ground-coat. Manganese was generally added to darken the colour, as it is doubtful whether at this time the bubble structure had been considered. Nickel oxide became gradually more important in replacing the more expensive cobalt, and so the very blue ground-coats became less blue.

During the 1930's, attention was given to the alteration of formulæ to reduce the temperature of fusing, until prior to 1940, firing at 840 to 860 deg. C. was considered to be quite adequate. This, of course, meant the re-formulation of ground-coats for sheet-steel not just reducing the refractory content, and expansion coefficient had to be considered as well as the viscosity of the molten glass. Other materials were introduced, such as cryolite, barium carbonate and calcium carbonate. Pursuing this drop in the fusing temperature still further, ground-coat formulations were made, which, some two years ago, produced enamels firing out at 780 deg. C. or lower. Generally, how-

TABLE XIII.—*Composition of Typical Black Enamels for Cast Iron (parts by weight).*

Constituent.	Lead-less Non-A.R.	Lead-less A.R.
SiO_2	30–35	40–45
Na_2O	12–15	8–14
B_2O_3	15–18	6–10
Al_2O_3	3–6	0–3
K_2O	0–5	2–4
CaF_2	8–14	2–6
BaO	2–5	0–8
ZnO	0–5	0–4
TiO_2	—	5–10
CoO	0–0.5	0–0.75
MnO_2	0–1	0–1.5
Cr_2O_3	0–0.3	0–0.3

ever, it is necessary to use two or more ground-coat frits in an enamel in order to obtain the properties required for commercial handling. Nevertheless, to-day, sheet-steel ground-coat combinations can be used over a very wide temperature range, by blending the correct quantities of the right frits. This is extremely useful where a variety of steels has to be used, which are not always of good enamelling stock. Iron oxide and copper oxide have also found their way into sheet-steel ground-coat formulæ, and these again affect principally the colour of the fused enamel.

The theory of cobalt oxide and adherence cannot be discussed at this time, but it should be borne in mind that ground-coats containing nickel only, and brown in colour, also have excellent adherence to the steel. White ground-coats for sheet steel also receive consideration from time to time, and although they are not popular, due to greater care being required in handling and metal preparation, their potential usefulness makes them more than a laboratory curiosity. These may contain such materials as antimony or zirconium oxides in the proportion of from 2 to 6 per cent. of the batch weight, and typical formulæ were shown earlier. Modifications were made to these white ground-coats by the introduction of one or more of the oxides of cobalt, nickel or manganese in very small amounts. It is claimed that as little as 0.05 per cent. of cobalt oxide improves the adherence of the ground-coat to the steel. These light-coloured ground-coats were stated to "cover" more easily than the blue-black ground-coats, although this probably is of no consequence to-day when white cover-coats of super opacity and covering power are available readily.

The silica content of the batch may be introduced as quartz, silica sand, felspar, sodium-silico-fluoride or china clay, and also as a constituent present to some small extent in many other raw materials. The nature of the material adopted to introduce this silica naturally influences the physical properties of the final enamel. For instance, silica introduced as felspar is always less refractory in its action than either quartz or sand, so that the final frit is softer or more fusible even although the SiO_2 content is similar. Softer ground-coats, therefore, generally contain a higher felspar-to-quartz ratio than the harder ones. Also, in the softer range the ground-coat compositions become more complicated as a larger variety of raw materials is introduced to obtain fusibility, consistent with desired working properties and adherence. Table XIV shows three types of composition ranges typical of blue-black sheet-steel ground-coat enamels. Acid-resisting ground-coat enamels have also been introduced during the last ten years, and here again titanium dioxide has been utilized in their formulation (along with a lower felspar content and a subsequent increase in quartz or sand).

This leads to the last main section for consideration, that of cover-coat enamels for sheet-steel. Many people believe that this class of enamel has developed more rapidly than any other during the last 25 yrs., and in many ways this is probably so. If this is admitted, then, though not absolutely certain, it might be considered the reason why in America cast-iron wet-process enamelling has practically ceased at the present day. Gradually, sheet steel has been introduced where once cast iron was considered necessary. However, in this country, and in Europe generally, enamelling of cast iron is still holding its own.

TABLE XIV.—*Typical Formulæ of Ground-coat Enamels for Sheet Steel, 1925 to Present Day (parts by weight).*

	1.	2.	3.
SiO_2	45–55	40–45	28–34
Na_2O	10–14	12–15	15–18
B_2O_3	12–15	14–16	16–20
K_2O	3–8	3–8	3–8
Al_2O_3	5–10	5–10	8–12
CaF_2	2–5	4–8	8–12
CaO	—	—	0–2
MgO	—	0.1	—
NaF	—	—	0–2
CoO	0–0.25	0–0.5	0.75
MnO_2	0–0.75	0–0.75	1.25
NiO	0–0.75	0–0.75	1.00

Fusing temperatures: (1) 900 deg. C.; (2) 840 deg. C.; and (3) 780 deg. C., respectively.

Cover-coat Enamels for Sheet Steel.

It was stated that during the first 25 yrs. of this century there was a gradual reduction and in many cases elimination of the lead content of sheet-iron enamels, and that the main smelted-in opacifier was antimony oxide. During the 1930's, antimony-opacified enamels were improved considerably from the point of view both of opacity and covering power. There was a development which resulted in what were known as super-opaque white enamels—superior to any white enamels which had been used until then, for similar or better results than with the older enamels were achieved with thinner coatings of enamel.

To some extent this improvement coincided with the changeover to borax in the dehydrated form, in place of the more common hydrated borax of the day. The use of this material in enamel formulations resulted in speedier melting and shorter periods of time during which the enamel was in the "boiling" or effervescent stage. Consequently, there was less opportunity for the antimony opacifier in the batch to dissolve in the melt. Without a digression into smelting practice, it should be appreciated that happenings such as this have all played some part in the process of enamel evolution.

Acid-resisting enamels in this class were also gradually developed, which, by the inclusion of titanium dioxide in place of some of the silica, were rendered more easily workable and given a high degree of resistance to acid attack, combined with good opacity and covering power. Black and clear frits for sheet steel, during this period also, received attention, so that the range of colours which could be used became considerable. From the blacks, through different shades of blue frits, to the clear glazes—some especially made to take difficult colours such as red—there was during the 1930's increasing stress upon colour. With the white, black and clear frits, greater fusibility and decreased temperature of firing, with all their added advantages, were always under consideration, and steadily the tendencies evolved until 820 to 830 deg. C.

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replaced the higher firing temperatures of earlier years. This move coincided with the introduction of lower-temperature firing ground-coat enamels.

When war came at the end of 1939, the industry naturally suffered a severe set-back, but still development work was continued, and when possible, not only were pre-war enamels revived, but completely new types were available. Frits based on zirconium opacification, with better covering power at lower application weight than the antimony enamels were produced. However, it has not yet been possible to obtain a very high degree of acid resistance in zirconium enamels, despite the ever-increasing demand for this quality.

The class of self-opacifying titanium enamels has become well known in the industry and, undoubtedly, this is an achievement of a high order. It was only in the early 1930's, that titanium dioxide was first introduced into enamel formulæ, and some fifteen years later, this material was found to be of supreme importance,. So much so, that most of the development work with white enamels to-day is centred around its use. Adequate covering power can be obtained with one coat of titanium enamel of about 0.005 in. thickness compared with from 0.012 to 0.015 in. for antimony enamels. The appearance is a dense white, the surface is very glossy (compared with antimony enamels) and the resistance to acid attack is of a very high order.

To-day, then, cover-coat enamels for sheet steel cover a wide range of available frits (Table XV). The older antimony types are still of importance; there are zirconium-opacified, non-acid-resisting whites of good covering power; titanium self-opacifying enamels for white and certain colours; clear frits for self colours; and blue or black frits for really dense colours. Even within these boundaries of general types, there have been developments within the last few years. The introduction of lithium compounds as enamel raw materials has given rise to the enamels of low firing temperature now in use, and while 780 deg. to 790 deg. C. may be a quite usual firing temperature to-day, it might conceivably be still lower consistent with other conditions.

Current Developments

Of current developments within the industry, perhaps foremost, and certainly one of the most interesting, is in the high-temperature field. Enamels have been developed for coating stainless steels which will resist temperatures within the 1,000 deg. C. range. The aircraft industry, particularly, is most interested in development of such enamels, which can be used to coat very expensive components and, because of the protection given, much increase their service life. Alternatively, in the same field, heat-resisting enamels for low-alloy or mild steels have been produced, and this suggests the possibility of replacing expensive metals with suitably-coated, cheaper materials. These coatings have been made possible not only by the use of some materials new to enamel manufacture, but also by the application of science and research to the industry. One formula for this type of enamel is the American National Bureau of Standards. A.417, enamel which is made up of 70 parts of frit to 30 parts of chromium oxide in the mill addition. The frit itself contains beryllium oxide, 2.5 per cent., and is free from alkalies. Other compositions incorporate prepared fused silica with an orthodox refractory frit. In fact, there are several coatings of this type to-day which but 25 years ago would have been considered revolutionary. It has frequently been suggested that, at some time in the future, it should be possible to apply white cover-coat enamels to sheet steel without the use of a ground-coat. This is to-day no idle dream; it can be done with very successful results, and the next few years may see the full-scale development of such a procedure.

During this Paper, no mention has been made of enamels for aluminium, although again in this field progress has been made, particularly in the production of such frits of low-firing temperature which are free from lead. The old-time majolica enamels, which contained a high lead content, and which were usually applied by dry methods, have been duplicated with wet-process, lead-less frits. These, as well as being free from poisonous material, offer a wider colour range in this class of enamels.

TABLE XV.—*Typical Formulae of Cover-coat Enamels for Sheet Steel (parts by weight).*

	Antimony.		Zirconium.	Titanium.		Clear.	Black.
	1.	2.	3.	4.	5.	6.	7.
SiO_2 ..	35–40	45–55	20–25	40–45	35–40	45–50	45–55
Na_2O ..	14–18	12–16	10–15	8–12	8–12	12–18	10–15
B_2O_3 ..	8–12	3–6	12–16	10–14	12–16	10–15	5–10
K_2O ..	2–4	—	1–3	5–10	8–12	3–8	2–8
Al_2O_3 ..	5–10	—	6–12	0–6	0–5	8–12	—
Sb_2O_5 ..	6–10	6–10	—	—	—	—	—
ZnO ..	2–4	0–2	2–6	—	—	—	—
NaF ..	6–8	0–4	5–10	0–4	0–4	—	0–4
BaO ..	—	0–2	—	—	—	—	—
CaF_2 ..	—	3–6	5–10	0–6	0–6	0–4	0–4
TiO_2 ..	—	3–6	—	14–20	14–20	—	3–5
CaO ..	—	—	0–4	—	—	—	—
ZrO_2 ..	—	—	10–15	—	—	—	—
CoO ..	—	—	—	—	—	—	0.5–1.0
MnO_2 ..	—	—	—	—	—	—	1.0–2.0
Cr_2O_3 ..	—	—	—	—	—	—	0–0.5
Li_2O ..	—	—	—	—	0.2–0.6	—	—

Notes: (1) Non-A.R. white; (2) A.R. white; (3) opaque non-A.R.; (4) fusing temperature, 820 deg. C.; (5) low-fusing-temperature enamel; (6) general composition for most colours (soft type); and (7) A.R. black.

Conclusion

Despite some omissions, the Author has listed certain points which have contributed towards the evolution of vitreous-enamel formulæ, and has tried to pick out certain landmarks and perhaps in conclusion these might be reviewed:—

(1) First, the probable start of the industry was by fusing pieces of glass on to metal; followed by the adoption of tin/lead glazes which, around the year 1600, had been modified sufficiently to give a fair, white covering. These, along with the early lead-bearing majolica enamels, were the foundations upon which formulæ were developed.

