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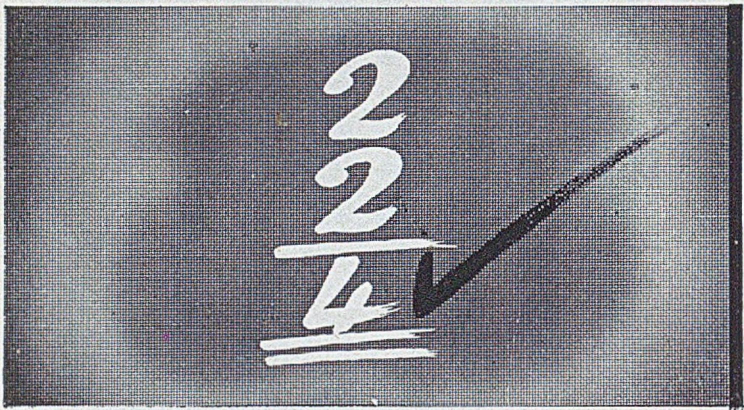
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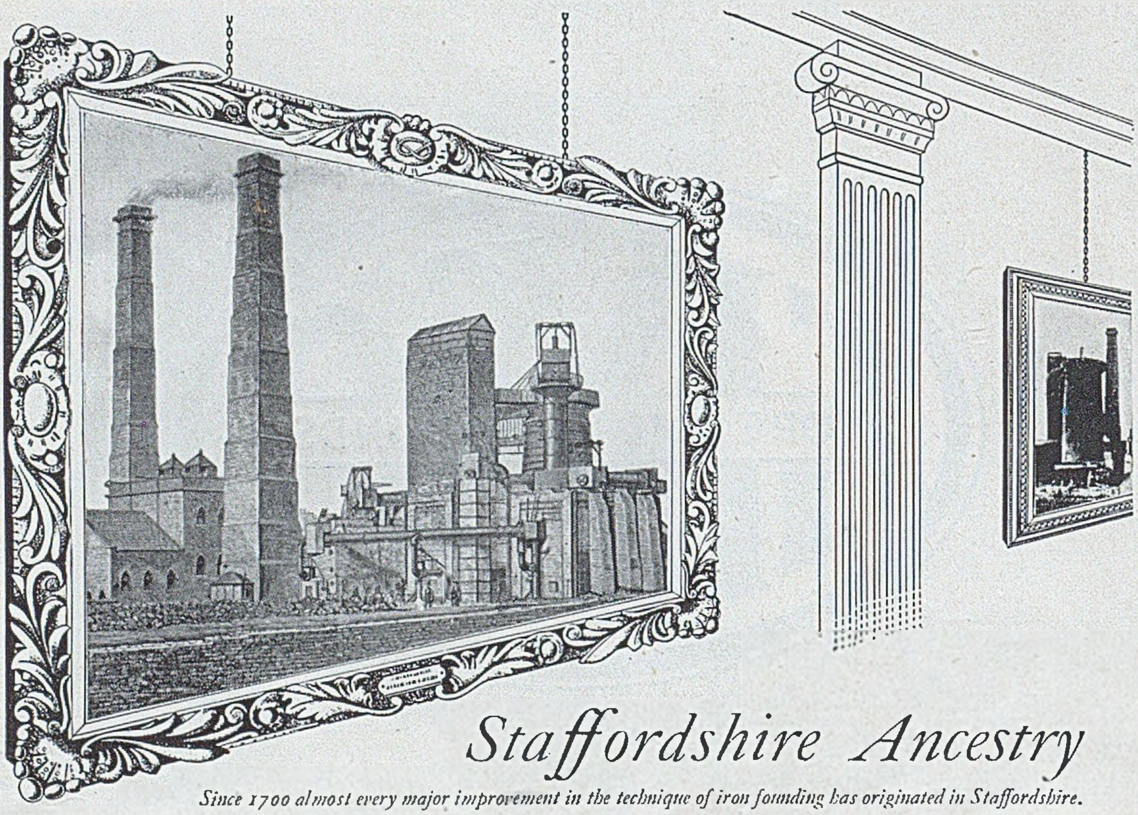

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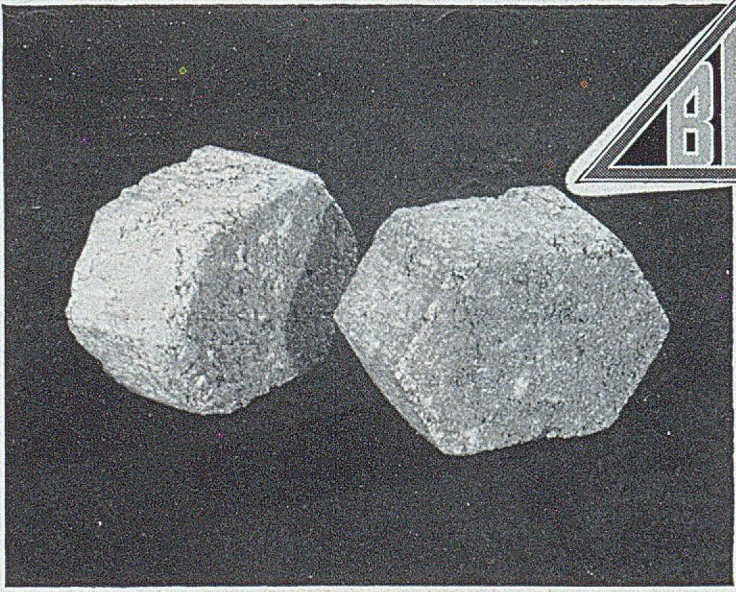

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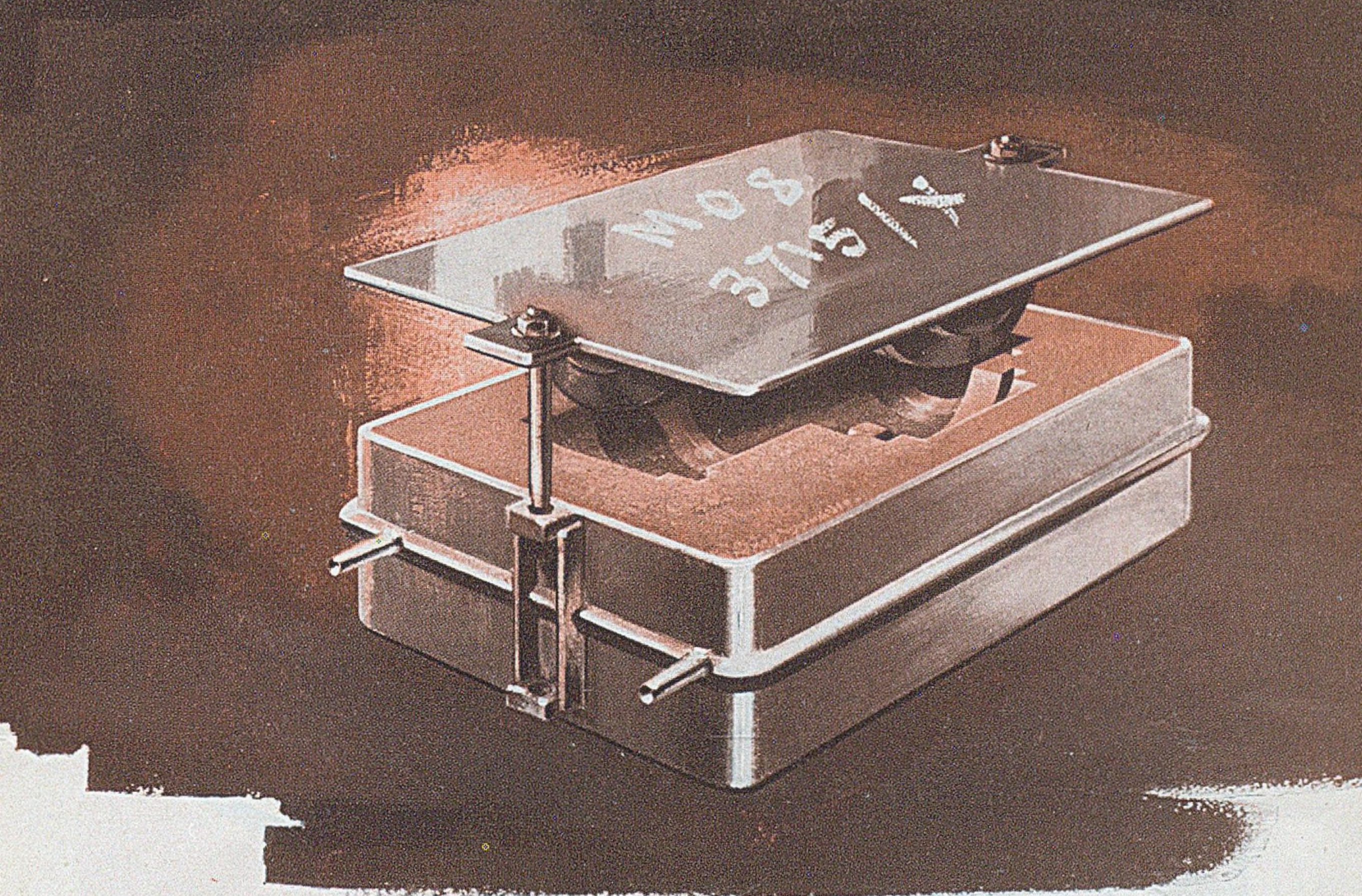

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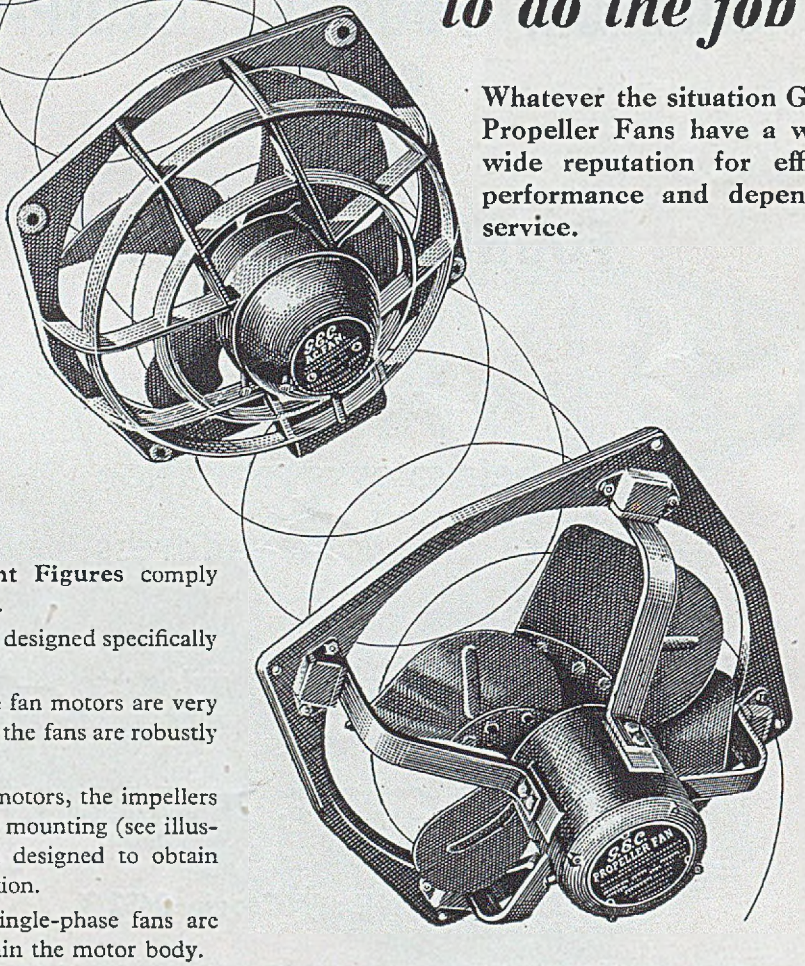

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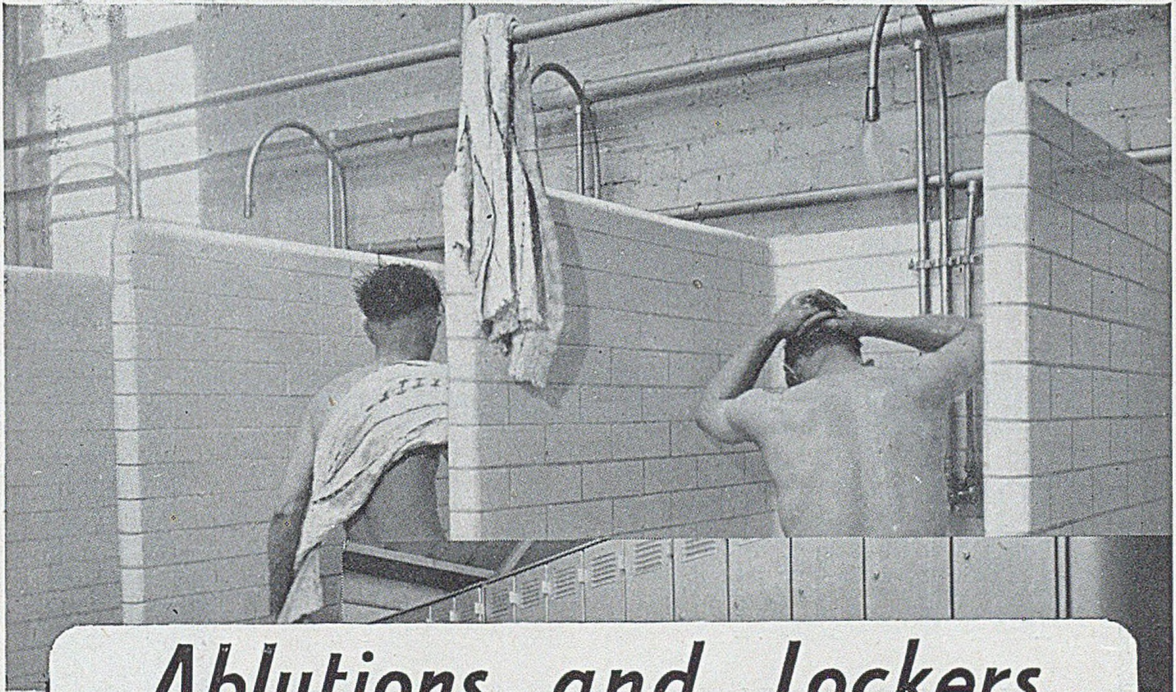

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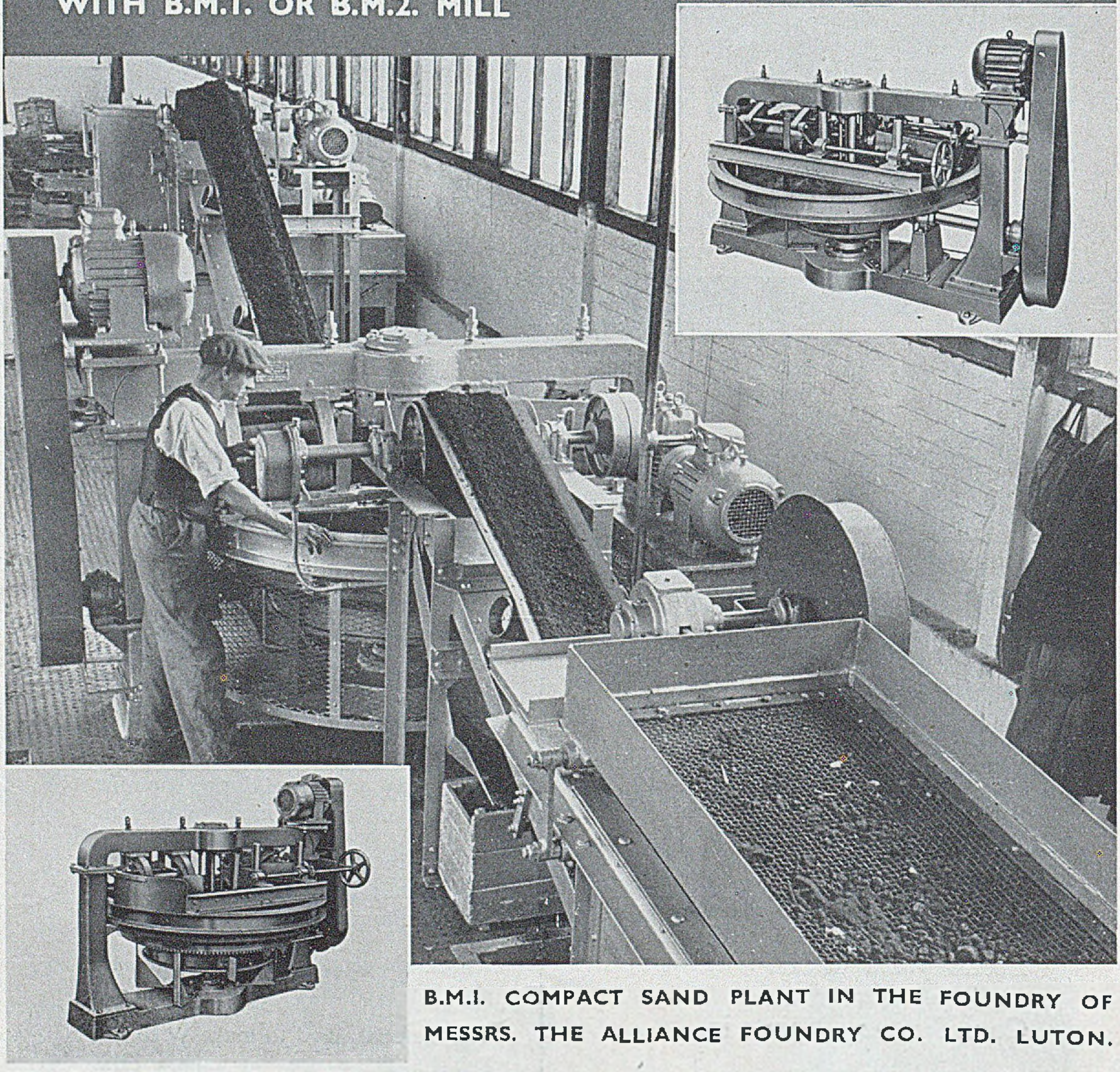

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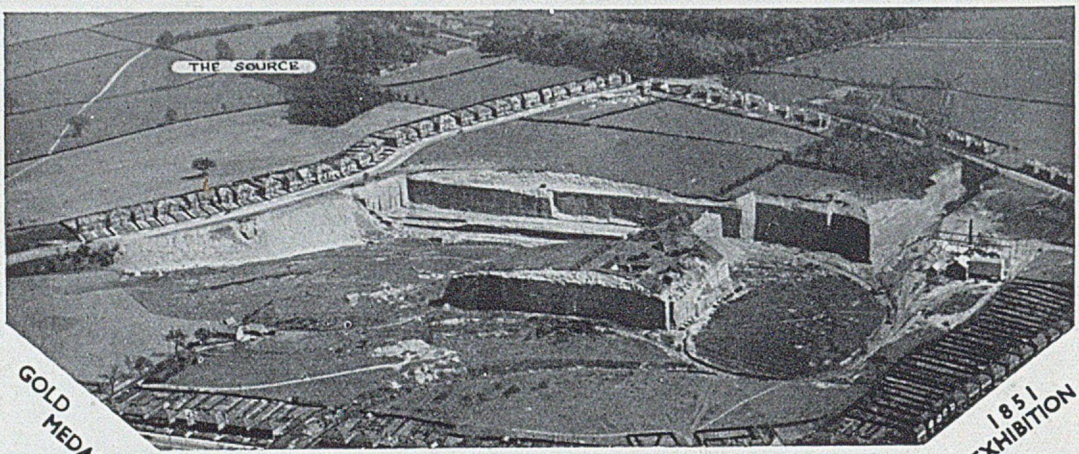
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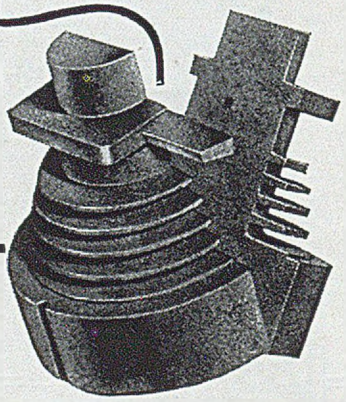