(2) The introduction of borax as a raw material, and the use of lead/tin and lead/arsenic enamels, on what one might loosely call jewellery of the 18th century, lead almost directly to enamelling of cast iron which was proceeding by the year 1800.

(3) Again, new base material necessitated the reformulation of enamels, in order to suit the metal better, and new raw materials such as felspar and fluorspar were introduced into the batch. The use of "ground-coats" as distinct from "cover-coats" began a classification which from that time onwards has never ceased to expand. It was not long (around 1850) before sheet iron was being enamelled and new formulæ again had to be developed. The quality of raw materials was by now steadily improving and, consequently, better enamels were produced. Up to this time, all enamels had been applied in the dry, powder form, but it was found that the addition of clay would help to keep this powder in suspension in water.

(4) Lead-less enamels gradually superseded those containing lead, antimony opacification was improved, more-fusible and better-workable enamels were produced, the introduction of titanium dioxide, the development of special types of enamels for specific jobs, all evolved in the period up to the present day.

What of the Future? That is always wrapped in secrecy and mystery, but one day, perhaps, enamellers may be able to produce their enamelled articles without the aid of sheet steel or cast iron or indeed any base which might spoil an otherwise perfect finish.

The Author wishes to record his thanks to the directors of Ferro Enamels Limited for the facilities given in the preparation of this Paper and for permission for publication.

DISCUSSION

MR. BALL, inviting questions said that many members could remember the industry prior to 1927, when there were no firms, or perhaps only very small ones, specializing in the supply of frit for enamelling. Before that, all enamellers made their own. Mr. Murdoch's study over the last 25 yrs. had been particularly interesting.

MR. CROXTON also congratulated Mr. Murdoch but criticized the absence of any mention of alkali-resisting enamel, which enamels had been made necessary by the use of detergents. Also what importance did Mr. Murdoch attach to the development of spraying equipment?

MR. MURDOCH said Mr. Croxton's criticism was justified. Alkali-resisting enamels should have been included to make the Paper complete.

With reference to spraying equipment, if this were included then also one must discuss furnaces, plant control, etc. Deliberately he had not wanted to bring in things such as equipment, which he knew had made great strides, and had contributed in no small measure to advancement in the industry.

DR. FISHER had an idea that watch dials used to have a white enamelled surface, but that seemed to have died out. Could the Author confirm that?

MR. MURDOCH said that would come under the heading of copper enamels. Usually the denseness of those enamels was obtained by a small addition of arsenic to some of the formulæ which he had given.

A MEMBER said that, in one Table, he thought of formulæ for cast-iron enamels, there was ammonium carbonate mentioned; what was the reason for this?

MR. MURDOCH said he could see no reason today for some inclusions during certain development periods. In some of these old enamel formulæ it was possible that some raw-material additions were either unnecessary or placed there deliberately to mislead. The man who made his own enamels, who has more frequently been referred to as the "hip-pocket" enameller, did not wish his formula to be known by anyone else. If such were passed on then some quite unhelpful addition or alteration might have been made. He could not see any reason for including ammonium carbonate.

Hydrated or Dehydrated Borax

MR. BALL thought there was a possibility that it was not introduced as a blind. It was possible that ammonium carbonate reduced sulphur absorption. Speaking of borax for instance, it was apparently generally accepted that it offered a saving to use the dehydrated variety in the formulæ. He quite agreed with the fact of the saving, but not that it gave a better enamel.

MR. MURDOCH said that if one were to use dehydrated borax in place of hydrous borax, then it might be necessary to make alterations to the particular enamel formula.

MR. BALL asked in what way a formula would have to be balanced for only a change of water content.

MR. MURDOCH said it could be done in two ways, and there was no doubt that in many instances, a definite advantage accrued from using dehydrated borax. The main thing was that the "boil" was quickly got through, and, in the case of antimony enamels, the opacifier did not go completely into solution in the melt.

ANOTHER MEMBER asked what were Mr. Murdoch's views on the use of sand or quartz as alternatives in enamel formulæ.

MR. MURDOCH agreed this was an important point. There could be quite a difference in the physical properties of the enamel whether the silica was added as quartz or in the felspar or some other raw material. There did not seem to be the

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same fluidity of the enamel during the smelting stage. As was known, if one substituted for felspar by adding silica, alumina and the alkalies, then a different result could be expected, depending largely upon the type of felspar being originally used and the raw materials added to replace it.

DR. FISHER asked what sort of sand was used for enamels.

MR. MURDOCH said it was not the type of sand used in a foundry, but, in certain instances, some sea-shore sands might be suitable. Sand of the Lochaline type was excellent. Frequently the material selected was a crushed and ground sandstone rock.

MR. GREEN asked, since there was no inclusion of nickel or cobalt, what promoted adhesion in white ground-coats.

MR. MURDOCH replied that antimony was usually there, or zirconium oxide, or both. Resort had to be made to other practices to obtain a satisfactory adhesion. Greater mechanical adhesion could be secured by obtaining more etch on the surface of the steel with the pickling process. Generally, for this type of ground-coat, a considerable amount of adhesion was contributed by mechanical means.

Colour Stability

MR. DONALDSON said vitreous enamelling of super-opaque cover-coat enamels had brought one or two troubles in its train, and asked if anything could be done to obtain colour stability which titanium enamels lacked.

MR. MURDOCH did not accept that all titanium enamels lacked colour stability. Provided that reasonable control was maintained during the enamelling process, then reasonable stability of colour could be expected. Referring to the coefficient of expansion of titanium enamels, generally, the range was from 260 to 280×10^{-7} cubic expansion. It was possible to raise that expansion, but by so doing frequently the acid resistance of the final enamel was decreased. It seemed, to-day that everybody in the industry wanted acid-resisting enamels. For colour stability, it might be that process control of these enamels in the shop needed to be greater, for he was confident that much colour instability could be tied down to lack of control of fusing temperature.

MR. DONALDSON agreed that one must emphasize acid-resistance and that colour instability could be due to application in the enamel shop, and temperature could have much to do with it, also muffle atmosphere.

MR. MURDOCH said that broadly speaking, incorrect muffle atmosphere had some effect on the colour stability of all enamels, particularly those more sensitive to it. Control of muffle atmosphere was absolutely necessary, for he was certain that the atmosphere inside some furnaces was not known. If more process control in the industry was practised, then there would be better stability of enamel colours.

MR. SEMPLE thought the industry had reached a stage in the development of enamels where developments of other things were awaited. What were the Author's views on the application of a cover-coat directly on to steel.

MR. MURDOCH had seen a white enamel being applied directly on to steel and the results had been excellent. A special method of preparation of the steel was necessary, but it was not a special steel. He believed that enamellers might expect advancements in enamels next year. From the enamel formulæ point of view, there was every reason to suppose that these would continue to improve, but when referring to the use of a white enamel direct on a steel base, then the quality of that steel must be very good.

Publications Received

The British Iron and Steel Research Association Annual Report, 1952. Published by the Association from 11, Park Lane, London, W.1.

Steady, if not remarkable growth is shown by this Report. B.I.S.R.A. now employs 400 people and enjoys an income of £474,000. A third research building is to be opened in Sheffield during the autumn. Details are printed of the work of the five divisions, the physics and chemistry departments, and the operational research station. Nearly half the book is taken up by appendices dealing with reports, committees and panels, staff and the like. The Report is well illustrated.

The Swinden Laboratories. Published by the Research and Development Department of the United Steel Companies, Limited, 17, Westbourne Road, Sheffield, 10.

Unlike a number of other publications dealing with research organizations, this one is essentially readable and tells in simple language just what each department is doing and why. There are no long catalogues of the equipment installed, neither is any attempt made to "blind the reader with science." It might well serve as a model for other research bodies to emulate.

Steel Castings for Oil Refiners. Published by the British Steelfounders' Association, Broomgrove Lodge, Broomgrove Road, Sheffield 10.

This is a timely publication as it deals with an ever-expanding industry, which is something between meticulous and pernickerty in its requirements. The pipe fittings the oil refiners use are subject to hard service conditions, and it was wise of the B.S.F.A. to give such an interesting, and it may be added artistic, account of the requirements of the oil refining industry vis à vis steelfounding.

All in the Day's Work. Published by the British Oxygen Company, Limited, Bridgewater House, London.

This beautifully illustrated brochure details the activities of this group of companies in both the industrial and medical fields, and gives a résumé of their overseas establishments. The only thing missing is the address of the issuing house!

The Industrial Management Bulletin, No. 69, issued by the Council of Ironfoundry Associations, Crusader House, 14, Pall Mall London, S.W.1, gives a comprehensive and careful analysis of the Report of the Chief Inspector of Factories for 1951, in as much as it has a bearing on the ironfoundry industry.

Developments at the August Thyssen Hütte

Reliable information regarding the long-term reorganization of the August Thyssen Hütte is now available. It will be remembered that, in May, 1952, the steel committee of the Organization for European Economic Co-operation considered the first project submitted by this works. This entailed an expansion of pig-iron capacity from 600,000 tons to 840,000 ton per annum, by repairing and putting back into operation the fourth of the existing blast furnaces. Crude steel capacity was to be expanded from 120,000 tons to 1,000,000 tons per annum. It was also announced, at that time, that the installation of a 66 in. continuous hot-strip mill was contemplated, which would process 600,000 tons of the annual ingot production, while the remaining 400,000 tons would be processed into semis and sections on the existing five-stand mill.

This phase of the plan is now well under way. The increase in pig-iron output seems to have been somewhat underestimated at 840,000 tons, since present production is running at 960,000 tons per annum. Four open-hearth furnaces are now operating with an output of about 250,000 tons per annum; and the installation of four Bessemer converters is well advanced.

A fifth blast furnace is to be installed which, it is estimated, will increase pig-iron output from the present 960,000 tons to 1,280,000 tons per annum. As a further step in a tentative long-term plan to expand the works to its pre-war crude steel capacity of 2,250,000 tons per annum, a fifth 30-ton Bessemer converter and a second 1,000-ton mixer are to be installed. Annual crude steel production would then be 1,000,000 tons of Thomas steel and 400,000 tons of open hearth. No additional extensions are envisaged for two or three years.

Increased Use of Titanium

Though much of the British Non-Ferrous Metals Research Association's work has been concerned with the improvement of materials and processes used by different sections of the membership, the Association also has in hand some more fundamental and longer-range work of less direct immediate application, says the chairman of the council, Lieut.-Col. R. M. Preston, in a statement accompanying the annual report.

He gives the examination of the properties of titanium alloys for the Ministry of Supply as an example. Titanium was not going to be a common industrial material in a few years' time, replacing steel, aluminium, etc. But its use for special purposes would spread rapidly.

Engineers' New Wage Claim

Representatives of the 38 unions affiliated to the Confederation of Shipbuilding and Engineering Unions decided in London last week to recommend that a new claim be made for an increase of 15 per cent. in the wage rates of all shipbuilding and engineering workers.

After the new claim has been considered separately by each union a final decision will be made at a meeting to be held in York on May 20. If granted the claim would add about £1 a week to the wages of skilled men and 17s. 6d. to those of unskilled workers.

European Steel Production Continues to Rise

Crude-steel production in Europe as a whole, excluding the U.S.S.R., showed a continuing tendency to rise during January and February, 1953, figures in the latest issue of the United Nations Economic Commission for Europe Quarterly Bulletin of Steel Statistics indicate. The rise, however, was not evenly spread over all the countries; France, Belgium, Luxembourg, Italy, and the Saar all showed decreases, particularly in February, a reflection of the fact that European net exports of finished steel to overseas markets fell by over 4,000,000 tons in 1952 as compared with 1951, and that this tendency continues into 1953.