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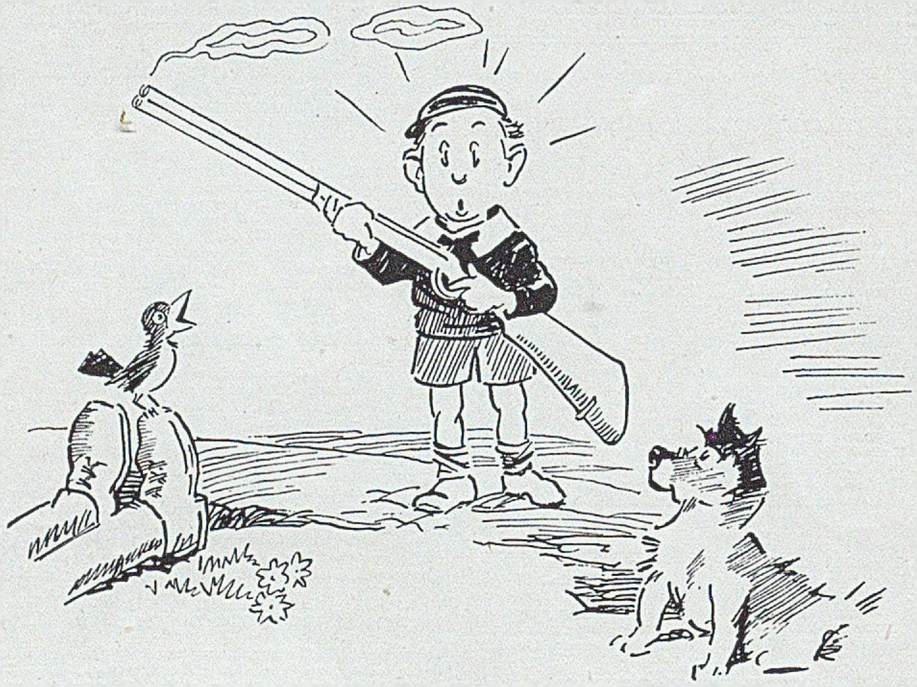

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49, Wellington Street, London, W.C.2. 'Phone: Temple Bar 3951 (Private Branch Exchange) Grams: "Zacatecas, Rand, London"

Zinc Allocation Scheme

It should be realised that the zinc allocation scheme which was recently announced by the Minister of Supply and detailed in our last issue outlines a general rather than a detailed scheme of prohibition and rationing. It has been thought wise to include copper to some extent in the list of prohibited manufactures. Between now and February 1, the various interests will detail to the Ministry what they believe will be the consequence of these prohibitions. It is obvious that they will be exceedingly severe in their impact as there will only be available some 50 per cent. of what was the normal average consumption last year.

There are two distinct aspects of the problem arising from the prohibition of zinc. The first and most important is the manufacture of brass castings, extrusions and the like, where the making of the complete article is ruled out. The second one is zinc as a protective coating. Unless manufacturers can find some cheap and suitable substitute, some quite "large ships are to be spoilt for the want of ha'porth of tar," or actually, in this case, zinc. Whilst many hundreds of manufacturing concerns will be affected, it is the Birmingham area which will suffer most as the centre of the non-ferrous industries. This is a time when membership of an employers' organisation is most beneficial, as individual approaches never carry the same weight as those from large groupings.

The situation which has arisen is no testimonial for the system of bulk buying by the Government, but we are sure that the various interests will do their best to make this new rationing system a success. We have no suggestion to make as to substitutes for zinc and copper, though obviously some exist. There are cases, for instance, where high-nickel cast iron can replace non-ferrous metals. At the Press conference when the prohibitions were first announced it was suggested that vitreous enamelling might be substituted, yet for most of the applications listed it would be too brittle. Moreover, the frit used for this purpose often contains zinc oxide and might come under the ban. In some cases, aluminium—a material not in too plentiful supply—could also be used. Though ingenuity will be brought to bear to overcome some of the difficulties, it still remains true that as a New Year's gift to the foundry industry the prohibitions were about as acceptable as a kick in the pants.

Record Production—But . . . ?

Yesterday, it was officially announced that the iron and steel production for 1950 was of record proportions, and steel, at over 16¼ million tons, has exceeded the figure set in the Government Economic Survey, by a very substantial amount. The production of pig-iron also increased from 9,498,000 in 1949 to 9,633,000 tons in 1950.

Yet despite these gratifying results, there is news of an important section of the motor-car industry reducing its activity to four days a week on account of shortages of steel sheets. This will quickly lower the demand for iron castings and incidentally for zinc too. It seems that about 4,000 to 5,000 tons of steel a month have in recent times been imported from America. However, it is anticipated that by mid-summer the gap should be closed by further supplies from the Margam works.

The importation of coal from America is also likely to affect the iron and steel industry as ships normally used for bringing in iron ore are now requisitioned to augment our inadequate fuel supply.

New Year Honours

In addition to the brief list printed last week, the following awards have been made to men prominent in the foundry or allied industries:—

C.B.E.

Mr. K. Baumann, a director of Metropolitan-Vickers-Beyer, Peacock, Limited, and Metropolitan-Vickers Electrical Export Company, Limited, for services to turbine development; Mr. C. H. Chester, chairman of the South Western Gas Board and president of the Institution of Gas Engineers; Mr. S. E. Chisholm, assistant comptroller, Patent Office; Mr. H. Constant, F.R.S., director of the National Gas Turbine Establishment, Ministry of Supply; Mr. S. K. Davies, chairman and managing director of George Elliot & Company, Limited; Mr. R. Irvin, a director of the Shields Engineering & Dry Dock Company, Limited, North Shields; Mr. W. L. M. Peshall, chairman of the North Midlands Regional Board for Industry; Col. C. D. Siddeley, chairman of the Coventry Local Employment Committee and a director of Armstrong-Siddeley Motors, Limited; and Mr. S. L. Smith, director of research of the British Shipbuilding Research Association.

O.B.E.

Mr. R. Clarke, marine director, Laurence Scott & Electromotors, Limited, Norwich; Mr. H. L. de Bourcier, principal, Ministry of Fuel and Power; Mr. A. E. Evans, secretary of the Association of Teachers in Technical Institutions; Mr. F. C. Fitzpatrick, representative of the Amalgamated Engineering Union on the Admiralty Industrial Council and the Shipbuilding Trades Joint Council; Mr. E. Hinrich, assistant controller of supplies, Ministry of Works; Mr. A. Hoare, engineer manager of J. Samuel White & Company, Limited, shipbuilders, of Cowes; Mr. J. C. Lang, chairman of the general council of the Scottish Trades Union Congress; Mr. E. A. Lovell, principal scientific officer, Air Ministry; and Mr. A. W. W. Taylor, chairman of the West Wales District Committee of the Welsh Board for Industry, managing director of Taylor & Sons, Limited, Briton Ferry, chairman of the Welsh Engineers and Founders' Association, and vice-president of the Wales & Monmouth branch of the Institute of British Foundrymen.

M.B.E.

Mr. W. T. Airlie, vice-chairman of the Edinburgh District Committee of the Scottish Board for Industry; Mr. F. P. Alexander, senior executive officer, Ministry of Supply; Mr. H. Allon, cashier, Charles D. Holmes & Company, Limited, engineers and foundrymen, of Hull; Mr. B. E. Blackledge, superintendent, coke ovens and fuel departments, Steel Company of Wales, Limited, Port Talbot; Mr. W. G. Brown, engineering manager, factory shops, Harland & Wolff, Limited, Belfast; Mr. T. C. Dickie, divisional organiser, Association of Engineering and Shipbuilding Draughtsmen; Mr. T. S. Duncan, assistant designer, aircraft division, Vickers-Armstrongs, Limited, Weybridge; Mr. W. Goldberg, vice-chairman, East and West Ridings Regional Board for Industry; Mr. G. J. Gordon, lately higher executive officer, Ministry of Supply; Mr. E. Harbron, divisional organiser, Amalgamated Engineering Union; Mr. W. R. Harrison, senior executive officer, Ministry of Supply; Mr. C. A. James, chief executive officer, Ministry of Supply; Mr. S. Jeffrey, works superintendent, W. H. A. Robertson & Company, Limited, of Bedford; Mr. H. D. Jennett, departmental manager, Brown, Bayley's Steel Works, Limited, Sheffield; Mr. A. Macdonald, works manager, North British Locomotive Company, Limited, Glasgow; Mr. F. H. Paley, vice-chairman, Wearside District Committee, Northern Regional Board for Industry; Mr. H. V. Pollard, senior experimental officer, Department of Scientific and Industrial Research; Mr. J. Rae, engineering manager, John Brown & Company, Limited, Clydebank; Mr. L. Rushforth, head of section, research laboratory, British Thomson-Houston, Limited, Rugby; and Mr. J. M. Walshe, works engineer, Belliss & Morcom, Limited, founders and engineers, of Birmingham.

B.E.M.

Mr. R. B. Y. Baird, foreman maintenance engineer, Glenboig Union Fire-clay Company, Limited; Mr. F. G. Baynes, senior foreman in steel tube mill, Wellington Tube Works, Limited, Tipton; Mr. H. C. Conyard, moulder and coremaker, Vickers-Armstrongs, Limited; Mr. R. T. Davies, coke-oven foreman, Cargo Fleet Iron Company, Limited, Middlesbrough; Mr. A. Gridley, senior artificer, Department of Scientific and Industrial Research; Mr. J. T. Hathaway, rolling-mill foreman, Henry Wiggin & Company, Limited, London, S.W.1; Mr. W. Jones, works foreman, Barker Bros. (Brassfounders), Limited; Mr. O. J. Stephenson, foreman, C. A. Parsons & Company, Limited, Newcastle-upon-Tyne; Mr. C. A. Stirling, plater, Consett Iron Company, Limited; Mr. H. Strickland, foreman electrician, Wm. Jessop & Sons, Sheffield; Mr. F. R. Waller, chargehand plater, Dorman, Long & Company, Limited, Middlesbrough; Mr. T. Whitley, foreman shipwright, Harland & Wolff, Limited, Belfast; and Mr. A. G. Wilkinson, patternmaker, Vulcan Foundry, Limited, Newton-le-Willows.

Forty Years Ago

The January issue of the Foundry Trade Journal for 1911 records that Cleveland No. 3 pig-iron was being sold at 52s. a ton. There was reported to be an attendance of the order of 300 to hear a Paper read before the Scottish branch of the British Foundrymen's Association, but somehow or other we suspect a misprint! The subject was "Improved Cast Iron—How to get it in the Foundry." The issue contains an excellent Paper by Mr. H. I. Coe on "Manganese in Cast Iron and the Volume Changes During Cooling." The photomicrographs are up to to-day's standard. There is also a Paper on the Influence of Briquetted Turnings on Cupola Irons. The death was announced of Mr. FitzHerbert Wright, J.P., D.L., of the Butterley Company Limited. He was born in 1831. Sir Robert Hadfield was presented with the Elliott Cresson Gold Medal by the Franklin Institute.

Developing the Market for Iron Castings

The Council of Ironfoundry Associations has published as Conference Report No. 2, a verbatim account of a discussion which took place at the September "Productivity" Conference in London. It is confidential to members, but it certainly makes very interesting reading. The question under consideration was co-operative advertising by the whole industry.

ACKNOWLEDGMENTS

Additional to the list published last week, calendars are gratefully acknowledged from the Northern Manufacturing Company, Limited, the Anderson-Grice Company, Limited, and Robey & Company, Limited.

Chilled-roll Manufacture*

By K. H. Wright, F.I.M.

This Paper has been arbitrarily divided for convenience of presentation into two sections. In the first, the Author discusses briefly the history of rolls, mentioning some bibliography, and defines the requirements of the finished product. Next, general characteristics are quoted, such as the formation of chill and its control, composition and stability of structure. Finally, various qualities of rolls are detailed, including alloyed rolls, duplex-poured rolls and the indefinite-chill type; typical compositions are tabulated. In the second section, shortly to be printed, founding methods are given prominence.

THE DEVELOPMENT of any skilled branch of the arts or sciences can be traced usually with some degree of chronological clarity and accuracy. In the case of cast rolls, however, such an approach is not easy and it appears impossible to state with any degree of certainty when and where the first rolls were made. There is some evidence to show that metals were formed in rolls made of stone; indeed, this would appear a fairly logical sequence following the use of millstones in flour milling.

Fig. 1 shows a stone roll which lies half buried in a field near to the Panteg Steel Works. The diameter of the roll is about 48 in. and tradition says it was used for rolling iron, but the Author cannot vouch for the accuracy of this report. The stone pinion exists also. This is still in reasonably good condition and is illustrated in Fig. 2.

With the growth of the wrought-iron industry, it seems reasonably certain that forged rolls were used prior to the development of the cast roll. These latter would most certainly have a "grain" or grey-iron structure throughout and one might surmise the technique of chilling developed subsequently, possibly more by accident than design.

Chilled rolls of a kind were known in this country before 1700 as there is on record an advertisement of a London ironfounder at that time which mentions "rolls for flattening iron, etc., of metal so hard that a file cannot touch it or so soft to admit of it being turned."

During the period 1753 to 1758 Isaac Wilkinson, father of the famous John Wilkinson, took out patents relating to the manufacture of rolls, guns, cylinders, pipes, etc., the bases of which are applied to-day, and the latter half of the eighteenth century saw the use of chilled-iron rolls fairly well established. It is known positively that the Bristol Ironfoundry was producing chilled rolls in 1764, but for how long before that date is not known.

However, it is not intended to deal at length on the early history of the industry as the subject has been dealt with very thoroughly elsewhere,[1] but these introductory remarks will indicate the relative antiquity of this particular branch of ironfounding. Because of this antiquity, one would expect a voluminous mass of informative data describing in detail all the phases of manufacture, but it is surprising to find the paucity of certain essential information.

Previous Literature

In 1938 the B.C.I.R.A. published a bibliography[2] containing 87 references to Papers on the subject of rollmaking, and to the Author's knowledge there are only three relatively small textbooks on the subject,[3] two in German and one in English, the

* A Paper read to the Birmingham Branch of the Institute of British Foundrymen, Dr. Angus presiding. The Author is on the staff of C. Akrill, Limited, a constituent company of the British Roll Makers' Corporation, Limited.

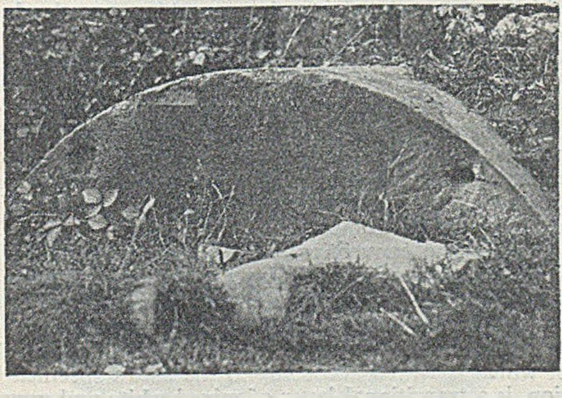

FIG. 1 (*above*)—*Stone Roll found at Pontyfelin, near Pontypool.*

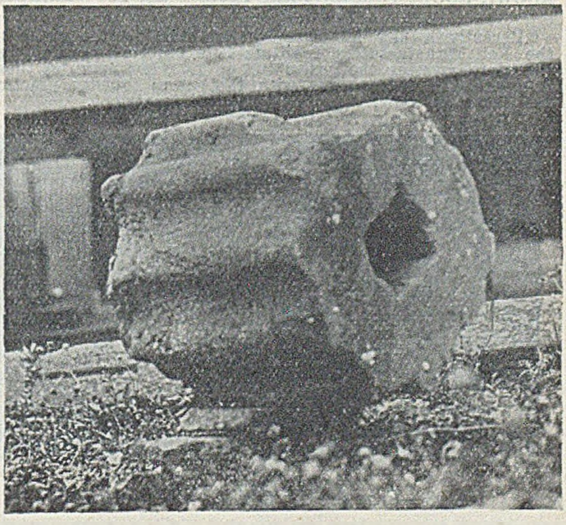

FIG. 2 (*right*)—*Stone Pinion also found at Pontyfelin.*

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latter by an I.B.F. member, Mr. A. Allison.* The 87 references form an interesting study as one finds very few authors have attempted to treat the subject on a purely scientific basis. They are, in the main, Papers by men skilled in the art and of long practical experience. Such phrases as "correct choice of raw materials" and "the physical characteristics of the pig-iron," appear with irritating frequency, irritating particularly as no further attempt at elucidation or definition is made.

Allison introduced into his book a good scientific approach in terms of the knowledge then existing, but it was left to the Japanese, Taniguchi,[4] to make a systematic study of the effects of alloying elements on chilled rolls. His researches, confirming as they do the work of investigators in other fields of the foundry industry, are most valuable to the would-be student. Allison, in addition to his book, is the author of several more modern Papers on the subject of rolls, and another member, J. Roxburgh, published in the FOUNDRY TRADE JOURNAL a Paper entitled "The Technique of Chilling."[5]

Admirable as this later existing literature is, however, it is far from complete, as there is practically no mention anywhere outside manufacturers' literature describing the remarkable and revolutionary developments which have taken place during the past 15 years, a development necessitated by the ever-increasing demands of the rolling industry. Neither does one find the panacea for the many ills which beset the inexperienced or ill-advised, nor can one find a positive recipe for the production of that all-important physical structure stressed so often by many writers.

In this Paper it is proposed to deal shortly with modern chilled rolls, including some of the means to be taken to ensure consistency in the product—a factor sadly lacking in earlier times, as records show. Great though progress has been in recent years, the increasingly-severe duties imposed on the rolls demands continual research into quality control and improvement. Until much more is known about fundamental factors as, for example, the exact mechanism of graphitisation, a large degree of *the art* must still remain in roll making, an *art* developed from long years of bitter and costly experience.

* Recently a new bibliography published in the U.S.A. by the Roll Manufacturers Institute lists 200 references to the literature covering the period 1921 to 1948, but many of these references are unconnected with the actual foundry practice and deal with other aspects of use and treatment.

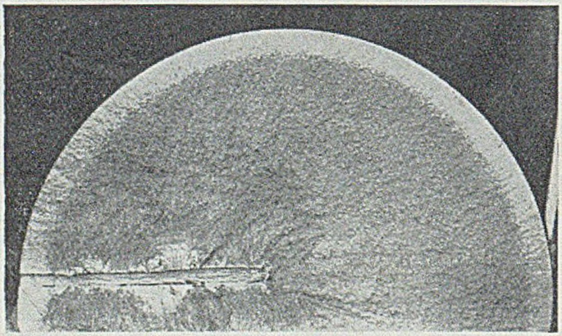

FIG. 3—*Fracture of Chilled-iron Sheet Roll.*

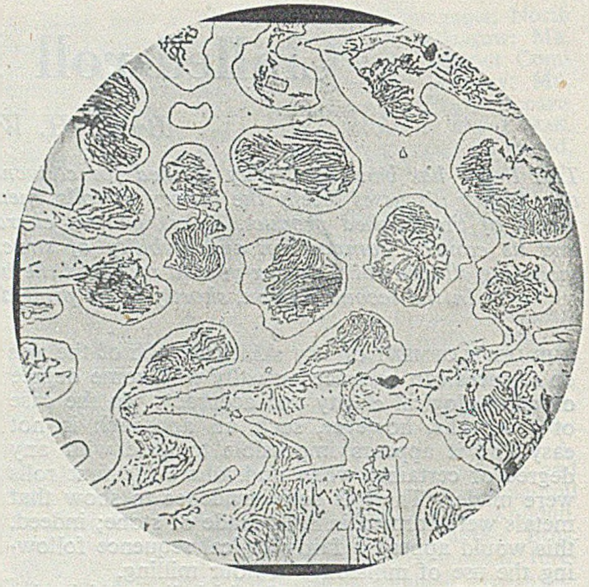

FIG. 4—*Chill structure of Straight Carbon Chilled Roll. Magnification* ×300 *dias.*

General Characteristics of Cast Rolls

To those who are familiar with a chilled roll and its physical make-up, the Author offers his apologies in advance, but to members who are not acquainted with this type of casting, it is proposed to devote some space to a brief description of what a chilled roll is.

A roll is virtually a mill tool—the very heart of the mill, for the finest mills in the world are dependent on the rolls' strength and durability. Moreover, the roll is generally the most highly stressed component in the mill train and is often required to withstand heavy shock loading, wide temperature fluctuations, sudden overloads in torsion and transverse and yet maintain its wear-resisting properties, be hard enough to withstand the impact deformation and slip of the rolled material and be of such a nature as to give the desired degree of bite. A chilled roll is, of necessity therefore, a sensitive article. It is also an expensive article and a knowledge of correct mill treatment will often avoid much trouble and expense on replacements.

Briefly, the conventional chilled roll consists, on the body, of a hard outer layer of white or chilled iron containing approximately 3 per cent. carbon and having a hardness of 400 to 500 Brinell. Immediately underlying the hard outer shell, the depth of which is varied according to the user's specification, is a transitional layer of mixed white and grey iron known in the trade as the "mottle," of a thickness approximately the same as the completely clear chilled outer layer. Finally, the core of the

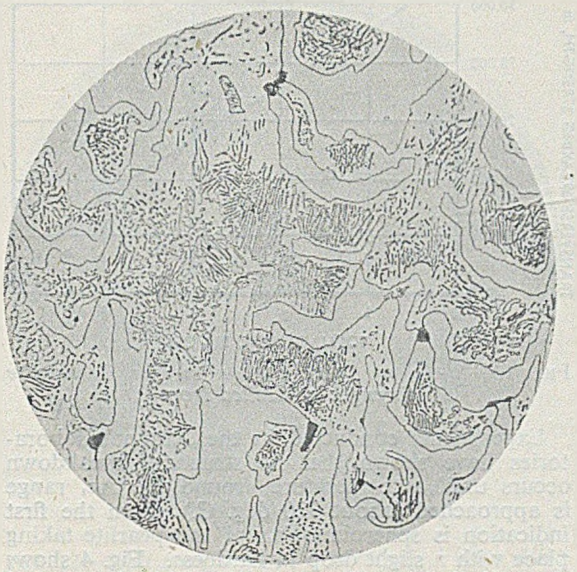

FIG. 5—*Chill structure of Straight Carbon Chill Roll Annealed at 750 deg. C. Magnification ×300 dias.*

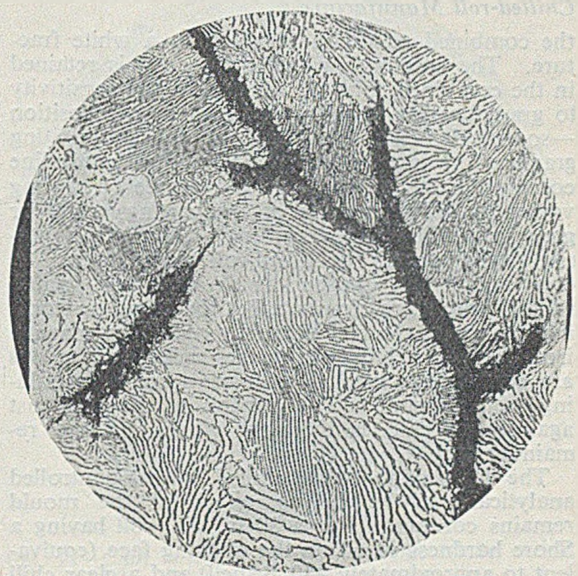

FIG. 6—*Core structure of Straight Carbon Chill Roll. Magnification ×300 dias.*

roll is of fully-grey iron wherein lies the major strength.

Fig. 3 is a fracture of a straight-carbon chilled roll and shows the features described. Now the outer zone, whilst possessing a high hardness and high compressive strength, is brittle and sensitive to shock loading. Furthermore, it has a higher coefficient of expansion than the grey core* but a lower thermal conductivity. The thermal conductivity of white iron is approximately 0·076 gm. cal. per sq. cm. per sec. whilst the corresponding figure for grey iron is 0·13. It is thus easy to understand that if violent temperature fluctuations are permitted in the roll, breakage is almost certain to occur. The roll maker does all he can to avoid excessive casting strains during manufacture but some degree of inherent stress is practically unavoidable.

* Coefficient of expansion of grey iron is 9 to 14 × 10^{-6} up to 600 deg. C. White iron has an expansion of 10 to 10.8 × 10^{-6} up to 200 deg. C and 15.9 to 16.4 × 10^{-6} between 276 and 684 deg. C.

Chilling and its Control

The first question the layman usually asks is how is the chill put on the roll and how is the depth controlled? It is well known that when cast iron solidifies rapidly enough the carbon is retained in

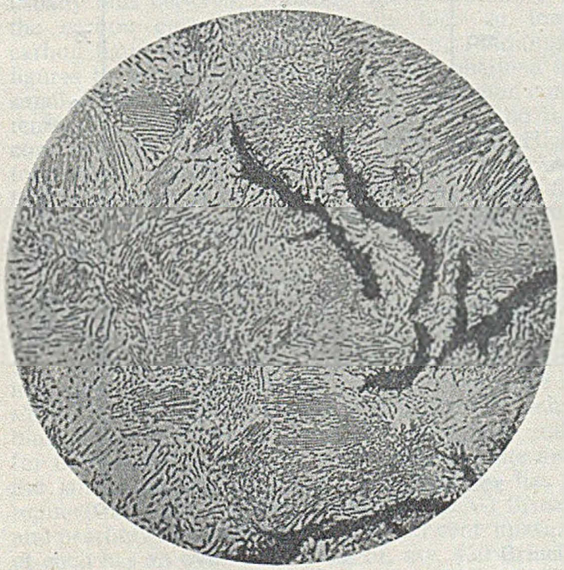

FIG. 7—*Core structure of Straight Carbon Chilled Roll Annealed at 750 deg. C. Magnification ×300 dias.*

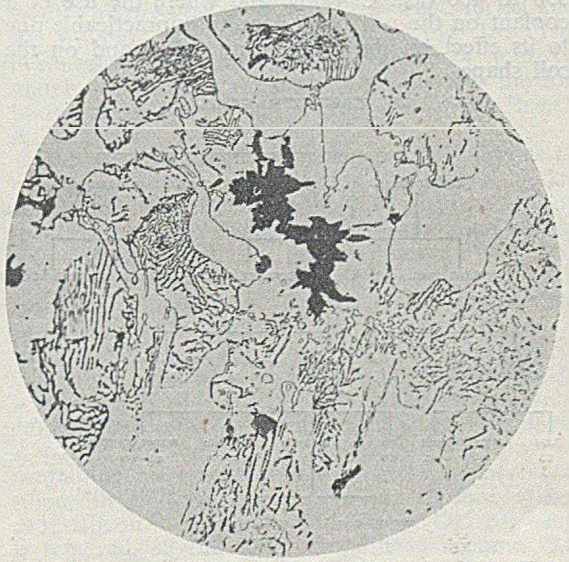

FIG. 8—*Chill structure of Straight Carbon Chilled Roll showing incipient Graphitisation. ×300 dias.*

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the combined condition resulting in a white fracture. The ease with which the carbon is retained in the combined form or conversely, the sensitivity to graphitisation, is influenced also by composition —some elements assisting and some inhibiting graphite-forming tendencies. Should a borderline composition be selected, and the degree of cooling varied in different parts of the casting, white or grey iron will result accordingly and that is precisely what occurs in chilled-roll manufacture. A composition is chosen which normally would solidify with a grey fracture, but the barrel or working surface of the roll is rapidly cooled by massive iron rings or chills whilst the necks and tenons are permitted to cool at a slower speed by moulding them in sand. The portion of the roll cast against the chill is therefore white and the remainder grey.

The depth of the white chilled layer is controlled analytically as the chilling effect of the mould remains constant. For a 30 in. dia. roll having a Shore hardness of 60 on the working face (equivalent to approximately 440 Brinell) and a clear chill depth of $\frac{1}{2}$ in., the composition normally lies within the following composition range:—T.C 2.9 to 3.2; Si 0.60 to 0.75; Mn 0.28 to 0.35; S 0.08 to 0.12, and P 0.4 to 0.45 per cent., with or without small additions of molybdenum often added to increase the core strength and reduce the tendency to fire check on the chilled face if the rolls are to be worked hot.

Stability of Structure

An interesting and important property of chilled iron is its ability to maintain hardness at elevated temperatures. Unlike a quenched steel it will not temper in use to any noticeable degree and remains therefore the only commercial material which can be used, for example, in hot steel and tinplate mills where the working temperature of the roll is in the 350 to 400 deg. C. range and where the use of a coolant on the roll body is quite impracticable due to its effect on the stock being rolled and on the roll shape.

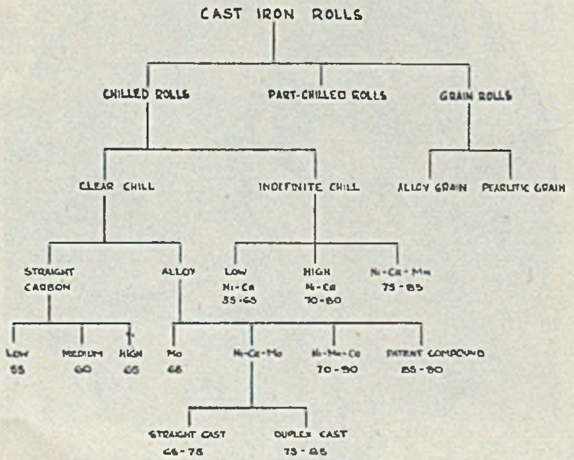

FIG. 9—*Present-day Range of Roll Qualities Manufactured.*

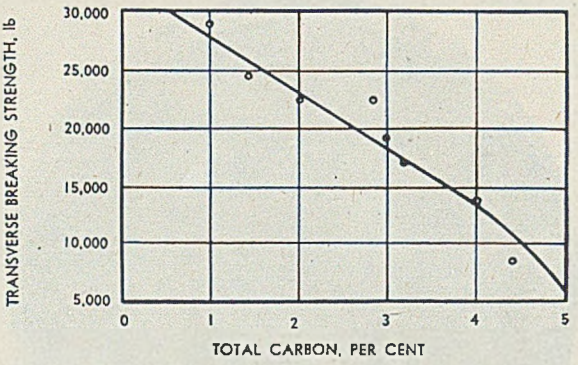

FIG. 10—*Effect of Total Carbon on the Transverse Strength of Chilled Iron.*

Experiments conducted in the Author's laboratories have shown that no structural breakdown occurs until a temperature around the Ac_1 range is approached (about 720 deg. C.), when the first indication is spheroidisation of the pearlite taking place with a slight drop in hardness. Fig. 4 shows the typical "as-cast" structure of chilled iron and Fig. 5 shows the structure developed after annealing for 1 hour per inch at 750 deg. C. Figs. 6 & 7 shows the comparative core structures before and after annealing at this temperature. Above 750 deg. C. incipient graphitisation of the chilled portion commences as shown in Fig. 8. These graphitic areas render the roll useless for the production of a prime sheet.

Roll Qualities

The foregoing preliminary remarks have referred only to the straight-carbon conventional chilled roll, many of which are still in use today. With the advent of the high-speed modern mills the cry for

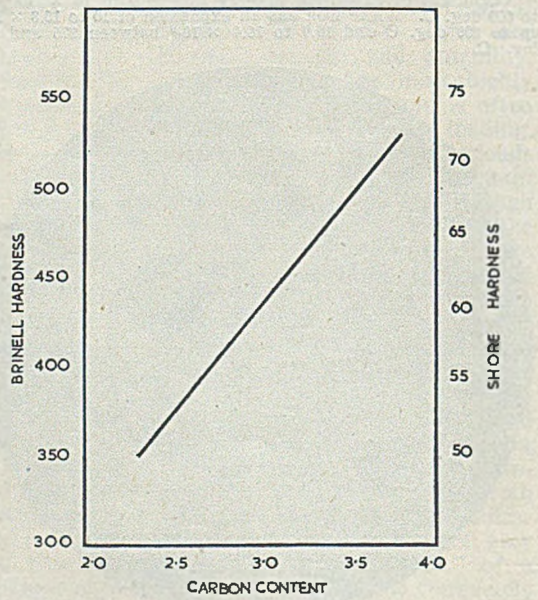

FIG. 11—*Effect of Total Carbon on the Hardness of Chilled Iron.*

FIG. 12—*Chill structure of 2½ per cent. Nickel Alloy Chilled Roll. Magnification* ×300 *dias.*

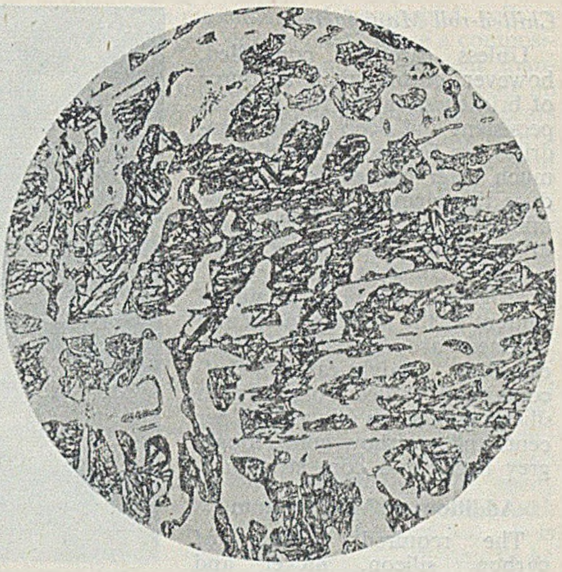

FIG. 13—*Chill structure of 4.2 per cent. Nickel Alloy Chilled Roll. Magnification* ×300 *dias.*

superior roll quality became insistent and the need for increased strength and hardness was paramount.

Fig. 9 shows the range of roll qualities developed by British Rollmakers Corporation, Limited, in the Midlands. It will be noted that no mention is made of cast-steel rolls, of which a large tonnage is made for varied purposes, or of forged and hardened steel rolls which fall into a separate category altogether. In what follows only reference to the left-hand portion of the diagram concerning chilled-cast rolls is made.

It will be observed these are divided into two main types comprising clear and indefinite chill. The simplest and oldest roll is, as before stated, the straight-carbon chilled roll, the hardness of which usually falls between 55 and 65 Shore, according to the carbon content. Abnormally high- or low-carbon figures will widen this range, but, although figures in the 80 Shore range may be obtained in small-diameter rolls with very high total-carbon contents, the fragility of the chill is increased and the core structure is correspondingly weakened. High total-carbon contents of the order of 3.8 per cent. find application in rolls for the paper and foodstuffs industries, but such rolls are rarely used for metal rolling.

Special Types

Fig. 10 shows the effect of total carbon on the transverse breaking strength of chilled iron, whilst Fig. 11 shows the effect of total carbon on the hardness. A 3.0 per cent. carbon chill microstructure is shown in Fig. 4; this percentage gives the best combination of shell hardness and core strength in rolls for hot-rolling. The white areas are cementite and the laminated areas pearlite. As cementite has a reputed hardness in the order of 600 to 700 Brinell and pearlite 200 to 230 Brinell, a 50 per cent. mixture of each has an overall hardness of, say, 430 Brinell. What can be done to increase the hardness and yet avoid excess brittle cementite? Obviously the pearlite phase is the main one to be considered and, if the original austenite decomposition can be retarded or made to occur at lower temperatures, the pearlite becomes harder and finer progressively until the maximum hardness with a martensitic matrix is obtained.

Fig. 12 shows chilled iron containing 2½ per cent. of nickel, whereas the pearlite phase is practically irresolvable at this magnification of × 300 dias., and the hardness of this particular structure is 72 deg. Shore. Further additions of nickel result in the appearance of yet harder Vickers Pyramid hardness numbers and at 3 per cent. of nickel, or thereabouts, martensite makes its appearance. With a normal rate of roll cooling, the structure of the matrix is wholly martensitic at about 4.2 per cent. nickel and the resultant structure is shown in Fig. 13. The hardness of this particular martensite is approximately the same as the carbide phase; thus the roll body has an overall hardness of 650 to 700 Brinell or 90 Shore.

During the addition of nickel for the purpose of hardening, another complication has arisen. Nickel is a graphitiser about one-third as potent as silicon in this respect, so that progressive additions of this element have reduced the thickness of the clear chilled layer. This graphitising action must therefore be balanced by a carbide stabiliser, and the usual element employed for this purpose is chromium. To illustrate by actual example, a 30-in. dia. roll is required at 85 to 90 Shore hardness, with a chill depth of ¾ in. A basic analysis would be 3.0 per cent. total carbon and 0.75 per cent. silicon. A 4.2 per cent. addition of nickel for the purpose of promoting martensite is equivalent to 1.4 per cent. silicon in chill reduction. To balance this 1.4 per cent. silicon a chromium addition of 1.05 per cent. is required, so the final composition becomes 3.0 T.C, 0.75 Si, 4.2 Ni, and 1.05 per cent. Cr.

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Unless carefully controlled, however, chromium is a source of brittleness in the roll core, as persistent and deep carbide dendrites are formed. Therefore, a much safer procedure is to reduce this element to a workable minimum, keeping a high nickel to chromium ratio and yet maintaining a constant chill depth by a progressive decrease in silicon content as the nickel content and hardness are increased. Some excellent straight-cast nickel-containing chilled rolls have a silicon content as low as 0.25 per cent. and yet show good, tough, grey necks and core structures.

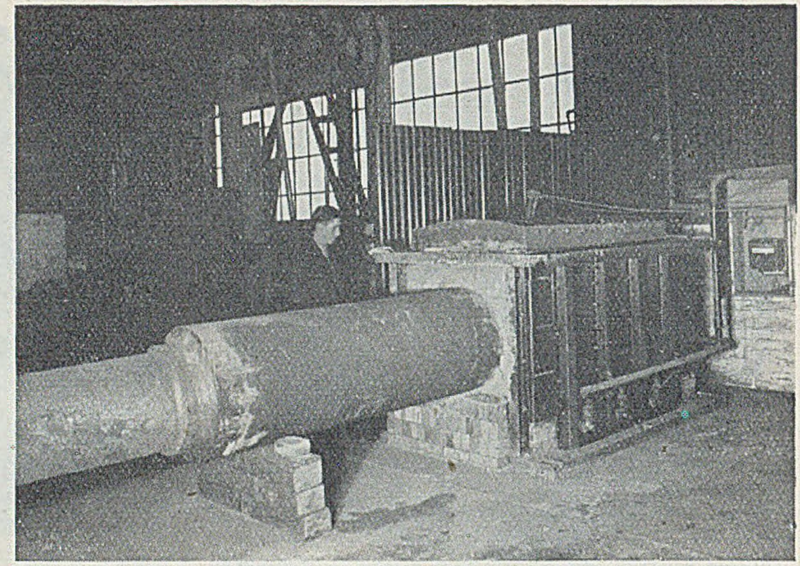

FIG. 14—*"Nichillite" Alloy Roll with 90 Shore Hardness. Ground to a Mirror Finish.*

Additions of Molybdenum

The required balance of carbon, silicon, nickel and chromium may be calculated in terms of hardness and chill depth and as a further structural refinement molybdenum is usually incorporated in the specification. This element, by modifying the shape of the time, temperature, transformation curve, reduces the risk of retained austenite and delayed transformations which are responsible for premature failure of a roll. Naturally, other combinations of alloying elements may be used to promote the desired martensitic structure, but the necessity for precise chill-depth control narrows the field of applicable ones. Manganese is a useful element in this respect and, with certain combinations of manganese, nickel and molybdenum hardnesses in the region of 820 Vickers Pyramid number have been developed.