The percentual increases in European production of raw materials and crude-steel in the production-record year of 1952, compared with the previous record year, 1951, as follows:—Coke, 16 per cent., iron ore, 10 per cent., pig-iron, 12 per cent., and crude steel, 9 per cent.

Most of the main European importers and exporters of finished steel were less active in 1952 than in 1951. Notable exceptions were Western Germany, where imports as late as December were continuing to rise steeply, and the United Kingdom, where imports were still high in December, although less so than in the middle of the year when the exceptional imports by the United States were at their peak.

British Rollmakers' Corporation

The increase in the trading profits for 1952 of the British Rollmakers Corporation, Limited, from £324,886 to £497,263, is due to several factors, such as the acquisition of Miller & Company, Limited, Edinburgh, the profit for a whole year from the company's new works at Crewe, and the expansion and reorganization programmes undertaken at other works, notably at the Coatbridge works of R. B. Tennent, Limited.

Extensions in course of construction at Coatbridge should be completed early next year and the additional melting capacity in view will enable the corporation to cast the largest steel rolls required in the U.K., states the chairman, Mr. Owen F. Grazebrook, in his review of the year accompanying the report and accounts.

Capital commitments at the end of 1952 amounted to £601,116. Expenditure of a further £365,000 had been approved at that date, and yet more projects are under consideration.

Recent Wills

CHARLESWORTH, J. H., scrap metal and iron and steel merchant, of Sheffield	£4,506
PARKINSON, A. E., of J. Parkinson & Son (Shipley), Limited, machine tool makers, etc.	£115,271
HOWARD, C. R., a partner of G. Howard & Sons, engineers and ironfounders, of Louth	£5,447
SWAIN, M. E., chairman of Matthew Swain, Limited, ironfounders, of Newton Heath, Manchester ...	£38,134
STORAR, BRIGADIER JAMES, chairman of Robert Stephenson & Hawthorns, Limited, locomotive builders, of Darlington, and of Vulcan Foundry, Limited, Newton-le-Willows	£15,267
FRENCH, SIR J. W., former chairman of Barr & Stroud, Limited, engineers, of Glasgow, who was one of the principal pioneers in the field of range-finding instruments and gun-sights	£125,174
DADE, C. H., late director of Clayton Dewandre Company, Limited, engineers, of Lincoln, and other companies, who was a member of the council of the Federation of British Industries	£73,953
KENRICK, G. W., a director of Baldwin, Son & Company, Limited, ironfounders, of Stourport-on-Severn, and of Archibald Kenrick & Sons, Limited, ironfounders, etc., of West Bromwich	£180,759

Personal

MR. B. H. SWAN has been appointed a director of Dueram Products, Limited, powder metallurgists, Boden Works, Chard, Somerset.

MR. F. W. JACKSON and MR. L. G. C. TUCK, M.I.M., have been appointed directors of Dualloys, Limited. Boden Works, Chard, Somerset.

MR. J. GILL, an iron founder, has again been nominated as a candidate at the coming elections for a seat on the Tipton Town Council.

SIR HARRY JEPHCOTT, a director of the Metal Box Company, Limited, London, W.1, has been elected president of the Royal Institute of Chemistry.

MR. S. A. DAVIES, formerly Midland Regional Controller of the Ministry of Supply, has been appointed adviser to the Committee of the proposed Birmingham Exchange and Engineering Centre.

MR. E. A. O'NEAL, Jun., chairman of Monsanto Chemicals, Limited, London, S.W.1, has been elected a director of Monsanto (Canada), Limited, and appointed president of the company.

DR. WALTER IDRIS JONES, director of research to the National Coal Board, has been elected unanimously by the council of the Institute of Fuel to succeed Dr. G. E. Foxwell as president for 1953-54.

MR. W. B. MOTUM, a special director of Vickers, and chief accountant of Vickers and Vickers-Armstrongs, has retired. He is succeeded as chief accountant of both companies by MR. M. G. SPRIGGS.

The degree of Doctor of Science of Glasgow University was conferred on DR. DAVID BINNIE, chief metallurgist of the Lancashire Steel Corporation, Limited, at the graduation ceremony on April 25.

MR. L. CHAPMAN, managing director of William Jessop & Sons, Limited, steelmakers and engineers, of Sheffield, sailed recently for the United States and Canada, to develop export trade in special steels, and to visit the firm's interests.

MR. W. WILSON has resigned his position as foundry manager at Western Foundries to join the Welwyn Foundry Company, Limited, Welwyn Garden City. MR. A. TALBOT, the foreman at Western Foundries, is being promoted to the position of foundry manager.

SIR ALEXANDER RAMSAY has retired from the directorship of the Engineering and Allied Employers' National Federation, a post he has held for 18½ years. A successor has not yet been appointed. Sir Alexander, who is 65, was Conservative M.P. for West Bromwich from 1931 to 1935. He is a former director of Ruston & Hornsby.

CHIEF ENGINEER and technical director for the past three and a half years, at Petters, Limited. Staines, Mr. C. H. Bradbury has been awarded the Percy Still medal by the Diesel Engine Users' Association for the best paper of the current session. The title of the paper was "Torsional Vibration in Diesel Engines—some Observations and Practical Aspects."

MR. J. T. SHARPLES, B.SC.TECH., A.M.I.E.E., recently resigned his position as engineer-in-charge of the heating element department, Metropolitan-Vickers Electrical Company, Limited, to take up an appointment as district engineer and manager (Northern Counties) with Barlow-Whitney, Limited, industrial heating engineers, London and Bletchley He will operate from their new address, 32 Deansgate, Manchester 3.

The President of the Board of Trade has appointed the following among new members of the Scottish Committee of the Council of Industrial Design:—MR. DAVID S. ANDERSON, director of the Royal Technical College, Glasgow; MR. T. COUGHTRIE, chairman and managing director of the Belmos Company, Limited, colliery and industrial switchgear manufacturers, of Bellshill (Lanark); and MR. W. RENNIE, chairman of Federated Foundries, Limited, Glasgow.

AFTER 45 years as traffic manager of Babcock & Wilcox, Limited, boilermakers, founders, etc., London, E.C.4, MR. W. R. CLARK LEWIS has retired. Joining the erecting department of the company in 1907, he eventually took charge of the traffic department on its inception in 1933. A member of the Institute of Transport, Mr. Lewis was also a member of the traffic committee of B.E.A.M.A. and the British Engineers' Association, being vice-chairman of the latter committee.

MR. NORMAN L. GOODCHILD has resigned his appointment as raw materials officer of the British Iron and Steel Federation. Mr. Goodchild was previously general manager of B.I.S.C. (Ore), Limited, and from 1939 to 1946, director for pig-iron and an assistant controller of iron and steel in the Ministry of Supply. He was one of the technical advisers to accompany the European Mission to America in 1947 in connection with the Marshall Plan. Prior to the war, Mr. Goodchild was an executive of the Stanton Ironworks Company, Limited, near Nottingham.

Obituary

MR. CYRIL GILBERT BLAKEY, who has died in a Leeds nursing home at the age of 56, was sales manager of Wilsons & Mathiesons, Limited, Scotch Foundry, Leeds. A native of Falkirk, he was employed by Carron Company on leaving school, and after Army service in the first world war, joined the Leeds firm.

MR. E. J. CRABTREE, general manager and a director of Ariel Motors, Limited, who died as a result of a road accident on April 25, first joined Ariels in 1926. From the service department he went to the buying office where he remained until he left to join the Triumph Engineering Company, Limited, as chief buyers in 1936. He returned to Ariel Motors, Limited, as general manager in 1950 and subsequently became a director.

THE DEATH is announced of Mr. Robert Anderson MacGregor, which took place at the Cancer Research Institute last Sunday. Mr. MacGregor was trained as a metallurgist at Sheffield University under the late Professor Arnold. After a period with the Stobie Steel Company pioneering an early type of electric steel-melting furnace, he joined Darlington Forge as metallurgist. Here were made some of the largest marine castings in the world. During this period he received a gold medal for a paper on fatigue cracks. His next appointment was as metallurgical inspector to the Government of India. When the last war broke out, he was designated director of munitions to the Indian Government and for his services he was made a Companion of the Indian Empire. After the war he remained in India as a consulting engineer to various large groups. Mr. MacGregor was a member of the Institution of Mechanical Engineers. His many business associates both at home and in the East will mourn the passing of a capable metallurgist, a wise counsellor and good friend.

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Imports and Exports of Iron and Steel in March

The following tables, based on Board of Trade returns, gives figures of imports and exports of iron and steel in March. Figures for the same month in 1952 are given for the purpose of comparison, and totals for the first three months of 1952 and 1953 are also included. All figures in tons.

Total Exports of Iron and Steel by Destination

Destination.	Month ended March 31.		Three months ended March 31.	
	1952.	1953.	1952.	1953.
Channel Islands	594	591	1,767	1,789
Gibraltar	83	91	210	620
Malta and Gozo	100	261	508	1,109
Cyprus	247	918	906	3,710
Sierra Leone	527	619	1,360	1,255
Gold Coast	1,846	6,964	8,427	13,769
Nigeria	3,637	7,272	13,399	16,245
Union of South Africa	12,958	17,801	37,672	45,106
Northern Rhodesia	2,405	2,728	7,644	8,212
Southern Rhodesia	4,814	4,798	11,973	13,426
Tanganyika	1,936	1,026	6,391	5,263
Kenya	3,623	5,572	12,188	18,693
Uganda	698	437	2,470	1,871
Mauritius	243	448	1,106	2,148
Bahrein, Qatar, and Trucial Oman	2,231	2,740	4,388	7,400
Kuwait	1,838	3,347	5,773	7,735
India	5,184	6,595	15,920	19,142
Pakistan	7,795	2,024	18,248	11,517
Malaya	5,323	8,257	19,356	20,302
Ceylon	2,098	3,002	5,653	6,766
North Borneo	287	360	891	1,779
Hongkong	1,020	3,059	3,804	8,049
Australia	36,575	13,856	94,672	59,222
New Zealand	7,863	12,867	32,891	36,617
Canada	16,352	17,545	43,492	36,923
Jamaica	2,820	1,871	7,197	6,302
Trinidad	3,648	3,559	12,881	13,301
British Guiana	309	642	1,176	1,348
Anglo-Egyptian Sudan	1,055	4,047	3,464	8,179
Other Commonwealth	1,940	6,462	7,491	20,134
Irish Republic	6,477	4,868	17,188	15,377
Soviet Union	—	1	1	3
Finland	6,854	2,427	18,272	9,164
Sweden	9,451	9,795	28,087	22,742
Norway	6,404	6,798	16,151	16,776
Iceland	102	277	409	635
Denmark	9,247	7,326	26,247	24,984
Poland	—	21	32	115
Western Germany	78	824	401	1,160
Netherlands	10,136	14,513	23,254	38,681
Belgium	849	1,886	2,205	6,022
France	172	736	732	2,347
Switzerland	769	980	2,187	2,326
Portugal	910	1,124	2,556	4,899
Spain	418	128	1,055	886
Italy	425	5,131	4,878	14,445
Austria	25	147	128	417
Yugoslavia	1,014	463	2,282	1,144
Greece	149	119	1,160	682
Turkey	1,080	1,009	2,285	3,017
Netherlands Antilles	1,022	1,024	3,672	4,358
Belgian Congo	407	155	868	644
Angola	237	720	1,829	997
Portuguese E. Africa	156	549	959	1,205
Canary Islands	124	10	363	257
Syria	272	373	544	416
Lebanon	2,109	444	4,226	1,817
Israel	1,090	445	4,531	2,368
Egypt	1,554	2,370	9,286	5,530
Saudi Arabia	727	216	1,640	733
Iraq	2,259	5,410	12,310	17,596
Iran	1,116	54	3,425	904
Burma	659	1,278	3,196	4,131
Thailand	678	624	2,179	3,003
Indonesia	1,920	724	3,655	2,901
China	—	68	—	71
Philippine Republic	320	106	1,378	642
U.S.A.	1,989	2,353	14,498	8,630
Cuba	140	333	608	859
Colombia	885	1,013	1,705	2,436
Venezuela	6,362	4,891	14,196	14,917
Ecuador	478	86	1,404	799
Peru	1,340	339	2,764	2,625
Chile	211	115	959	765
Brazil	1,936	286	4,878	1,339
Uruguay	729	121	1,772	314
Argentina	3,095	1,657	9,619	3,958
Other foreign	1,944	2,659	5,301	6,554
TOTAL	218,368	226,755	644,593	654,583