High hardness, clear chilled rolls find a wide application in the cold-rolling of metals where resistance to tail marking, bruising and abrasion, plus an ability to carry a high degree of finish, are of paramount importance. Fig. 14 shows a 90 Shore " Nichillite " roll being ground to a mirror finish.

Duplex Rolls

The successful manufacture of a high-hardness martensitic chilled roll calls for a high degree of metallurgical and practical skill if cracking and internal strains are to be avoided and the difficulties inherent in the process have led to much research and investigation into means whereby the core of the roll may be strengthened, persistent carbides avoided, and the correct degree of austenite transformation secured in chill and core.

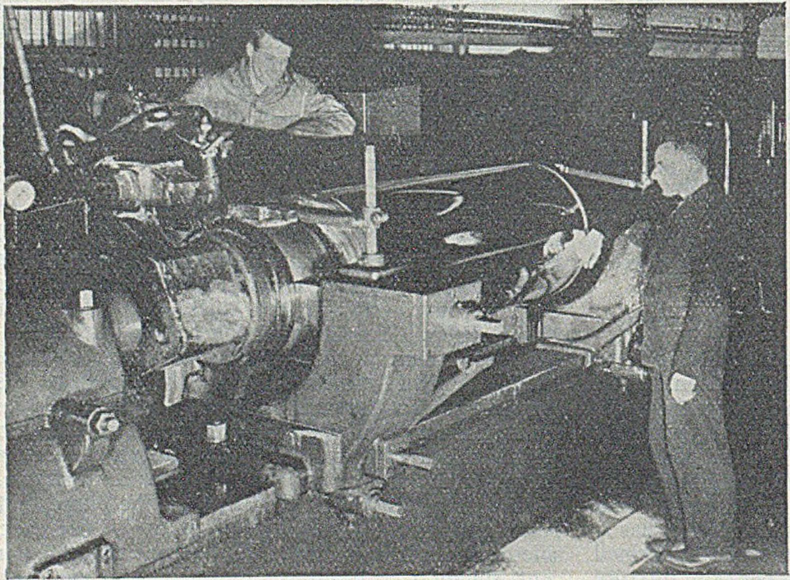

FIG. 15—*Method of Softening Roll Necks by Part Annealing.*

The principal outcome of these researches has been the development of the duplex or compound roll. In the manufacture of this type, the roll body is poured with the hard, highly-alloyed parent metal. After a predetermined time interval during which the ingate is prevented from freezing by the introduction of small additions of hot metal, soft grey iron is poured down the original gate and the excess metal flowed off at the cope body shoulder. The shell thickness on the roll body has already solidified against the chill mould, but the drag neck and roll core is replaced by soft iron. When a sufficient amount of this latter has been poured, the flow-off hole in the top neck mould is plugged, and this neck is then poured *via* the sink head. Many variations of the duplexing or compounding technique are practised. One German patent permits pouring the core metal down the sink head and flowing off the excess parent metal upwards through the gate. This method has an advantage in that downward displacement is effective in avoiding piping effects.

All duplexing and compounding procedures demand precise timing and temperature control, otherwise such disconcerting effects as shell wash-off can easily occur. The methods and their variants may employ percentages of core metal replacement up to 100 per cent., but the basic principles are the same whatever the amount of core metal poured.

As with most metallurgical processes, however, the panacea for all ills is not found in the compounding technique. Whilst the certainty of grey necks, cores and tenons is assured, additional strains may be set up due to the widely differing austenite transformation temperatures in shell and core. Thus, with white iron shell composition necessary for martensitic structures, transformation of the austenite commences below 200 deg. C. with a pronounced expansion. The pearlitic core (if such be used) has already transformed at 700 deg. C. or thereabouts, and at 200 deg. C. normal contraction is proceeding. The net effect is a highly-stressed condition which often results in mosaic-pattern hair-line cracks or premature rupture of the roll in the mould.

Core compositions and amount of compounding need to be controlled to avoid too wide a discrepancy in transformation temperatures, and in the hardest German-manufactured compound rolls a fully martensitic grey core is used having a composition of 4 per cent. silicon and 11 per cent. manganese, ensuring the correct structure in sections up to 36-in. dia. Up to the moment, 90 Shore appears to be the maximum hardness limit of alloy chilled rolls, but there is good reason to believe the limit has not yet been reached. By meticulous attention to roll-cooling speeds in relation to the appropriate time-temperature-transformation curve for the particular alloy composition chosen, it is possible to produce true martensites with little or no residual austenite and certainly avoid the lower bainites.

The British roll industry has secured hardnesses of 850 Vickers Pyramid hardness in a full roll section by these means and, with this hardness, white iron will easily cut glass. There are practically no published data on the time-temperature-transformation curves for alloyed white iron, and any such work forms a laborious investigation not easily undertaken in a foundry research department, though great strides are being made at the moment. It is interesting to learn that if nickel and chromium be the principal alloying elements in a white martensitic iron, two noses of rapid transformation occur at 538 and 260 deg. C., with the M point at approximately 93 deg. C.

Often, the tenons of these hard rolls must be machined in an intricate manner and to fine limits. Although these are grey, the martensitic matrix makes fine machining limits very difficult. These portions of the roll are therefore softened by annealing. Fig. 15 shows this operation in progress. Furthermore, there are occasions when a bainitic white structure is desirable, an example of which is shown in Fig. 16. This is produced by controlled heat-treatment, but the appropriate time-temperature-transformation curve must be known. The clear-chilled roll and its alloyed varieties are perhaps the most interesting metallurgical study in the

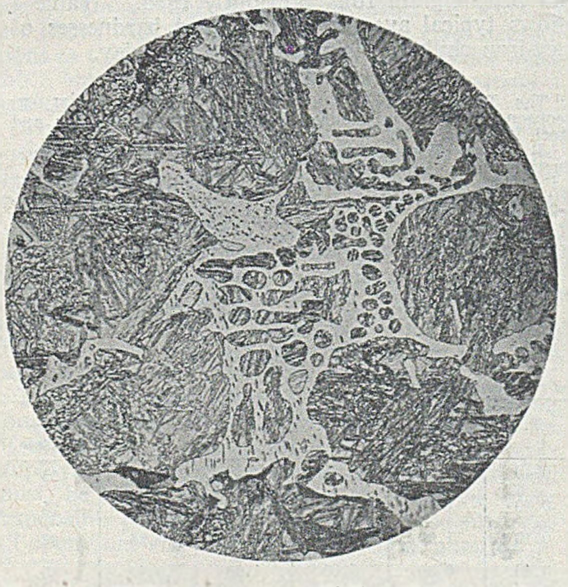

FIG. 16—*Chill structure of Chilled Roll containing Bainite. Magnification* ×300 *dias.*

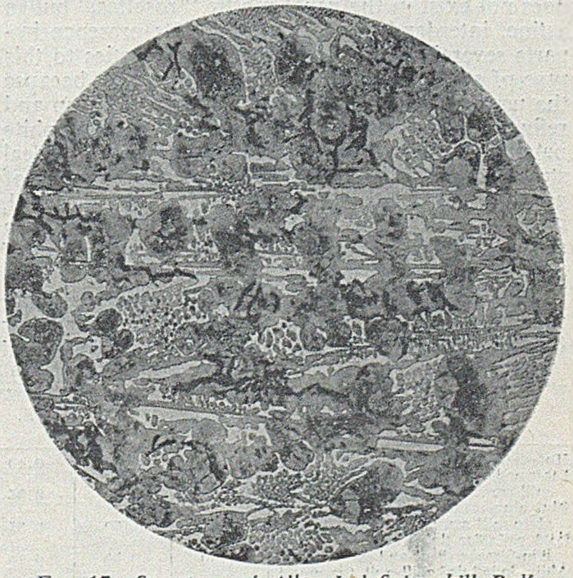

FIG. 17—*Structure of Alloy Indefinite-chill Roll Magnification* ×300 *dias.*

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whole of the ironfoundry industry, when one considers that the hardest of these is incapable of being turned even with tungsten-carbide tools, and must of necessity be ground to the required finish from the rough casting. The matter is further complicated by the fact that even one small pinhole may ruin an otherwise perfect roll; the hazards can thus be appreciated.

Indefinite-chill Roll

Obviously, the use of the clear-chilled roll is confined to flat or shallow section work due to the limitation imposed by the clear-chill depth. In order to accommodate rolls for profiles requiring deeper grooves or passes and rolls where a high degree of spall resistance and fire-crazing resistance are required, the indefinite-chill or American "grain" rolls was a simultaneous development. It will be recollected that the physical make up of a clear-chilled roll consisted of three zones or divisions of structure, namely, the clear chilled outer surface, the mottle or mixed white-and-grey structure and the dense grey necks and core. Naturally, the clear or effective chill depth determines the limit of wear resistance, and if this chill depth is excessive, the rolls become too fragile for use. Further, as the roll is re-dressed and reduced in diameter, a point is reached where the hardness falls off rapidly, this point coinciding with the mottled zone.

In the case of the indefinite-chill roll, there is no clear white graphite-free chill and no intermediate mottled zone, although the normal chill-casting technique is employed. This effect is produced by a compositional adjustment, principally in respect of alloys, and the fall in hardness from surface to centre is regular and continuous. The surface layer itself contains a certain amount of fine graphite, visible only under the microscope. This graphite does not exist in the usual mottle "rosettes," but in a fine, interdendritic formation. Its presence imparts several special and unusual properties to this type of roll. It inhibits excessive firecrazing because the usual columnar chill structure is broken up and refined; it improves spall-resistance, as each graphite particle acts as a minute cushion for relieving local stress concentration and because of the presence of graphite rolls have a better "bite" in the mill, minimising slippage troubles. Fig. 17 shows a typical indefinite chill structure at a magnification of × 50 dias.

Due to the gradual change in structure from surface to core, stresses in the casting are less liable to occur, providing reasonable compositional limits are maintained, and again by adjustment of the composition the rate of hardness drop per unit penetration may be controlled as desired. As with clear-chill rolls, the indefinite-chill roll is made in all hardness ranges by suitable matrix structure control. The softest usually fall in the 55 to 60 Shore category and have a pearlitic matrix, whilst the hardest at 85 to 90 Shore have a martensitic matrix.

Development of Structure

The chief element employed to develop the indefinite-chill structure is chromium. Chromium is responsible for persistent dendritic carbides, in other words, the mottled zone is widened and refined and, so long as it is not carried to extremes, an otherwise objectionable feature is put to good use. If the correct carbon, silicon and chromium balance be maintained, clear-chill is eliminated and a mottled zone sufficiently deep to accommodate the section being rolled may be produced. Should a deep section be required with consequent deep penetration of hardness, the danger of core embrittlement is avoided by adopting the duplexing technique.

Low total-carbon contents increase the hardness penetration but increase the brittleness of the roll core. Nickel is usually employed in conjunction with chromium, and of course this element becomes a necessity when alteration to the matrix is desired.

In the United States the indefinite-chill roll has replaced the clear-chill type for many diverse applications; for example, large plate mills are now favouring indefinite-chill-type rolls where previously straight-carbon or molybdenum-alloy chilled rolls were considered indispensable.

In this country and on the Continent more and more mills are turning over to the indefinite-chill type and for finishing sections, improved performances up to 300 per cent. have been recorded over the British grain rolls previously used. Table I shows typical average analyses and hardnesses of cast-iron chilled rolls most favoured to-day.

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(To be continued)

TABLE I.—*Typical Chilled-roll Compositions.*

	T.C.	Si.	S.	P.	Mn.	Ni.	Cr.	Mo.	Shore hardness.
Hot-sheet-mill rolls	3.00	0.70	0.10	0.40	0.40	—	—	0.25	60
Intermediate continuous hot-strip-mill work rolls	3.30	1.00	0.05	0.10	1.00	3.00	1.20	0.25	75
Finishing-stand continuous hot-strip-mill work rolls	3.30	1.00	0.05	0.10	1.00	4.00	1.50	0.25	82
Cold rolls for finishing ferrous and non-ferrous sheet and strip ..	3.30	0.50	0.10	0.40	0.30	5.00	1.00	0.40	85
Alloy indefinite-chill roll for small sections	3.20	1.00	0.05	0.10	0.50	1.00	1.00	—	60

Safety and Hygiene in the Foundry*

By J. Steele

In foundrywork, as in all other occupations, carelessness and subsequent accidents cause suffering if not loss of life to the workman, and loss of production to the firm. Without changing human nature it would be extremely difficult to eliminate accidents entirely, but at least the conditions which encourage haphazard working and the taking of needless risks can be removed. Outlay on hygiene and accident-precaution is more than repaid by increased output, reduction in man-hours lost, and inducing suitable recruits to enter the industry.

AN EXAMPLE of what can be done by a responsible management in the way of safety and hygiene is provided by methods which are in operation in a certain workshop and foundry with which the Author has been connected. The entire factory comes under the jurisdiction of a safety engineer. It is the duty of this official to ensure that all possible measures are taken throughout the works for the safety and hygiene of all employees.

Due to the large number of employees (8,500) the safety engineer's staff consists of one assistant and two inspectors. The duty of these inspectors is to make regular tours of the various departments in the works, and to ascertain that all safety measures are in operation. This routine inspection dispenses with the usual scurry for guards and safety devices which takes place when word is passed round that the government inspector is due to pay a visit.

There is also a central safety committee for the entire factory. This committee has one or two representatives from each department, and it meets regularly, during working hours, under the chairmanship of the safety engineer or his assistant. At these meetings, departmental problems concerning safety and hygiene are brought to the notice of the chairman, discussed, and dealt with accordingly. On commencing employment, all workers are issued with a safety manual which gives instructions as to the correct methods of going about one's job. New employees are also required to attend a safety-first lecture.

To ensure that all accidents are treated with the urgency which they require, the firm has an up-to-date casualty station. It is not merely a first-aid dressing station, but has a fully staffed and equipped operating theatre complete with X-ray apparatus. There is also a dentist in attendance at the casualty station. These measures, while seemingly elaborate, have been found to be absolutely essential if a low accident rate is to be maintained. This organisation has been built up gradually, after keen and careful study of all the relative factors.

It is understood, of course, that in small jobbing foundries, measures on such a scale are usually out of the question due to the small number of men employed. Nevertheless, precautions should, and must, be taken, and the foreman, or some other responsible person, should be instructed to supervise all operations and make them as safe as possible.

* Paper delivered to the South African branch of the Institute of British Foundrymen. For this work, the Author was awarded second prize (gold medal) in the 1948 John Surtees Memorial Examination in Scotland.

FOUNDRY HYGIENE

It is unfortunate that, at the present time, there are still a large number of foundry managements who could not satisfy or convince themselves that hygiene—in the truest sense of the word—is practised in their establishments. In some foundries, the laws of sanitation appear to be unknown, and facilities are often totally inadequate and definitely unhygienic. Irrespective of what measures are adopted in the foundry for the preservation of the employees' health, if the plant is badly laid out a very serious handicap exists.

Ventilating and Lighting

Where possible, all foundries should have high, well ventilated roofs—say 50 ft. to 60 ft. to the apex. The purpose of this is to enable the dust-laden atmosphere to be disposed of, and reliable fans or extractors can be suitably spaced along the roof to take care of gases, heat and dust as they rise from the foundry floor.

Carefully considered use of windows is an essential in any well-planned building. Admittedly, glass costs more than bricks or corrugated iron sheeting, but the difference is quickly made up by fuel saving. One handicap generally encountered with windows is that their inaccessibility makes them difficult to clean. However, the modern trend in workshop construction is to use saw-toothed roofs. For illuminating purposes, the advantage of this type of roof is that the windows do not get dirty so easily, due to the inability of dust to settle thickly on a vertical surface. Furthermore, provided a suitable erection is made, the windows are easily cleaned.

A saw-toothed roof is shown in Fig 1 (a). Note the gangway "A" and the handrail "B." The inside of the windows, "D," are cleaned from this gangway, and the outside cleaned by walking along the valley gutter shown at "C." The gangway as shown at (b) is of lattice construction, which prevents any obstruction of the light through the windows.

Foundry Floor

A suggestion which has been adopted in some foundries, and which is worthy of adoption in many more, is the separation of the moulding floor from the casting floor. It is often stated that a cement floor should be used as far as possible, because it is much more comfortable to walk about on a level cement floor than on an uneven sand floor. However, where "bedding in" is carried out, unless a

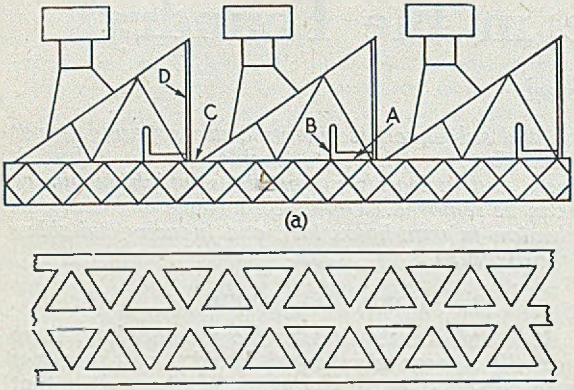


FIG. 1.—(*a*) *Saw-tooth type of Roof. The Windows are cleaned from a Gangway of Lattice Construction as shown at* (*b*).

part of the floor is left with a sand foundation, a cement floor is out of the question.

One danger of cement floors arises when casting is in progress, especially where bottom-pouring ladles are in use. Should a running nozzle develop, as soon as the metal hits the cement floor it will spatter in all directions. On the other hand, one definite advantage of a cement floor is that it can be kept clean.

Dust Problem

Another measure which should be taken, if possible, is to have the sand reclamation and mixing plant in a lean-to. The reason for this is that, using a satisfactory dust-extraction plant, the minimum amount of dust will enter the foundry, as it will be concentrated in one area and the extraction plant will deal with it there. With regard to the knocking out of moulding boxes, this can hardly be done in a lean-to without the use of a conveyor apparatus. If possible, then, this operation should be carried out after normal working hours. By this method, the minimum number of men will be working, and the health of these men can be safeguarded by issuing them with suitable respirators. One alternative is to have a shake-out plant erected, and equipped with accompanying dust-extracting plant.

The use of respirators and protective equipment is advisable for the operators of the sand-milling machines. Where these mills are manually charged, the operators must be protected while handling silica sand (effect: silicosis), pitch (effect: skin irritation), and coal dust (effect: weakens respiratory system) to name three common elements. All employees engaged in this work should be provided with respirators, gauntlets and goggles; the latter particularly if pitch is used.

Smoke and Obnoxious Fumes

A frequent cause of irritation in the foundry is the indiscriminate lighting of fires for many uses, from making tea to drying moulds. Where a coal fire is used, smoke is given off and generally pollutes the atmosphere. Coke fires, on the other hand, give off a large supply of carbon monoxide. This gas has been termed "No. 1 acute poison killer," due to the many deaths which are caused by this type of fume. There are also the gases given off from certain cereal binders when cores are being dried in the stoves.

If it is necessary to light fires, it is advisable to do so when there are few men working. In one particular foundry, producer gas is used entirely in drying stoves, for drying ladles, moulds bedded in the floor, and moulds which are too large for the stoves. Of course, this foundry has the advantage of being a department in a factory where gas is produced—hence the reason for such widespread use of this type of fuel.