Total Imports of Iron and Steel and Origin

From	Month ended March 31.		Three months ended March 31.	
	1952.	1953.	1952.	1953.
India	—	34	44	101
Canada	6,202	13,934	14,236	38,416
Other Commonwealth countries and the Irish Republic	240	3,470	1,187	18,048
Sweden	2,963	1,723	7,349	5,958
Norway	7,213	6,408	17,175	16,917
Western Germany	9,038	2,837	24,283	7,429
Netherlands	12,901	11,451	34,373	26,499
Belgium	22,617	17,432	67,960	73,252
Luxembourg	12,944	9,077	39,018	36,723
France	21,866	33,276	70,446	83,321
Italy	465	112	2,178	2,961
Austria	5	49,128	20,151	100,065
Japan	12,748	21,447	26,442	31,517
U.S.A.	34,125	19,972	62,705	85,438
Other foreign countries	1,650	8,528	2,030	18,354
TOTAL	144,977	198,829	389,577	544,999
Iron and steel scrap and waste, fit only for the recovery of metal	28,833	55,921	114,651	180,336

Exports of Iron and Steel by Products

Product.	Month ended March 31.		Three months ended March 31.	
	1952.	1953.	1952.	1953.
Pig-iron	308	1,319	941	1,923
Ferro-tungsten	21	—	49	21
Other ferro-alloys	675	219	1,110	717
Ingots, blooms, billets, and slabs	31	33	108	79
Iron bars and rods	241	154	919	606
Steel and tinplate bars and wire rods	46	1,326	421	3,802
Bright steel bars	1,189	1,035	3,493	4,692
Alloy steel bars and rods	1,164	1,194	3,773	4,188
Other steel bars and rods	9,173	8,940	29,289	28,151
Angles, shapes, and sections	13,498	10,048	35,998	33,150
Iron and other castings and forgings	1,169	1,085	3,295	2,714
Girders, beams, joists, and pillars (rolled)	3,184	2,098	9,652	6,253
Hoop and strip	4,540	3,102	13,203	12,546
Iron plates and sheets	44	37	102	95
Tinplate	24,781	25,785	71,054	74,461
Tinned sheets	79	94	353	513
Terneplates and decorated tinplates	94	147	208	455
Other steel plate (¼ in. thick and over)	21,553	22,867	60,882	62,034
Galvanized sheets	5,259	8,093	16,130	24,383
Black sheets	10,945	13,758	34,683	34,715
Other coated plates and sheets	1,306	1,072	2,836	2,851
Cast-iron pipes up to 6 in. dia.	7,469	6,552	23,133	20,533
Do., over 6 in. dia.	5,830	7,739	16,103	17,288
Wrought-iron tubes	35,751	35,720	111,818	110,490
Railway material	18,519	23,468	51,354	62,261
Wire	4,687	5,310	14,100	14,049
Cable and rope	2,427	2,528	7,251	8,003
Wire nails, etc.	926	1,225	3,048	2,787
Other nails, tacks, etc.	484	283	1,830	888
Rivets and washers	595	492	1,601	1,371
Wood screws	391	126	1,105	549
Bolts, nuts, and metal screws	2,050	1,877	6,886	5,150
Baths	1,783	305	5,229	1,051
Anchors, etc.	620	562	2,068	2,624
Chains, etc.	916	727	2,781	2,396
Springs	478	421	1,523	1,172
Holloware	8,370	10,295	23,901	27,726
Doors and windows	1,748	1,663	5,504	5,482
TOTAL, including other manufactures not listed above	218,368	226,755	644,593	654,583

News in Brief

A FRENCH FOUNDRY GROUP has acquired, it is understood, controlling interest in a Dortmund coal-mining company from the (German) Flick iron and coal combine.

LAST WEEK'S debenture offers by Bakelite, Limited, makers of plastic materials, was heavily oversubscribed. The issue was £1m. 5 per cent. debenture stock, 1968-77, at par.

THE TELEPHONE NUMBER of the Central Manufacturing & Trading Company (Dudley), Limited, Halesowen Road, Old Hill, Staffs, has been altered to Cradley Heath 69434 (6 lines).

THE LINER Clan McQuarrie, of 7,000 tons, which was grounded at Borve, Lewis, in the January gales, is to be broken up for scrap, as is the 15,550-ton P. & O. liner Chitral which now lies inactive at Dalmuir.

BRITISH RAILWAYS carried a record tonnage of 355,200 tons of iron ore during the week ended April 18. During the same period 225,543 tons of iron and steel were conveyed from the principal steelworks.

THE MINISTRY OF SUPPLY announces that February saw the introduction of 1,864 tons of aluminium sand castings, 2,474 tons of gravity die and 670 tons of pressure die. Additionally 366 tons of magnesium alloy castings were made.

LORD ALEXANDER of Tunis paid a visit to the Rolls-Royce works, Derby, on May 1, and saw the production, research, and development of the company's aero engines. He was received at the works by Lord Hives, chairman and joint managing director.

LEWS CASTLE, which stands at the north end of Stornoway harbour, overlooking the town, is to be opened by Ross & Cromarty Education Committee as a technical college at the beginning of session 1953-54. It will be known as Lews Castle College.

STAFF of the Birmingham Aluminium Casting (1903) Company, Limited, will be entertained to a dinner and dance at the Grand Hotel, Birmingham, on May 15, by the management as part of the firm's programme for celebrating its golden jubilee this month.

BRITISH INSULATED CALLENDER'S CABLES, LIMITED, are showing a comprehensive range of cables and accessories on stand H.601 at the Central African Rhodes Centenary Exhibition being held at Bulawayo, Southern Rhodesia, from June to August, 1953.

THE TRUEMAN WOOD LECTURE on "Training for Science and Technology," will be delivered by Sir Richard Southwell, M.A., LL.D., D.SC., F.R.S., at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, on Wednesday, May 13, at 2.30 p.m.

THE ROYAL YACHT Britannia recently launched by H.M. the Queen was built to the requirements of the Admiralty by John Brown & Company, Limited, Clydebank. Murex "Vodex" arc-welding electrodes were extensively used for the welded work on this fine vessel.

A RESIDENTIAL COURSE for technical personnel and works engineers using liquid fuel is being arranged by the Ministry of Fuel and Power in collaboration with Cambridge University authorities, from June 29 to July 1 at the Cambridge University Engineering Laboratory.

TWO NEW CONTRACTS for Port Glasgow shipyards have been received. Wm. Hamilton & Company, Limited, are to build a large turbine cargo vessel of about 9,000 tons for the Brocklebank Line, Liverpool, and Ferguson Bros., Limited, are to build a twin-screw tug for the Nigerian Government.

IN HIS ANNUAL REVIEW, Mr. F. A. Perkins, chairman of F. Perkins, Limited, Diesel-engine manufacturers, of Newark (Northants), states that the company's 1952 turnover expanded to a record figure of £11,374,203 for 1952, an increase of £2,025,219, or 22 per cent., over 1951. Nearly £8,000,000, approximately 70 per cent., of the turnover represents exports shipped to 118 countries.

ELECTRO-MAGNETS, LIMITED, of Bond Street, Birmingham, have now received a pilot order for experimental work worth £15,000 to provide machinery for metal reclamation on the new Pitsea scheme for the Ministry of Supply. On a South Wales land-reclamation scheme involving eight million tons of refuse a year, it is thought that 8,000 tons of scrap steel could be reclaimed per week.

THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION, of 11, Park Lane, London, W.1, are organizing a conference on heat-treatment practice, to be held from June 15 to 17. The programme is now available. Dr. H. H. Burton, the Chairman, is a director and chief metallurgist of the English Steel Corporation, Limited, Sheffield. Readers wishing to attend the conference should write to Mr. A. M. Sage at the above address.

CONTRASTING the two Elizabethan eras, Mr. T. Dixon, who was elected president of the Walsall Chamber of Commerce on April 27 said, "What Drake and his merry men would have thought or done had they known that half or more of their treasure would go to the Treasury, I don't know, but I think the spirit of daring and adventure would have suffered." There was no doubt, he added, that the present level of taxation was killing the willingness to take risks that made this country great.

A SEVERE CRISIS has hit Scottish light castings foundries and slump conditions prevail in the Falkirk area —the heart of the industry. This was the picture given to the Commons last week by Mr. Malcolm MacPherson, Labour Member for Falkirk and Stirling. Unemployment in the area, he said, had risen from 850 in October to 1,600 in March and there was also a great deal of under-employment and short-time. Import restrictions, particularly by Australia, had hit the industry—also home demand had dropped away for its domestic and building products.

A. LUSON & SONS, LIMITED, of "Gem" Works, Minerva Road, Park Royal, London, N.W.10, announce that they have recently instituted a research and development department in their works, in connection with which they offer a free technical consulting service to all branches of industry. Their experience has taught them that there is a great need for such a service as many large industrial concerns have been found to be using methods where the application of wire brushes would considerably increase efficiency and reduce operating costs. Readers are invited to avail themselves of this service on application to the technical manager of Lusons, making reference to this Journal.

AN ENCOURAGING OUTLOOK for trade and industry, despite increasing competition, was forecast by Mr. T. G. Robinson in his presidential address on April 27 at the quarterly meeting of Glasgow Chamber of Commerce. Although the future might be difficult and strenuous, he said, it would be anything but gloomy. Perhaps never since Britain's flying start in the industrial era was the inventive genius behind our goods "shining more brightly to the world at large." Nor did he think was greater study ever given to achieving efficiency in production methods in our factories. For various other reasons, he thought they should find that Britain was in a much better position to compete with the U.S.A. and Continental countries than had been the case for many years.

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Raw Material Markets

Iron and Steel

Announcing the Government's decision to end the rationing of iron and steel, in the House of Commons on Tuesday, Mr. Duncan Sandys, Minister of Supply, said that the output of iron and steel in general had been steadily increasing. It was expected that home production of steel in 1953 would be about 1,300,000 tons more than in 1952. Subject to the continuance of a voluntary scheme for the distribution of steel plate, the Government was satisfied that iron and steel rationing was no longer necessary.

Originally introduced in 1940, and continued until May, 1950, iron and steel rationing was reintroduced in full by the Labour Government in the autumn of 1951 following a temporary measure of allocation introduced to ensure supplies for the defence programme. The Labour Government's decision was endorsed by the new Government when it assumed office, rationing being brought into operation on February 4, 1952.

The flow of raw materials to the foundries is about equal to demands and, apart from hematite pig-iron from home furnaces, there appears to be little difficulty in acquiring adequate supplies to implement the reduced demand for castings. The engineering and speciality foundries which utilize hematite in their mixtures are able to obtain supplies of imported iron, which is easing the supply position appreciably. The other grades of pig-iron mostly used by these foundries—the low- and medium-phosphorus irons—are plentiful, as also is high-phosphorus iron for the light and jobbing foundries.