Where possible, stoves for drying cores and general moulding work should be built on the side of the foundry with a good flue and ventilating system so that all gases, from fuel and binders, can quickly be dissipated in the atmosphere. Where brass crucible furnaces are in use a stack, shown in Fig. 2, should be used. When the roof "A" has been placed on the furnace, the pipe "B," swivelling on "D," is placed in position over a corresponding hole in the furnace roof. The joint is luted as shown at "C," and all fumes then pass through the stack and outside the building. This method, of course, is most convenient when the furnace is situated next to the foundry wall.

Washing Facilities

A very important point in foundry hygiene is the provision of adequate washing facilities for employees. If a worker can come to his work dressed in "top hat and bow tie" and return home after a day's toil in similar fashion, so much the better for all concerned. Wash hand-basins alone are not enough; shower baths with hot and cold water

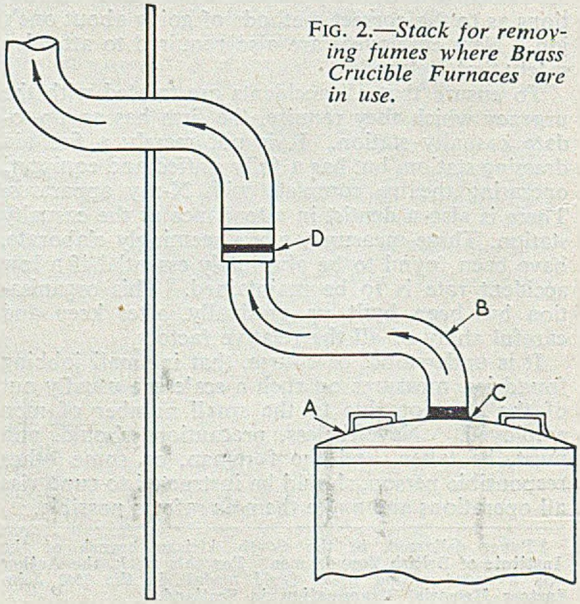


FIG. 2.—*Stack for removing fumes where Brass Crucible Furnaces are in use.*

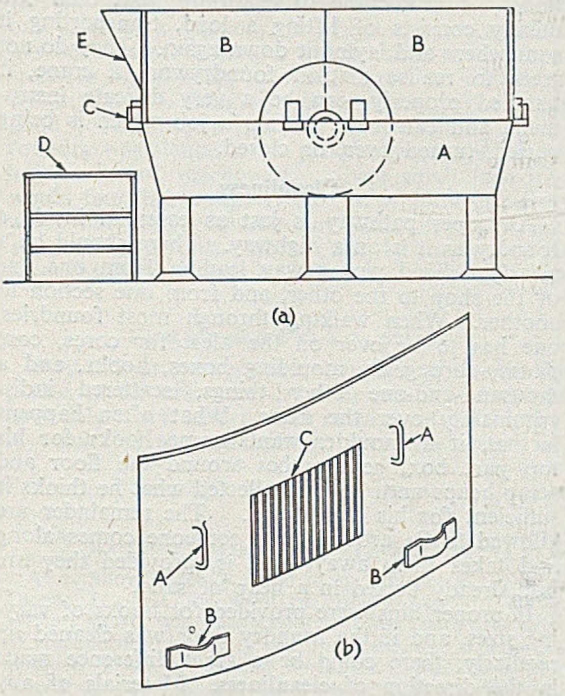


FIG. 3.—*Protective Guards suitable for Fitting to Milling Machines used for the mixing of Mould and Core Sands.*

are really essential. Proper lockers should be provided where men can keep their changes of clothing in good condition and safe custody. For wet weather, wash houses should be provided with pulleys and hangers on which the men can leave their wet clothes to dry.

Proper sanitary conditions are also sadly lacking in many foundries, and are often in a deplorable state. This is a point which requires urgent attention, and more consideration must be given to this subject than has apparently been given in the past.

SAFETY MEASURES

The most apparent danger in all foundries, large or small, is that of personnel being burned. The presence of this danger supports the suggestion already made that moulding and casting operations should be separated where possible, as, by this method, only the men who are casting and feeding are near the metal. If these workmen are suitably clothed, the danger of burns is greatly lessened. On the other hand, where casting takes place beside men who are moulding, unless sufficient warning is given a serious threat of burning exists due to the moulders being unprotected against any splashing which may take place.

All men who handle the metal should be provided with protective goggles to preserve the eyes against flying sparks. In steelfoundry practice coloured goggles are necessary. For the ladleman and cupola attendant, the following articles of protective clothing are suggested:—Gauntlets, to prevent burns to the hands and arms; leather aprons; face shields. The type of face shield suitable for furnace work has an adjustable head-band, and the transparent part is hinged to the band so that it can easily be pulled down or pushed off the face as required.

Where casting pits are used, these should not be level with the floor as there is always the possibility of the edges being broken, and someone may fall into the pit. When pouring the metal into moulds which require the ladleman to stand on a raised platform, a very dangerous practice in foundries is to rig up some form of makeshift platform. The ladleman is expected to stand on this erection, often precariously, and direct tons of metal into a mould. Where it is necessary to fix up a pouring platform, care should be taken to ensure that it is absolutely safe. For reasonable heights, small, portable metal stepladders should be provided. Wooden stepladders, while more portable and usually cheaper, have much shorter lives than metal ones, and there is always the danger that when they have aged and received a good number of burns they will still be used and so add risk of collapse to the danger of wobbling while casting is in progress.

Another point to be considered during casting is the advantage of having a couple of bot sticks, complete with bot, standing in readiness to stop, or try to stop, any possible run-outs. Often, when a run-out occurs during casting, it is followed by a sudden scurry to try and find something to stop the metal flow. Apart from the loss of metal, there is always physical danger when a run-out of any size occurs.

Sand Plant

Where mechanical milling machines are used for mixing moulding and core sand, a very dangerous practice is for the operator to put his hand in the mill, and extract a sample of sand, this being done when the mill is still in motion. Unfortunately, human nature being what it is, prohibiting this practice will not stop it. The precaution of fixing protective guards round the machines is a safety measure worthy of wide application. This is illustrated in Fig. 3. A sketch of a mill with this safety device is shown at Fig. 3(a).

The mill body is shown at " A " and two safety guards are shown in position at " B." As these guards are detachable, locating lugs are shown at " C " in the same illustration. The sand is loaded into the mill by mounting the platform " D " and

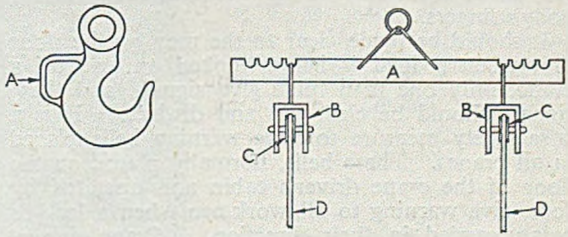


FIG. 4 (*left*).—*Suggested Handgrip for Chain Hooks.*
FIG. 5 (*right*).—*Beam for turning over Large Boxes.*

Safety and Hygiene in the Foundry

tipping the sand down the chute " E." There are four such guards on the mill, and one is shown in Fig. 3(b). Note the lifting handles at " A " and locating lugs at " B." In order that the sand mixing operation can be seen without mounting the platform, inspection grids are provided in two of the guards.

This grid is indicated at " C " (Fig. 3(b). All sand mixtures are given in buckets or small specially prepared measures. Apart from the unreliability of measurements, it is not practical to load the mill by shovelfuls, due to the height of the guards.

Where a sand-reclamation plant is in use, due to the mill generally being a considerable height above the floor level, an ever present danger exists unless special precautions are taken. The operator, when cleaning out the mill, is often completely obscured from the view of anyone standing on the floor. When cleaning is in process, the main switch should be padlocked, making it impossible for anyone to start up the machinery and maim or kill the cleaner.

Cranes

In jobbing foundries where small, manually operated cranes are used, the main point is to ensure that all parts are kept in good, reliable condition. Regarding overhead electric cranes, it is necessary that these be the object of very rigid and regular inspections, as the safety of the men on the floor depends, to a large extent, on the efficiency and worthiness of the cranes. The wire ropes and pulleys should be inspected regularly for defects and changed when there is the slightest sign of a flaw.

All chains and slings should also be subjected to rigid routine inspections. Immediately a link or hook appears defective in any way, the matter should be reported to the foreman, and the chain should then be put out of service until the defect is made good An excellent safety device on chain hooks is shown in Fig. 4. The handgrip " A," attached to the hook, allows the moulder to hook the chain on to the load and retain his hold on it, without the slightest danger of his hand being caught between hook and load, while the strain is being taken. The device can be attached to every hook in the foundry, irrespective of size. All that is required is a $\frac{1}{2}$-in. or $\frac{3}{4}$-in. steel rod, bent to shape, and welded onto the chain hook. It costs very little, but it may be the means of saving somebody's fingers.

It should be made clear to the men on the floor that when a load is being hooked on and off a crane, only one man must give signals, and these signals should be clear cut and distinct. It is a wise safety measure to have warning bells placed in all cranes. These bells, normally placed on the floor of the crane driver's cabin and operated by foot, give warning to all workmen when a load is being carried in their direction. Crane drivers new to foundrywork must understand the importance of taking instructions from the man on the floor. Some crane drivers think that their job merely consists of lifting a load, transporting it somewhere and laying it down again. They do not seem to realise that in foundrywork a crane, if handled properly, can be a very delicate instrument, and can make or mar a job which is being parted, turned over, or closed.

Cleanliness

A proper pathway is just as essential inside a foundry as it is on a highway. There should be a clearly defined passageway leading from one end of the shop to the other, and from one section to another. When walking through most foundries, one has to be ever on the alert for cores, core plates, core grids, moulding boxes, hooks, and a thousand-and-one other things, scattered indiscriminately over the floor. What often happens is that, if a moulder wants some hooks for his top part box, he searches around the floor and scrap heaps until he has collected what he thinks is sufficient for his own needs. The remainder are allowed to lie around until someone comes along and takes them away—that is, provided they are not already buried in a heap of sand.

If proper bins were provided for hooks of varying sizes, and if the foundry floor was cleaned up regularly, there could be a great difference made in the direction of cleanliness. Materials of any sort lying about the floor are a source of danger. Anyone can trip up and have a very serious accident. If haphazard methods are adopted, it means waste of materials and money.

Turning-over Operations

The operation of turning moulds over can be really dangerous unless the proper equipment is used for each particular job. Wherever possible, beams of the type shown in Fig. 5 should be used for turning boxes of reasonable size, especially where there are two or more boxes together. In Fig. 5 the beam is shown at " A," the movable struts at " B." The chains " D " revolve on two free pulleys shown at " C " in the illustration. The advantage of using a beam is that it gives an easier turnover without any sudden jerks to strain the chains, and, because of this, it is much safer; the jerk sometimes causes chains to break, thus endangering the workmen.

For large-size boxes where it is not possible to use beams, the jerk must be eliminated as much as possible. One method in operation is to use old motor car and lorry tyres on which to roll the boxes. This gives a cushioning effect—and provided the craneman is careful, there is no danger of a jerk. If there are any defects in the crane chains, this operation will bring them to light, as a weak link, if jerked, will be very liable to snap, with disastrous results.

Colour Scheme

Planned colour schemes are increasing in popularity, especially in machine shops. One such shop has all the machines painted in two colours—moving parts and danger spots are painted orange, and grey paint is used for stationary parts. So far, the only application of colour which the Author has seen in a foundry is where the crane block has been painted orange, which makes it very conspicuous when being lowered, raised, or stationary, without chains hanging on the hook. There are good possibilities in this idea of brightening up the foundry—particularly in production shops which have a lot of machinery. Even small foundries would find that a regular coat of whitewash on the walls, and maybe aluminium paint on beams and supporting colums, would not be beyond their modest means.

First-aid and Fire Equipment

First-aid and safety-first equipment should be placed in all foundries, large or small, and should be within reach of everyone in cases of emergency. It would be a good idea if employees were encouraged to study elementary first-aid so that they would be able to deal with casualties should the occasion arise.

Where there is danger of fire due to electrical faults, special fire-extinguishers with a non-conducting liquid must be used. This type of extinguisher should be indicated as such—and all others should be clearly marked NOT FOR ELECTRICAL USE.

The necessity for this notice is that, in cases of emergency, someone may inadvertently use an ordinary extinguisher on a fire caused by an electrical fault. Should this occur, there is risk of serious injury.

Acknowledgments

The Author wishes to thank the management and foundry staff of Iscor Works, Pretoria, for their generous encouragement and willing assistance in the preparation of this Paper.

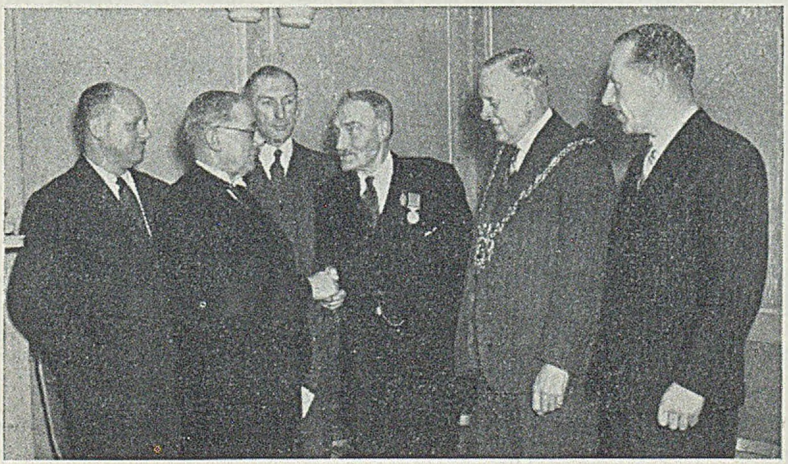
Veteran Moulder Honoured

At a dinner recently given in Ipswich by E. R. & F. Turner, Limited, the guest of honour was Mr. F. M. Minter, B.E.M., who was celebrating his retirement after 70 yrs. continuous service with the company. The guests included 35 of his former workmates, who have now retired on pension, and all those employees who had completed 40 yrs. or more with the firm. By a coincidence, their number totalled 70, with the sum total of 3,151 years of service.

Fred Minter worked as a moulder in the foundry and he has one regret—that he was unable to serve a further two years to bring him up to the age of 85 years before his intended retirement. He joined the firm in 1880 and served for 70 years in an arduous daily task. In the days when he commenced as an apprentice, he worked from 6 a.m. until 5 p.m. as a boy of 12 years of age, earning 1s. a week with 6d. "ticket money" added for good conduct. He learned the intricacies of making moulds for castings, in due course becoming expert in the art of making side frames for the Turner roller mills which were then supplanting the traditional millstones in the milling of flour. In the course of time he achieved a degree of craftsmanship which would now be difficult, if not impossible, to match. In the making of intricate castings, no machine can entirely supersede the skill of the moulder and Fred Minter displayed a dexterity which no one could fail to admire.

During the second world war, he was singled out for his craftsmanship in the foundry and gained the award of the B.E.M. This was the third major war during which he had worked for long hours to turn out essential munitions and plant, as the firm supplied complete grain-milling plants during the Boer war, built hundreds of shell lathes during the first world war and in the second world war thousands of electric motors and special equipment of many kinds. Long hours were nothing new to this veteran who recalls the days of industrial expansion when the completion of large contracts necessitated working for long continuous spells. In those days, there were few regulations covering an apprentice and he worked as long as the craftsmen needed him.

During the dinner, a presentation was made by the chairman, Mr. A. Leggett, senior, who has himself been with the company for 58 yrs. and who expressed the hope that Mr. Minter and his wife would enjoy many more years of comfort in their retirement. The Mayor of Ipswich was present to add a tribute and as a further souvenir of the occasion, Mr. Minter was presented with a gold medal.



Mr. F. M. Minter being congratulated by Mr. A. Leggett on his retirement after 70 years continuous service with E. R. & F. Turner, Limited.

New Sand-testing Apparatus

*By W. H. Moore**

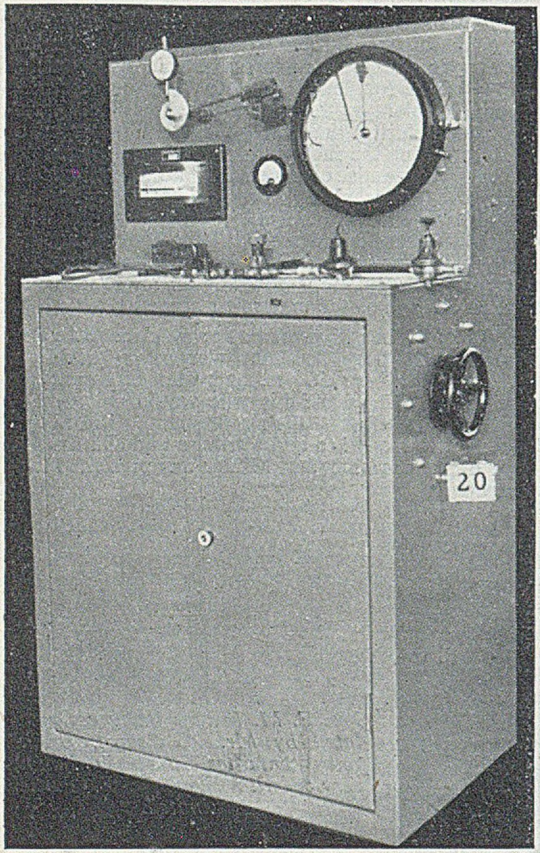
SAND CONTROL in the past has been largely directed towards lowering the stresses and forces produced in the sand when it is subjected to heat. It is a known fact that silica, which is the basis of all sands, exhibits a differential expansion when heated. This expansion leads to the development of rupturing forces within the sand body. In the same way, when a sand is heated gases are evolved and in travelling through the sand body they set up back pressure forces which tend to fracture the sand. By adjustments in the type of silica grain and in the type and amount of binders used in the sand, it has been possible to exercise a limited degree of control over these forces. However, this means that all control is largely uncertain because it is impractical to measure the extent of these rupturing forces completely and accurately.

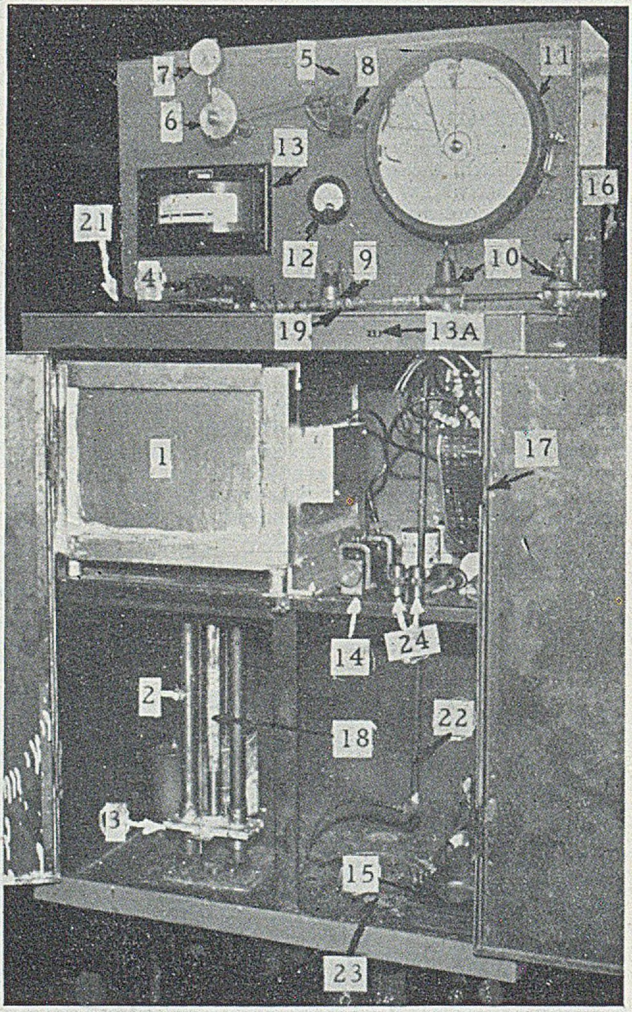
Fresh Approach

The sand technologists of the Mechanite group have adopted a new approach to this problem. Their basis of reasoning is that if the strength of

* The Author is on the staff of the Meehanite Metal Corporation, New Rochelle, New York.