Some refined-iron makers need additional orders to maintain capacity outputs, although the demand for this grade has been increased by the shortage of hematite. Producers of the foundry grades of pig-iron have little tonnage for stock after current demands are satisfied. Most foundries are ordering only the quantities needed for immediate consumption in view of the uncertainty of forward business; in fact, some prefer to utilize their stocks instead of taking up their current allocations. It is hoped, however, that the reduction in purchase tax, together with a possible expansion in export trade, will result in some improvement.

Output of pig-iron is mainly directed to the steelworks, whose requirements of basic pig-iron are heavy. Of the aggregate tonnage of pig-iron produced, only about one-third is in hematite and foundry grades, and a large percentage of the former is diverted to the steelworks. Supplies of home scrap are being received in much larger tonnages by steelworks in some areas than others, but overall quantities still compel the use of a much larger proportion of pig-iron in the melting furnaces, and the shortage of raw materials, particularly scrap, is preventing the restarting of furnaces at present out of commission. Scrap supplies to the foundries are generally sufficient for current consumption.

Many of the re-rollers are very short of the small sized billets of 2 in. to 3 in. square. They have difficulty in fixing up a rolling programme for small sections and bars, being dependent on day-to-day deliveries. Little, if any, help is being obtained from imported material, and home steelworks are unable to send increased tonnages. The re-rollers of the larger sizes of sections and bars have fared better, good deliveries having been forthcoming of the larger sized billets from home steelworks. Most of the work on hand is for home users; there has not so far been any improvement in export trade following the recent reduction in price for small bars. The sheet re-rollers are not so heavily employed on the thinner sheets, but they have plenty of orders for the thicker gauges, for which they are in need of larger supplies of the thicker sheet bars.

Non-ferrous Metals

The Minister of Materials announced in the House of Commons on Monday that, after reviewing the situation in all its aspects, the Government had decided that private trading in copper should be restored at the earliest practicable date. The necessary notice was being given to the Commonwealth producers and from August 5 the private import and sale of copper would be permitted and the Copper Distribution Orders would be revoked. He understood that the London Metal Exchange would reopen for dealings in copper on the same day.

The Minister went on to acknowledge the co-operation of Commonwealth producers who had supplied this country throughout the long period of public trading and would, he was sure, continue to do so under the new arrangements.

So far as values are concerned, copper seems, temporarily, at any rate, to have settled down at 30 cents, apart, of course, from the Chilean valuation at one end of the scale and cheap offers from Germany at the other. Consumers in this country are certainly of the opinion that we are going to see a lower price within the next two or three months, and this being so they are clinging to their policy of buying hand to mouth, believing with good reason that they can hardly go wrong in this since stocks in the U.K. are so large. The only way in which this might not work out too well for them would be if the Government were to decide to freeze an unduly large proportion of the tonnage, placing at the disposal of the market a comparatively modest amount.

Following the course of the London lead market, which rallied in no uncertain fashion in the first half of last week, the U.S. quotation advanced by ¼ cent to 12¼ cents. No change was made in zinc, which remained at 11 cents, and on the Commodity Exchange futures of these two metals fluctuated day by day. In Whittington Avenue price movements were rather wide. Tin was also under pressure.

As we write, there is no change in the aluminium quotation, which, it will be remembered, dropped £5 when copper was reduced, but whether this will happen again remains to be seen.

Official tin quotations were as follow:—

Cash—April 30, £715 to £720; May 1, £690 to £695; May 4, £727 10s. to £732 10s.; May 5, £737 10s. to £742 10s.; May 6, £750 to £755.

Three Months—April 30, £710 to £715; May 1, £690 to £695; May 4, £720 to £730; May 5, £740 to £745; May 6, £752 10s. to £755.

Official prices of refined pig-lead were:—

May—April 30, £78 10s. to £79; May 1, £77 to £77 10s.; May 4, £78 15s. to £79 5s.; May 5, £80 17s. 6d. to £81 2s. 6d.; May 6, £80 to £80 5s.

August—April 30, £77 10s. to £78; May 1, £76 to £76 10s.; May 4, £78 to £78 5s.; May 5, £80 to £80 5s.; May 6, £79 to £79 5s.

Official zinc prices:—

May—April 30, £67 to £67 10s.; May 1, £64 10s. to £64 15s.; May 4, £67 to £67 10s.; May 5, £69 15s. to £70; May 6, £68 12s. 6d. to £68 15s.

August—April 30, £67 15s. to £68; May 1, £65 5s. to £65 10s.; May 4, £67 10s. to £68; May 5, £70 5s. to £70 10s.; May 6, £69 to £69 5s.

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

(Delivered unless otherwise stated)

May 6, 1953

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 18s.; Birmingham, £13 11s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £16 14s. 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, £17 0s. 3d.

Scotch Iron.—No. 3 foundry, £16 11s., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 3s.; South Zone, £18 5s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 3s.; South Zone, £19 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, £16 12s.; Scotland (Scotch iron), £16 18s. 6d.; Sheffield, £17 13s.; Birmingham, £17 19s. 6d.; Wales (Welsh iron), £16 18s. 6d.

Basic Pig-iron.—£14 6s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered).

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45 per cent. Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75 per cent. Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. to 11s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204 to £210 per ton; 38/40 per cent., £235 to £265 per ton.

Ferro-tungsten.—80/85 per cent., 22s. 10d. to 23s. 6d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 25s. 9d. to 28s. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60 per cent. Cr, scale 28s. 3d. per unit: 6/8 per cent. C, £80 17s., basis 60 per cent. Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr; max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £262 to £275 per ton; 96/98 per cent., £280 to £295 per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 40s. to 70s. per lb., Nb + Ta.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £26 2s. 6d.; hard (0.42 to 0.60 per cent. C), £28; silico-manganese, £33 16s.; free-cutting, £28 16s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 12s.; case-hardening, £33; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s.; acid, up to 0.25 per cent. C, £33.

Sheet and Tinplate Bars.—£25 11s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £30 6s. 6d.; boiler plates (N.-E. Coast), £31 14s.; floor plates (N.-E. Coast), £31 15s. 6d.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £28 9s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 4s. 6d.; flats, 5 in. wide and under, £32 4s. 6d.; hoop and strip, £32 19s. 6d.; black sheets, 17/20 g., £41 6s.; galvanized corrugated sheets, 24 g., £50 13s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £51 14s. 3d.; nickel-chrome, £73 3s. 6d.; nickel-chrome-molybdenum, £80 18s. 3d.

Tinplates.—57s. 9d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £253; high-grade fire-refined, £252 10s.; fire-refined of not less than 99.7 per cent., £252; ditto, 99.2 per cent., £251 10s.; black hot-rolled wire rods, £262 12s. 6d.

Tin.—Cash, £750 to £755; three months, £752 10s. to £755; settlement, £750.

Zinc.—May, £68 12s. 6d. to £68 15s.; August, £69 to £69 5s.

Refined Pig-lead—May, £80 to £80 5s.; August, £79 to £79 5s.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £94 15s.; rolled zinc (boiler plates), all English destinations, £92 15s.; zinc oxide (Red Seal), d/d buyers' premises, £99.

Other Metals.—Aluminium, ingots, £161; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £70 10s. to £71 (nom.); nickel, £483.

Brass.—Solid-drawn tubes, 23d. per lb.; rods, drawn, 32⅜d.; sheets to 10 w.g., 273s. 6d. per cwt.; wire, 30½d.; rolled metal, 241s. per cwt.

Copper Tubes, etc.—Solid-drawn tubes, 28⅞d. per lb.; wire, 282s. 9d. per cwt. basis; 20 s.w.g., 311s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £172 to £218; BS. 1400—LG3—1 (86/7/5/2), £182 to £238; BS. 1400—G1—1 (88/10/2), £274 to £375; Admiralty GM (88/10/2), virgin quality, £275 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £300 to £385; L.P.Bl, £224 to £275 per ton.

Phosphor Bronze.—Strip, 368s. per cwt.; sheets to 10 w.g., 389s. 9d. per cwt.; wire, 43⅜d. per lb.; rods, 40d.; tubes, 38½d.; chill cast bars: solids 3s. 3d., cored 3s. 4d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising 2s. 5¾d. per lb. (7 per cent.) to 3s. 8¾d. (30 per cent.); rolled metal, 3 in. to 9 in. wide × .056, 2s. 11¾d. (7 per cent.) to 4s. 2¾d. (30 per cent.); to 12 in. wide × .056, 3s. to 4s. 3d.; to 25 in. wide × .056, 3s. 2d. to 4s. 5d. Spoon and fork metal, unsheared, 2s. 8¾d. to 3s. 11¾d. Wire, 10 g., in coils, 3s. 6½d. (10 per cent.) to 4s. 8¾d. (30 per cent.). Special quality turning rod, 10 per cent., 3s. 5½d.; 15 per cent., 3s. 11¼d.; 18 per cent., 4s. 4d. All prices are net.

Ironfounders' National Confederation

(*Continued from page* 524)

re-elected. Mr. W. A. Douglass, Mr. A. L. Nadin, Dr. A. Ivanhoff and Mr. G. C. Pierce were elected to the Council.

The present membership was reported as 257, representing a gain of eleven during the year.

Employers' Organizations

That afternoon was devoted to the delivery of lectures by Mr. Shelton and Dr. Ivanhoff.* The former dealt with services rendered by trade associations and employers' organizations, whilst the latter covered the subject of the modern training of foundry technicians.

Mr. Shelton first reviewed the origin and evolution of trade associations, and showed that it was after the 1914 war that they received recognition as being a necessary part of the national economic life. The movement had grown so that there are to-day about 1,200 trade associations of all types in this country. In 1939, the existence of these bodies was of the utmost use to the Government departments, and this fact made them indispensable to-day. There is little uniformity in the activities of these associations but the one common factor was that each is the nerve centre of the industry represented.

Organization and Administration

Mr. Shelton deemed it best to separate into different bodies, those dealing with labour and those engaged on commercial matters. Membership was always on a voluntary basis and members should have the interests of their industry at heart. He also favoured in national bodies the appointment of an independent chairman. This relieved a company director from being neutral when the affairs of his own company called for an expression of opinion.

Activities

After dealing with finance, Mr. Shelton listed the following activities as being representative:—Research and development; standardization; uniform costing and exchange of information on costs; the pooling and interchange of patents; adoption of standard contract terms; joint advertising campaigns; uniform trade terms; market surveys; safeguarding of interests and the interpretation of legislation; negotiation with distributors and Government departments and publication and dissemination of trade statistics. The ultimate consumer was not a victim but a beneficiary of these activities, as an industry rendered hard up through insensate competition could not give proper service either to customer or workpeople. Finally, Mr. Shelton dealt with co-operation with the trade unions.

The final day was taken up with a golf competition at which the cup was won by Mr. Bisset's son and the ladies' trophy by Mrs. T. Lee, wife of the president of the National Ironfoundry Employers' Federation. Both awards were presented by the chairman at the closing banquet. This very enjoyable Convention was organized by Mr. Forbes Baird, the director and his capable secretary.

* To be reported *in extenso*.

CLASSIFIED ADVERTISEMENTS

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

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

SITUATIONS WANTED

PURCHASING OFFICER, M.P.O.A., with large concern Ironfounders and Vitreous Enamellers, desires change. Excellent knowledge of trade and valuable connections.—Box 3465, FOUNDRY TRADE JOURNAL.