FIG. 1.—*Sand-testing Machine produced to Reveal Maximum Strength in the Sand Body.*





(1) Furnace capable of reaching 1,650 deg. C. usually run at 1,100 deg. C.
(2) Guides for specimen holder.
(3) Specimen holder support.
(4) Guide for locating specimen in the testing position.
(5) Striker in the upper position.
(6) Eccentric cam for magnifying the spindle movement.
(7) Dial gauge for registering the position of the pendulum.
(8) Magnetic release for the striker pendulum.
(12) Ammeter for furnace control.
(13) Thermocouple indicator for temperature control.
(14) Specimen preparation die (double compression method).
(17) Transformer for voltage control.
(18) Refractory specimen holder support.

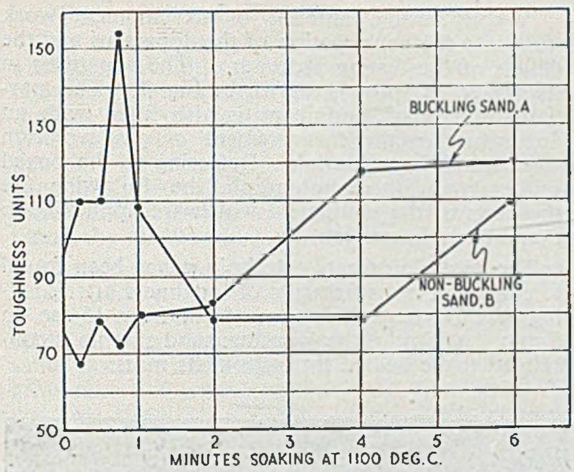


FIG. 2.—*Direct Comparison of Two Moulding Sands by the New Methods of Testing.*

the sand or the ability of the sand to resist these forces at a time when they are at their highest is controlled, the sand will not be ruptured or broken by the effect of heating. This is the same line of reasoning which is adopted in making a casting to certain physical properties. The strength of the casting is always made sufficiently high to withstand the forces which are imposed upon it in use.

The emphasis of control is, therefore, placed on developing strength in the sand body to withstand rupturing forces rather than on reducing the rupturing forces to the point where they do not exceed the strength characteristics of the sand. The reason for this line of approach is basically simple. To reduce expansion forces in a sand an exact balance of the clay bond and the silica base has to be arrived at. This usually results in the use of sufficient clay bond seriously to impair the flowability of the sand which must be sufficiently high to allow of a uniformly rammed mould with the expenditure of the minimum time and effort.

Another means of reducing expansion forces is to increase the spread of the basic grain distribution of the silica particles so that we have in effect a mass of sand composed of varying sizes of particles. With such an arrangement there is the chance of relative movement or adjustment of the sand grains when they are subjected to heat. This relative movement prevents the build up of a high stress concentration. Unfortunately, however, a grain-size distribution consisting of many different size particles is subject to many ills, the chief being that the smaller grains tend to fill in the spaces between the larger grains thereby lowering the permeability or gas-carrying capacity of the sand. Such a sand also is extremely sensitive to the variations in degree of ramming which exist in almost any method of preparing a mould.

Failure to control the effect of expansion and gas pressure forces will lead to the types of casting defects illustrated here. By adopting the testing technique described in this article and changing the sand to conform to basic specifications with respect to hot toughness, it has been possible to eliminate entirely these costly defects in many cases.

High-temperature Testing

The field of high-temperature testing of sand has expanded considerably in the past few years and methods of testing strength have, in general, narrowed themselves down to the following steps:—(1) Preparation of a standard sample 1⅛ in. dia. by 2 in. high; (2) soaking the sample at a pre-selected temperature for a pre-selected time; and (3) fracture of the specimen by the application of a compressive load while it is still under the influence of temperature.

This method of testing has several distinct limitations. The size of the sample necessitates a long soaking time to arrive at the chosen temperature throughout its mass. It has been argued that the sample must be brought entirely up to the chosen temperature if one expects to measure accurately the properties of the sample at this temperature. This is scientifically and theoretically correct, but it is not practical. It is definitely known that most of the casting defects orginating from a sand condition occur while the metal in the mould cavity is still in a liquid or semi-liquid condition. In the case of light-section castings in particular, this period represents a very short time—a fraction of a second—rather than in minutes. Technicians are, therefore, interested in the behaviour of a sand in this very short space of time and they desire to control the properties of the sand during this period. If this premise be adapted, it is found that breaking the sample under a compressive load is not dependable and accurate because the time taken to apply the load is often longer than the time interval over which one desires to study the properties of the sand.

New Method

It was to overcome this basic difficulty that the testing technique and equipment described and

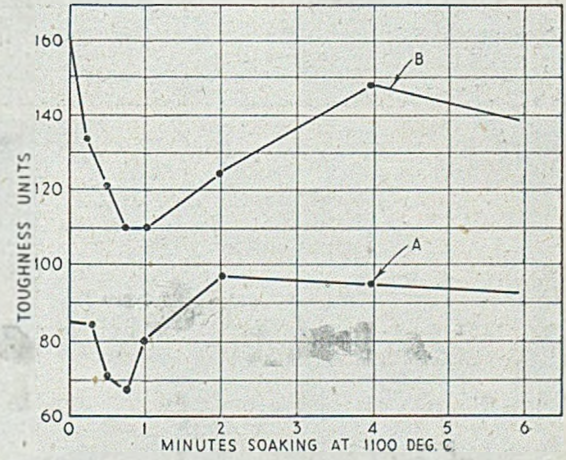


FIG. 3.—*Comparison between Results obtained on Two Dry-sand Facing Mixtures.*

illustrated in this article were adopted.* The technique is straightforward and simple. The sand sample, $\frac{3}{4}$ in. dia. and 2 in. long, is placed in the furnace, maintained at the desired temperature, and is then raised instantaneously to a position immediately above the furnace, where it is fractured by means of a transverse impact blow. The energy required to fracture the specimen is taken as a direct expression of toughness and the units of measurement are toughness units, one of which equals 100 gm./cm. (that is, the energy derived from the free fall of a weight of 100 grams through a distance of 1 centimeter).

* This method of testing is covered by U.S. Patent No. 2.491,512.

A considerable amount of development work went into the construction of the apparatus and the details of the testing procedure. The apparatus in its preferred form is shown in Fig. 1. This particular piece of equipment is also fitted with an apparatus for the measurement of gas evolution from moulding materials. Referring to the boxed numerals on the photograph, the following are the parts of the equipment which are applicable to the hot-toughness test:—

The most informative technique has been found to consist of measurements of toughness after soaking at 1,095 deg. C. for periods of from 15 sec. to 5 min. At 5 min. the $\frac{3}{4}$-in. dia. sand sample is considered to be heated throughout its mass.

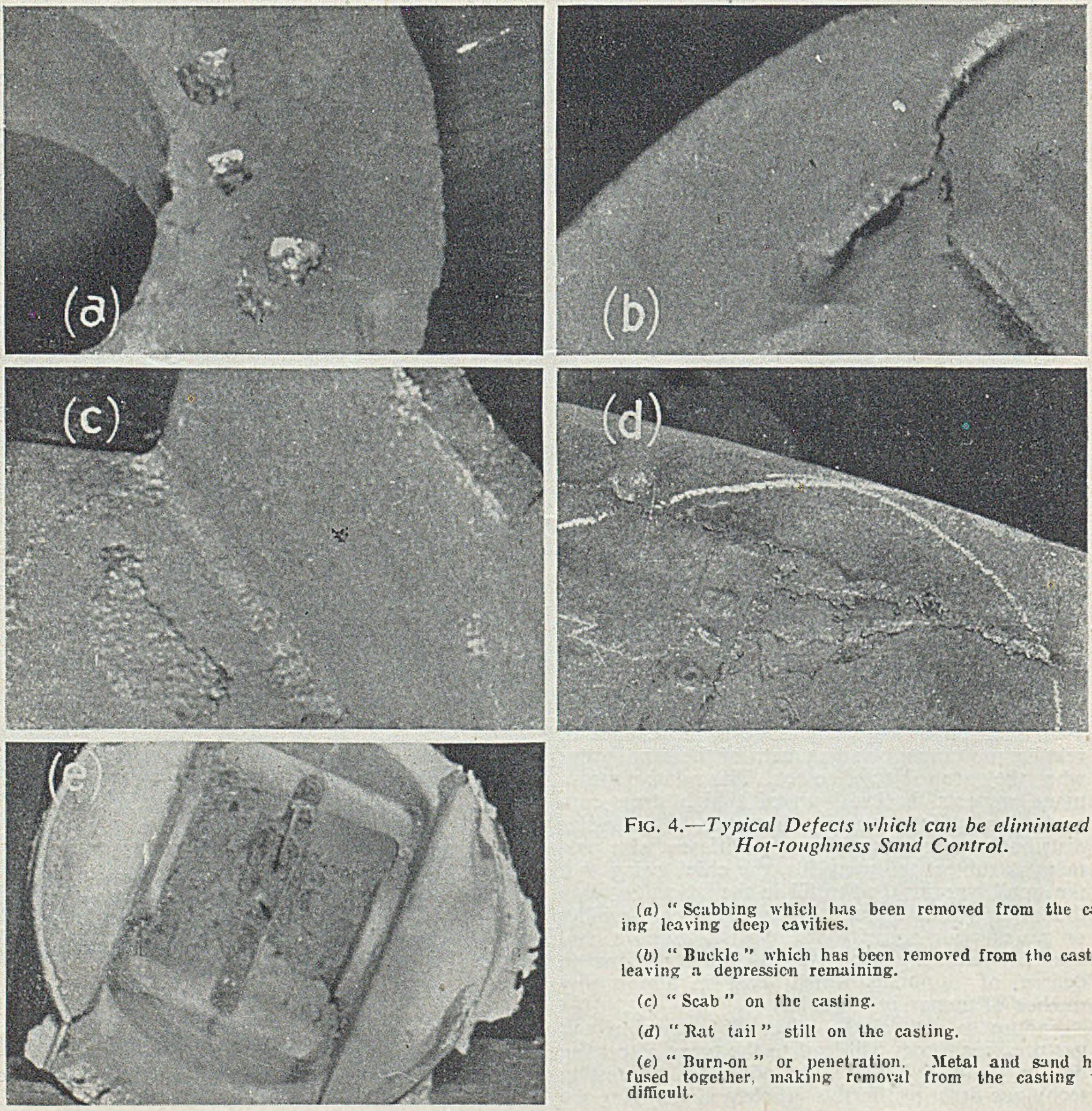


FIG. 4.—*Typical Defects which can be eliminated by Hot-toughness Sand Control.*

(*a*) "Scabbing which has been removed from the casting leaving deep cavities.

(*b*) "Buckle" which has been removed from the casting leaving a depression remaining.

(*c*) "Scab" on the casting.

(*d*) "Rat tail" still on the casting.

(*e*) "Burn-on" or penetration. Metal and sand have fused together, making removal from the casting very difficult.

Buckling

The results obtained with this method of testing are quite revolutionary and have led to an entire change in the control of sand for the elimination of buckles, rat tails, veining and allied casting defects. Without delving into a mass of detailed test results one may immediately point to the most significant conclusion reached with respect to buckling. Two sands were tested as a direct comparison of behaviour, the results being shown graphically in Fig. 2.

These results were obtained by testing the sands in the green condition and each point plotted is the average of three determinations. The sands were taken directly from the same system making the same castings under standard conditions. Sand A gave excessive trouble due to buckles and sand B was free from this difficulty. Sand B, incidentally, contained about 2 per cent. of corn flour. If one examines these curves in the light of conventional testing methods, it will be observed that at a 6-min. soaking period, sufficient to ensure complete heating throughout the mass of the sample, the toughnesses of the two sands are not materially different, the buckling sand A being slightly tougher. If, however, one examines the form of the curves in the period up to 2 min. of soaking, it is immediately noticed that there is a marked difference in behaviour. Sand A exhibits a low but gradually increasing toughness, whereas sand B shows a remarkable increase in toughness within the first 45 sec. of heating.

It is this tremendous increase in toughness during the initial period of heat shock that determines the non-buckling character of this sand. The toughness is quite evidently at a sufficiently high value to resist spalling and rupturing forces developed from the phenomena of silica expansion and gas evolution.

Potentialities

The potentialities of this method of testing are amazing and several case-histories point to the elimination of buckling defects and rat-tails by adjusting sand ingredients to give the type of hot-toughness curve characterised by sand B in Fig. 2. Needless to say, the realm of impact testing of sand has been extended to include green toughness, dry toughness, retained toughness, and so on. In general, it has been found extremely informative to record sand-toughness in a single unit of measurement regardless of whether the sand be tested green, dry, or at an elevated temperature.

Dry-sand Results

A typical example of dry-sand control by means of this method of testing is given in Fig. 3. In this case a dry-sand facing, which gave severe defects in the nature of scabs and washes, gave the test results shown in curve A. This same facing with added western bentonite gave complete freedom from trouble and the results shown in curve B. Basically, the form of the curve remained unchanged, but the toughness was raised appreciably over the entire heating range.

Many more examples of test results could be quoted, but suffice it to say that the method of testing described in this article has enabled an entirely new interpretation of sand behaviour and has paid very definite dividends in the shape of a reduction in defective castings (Fig. 4) and in the reduction of other costly items such as shake-out difficulties, and in preparation of economical core-sand mixes.

Correspondence

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

DOUBLE-SIDED MATCHPLATES

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—I read with interest your article (F.T.J., December 28, 1950) in abstract of the Grey Ironfounding Productivity Report on the recent visit to the U.S.A. which deals specifically with the production of double-side matchplates for repetition moulding. Since I am familiar with the technique, which incidentally is not a new one, and is analogous with the Randupson process for patterns, except in the latter case aluminous cement is used instead of gypsum, I should like to add the following observations:—A glass surface table is only used when the parting is all in one plane. If the parting is irregular, the board must follow the contour of the parting. Secondly the baking temperature must be maintained for a considerable time, and is simply the chemical change that takes place when calcium sulphate (gypsum) is dehydrated, losing the elements of water and reverts back to plaster of Paris. The change is endothermic. Thirdly, the gas holes which Mr. Perry refers to are probably due to hydrogen in solution in the aluminium alloy, and can be partly eliminated by the various methods of degasification available for these alloys.

Mr. Perry's comments on the time taken to supply one of these plates in the U.S.A. would astonish anyone familiar with the light-casting industry in the Falkirk area where it is not uncommon to have a double-sided plate made and castings produced from same all in one day, and may I add there are tens of thousands of such plates in this district. In conclusion, I would add that Falkirk patternmakers have disseminated the technique of making all kinds of matchplates throughout the entire British Empire and the U.S.A. It would be interesting to learn if our kindred craftsmen in Chicago were instructed by a Falkirk patternmaker in the first instance.

Yours, etc.,
ROBERT R. SHAW,
Patternmaker

Larbert, Scotland
January 3, 1951

THE MINISTER OF FOOD has issued a further amendment to the Oils and Fats (No. 2) Order, 1949, from January 10, 1951, from which the following have been abstracted:—(1) Licences are no longer needed to sell by wholesale oilseeds and oils and fats other than cooking fats, margarine and lard. (2) Neatsfoot oil, castor seed and castor oil, niger seed and niger-seed oil, rape seed and rape-seed oil and perilla-seed oil are freed from all restrictions on processing and use.

Scottish Ironfounding Review

By our Scottish Correspondent

TWO parallel and significant progressive tendencies have been quietly overturning traditional methods in the light iron-castings industry during the post-war period, and the year just ended may be said to have seen their fruition, with resultant benefit to the trade. These two movements, a growing trend towards mechanisation of foundry practice, and the revolution in design of products that are the result of much patient research work, have been largely forced on the industry by the peculiar post-war conditions. It is greatly to the credit of the founders that they have so swiftly and efficiently met the challenge of the times with new methods and new products. But it may well be that 1950 will go down in the annals as a culmination in the post-war reconstruction period for, with the switch to intensive rearmament, a new pattern for industry may soon be required. Foundries, which in the past have so triumphantly surmounted obstacles, can face any demands made on them by these new circumstances with confidence.

Mechanisation Projects

Of the two lines of advance which the year brought to fruition, possibly the more spectacular was the development of mechanical processes. Machine moulding is, of course, nothing new to Falkirk foundries. In the past, with craftsmen of unsurpassed skill on whom to call, the industry locally has tended to favour manual methods. But with a diminution in the flow of recruits to the moulding shops, it was inevitable that there should be an increasing turn towards the machine.

Among the most significant developments of this concession to machine processes has been the erection by Smith & Wellstood, Limited, Bonnybridge, of a new mechanised foundry which went into production during December. The new foundry has this unusual feature, that it is completely mechanised and capable of turning out all ranges of the firm's good with the exception of the very large castings. Among the most modern in the country, it can be compared even with the world's best. Allied Ironfounders also brought a new mechanised plant into production in May, 1950, and output, as a result, has increased. The Carron Company have completed a mechanised bath plant and are at present installing a pipe plant which is expected to be in operation in six months' time. Grahamston Iron Company, Limited, are in the van of the march towards greater mechanisation. They began to erect their first fully-mechanised plant after the war and have continued to improve their moulding practice since. Another mechanised mould shop is being brought into use early next summer and other plans are entertained. Generally, all but the very smallest of the 35 foundries in Falkirk and district have installed, or are in the process of installing, mechanised plants.

Some of the ancillary effects of this change may be noted in passing. Mechanisation has, generally speaking, been accepted by the moulders, since they rightly feel that in the prevailing circumstances it is not a threat to their livelihood. In fact, there are jobs for more moulders than are available. Another expected effect is that increased mechanisation will help to reduce the number of accidents due to handling of materials and the transport of molten metal. This accident rate, which stood high in the industry throughout the country, has shown a continuous decline within the last three years.

New Designs of Product

The other development, the benefit of which to the industry has been felt during the past year, is the production of new and radically changed designs of products. This is the result of much hard work, study and research, done mostly on the foundry benches. Shortage of solid fuels over the past years has compelled founders to contemplate new ways of restricting the solid fuel used, and this has been achieved by ingenious methods of draught control on the ordinary fire and insulation or "lagging" on the cooking unit. Result of this latter is that retained heat in these units has been proved to be of considerable value commercially. There has been a substantial cut in the production of electrically-heated equipment at the request of the authorities and this has resulted in a growing concentration on gas-operated units. In this line, many new and streamlined models for commercial and private use have reached the market and have obviously been well received, judging by the steady demand.

Production and Future Outlook

Production generally has exceeded the 1949 totals, and in some foundries has passed the pre-war output figures. Some of this progress can be attributed, of course, to the new processes of manufacture, but there are other factors. In one large foundry, part of the increased production is attributed to successfully-operated incentive schemes. Another factor which has contributed to the rising output is the growing standardisation of products. Again instancing one foundry, the range of products has been cut from the pre-war total of 50 or 60 to between 15 and 20 to-day. Naturally, this concentration on fewer types has speeded up manufacture.

The market for these products has been maintained, although the cut in the housing programme earlier in the year caused a slight recession, from which, however, there was a quick recovery, and present indications are that the traditional house-building programme will continue to make large demands on the goods supplied by the foundries, provided that the rearmament drive does not interfere.

Foreign Business

The most impressive development in the market position, however, has been a big increase in the demand from overseas countries. Scandinavian countries, and to a lesser extent, Belgium, have shown interest in the products of our home foundries, and a tentative approach has been made since devaluation, to the dollar market with results which, it is hoped, will be apparent during the ensuing year. A foundry which specialises in baths has been sending for the first time large numbers to Canada, and reports from there say they are superior to anything supplied by American foundries. The same foundry during the year supplied luxury models to the Grand Duchess of Luxembourg, the Sultan of Zanzibar, King Farouk for his yacht, and the Foreign Minister of the Argentine. This foundry is possibly without equal in the manufacture of the luxury type of product.

The larger part of the overseas market lay with Australia and New Zealand, from whom large orders have been received. There has been a feeling that the development of foundry resources in these two countries might adversely affect local foundries, but, so far, this has not become apparent. A Dominion where the development of local foundries is being not only approved, but also encouraged by local founders, is South Africa. The import embargo imposed by the Government of that country had the effect of seriously hampering trade, and in an endeavour to overcome this obstacle, several of the larger local groups have acquired interests there. Smith & Wellstood last year floated a company in the Transvaal, and they have sent a technical staff, including a managing director, under-manager, and six key men out there. The factory is ready and the foundry will be in production soon.

The lead given in South Africa may encourage similar enterprise in Australia and New Zealand. Though these developments may affect the export trade in Scotland at first, they may eventually prove beneficial in promoting a further development in new markets within the Commonwealth countries.

Labour and Recruitment

During the year, the supply of skilled labour has continued to be a problem despite increased mechanisation. An executive of one large foundry insisted that there were too many moulders doing jobs other than moulding, adding that at a large industry in the area one in three of the employees were ex-moulders. He estimated the number of additional moulders needed in the area at about 300. In a worthy endeavour to overcome this shortage, the Allied group have, during the year, opened an apprentice training centre at Castlelaurie, the first of its kind in Scotland. So successful has the experiment proved that arrangements have been made to increase the accommodation from 12 to 24 apprentices. The venture is being watched with sympathetic interest by foundries throughout the country. The Burnbank scheme for trainees, which has been on the agenda of the Education Committee of the County Council for a long time, is at last on the point of full realisation, and it is hoped that something may transpire early this year in this connection.

Every endeavour has been made within the last few years to make the trade as attractive as possible to new entrants and, continuing the provision of amenities, shower baths were provided in several more foundries during the year. It is reported that over 90 per cent. of the workers are making use of these facilities, though there was an initial reluctance among some of the older men to change to the new habit of bathing before leaving the foundry.

Raw Materials

Raw materials have in some instances proved rather more difficult to obtain. For those foundries which use large quantities of sheet steel there was a cut in the allocation for December, and the prospects of any improvement during the new year are not bright. Large groups seem to have managed fairly well with supplies of scrap and pig-iron, but some of the medium-size foundries had complaints that these were becoming difficult to obtain in the required quantities

Generally speaking, however, the year has presented fewer problems and has given more rewards to the industry than has been the case since before the war. Hopes in the foundries for 1951 are bright, and if, in addition to a sustained house-building programme, rearmament does not make excessive demands on the available raw materials, then it may well be that this year will rival the best pre-war year in the foundry industry.

F.T.J. Prize Crossword Puzzle

The solution to the puzzle printed on page 536 of our December 21, 1950, issue is given below. The name of the winner will be announced next week.

■	1A	2S	P	3A	R	4E	■	5R	E	6B	A	7T	E	■
8B	■	H	■	L	■	V	■	O	■	U	■	R	■	9M
10A	I	R	L	I	N	E	■	11C	A	R	B	I	D	E
R	■	I	■	N	■	N	■	K	■	N	■	M	■	T
12R	U	N	N	E	13R	■	14T	■	15R	E	A	M	E	R
O	■	K	■	16R	E	D	U	C	E	D	■	E	■	E
17W	A	S	H	■	P	■	Y	■	F	■	18O	R	E	S
■	■	■	■	19C	O	R	E	B	O	X	■	■	■	■
20S	O	21F	T	■	R	■	R	■	R	■	22T	23H	I	24N
A	■	O	■	25S	T	R	E	A	M	26S	■	A	■	O
27F	L	U	X	E	S	■	S	■	28S	T	O	R	E	D
E	■	N	■	C	■	29U	■	30S	■	R	■	D	■	U
31T	E	D	I	O	U	S	■	32T	H	E	F	E	E	L
Y	■	E	■	N	■	E	■	I	■	S	■	N	■	E
■	33G	R	A	D	E	D	■	34R	E	S	I	S	T	■

News in Brief

Newcast Foundries, Limited, have prepared plans to again extend their premises at Silverdale, Staffordshire.

Wilcolmlee Foundry, Limited, are seeking permission to erect a new foundry on industrial site No. 5 at Hull.

The 55th annual congress of the American Foundrymen's Society is to be held at Buffalo, New York, from April 23 to 26, 1951.

Gillet & Johnston, Limited, Croydon, have cast a carillon of 51 bells, weighing more than 50 tons, for the Culver Military Academy, Indiana.

The Dagenham works of the Ford Motor Company, Limited, produced over 185,000 vehicles and tractors in 1950—an all-time record for the company, being 32,000 more than the previous record in 1948.

At the Northampton Polytechnic, St. John Street, London, E.C.1, Mr. G. F. J. Murray is delivering a series of lectures on "Liquid Fuels, Their Properties and Utilisation" on Tuesday evenings at 7 p.m. commencing on February 6. The fee for the course of six lectures is 20s.

Seven locomotives to work in the ironstone mines of Stewarts and Lloyds, Limited, which are being built by Robert Stephenson & Hawthorns, Limited, Newcastle-upon-Tyne, are standard gauge 0-6-0 engines. The boiler pressure is 180 lb. p.s.i. and the tractive effort 26,574 lb. The weight of each locomotive is 52.75 tons. Both steam and hand brakes are fitted.

Construction of a new building of nearly 25,000 sq. ft. area is starting at the Glacier Metal Company, Limited's, London factory. The additional floor space will permit internal rearrangements needed to relieve congestion. This addition, together with the expansion of the firm's Kilmarnock factory, will provide a total floor area of 415,000 sq. ft., nearly 30 per cent. more than is in use at present.

In the main canteen of the Bradford engineering works of Hepworth & Grandage, Limited, Mr. William Hepworth, managing director, on December 21, presented gold wristlet watches to five employees of the firm who had completed more than 25 years' service. The recipients were Mr. H. Speight, Mr. D. Starkey, Mr. V. Williams, Mr. H. L. Wraith and Mr. A. Yorke. The company has now presented a total of 48 watches to long-service employees.

Festival of Britain 1951

British manufacturers who are willing to receive visitors at their factories during the Festival of Britain, 1951, are invited to send particulars to the Council of Industrial Design. The Council will compile a list of such firms and arrange for it to be carried at all industrial information bureaux in the official Festival Exhibitions. The list will be issued to visitors on presenting a trade or business card. Manufacturers who would like their names to appear on the list should write to Mr. S. D. Cooke, Council of Industrial Design, Tilbury House, Petty France, London, S.W.1 (tel. Victoria 8484), enclosing in addition to the name and address of their factory some particulars of the goods they make, the approximate number of employees in the factory or other indication of size, the most convenient days and hours for receiving visitors, and the person to whom visitors should apply in advance. Details of languages spoken by staff available as conductors will be welcome.

Personal

W. & T. Avery, Limited, lost their oldest worker on Friday last, with the retirement of Mr. H. H. Smith, aged 72, who had been with the firm for 60 yrs.

Mr. H. A. R. Binney, c.b., has been appointed by the British Standards Institution to be their new director and secretary in succession to the late Mr. P. Good, c.b.e.

Mr. D. M. Semple, managing director of Mirrlees Watson Company, Limited, Glasgow, has been re-elected president of the Scottish Engineering Employers' Association.

Mr. E. L. Roth of the Motor Castings Company has been elected president of the Gray Iron Founders' Society of America. He replaces Mr. H. P. Good, who during his year of office visited this country.

Mr. Jack Clarke, of 192, Mayors-walk, Peterborough, foundry superintendent at Baker Perkins, Limited, engineers, Westwood Works, Peterborough, has retired after 45 yrs. with the company. On his retirement he was the recipient of various presents from the directors and staff.

Mr. E. A. Skinner, a.m.i.b.f., foundry engineer, late of Ford Motor Company, Limited, has been appointed sole technical and sales representative for London and the south, of Modern Furnaces & Stoves, Limited, Handsworth, Birmingham, and A. E. Griffiths (Smethwick, Limited, makers of dust-extraction plant, general drying ovens and light constructional steelwork, of the same address.

Mr. Felix L. Levy, who has for many years served on the board of the New London Electron Works, Limited, has been elected chairman and managing director with effect from December 6, 1950. In this office he succeeds his father, the late Mr. Lawrence Levy. Mr. Felix Levy is a director of the parent company of the "600" Group, George Cohen Sons & Company, Limited, and of its subsidiaries K. & L. Steelfounders & Engineers, Limited, T. C. Jones & Company, Limited, Westbourne Park Coal & Iron Company, Limited, Southall & Hayes Coal & Iron Company, Limited, and Pollock Brown & Company, Limited.

Mr. D. Waterhouse has retired from the position of managing director of Prince-Smith & Stells, Limited, worsted-machinery makers, Keighley, although he remains chairman of the company. It is 22 yrs. since Mr. Waterhouse became general manager of Prince-Smith & Son, and in 1931 he joined the newly constituted board of directors when his firm became amalgamated with Hall & Stells, Limited, later being appointed managing director. To-day he is the only member of that founder board still left in the firm. He has been presented with an engraved silver salver bearing autographs of the senior staff. Mr. F. D. Nickell-Lean and Mr. R. Chiles have been appointed managing directors, and Mr. O. G. L. Holmes, Mr. H. M. Kern, and Mr. L. Featherstone as directors.

French Metallurgical Awards

The blowing-in of the first blast furnace at the reconstructed works of the *Société Métallurgique de Normandie* at Caen-Colombelles took place recently. Speaking at the ceremony the Minister of Industry and Commerce announced the award of the Cross of an Officer of the Legion of Honour to M. Walckenaer, chairman and director-general of the company. Other awards go to M. Logelin, chief engineer, and M. Maucorps, welfare officer, both of whom are made Knights of the Legion of Honour.

Obituary

MR. JOHN EDWARD COWAP, who died on December 18, was joint managing director of Fodens, Limited, Diesel vehicle manufacturers, of Sandbach.

MR. HARRY NEWTON, who was for 63 years employed by Henry Wallwork & Company, Limited, ironfounders, of Manchester, died on December 26.

MR. HUBERT NAPIER ROBSON, sales director of James A. Jobling & Company, Limited, manufacturers of scientific glassware, etc., of Newcastle-upon-Tyne, died on December 28 at the age of 57.

MR. JOHN ALBERT ROLLINSON, former managing director of William Rollinson & Sons, Limited, ironfounders, of Old Basford, Nottingham, has died at the age of 86. He was responsible for the introduction of cross-spoking in cycle wheels and was a pioneer of cycle racing.

MR. ROBERT TAYLOR, managing director of R. Taylor & Company (Ironfounders), Limited, Larbert, has died at the age of 63. He served his foundry apprenticeship with the Carron Company and was later employed by Jones & Campbell, Limited, Torwood foundry, which firm he left to start in business for himself about 30 yrs. ago.

MR. E. R. FODEN, who died recently, was a director of E.R.F., Limited, manufacturers of commercial motor vehicles, of Sandbach (Cheshire). He was a son of the founder of Fodens, Limited, and the famous Foden's Motor Works Band, to which Mr. Foden devoted much of his life, played in the church during the funeral service on December 28.

PROF. JAMES FREDERICK SPENCER, Emeritus Professor of Chemistry in the University of London, has died at the age of 69. He was the author of a number of chemical papers, among them "The Metals of the Rare Earths," written in 1919 and translated into French in the following year. During his career he occupied several appointments at Bedford College, University of London. He retired in 1946.

MR. FREDERICK CHARLES FAIRHOLME, formerly well known in steel and engineering circles, died at Beaconsfield (Bucks) on Christmas Eve. He was 84. He was a managing director of Cammell, Laird & Company, Limited, after which, from 1908 to 1929, he served as managing director of Thomas Firth & Sons, Limited, to which he was acting chairman when the firm amalgamated with John Brown & Company, Limited, in 1931. Chairman of Firth-Brearley Stainless Syndicate, Limited, Mr. Fairholme was identified with the development of stainless steel. He was president of Sheffield and District Engineering Employers' Association, vice-president of Sheffield File Manufacturers' Association, and a director of the Iron Trades Employers' Insurance Association.

Wills

DEELEY, R. B., a director of Lightalloys, Limited, of Willesden, London, N.W.10	£8,236
REICHWALD, E. E., late chairman of Reichwald (London), Limited, metal merchants	£1,404
RODGER, J. P. M., a director of John M. Rodger & Son, Limited, ironfounders, of Townhead, Ayr	£13,930
WILSON, HERBERT, a former proprietor of W. H. & H. Wilson, iron and steel stockholders, of Cleckheaton (Yorks)	£13,218
LOVERING, J. S., a director of Lovering China Clays, Limited, Newton Abbot Clays, Limited, and other companies	£52,707
KIRTON, ARTHUR, former secretary and a director of Gjers, Mills & Company, Limited, pig-iron manufacturers, of Middlesbrough	£2,653
ALLOTT, G. W., late technical adviser and sales manager of the heavy constructional division of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield	£7,385

Board Changes

PETROCHEMICALS, LIMITED—Mr. P. C. Chaumeton has been elected a director.

MELLOWS & COMPANY, LIMITED—Mr. G. H. Tuffley has retired from the board.

ASSOCIATED LEAD MANUFACTURERS, LIMITED—Mr. A. J. Bester has resigned from the board.

MINERALS SEPARATION, LIMITED—Mr. Eris Weiss and Mr. D. K. Bailey have been appointed directors.

CHESTERFIELD TUBE COMPANY, LIMITED—Mr. D. Lacy-Hulbert has been appointed joint managing director (technical).

STEEL CORPORATION OF BENGAL, LIMITED—Mr. E. G. Spooner has been appointed a director in place of Mr. F. G. Liversedge, who has resigned.

NATIONAL SMELTING COMPANY, LIMITED—Mr. D. M. G. Sneddon, Mr. D. S. Burwood, and Mr. S. W. K. Morgan have been elected directors.

CARGO FLEET IRON COMPANY, LIMITED—Mr. G. B. Thomas, works manager, has been appointed a director and Mr. W. A. Metcalfe has been appointed secretary.

RIO TINTO COMPANY, LIMITED—Mr. J. N. V. Duncan has been appointed managing director in succession to Sir Mark Turner, who will be deputy chairman and finance director.

VULCAN FOUNDRY, LIMITED—Mr. Frederick Seymour Whalley has relinquished the chairmanship, but retains his directorship. The vice-chairman, Brig. James Storar, has been appointed chairman.

GENERAL ELECTRIC COMPANY, LIMITED—Mr. Harold Hobson has joined the board. He was chairman of the Central Electricity Board from 1944 until the British Electricity Authority was set up in 1947.

NATIONAL GAS & OIL ENGINE COMPANY, LIMITED—Mr. A. E. Carodus, managing director, and Mr. E. M. Benjamin have resigned from the board, and Mr. A. C. Geddes and Mr. J. T. Rymer have been appointed directors.

ALEXANDER SHANKS & SON, LIMITED, and SHANKS IRONFOUNDERS, LIMITED—Lord Inchcape has been appointed chairman. Miss Marjory Shanks, who has retired from the position of temporary chairman, will remain a director of the former company.

National Scrap Drive

A letter, signed by the presidents of the British Iron and Steel Federation, the Joint Iron Council and the National Federation of Scrap Iron, Steel and Metal Merchants, has been sent to 15,000 users of iron and steel in Great Britain and Northern Ireland urging a national scrap drive. A special approach is being made to the Services, public undertakings and municipal bodies, government departments, and through the Federation of British Industries, to industry as a whole. For this purpose, area committees have been formed. A supporting advertising campaign has already commenced in the national press and special campaigns will be directed to particular sections of industry through the trade Press.

WHEN ANNOUNCING that in future all correspondence for the Coleman Foundry Equipment Company, Limited, of Stotfold (Beds), should be addressed to 157, Victoria Street, London, S.W.1, we omitted to stress that this only applied to the matter of *sales*. Correspondence on all other subjects should be addressed to Stotfold.

Imports and Exports of Iron and Steel in November

The following tables, based on Board of Trade returns, gives figures of imports and exports of iron and steel in November. Figures for the same month in 1949 are given for purposes of comparison, respective totals for the 11 months of this year and of 1949 are also included.

Total Exports of Iron and Steel.

Destination.	Month ended November 30.		Eleven months ended November 30.	
	1949.	1950.	1949.	1950.
	Tons.	Tons.	Tons.	Tons.
Channel Islands ..	732	605	10,827	7,950
Gibraltar	151	86	1,656	1,532
Malta and Gozo ..	450	243	4,749	3,849
Cyprus	322	517	4,204	8,117
British West Africa ..	8,399	10,515	80,746	84,800
Union of South Africa	9,374	14,865	129,618	166,537
Northern Rhodesia ..	1,782	2,217	18,848	26,212
Southern Rhodesia ..	2,789	4,542	47,670	63,904
British East Africa ..	9,743	7,293	81,775	90,787
Mauritius	969	735	7,514	8,127
Bahrein, Koweit, Qatar, and Trucial Oman	387	325	19,016	6,671
India	5,074	8,236	76,005	91,813
Pakistan	4,168	13,762	34,898	98,067
Malaya	5,761	5,874	54,254	70,464
Ceylon	2,316	4,789	24,109	33,864
North Borneo ..	306	1,889	9,109	6,567
Sarawak	228	11	1,748	754
Hongkong	3,810	6,802	31,980	47,641
Australia	22,749	46,044	171,498	405,730
New Zealand ..	12,133	16,423	105,481	164,757
Canada	4,816	33,792	62,510	207,901
British West Indies ..	3,543	6,196	57,773	58,044
British Guiana ..	498	218	4,369	6,513
Anglo-Egyptian Sudan	1,415	910	13,645	15,954
Other Commonwealth countries	613	1,195	10,462	12,985
Irish Republic ..	6,796	10,138	62,742	92,277
Russia..	146	1	8,984	539
Finland	5,578	6,573	69,895	67,091
Sweden	5,337	6,996	54,855	82,877
Norway	5,228	6,456	62,339	78,653
Iceland	655	472	7,418	4,106
Denmark	6,968	5,686	82,087	100,856
Poland	27	107	1,074	1,545
Germany	9	87	480	910
Netherlands	7,053	6,347	101,193	71,838
Belgium	991	1,943	10,197	13,134
Luxemburg	500	—	5,878	394
France	1,385	1,684	30,179	22,717
Switzerland	663	839	11,772	9,993
Portugal	2,265	1,036	17,621	18,244
Spain	384	391	9,104	6,773
Italy	388	680	2,996	11,536
Hungary	69	—	964	330
Greece..	273	575	4,696	7,164
Turkey	963	684	16,834	8,637
Indonesia*	952	472	23,749	10,538
Netherlands Antilles	713	421	7,759	7,727
Belgian Congo ..	29	337	1,544	1,909
Angola	124	113	5,820	2,061
Portuguese E. Africa	387	417	4,183	4,424
Canary Islands ..	270	67	2,719	2,014
Syria	28	37	1,847	1,680
Lebanon	1,409	811	27,129	11,496
Israel	975	4,636	15,518	24,415
Egypt	3,717	5,874	52,197	55,680
Morocco	455	797	1,574	4,639
Saudi Arabia ..	672	19	6,049	2,199
Iraq	956	4,106	47,078	33,427
Iran	16,176	6,296	144,943	92,244
Burma	782	831	8,658	11,337
Thailand	1,558	2,072	5,463	9,560
China	42	1,644	2,698	6,027
Philippine Islands ..	178	519	3,218	8,533
USA	1,279	19,954	4,325	54,173
Cuba	68	176	441	2,096
Colombia	1,105	144	5,848	5,998
Venezuela	2,985	2,047	50,228	29,054
Ecuador	94	444	2,686	3,688
Peru	673	820	6,805	10,881
Chile	501	1,296	6,480	15,077
Brazil	1,879	3,185	17,159	30,325
Uruguay	379	985	7,621	9,616
Argentina	10,487	5,426	66,876	60,031
Other foreign countries	1,527	3,719	12,751	31,927
TOTAL ..	198,606	306,444	2,169,144	2,831,930

* Includes Netherlands New Guinea in 1949.