FOUNDRY PLANT ENGINEER, young, energetic, executive experience of design, development, maintenance, and technical sales, seeks working Partnership.—Box 3454, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (35), M.I.B.F., accustomed to large foundry and all classes of engineering castings up to 12 tons, grey, high duty, non-ferrous, practical and technical, requires position, preferably in the Midlands. Not afraid of hard work to get results.—Box 3453, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (44), M.I.B.F., desires progressive post. Experienced full control of jobbing, engineering, and mechanised foundries. Capable organiser; good profit record; sound experience costing, estimating, for competitive markets.—Box 3433, FOUNDRY TRADE JOURNAL.

URGENTLY WANTED, position as Manager or Foreman small Midlands Foundry; fully practical man with life experience trade; 46; M.I.B.F.; take full responsibility running and development; grey, malleable, non-ferrous; salary quite secondary for prospects; West Midlands.—Box 3441, FOUNDRY TRADE JOURNAL.

EXPERIENCED FOUNDRYMAN; 46; resident Midlands; car owner, phone, etc., requires urgently full time Representation reputable foundry; steel, grey, malleable, non-ferrous, experience wide range castings; practical and technical ability; excellent connections business 60 miles radius Birmingham.—Box 3442, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 *inclusive or a woman aged* 18-59 *inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order* 1952.

QUALIFIED METALLURGIST required for the control of whiteheart malleable iron production. A person who has experience of gas annealing preferred. Write giving details of age, training, experience, etc., to Box 3447, FOUNDRY TRADE JOURNAL.

RADIOGRAPHER required. A.I.D. Approved. Ferrous Metals, and having experience with heat resisting alloys, for Investment Casting Foundry.—Apply in writing, giving particulars of training, experience, and salary required, to JOSEPH LUCAS, LTD., Formans Road, Sparkhill, Birmingham, 11.

SITUATIONS VACANT—*Contd.*

PATTERNMAKERS required for small master shop in Kent. Good wages for accurate clean workers.—Apply, CHARLES MANN & SONS, Ross Street, Rochester. 'Phone Chatham 3014.

STEEL Foundry SUPERINTENDENT required by North-East Coast Founders. Must be fully experienced and knowledgeable in all aspects of modern foundry practice. Good salary and prospects for first-class man of the necessary technical and managerial calibre.—Send fullest details to Box 3459, FOUNDRY TRADE JOURNAL.

REPRESENTATIVE required to cover the South Midlands area for the sale and servicing of a well-known range of Core Binders. Practical experience in the use of these products essential and an existing connection decidedly advantageous. Payment by salary and commission.—Box 3451, FOUNDRY TRADE JOURNAL.

METAL PATTERN PLATE FITTER required, with experience in pattern making, wood and metal (moulder's apprenticeship an advantage), as ASSISTANT FOREMAN in a Malleable Iron Foundry in the Home Counties. Permanent position with good prospects.—Apply, giving full details of age, experience, etc., to Box 3464, FOUNDRY TRADE JOURNAL.

HOOVER (ELECTRIC MOTORS), LTD., Cambuslang, Scotland, invite applications for the post of METALLURGIST. Candidates must possess a Degree or Higher National Certificate in Metallurgy. Experience of pressure die-casting and chemistry preferred. Salary will be commensurate with training and experience. — Applications should be addressed to the PERSONNEL MANAGER.

FOUNDRY ESTIMATOR required for large Light Alloy Foundry. Wide experience of modern patternmaking is essential. Some knowledge of weight estimating and foundry rate fixing is desirable. Preferred age limits are 28-35, and this is an excellent opportunity for the right type of man.—Applications will be treated as confidential, and should be made to Box 3468, FOUNDRY TRADE JOURNAL.

DEPUTY CHIEF RADIOLOGIST required for large X-ray Laboratory examining aircraft castings. Applicants should have sound knowledge of radiology and metallurgy and must possess drive initiative and organising ability. Applicants will be treated in strict confidence Salary according to experience and ability —Apply to Box 3467, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN required, to take charge of small Semi mechanised Foundry producing light grey iron castings for vitreous enamelling Must have thorough knowledge of Cupolas Sand Plant, Moulding Machines, etc., and be able to control labour. Permanent position with good prospects; pensionable. South Yorkshire.—Box 3466, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*Contd.*

CHIEF DRAUGHTSMAN, experienced all types conveying. Knowledge foundry mechanisation advantage. Glasgow area. State age, experience, and salary required.—Box 3458, FOUNDRY TRADE JOURNAL.

WELL-KNOWN malleable iron foundry in the Midlands producing castings from a few ounces to 5 cwts for the motor, engineering, agricultural, shipbuilding and electrical trades requires representation in South Wales, in the West of England and in London and the Home Counties.—Apply Box 3437, FOUNDRY TRADE JOURNAL.

METHODS ESTIMATOR RATEFIXER wanted. Wide, practical, technical and commercial experience on semi-mechanised plant—High Duty and Grey Iron. Job offers scope for man with initiative.—Write, giving full particulars of experience, and salary, to SYKES & HARRISON, LTD., Port Penrhyn, Bangor, North Wales.

FOUNDRY FOREMAN required for Steel Foundry at a salary of £700 per annum. Knowledge of modern methods of production and mechanisation are essential together with the ability to control labour. Housing accommodation will be provided for the successful applicant. Full details of age and experience to date should be sent to Box 3460, FOUNDRY TRADE JOURNAL.

WELL-KNOWN Midland Ironfounders require SALES REPRESENTATIVES for Greater London area, South and South-Eastern Counties and West Country. Only applicants with established connections with Engineers and real knowledge of Grey Iron and High Duty Castings from 1 lb. to 2 tons in weight will be considered. Company also operates Shell Moulding Process producing castings of extreme accuracy.—Box 3469, FOUNDRY TRADE JOURNAL.

CROWN AGENTS FOR THE COLONIES

CHARGEHAND (FOUNDRY) required by the East African Railways and Harbours Mechanical Department for one tour of 40-48 months, with prospect of permanency. Salary, etc., in the scale £676, rising to £793 a year. Commencing salary according to age. Outfit allowance £30. Separation allowance payable in certain circumstances. Free passages. Free quarters or an allowance in lieu. Liberal leave on full salary. Candidates, under 35 years of age, must have served an apprenticeship in a foundry dealing with non-ferrous and iron castings and have had subsequent experience. They must have had experience of oil-fired brass melting furnaces, moulding machines and cupolas. Experience in the foundry of a Railway repairs shop would be an advantage.

Applicants now serving with British Railways would be eligible for secondment, and should apply through their local officers.

Apply in writing to the CROWN AGENTS, 4, Millbank, London, S.W.1, stating age, name in block letters, full qualifications and experience, and quoting M2B/29950/F.H.

SITUATIONS VACANT—*Contd.*

NON-FERROUS FOUNDRY.—Fully experienced FOREMAN required, to take complete control of small, modern, Non-ferrous Foundry situated in Birmingham district. The advertisers, who are specialists in the Industrial Gearing trade, will only consider an applicant who has had previous similar experience as a Foreman and who is fully practical as well as technical. Staff position.—Apply in first instance, with full details of past experience, age, and salary required, to BOX 3456, FOUNDRY TRADE JOURNAL.

DRESSER (Foreman) for Steel Foundry in Scotland. Must be experienced in Heat Treatment, Dressing and Welding of medium weight castings, the output of which is approximately 300 tons per month. Applicant should be a good disciplinarian and must possess initiative and ability to organise. Must have had previous control of labour. House available. Superannuation Scheme operates. Apply stating age, salary expected and full particulars of experience to BOX 3444, FOUNDRY TRADE JOURNAL.

FOREMAN/MANAGER required for small non-ferrous Foundry Department, Sheffield; sound all-round technical knowledge essential, also a progressive outlook upon the importance of good working conditions and high productivity; room for considerable expansion. Write in first instance stating age, experience and salary required to A. G. WILD & CO., LTD., Charlotte Road, Sheffield.

FOUNDRY MANAGER required for medium sized semi - mechanised malleable foundry in the Midlands. Good prospects for a keen, capable man. Reply, giving age, education and experience to BAYFIELD & BAYFIELD, 95, Colmore Row, Birmingham, 3.

TIME AND MOTION STUDY. Man required for Repetition Foundry to carry out all duties of Time Study work. Applicant should have held similar position and be fully conversant with foundry practice. Excellent opportunity for young man, with possibility of advancement. Please reply giving full particulars of past experience and salary required to Box 3450, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for medium sized foundry producing Blackheart Malleable Iron. Applicant should be fully experienced and have the necessary technical knowledge to control all branches of the foundry. This is a good opportunity for a man capable of producing results. Please reply giving full particulars of past experience and salary required to Box 3463, FOUNDRY TRADE JOURNAL.

SYNTHETIC RESIN MANUFACTURERS require Representatives to handle sales of their Core and Shell Moulding Resins. Apply giving full details of age, qualifications and Foundry experience.—Box 3431, FOUNDRY TRADE JOURNAL.

MACHINERY WANTED

MORRIS Screenarator Sand Conditioner.—Box 3411, FOUNDRY TRADE JOURNAL.

WANTED: Full set of Patterns for 4 ft. 0 in. underdriven stationary Pan Mill for sand, etc.—Full details to Box 3462.

MACHINERY WANTED—*Contd.*

TWO-ROLL MORTAR MILL required. 9 ft. or 10 ft. dia. pan. Rotary pan type. Second-hand. Must be in reasonable condition. Price and full particulars to Works Engineer, DARTMOUTH AUTO CASTINGS LTD., Dartmouth Road Smethwick, 40.

DRYING Oven, approx. 8 ft. to 10 ft. cube, required. Gas fired, recirculating type preferred.—Price and particulars, Box 3425, FOUNDRY TRADE JOURNAL.

TENSILE TEST MACHINE required for non-ferrous test bars. Capacity up to 10 tons load. Must be in good condition in view of subsequent A.I.D. Approval. Full particulars to Box 3446, FOUNDRY TRADE JOURNAL.

MACHINERY FOR SALE

ONE 2,000 gallon capacity Oil Fuel Tank, complete with thermostatic heater. First class condition, only two years' use.—THE FURNACE EXCHANGE, Lewes & Harpers Road, Corner, Newhaven, Sx. Tel.: 414.

FOR SALE two half tonner (1952) Jolt Rollover Pneulec Machines, complete with spare Bumping Unit. Write CATTON & COMPANY, LTD., 29, Chadwick Street, Leeds, 10.

FRANK SALT OFFERS

COKE FIRED CORE STOVE, draw type, 6 draws, trays 36 in. by 36 in.

Two Pneulec Herman 750 lbs. Rollover moulding machines.

Two new 2 ft. 6 in. shell diam. Cupolas.

CRANES:

One 2 ton E.O.T. Crane, 30 ft. span, 3 motor type, floor controlled, 400/3/50.

One new Abacas 5 ton, 2 motor Crane Grab, 4 ft. 0 in. wheel centres, 400/3/50.

One new 6 ton "Coles" Electric Hoist block, fitted with hand geared travelling carriage, 400/3/50.

One 1 ton Morris Electric Hoist Block, as new.

One "Asea" Electric Hoist block including travelling carriage, as new.

Hand Overhead Travelling Cranes 1-5 tons, spans up to 36 ft. in stock.

REASONABLE PRICES.

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AIR COMPRESSORS.

600-C.F.M. vert. single stage Air Compressor by TILGHMAN, type FC9.A.M. 60 lb. pressure, 365 r.p.m.

505-c.f.m. vert. single stage watercooled Air Compressor by TILGHMAN, type FC8.B. 30 lb. pressure, 365 r.p.m.; belt driven from 60-h.p. LAURENCE SCOTT S/R Motor, 440/3/50.

200-c.f.m. vert. 2-stage, watercooled Air Compressor by TILGHMAN, type MD.4. 100 lb. pressure; belt driven from 60-h.p. CROMPTON PARKINSON auto-synchronous Motor 400/3/50.

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SONS & CO., LTD.
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and STANNINGLEY nr. LEEDS
Tel: Pudsey 2241

MACHINERY FOR SALE—*Contd.*

SECONDHAND KOREX type Core Stove. Complete with Fan, Motor and Starter, to take 40 18-in. by 18-in. Core Plates. With dial thermometer. All in good condition. £100 o.n.o. ex-works.—BOX 3457, FOUNDRY TRADE JOURNAL.

UNIQUE opportunity occurs to acquire a brand new Stationary type Double Belt Sand Slinger by Foundry Plant & Machinery Ltd., at below present day cost. 12 ft. arm rotating through 360 deg., complete with all electrical control gear.—Enquiries to Box 3448, FOUNDRY TRADE JOURNAL.

ALBION TWW WORKS

SHOT BLAST PLANTS.

COMPLETE SHOT BLAST INSTALLATION comprising 4 ft. cube cabinet by St. Georges Engineers with dust extraction unit; M.D. Fan; Broom & Wade D.22 Motor Driven Compressor; driven by 22 h.p. s.c. Motor; Air Receiver; Water Tank, Pump, etc.

"FORWARD" FOUNDRY SAND RIDDLE:

"FORWARD" FOUNDRY SAND RIDDLE, 5 tons per hour capacity. Complete with Tripod and 22-in. dia. sieve. Motorised.

GEARED FOUNDRY CRANE LADLES (STOCK OR EARLY DELIVERY):

3-ton; 50-cwt; 2-ton; 30-cwt.; 25-cwt.; 20-cwt.; 15-cwt.; 12-cwt.; 10-cwt.

3/4-cwt. UNGEARED LADLE.

"POLFORD" MOTOR DRIVEN VIBRATORY SCREEN: 20 in. by 40 in.; capacity up to 8 tons per hour; robust fabricated steel construction, driven through eccentric shaft by 1 h.p. TOTALLY ENCLOSED S.C. MOTOR, 400/3/50—IMMEDIATE DELIVERY.

AIR COMPRESSORS — WE CARRY LARGE STOCKS OF AIR COMPRESSORS OF ALL TYPES RANGING FROM 2 C.F.M. UP TO 3,000 C.F.M. AGAINST PRESSURES VARYING FROM 5 lbs. P.S.I. to 200 lbs. P.S.I.

THOS W. WARD LTD.
ALBION WORKS : SHEFFIELD
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Remember . Wards might have it!

IMMEDIATE DELIVERY.

Cupolettes, new and secondhand.
Core Ovens, several nearly new; small ones in stock, cheap.
Fordath Senior Sand Drier. £85.
Morgan Tilting and Bale-out Furnaces—over 50 in stock, all sizes.
New Broomwade Compressors at list prices, all sizes up to 30 h.p.
New Broomwade Air Receivers, all sizes up to 6 ft. by 3 ft.
Over 100 new Keith Blackman Fans in stock; all sizes.
Shot Blast Equipment and General Plant.
Immediate attention to all enquiries.

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Telephone: Slough 22877.

MACHINERY FOR SALE—*Contd.*

STORAGE.

USE BOILER TANKS FOR OIL AND CHEMICALS.

WE Specialise in 30 ft. by 8 ft. dia. Tanks. Each 9,000 gallons. Ready for use.

MADEN & McKEE LTD.,
317, Prescot Road, Liverpool, 13.

B.T.H. very powerful Dust Extractor-Blowers. Motorised units (unused). £15 each. One-third to-day's cost.—BELLANGER'S, 306, Holloway Road, London, N.7. North 4117.

TWO B.M.M. Jolt-Squeeze Pin Lift Moulding Machines, Type HPL.1, purchased new 1949. Price: £125 each or £230 the two.—RICHARDS (LEICESTER), LTD., Phoenix Iron Works, Leicester.

FOR SALE.

NO. 16 ATRITOR CRUSHER by Alfred Herbert, complete with Feed Hopper, overhauled and with a quantity of spares. Also a No. 12 Atritor by Alfred Herbert, for which we have available about 6 tons of spares. Both these machines are offered at extremely low prices for quick clearance.

SAVILLE-CALVERT (MACHINERY) LIMITED.
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LARGE MOULDING BOXES.

HEAVY Duty Steel Boxes for continuous use on the largest moulding machines. Good delivery.

THE CHEMICAL & FOUNDRY ENG. CO.,
Winker Green Mills, Leeds, 12.

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DELIVERY EX STOCK

New shot blast cabinets complete with Dust Extractors, etc., size 5ft. × 3ft. Also new 8ft. cube room Plants

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MACHINERY FOR SALE—*Contd.*

FOR SALE.

LANCASHIRE BOILER FLUES, suitable for Cupolas; can be inspected at our works; cheap.

MARKLAND SCOWCROFT, LTD.,
Cox Green Works, Bromley Cross, near Bolton.
Tel. No. Eagley 600/1/2

CUMMINGS No. 4 MECHANICAL JOLTER; 400 volt, 3 phase, 50 cycles; new condition.—NEWCAST FOUNDRIES LTD., Silverdale, Staffs.

1—30 cwt. capacity Geared Drum Type Receiver mounted on four wheel bogey. Height from floor to centre of ladle trunnions 3 ft. 1½ in. One Spare Body for above 30 cwt. Receiver with fibre brick lining. One Gas Fired Burner for drying and preheating the above Receiver. —BOX 3461, FOUNDRY TRADE JOURNAL.

CAPACITY WANTED

1 to 2 tons weekly of Non-ferrous Alloy (melting temperature about 1,250 deg. C.) required regularly by London firm. All materials supplied.—Enquiries or offers to Box 3455, FOUNDRY TRADE JOURNAL.

CAPACITY AVAILABLE

CLEAN, ACCURATE, SHOTBLASTED CASTINGS

CAPACITY available for Castings up to 15-cwt., including Castings for Vitreous Enamelling.

DELIVERIES IMMEDIATE.

FERROUS CASTINGS, LTD.,
Loushers Lane, Warrington
Telephone: Warrington 3525 (3 lines)

CAPACITY AVAILABLE for Castings up to 15 cwts. Prompt Delivery. Machined if required.—THE GRANTHAM IRONWORKS CO., LTD., Engineers and Ironfounders, Springfield Road, Grantham. Tel.: 1192.

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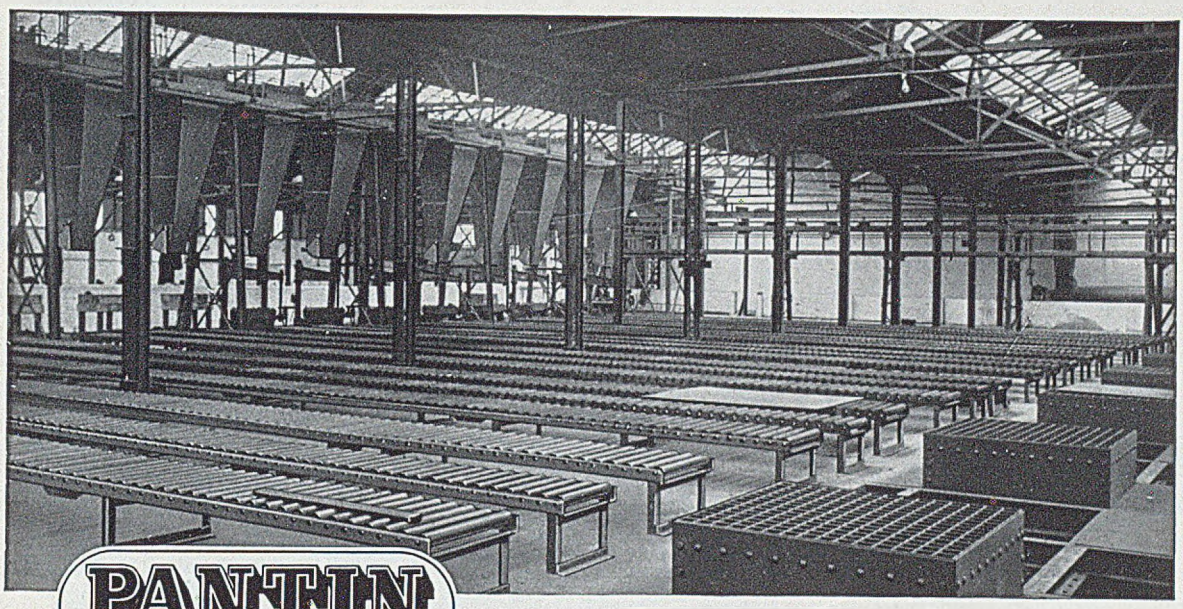

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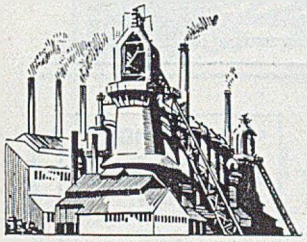
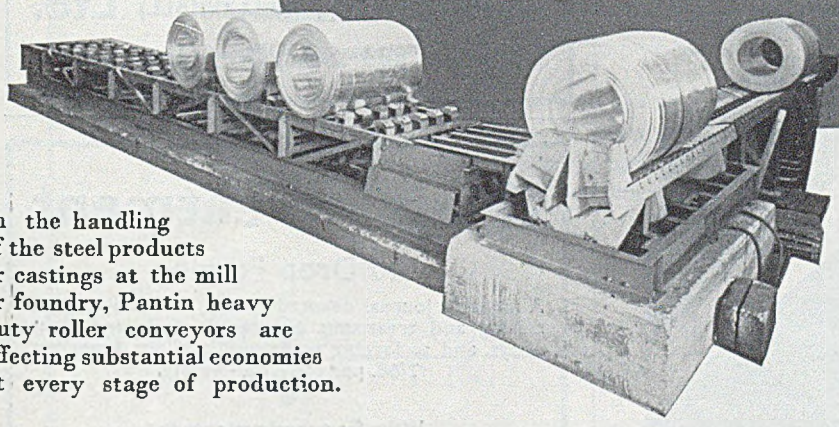


Heavy Duty Roller Conveyors



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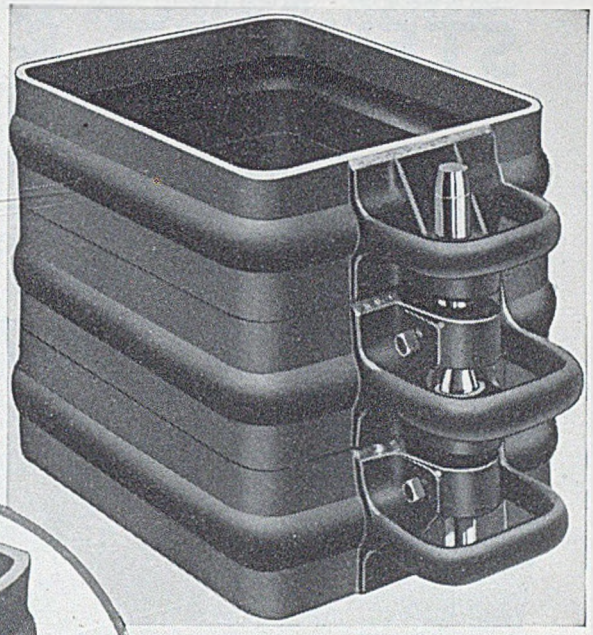
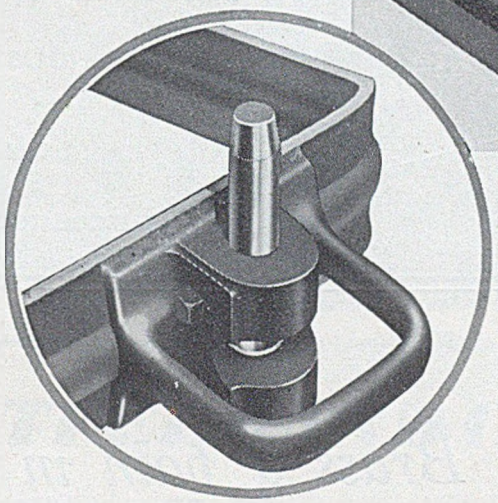


Standard 3-part Set.
Type "O" Top and Bottom
Type "M" Middle Part.



TYPE "M" LUG

Cast malleable lugs and fittings
2 Accurately ground box faces
3 Precision ground pins adjustable for length
4 Full range of loose pin and multi-part boxes
5 Accurate pin centres and guaranteed interchangeability
6 Renewable steel bushes, round or elongated
7 Straight lifting handles optional
8 Special brassfounders boxes
9 Range of bars, clamps, etc., as required
10 Specially finished and packed for export

These Sections are intended for use with Type "O" Boxes to form 3-part Sets, or may be used in multiples for stacking. Type "M" Lugs are fitted and the Top Section carries a turned and ground pin held in place by a set screw. The Lug Bottom Section is drilled and bushed.

One Type "M" Box can be placed between the Drag and Cope halves of a pair of Type "O" Boxes. Several Type "M" Boxes can be built up to form multi-part sets.

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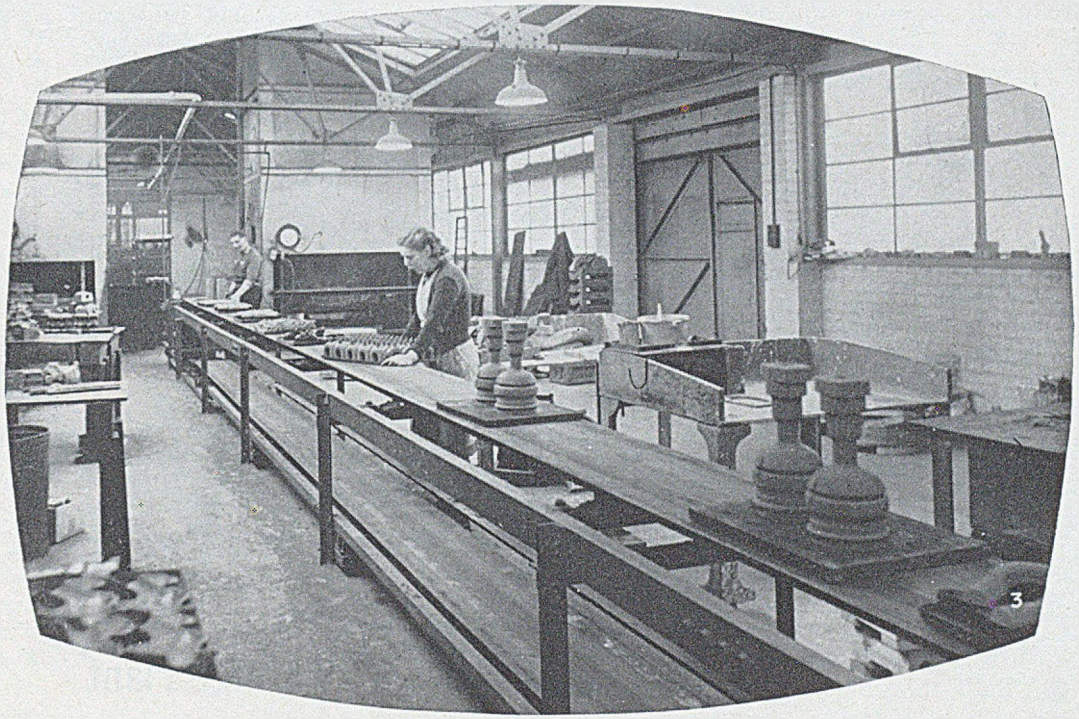
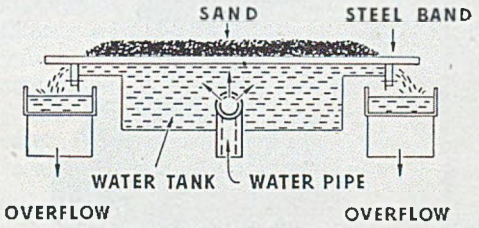
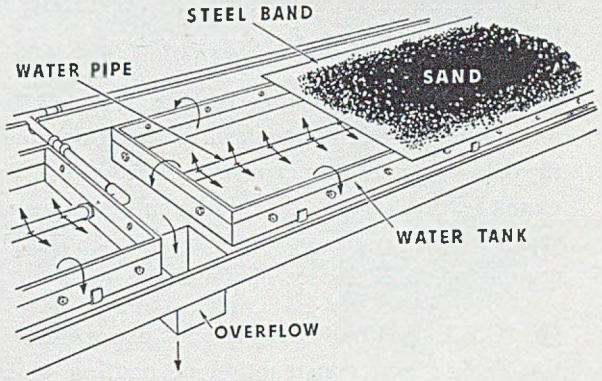
MODERNISE YOUR CORE SHOP . . .



This photograph shows one of our many conveyors conveying cores from the benches to the drying stove.

WITH STEEL BAND CONVEYORS





If you have difficulty with your warm sand adhering to patterns why not cool it on our patented water-cooled steel band conveyor as illustrated by diagrams above and on right.

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B.F.T. Division

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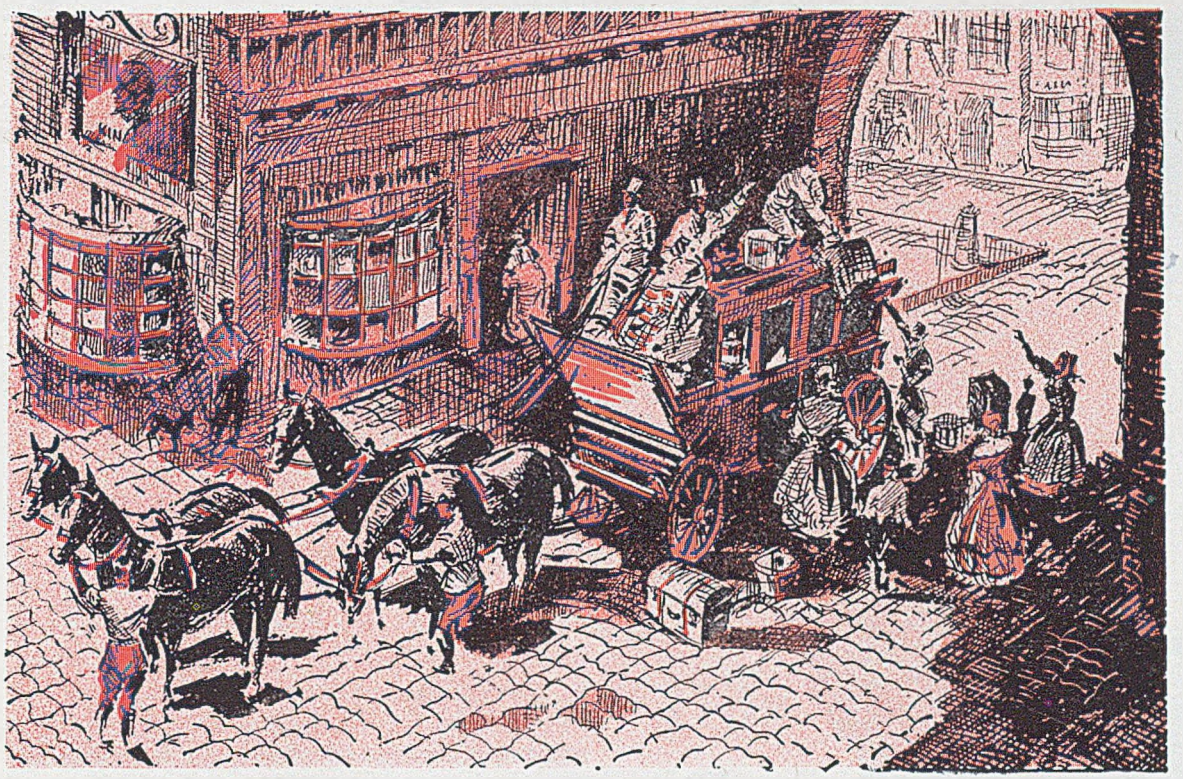

V79

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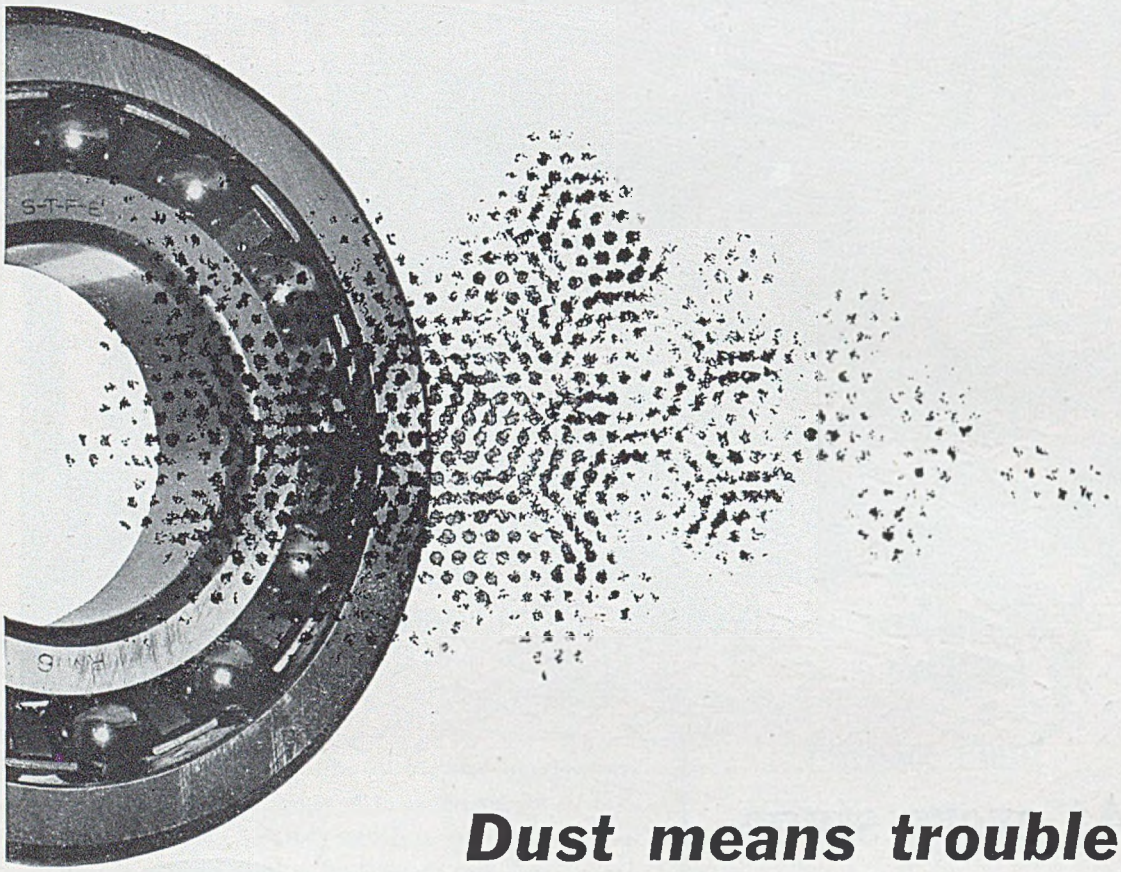

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