Total Imports of Iron and Steel.

From	Month ended November 30.		Eleven months ended November 30.	
	1949.	1950.	1949.	1950.
	Tons.	Tons.	Tons.	Tons.
Australia	2	1	11,753	51
Canada	4,416	3,185	59,749	35,015
Other Commonwealth countries and Irish Republic	235	152	23,062	24,443
Sweden	970	1,715	15,254	12,603
Norway	1,003	6,228	25,491	48,416
Germany	2,727	2,132	21,175	67,312
Netherlands	4,491	2,034	89,488	43,053
Belgium	13,032	7,355	324,384	89,148
Luxemburg	8,653	3,845	158,573	39,483
France	4,448	24,701	182,883	272,422
Austria	520	27	31,884	3,376
USA	2,819	4,861	237,529	60,953
Other foreign countries	177	142	3,249	6,257
TOTAL ..	43,493	56,378	1,184,474	703,432
Iron ore and concentrates—				
Manganiferous ..	—	—	7,006	10,876
Other sorts.. ..	598,027	624,188	8,010,970	7,774,022
Iron and steel scrap and waste, fit only for the recovery of metal	172,822	94,979	1,959,849	1,882,194

Exports of Iron and Steel by Products.

Product.	Month ended November 30.		Eleven months ended November 30.	
	1949.	1950.	1949.	1950.
	Tons.	Tons.	Tons.	Tons.
Pig-iron	1,345	5,914	7,725	32,055
Ferro-alloys, etc.—				
Ferro-tungsten ..	80	112	781	1,083
Spiegeleisen, ferro-manganese ..	2,128	208	8,710	2,330
All other descriptions	67	135	943	1,420
Ingots, blooms, billets, and slabs	314	440	2,878	5,855
Iron bars and rods ..	575	822	6,440	4,498
Sheet and tinplate bars, wire rods ..	176	3,982	3,103	19,075
Bright steel bars ..	2,226	5,491	18,127	42,203
Other steel bars and rods	16,306	32,751	160,058	245,822
Special steel	1,536	1,655	13,618	13,734
Angles, shapes, and sections	8,718	21,838	106,777	148,190
Castings and forgings	990	645	7,706	7,466
Girders, beams, joists, and pillars	2,992	6,291	28,110	63,209
Hoop and strip ..	5,649	12,291	49,502	110,981
Iron plate	1,759	234	7,181	2,416
Tinplate	15,778	21,413	176,314	227,155
Tinned sheets.. ..	213	215	3,306	2,595
Terneplates, decor. tinplates	121	48	479	815
Other steel plate (min. ⅛ in. thick) ..	19,043	26,737	204,655	304,326
Galvanised sheets ..	7,672	7,552	83,470	105,198
Black sheets	11,042	9,341	126,454	127,125
Other coated plate ..	767	820	6,425	11,170
Cast-iron pipes up to 6-in. dia.	5,382	7,744	71,822	71,268
Do., over 6-in. dia. ..	4,296	7,565	76,640	74,806
Wrought-iron tubes ..	26,930	36,647	305,284	322,320
Railway material ..	13,838	30,000	177,740	287,618
Wire	5,644	10,127	50,633	79,719
Cable and rope ..	2,411	3,048	28,159	30,995
Netting, fencing, and mesh	1,305	2,321	18,781	17,103
Other wire manufactures	1,246	2,910	12,068	28,210
Nails, tacks, etc. ..	377	943	6,216	6,371
Rivets and washers ..	665	860	8,280	7,698
Wood screws	336	394	3,152	3,739
Bolts, nuts, and metal screws	2,334	2,643	24,367	28,562
Stoves, grates, etc. (excl. gas)	867	1,230	8,692	11,189
Do., gas	268	353	2,457	2,512
Baths	1,181	1,027	9,540	12,772
Anchors, etc.	911	645	9,126	8,289
Chains, etc.	1,022	871	9,619	9,568
Springs	522	872	7,562	7,792
Hollow-ware	8,096	7,088	76,246	80,765
All other manufactures	21,478	29,621	239,998	261,904
TOTAL	198,606	306,444	2,169,144	2,831,930

Increases of Capital

Increases of capital are announced by the following companies:—

WATFORD ENGINEERING WORKS, LIMITED, increased by £70,000, in £1 ordinary shares, beyond the registered capital of £80,000.

BRITISH ROLLING MILLS, LIMITED, Tipton (Staffs), increased by £50,000, in £1 ordinary shares, beyond the registered capital of £50,000.

NOLTON FOUNDRY, LIMITED, Bridgend (Glam), increased by £4,000, in £1 ordinary shares, beyond the registered capital of £1,000.

LANGLEY ALLOYS, LIMITED, Langley, Slough (Bucks), increased by £75,000, in £1 ordinary shares, beyond the registered capital of £100,000.

CHARLES PERKS, LIMITED, ironfounders, etc., of Willenhall (Staffs), increased by £35,000, in £1 ordinary shares, beyond the registered capital of £15,000.

VULCAN STEEL & TOOL COMPANY, LIMITED, Cornish Steel Works, Sheffield, increased by £10,000, in £1 ordinary shares, beyond the registered capital of £10,000.

WOLVERHAMPTON METAL COMPANY, LIMITED, increased by £250,000, in 1,000,000 ordinary shares of 5s each, beyond the registered capital of £250,000.

HARRISON (BIRMINGHAM), LIMITED, brassfounders, metal rollers, etc., increased by £33,000, in 132,000 ordinary shares of 5s., beyond the registered capital of £316,000.

ROBERT HUDSON LIMITED, engineers and ironfounders, etc., of Leeds, 11, increased by £300,000, in 1,200,000 ordinary shares of 5s., beyond the registered capital of £300,000.

HEWARD & DEAN, LIMITED, ironmongers, iron and steel merchants, of Tottenham, London, N.15, increased by £4,000, in £1 shares, beyond the registered capital of £8,000.

ROBERT CORT & SON, LIMITED, engineers and founders, etc., of Reading, increased by £50,000, in £1 cumulative preference shares, beyond the registered capital of £150,000.

NON-FERROUS METAL PRODUCTS, LIMITED, Basinghall Street, London, E.C.2, increased by £396,400, in 7,928,000 ordinary shares of 1s., beyond the registered capital of £450,000.

CHRISTY BROS. (CHELMSFORD), LIMITED, mechanical and electrical engineers, etc., of Chelmsford, increased by £50,000, in £1 ordinary shares, beyond the registered capital of £200,000.

W. H. BRISCOE & COMPANY, LIMITED, stampers, brassfounders, etc., of Tyseley, Birmingham, increased by £35,000, in £1 ordinary shares, beyond the registered capital of £40,000.

DAWSON BENTLEY & COMPANY, LIMITED, ironfounders, etc., of Keighley, increased by £10,000, in £1 participating pereference shares, beyond the registered capital of £20,000.

CHARLES HILL & COMPANY, LIMITED, general brassfounders, etc., of Cateswell Road, Birmingham, increased by £48,000, in £1 ordinary shares, beyond the registered capital of £2,000.

K.M.G. (ENGINEERS), LIMITED, mechanical, constructional, domestic engineers, etc., of Dunraven Street, London, W.1, increased by £17,000, in £1 shares, beyond the registered capital of £3,036.

BROOM & WADE, LIMITED, manufacturers of air compressors, etc., of High Wycombe (Bucks), increased by £600,000, in 2,400,000 shares of 5s., beyond the registered capital of £400,000.

WALTER GRAFTON & SON, LIMITED, engineers, metal merchants, shipbuilders, etc., of Footscray Road, London, S.E.9, increased by £47,000, in £1 "B" shares, beyond the registered capital of £3,000.

JOHN WILLIAMS & SONS (CARDIFF), LIMITED, iron and steel stockholders, engineers, etc., of East Moors Road, Cardiff, increased by £150,000, in £1 ordinary shares, beyond the registered capital of £130,000.

HOLT, WHITNEY & COMPANY, LIMITED, manufacturers of brass and iron work, etc., of Whittall Street, Birmingham, increased by £5,000, in £1 ordinary shares, beyond the registered capital of £5,000.

B. BIRKS & COMPANY, LIMITED, general metal workers, etc., of Cradley Heath (Staffs), increased by £15,000, in 11,270 ordinary, 2,500 preference and 1,230 unclassified shares of £1 each, beyond the registered capital of £15,000.

MARRYAT & SCOTT (HOLDINGS), LIMITED, lift manufacturers, engineers, etc., of Hounslow (Middx), increased by £199,900, in 99,900 6 per cent. redeemable cumulative preference shares of £1 and 999,500 ordinary shares of 2s. each, beyond the registered capital of £100.

HENRY SYKES, LIMITED, manufacturers of pumping, hoisting machinery, etc., of Southwark Street, London, S.E.1, increased by £110,000, in 70,000 ordinary and 40,000 5½ per cent. cumulative redeemable preference shares of £1 each, beyond the registered capital of £40,000.

ASSOCIATED BRITISH OIL ENGINES (EXPORT), LIMITED, Loughborough, increased by £140,000, in £1 shares, beyond the registered capital of £10,000. At July 13, 1950, Associated British Oil Engines, Limited, held practically the whole of the issued share capital.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

CARLISLE, January 27—Provision and laying of approx. 45,048 yds. of 3 in. and 4 in. dia. spun cast-iron and asbestos water mains, for the Border Rural District Council. Mr. E. E. Harding, clerk of the council, 7, Victoria Place, Carlisle.

CHIPPENHAM, January 20—Provision and laying of cast-iron water mains, etc., for the Town Council. The Borough Engineer, 10, Market Place, Chippenham. (Deposit, £2 2s.)

HARROW, January 26—Road castings, for the Urban District Council. The Engineer and Surveyor, Council Offices, Uxbridge Road, Stanmore (Middx).

HUNTINGDON, January 31—Manhole covers, gully gratings, and frames, for the County Council. Mr. T. H. Longstaff, county surveyor, Walden House, Huntingdon.

LONDON, E.8, January 24—Iron, etc., for the Hackney Borough Council. The Borough Engineer and Surveyor, Town Hall, Hackney, London, E.8. (Deposit, £1 1s. each item.)

LONDON, S.W., January 22—Iron castings, for the Battersea Borough Council. The Town Clerk, Town Hall, Lavender Hill, London, S.W.11.

MANCHESTER—Mild-steel formers in half-segments, for the Corporation Waterworks. The Secretary, Waterworks Offices, Town Hall, Manchester, 2.

MANCHESTER, January 29—Supply and site welding of approx. 5,381 yds. of 55 in., 49 in., and 30.75 in. dia. steel water pipes, for the Corporation Waterworks. The Secretary, Waterworks Offices, Town Hall, Manchester, 2.

NAIROBI, February 6—Triangular cast-iron manhole covers and step irons, for the City Council. Howard Humphreys & Sons, consulting engineers, 191, Victoria Street, London, S.W.1.

POCKLINGTON—Supplying and laying about 10 miles of 9 in. and 8 in. dia. spun-iron mains, for the Rural District Council. Mr. J. H. Haiste, civil engineer, 4, Queen Square, Woodhouse Lane, Leeds, 2. (Deposit, £3 3s.)

SCUNTHORPE, February 3—Castings, for the Borough Council. The Borough Engineer and Surveyor, Comforts Avenue, Scunthorpe.

SHREWSBURY, February 5—Castings, for the Borough Council. The Borough Surveyor The Guildhall, Shrewsbury.

SUDBURY, February 3—Provision and installation of 6,600 yds. of ¾ in. dia. lead pipe, etc., for the Rural District Council. The Engineer and Surveyor, Stonehall, Clare, Sudbury (Suffolk).

SWANSEA, February 3—Iron, steel, gullies, frames, and manhole covers, for the Borough Council. The Borough Engineer and Surveyor, Guildhall, Swansea.

TRURO, January 29—Cast-iron gully gratings, frames, weirs, etc., for the Cornwall County Council. The County Surveyor, County Hall, Truro.

WAKEFIELD, February 1—Castings, etc., for the City Council. The City Engineer, Town Hall, Wakefield.

WATFORD, January 15—Cast-iron fittings, etc., for the Borough Council. The Borough Engineer, Town Hall, Watford.

New Companies

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

GEORGE E. WASE (METALS), Gordon's Yard, Skinner Lane, Leeds—£500. A. Hall and G. E. Wase.

A. E. A. ENGINEERS & FOUNDERS, 2, Berkeley Crescent, Bristol, 8—£5,000. H. W. Adams and A. M. Horton.

R. P. ALLISON, Jersey Street, Ancoats, Manchester—Hardware manufacturers, etc. £3,500. J. W., B., T., and A. D. Tennant.

THOMAS DUDLEY, Wolverhampton Road New, Dudley (Worcs)—Ironfounders. £50,000. T. E., H. A. R., E. M., and M. Dudley.

SPRINGFIELD METALS, 373, Ordsall Lane, Salford, 5—Metal and machinery merchants, etc. £2,500. L. Meadowcroft and S. A. Gradwell.

ASSOCIATED ENGINEERING (SALES), 118, Gt. Portland Street, London, W.1—£20,000. J. W. Howlett, E. Hepworth, E. Carpenter, and E. C. Raffle.

MATEMINE (GREAT BRITAIN), mining machinery manufacturers, etc.—£100. Subscribers, R. A. Clark & D. Wisdom, solicitors, of 18, Austin Friars, London, E.C.2.

F. V. BLAKE (WALES), scrap metal, metal, and machinery merchants, etc.—£2,000. E. Ramsey, Windermere, The Glebe, Bishopston, Swansea, and F. V. Blake and M. Ramsey.

F. H. BURGESS (LINCOLN), Wolverhampton Road, Stafford—To take over business of agricultural engineers carried on at Horncastle (Lincs) by Kenneth A. Warren. £20,000. M. F. and W. D. Burgess.

Raw Material Markets

Iron and Steel

The shortage of pig-iron is not yet so acute as to cause any interruption of operations at the foundries, but that is a position which may conceivably develop in the not distant future. Stocks are low and the best that blast-furnace men can do is to distribute current outputs as equitably as possible. Generally, the higher qualities, such as hematite, low- and medium-phosphorus, and refined iron, are less readily obtainable than No. 3 foundry grade. More basic iron will also be needed, unless the intake of foreign scrap is speedily restored to something like the volume of the first half of 1950.

British steelmakers are doing their utmost to satisfy the heavy requirements of the re-rolling industry. Demand, however, has been swollen by the recent sharp contraction in the imports of billets from Belgium and Luxemburg, and full-scale operation of some of the mills engaged on light sections and bars is already jeopardised by deficient supplies of billets. Better care is being taken of the needs of the sheet mills, but the scarcity of zinc will probably mean that the operation of the galvanising shops will be curtailed.

All the finishing mills begin the year with substantial rolling programmes. During the next two months home requirements will be given special attention, and by the end of February it may be possible to estimate more accurately the extent of the calls to be made upon the industry for rearmament. It appears to be tolerably certain that the halt in the export drive is no more than a temporary expedient. The Minister of Supply insists on the vital importance of the export trade, and this must take priority over all but the most urgent home demands. Shipbuilders have impressive bookings and their only fear is that steel supplies may be curtailed. Power-plant producers' needs have never been so heavy, and big tonnages of steel are required by mechanical and constructional engineers, wagon and tank builders, and boilermakers.

Non-ferrous Metals

As from Monday last, the prices at which copper, lead, and zinc will be sold (subject to licence) by the Ministry of Supply to consumers in the United Kingdom will be the prices ruling on the next working day after the consumer's order is posted, and not, as previously, the day on which the order was posted.

Interest continues to centre round the disastrous results of the shortages in copper and zinc and the effect on industry of the list of banned uses for these two metals. Inevitably there are a number of queries which the Ministry of Supply is being pressed to answer, but the upshot of it all is that many firms will be obliged to close down, or so it would appear at present. One fear among the manufacturers is that they will lose their skilled operatives, who, not unnaturally, will seek employment elsewhere, and if ever the time comes under bulk purchasing when the country is again adequately supplied with metal, it may well be very difficult to get things going once more. The notice given, little over a month, is absurdly inadequate, as everybody with any claim to knowledge of industry must realise. Six months, or maybe three months, would have been more reasonable. Unfortunately this is the kind of thing that happens in the absence of a free market, and it looks very much as if the firms affected by the "banning" list will have to make the best of a bad job.

Almost unnoticed against this background of complaint and confusion created by the situation in copper and brass, the rise of £4 in the aluminium price, although less than had been expected, created little interest. While supplies of this metal are not what they ought to be, there is not a situation which compels the Ministry to issue a list of banned uses. Nevertheless the supply of certain domestic goods made from aluminium may well be affected.

Tin was a fairly quiet market last week. Yesterday (Wednesday) the backwardation was washed out. According to the Bureau of Non-ferrous Metal Statistics, consumption of tin in November was 2,156 tons, the biggest month for some time. The same authority gives November consumption of copper as 52,168 tons, compared with 47,204 tons in October, a feature of the November total being the usage of virgin copper at 36,334 tons. Stocks fell from 120,411 tons at October 31 to 103,384 tons at the end of November. Zinc stocks declined from 40,981 tons at October 31 to 37,308 tons at the end of November. Consumption was virtually unchanged at 29,869 tons, all grades. Lead stocks came down to 65,102 tons at November 30 from 72,044 tons a month earlier.

London Metal Exchange official tin quotations were:—

Cash—Thursday, £1,170 to £1,175; Friday, £1,175 to £1,180; Monday, £1,170 to £1,175; Tuesday, £1,175 to £1,180; Wednesday, £1,240 to £1,245.

Three Months—Thursday, £1,140 to £1,145; Friday, £1,155 to £1,160; Monday, £1,155 to £1,165; Tuesday, £1,165 to £1,170; Wednesday, £1,240 to £1,245.

Zinc Allocations

The Ministry of Supply announces that the list of prohibited uses for zinc, copper and copper alloys printed in our last week's issue has caused some misunderstanding. While bearing in mind that the list is provisional, readers should note that:—

(1) Galvanised articles are only prohibited if they appear under the headings about galvanising. For example, the ordinary household bucket does not appear under "galvanised hollow-ware," and its manufacture is not banned. Buckets do appear under "household appliances and domestic utensils"; this item relates to buckets made in zinc, copper or their alloys. Thus brass or copper buckets will be prohibited.

(2) For listed articles made for the most part of other materials, but containing a very small but indispensable amount of zinc, copper or alloy for a particular purpose (*e.g.*, gear wheels), special exemption from the Order will be considered. Readers who have any such special queries should address them to the Government department with which they normally deal in connection with licences or other matters concerning the particular application.

Core Practice

In the Swedish magazine *Gjuteriet*, Mr. E. Westerling has written a long article on air-hardening moulding and core sands. The author gives a short review of the air-hardening binders used in foundries on the Continent. The modern cement-sand technique is described and its advantages and disadvantages enumerated. Some of the air-hardening oil binders which are so commonly used in Holland and Germany are discussed. Attention is also drawn to oil-cereal-bentonite bonded steel foundry sands for dry-sand work.

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

(Delivered, unless otherwise stated)

January 10, 1951

PIG-IRON

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

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

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

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

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

Cold Blast.—South Staffs, £16 3s. 3d.

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

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

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

FERRO-ALLOYS

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

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

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

Ferro-molybdenum.—70/75 per cent., carbon-free, 8s. 7d. per lb. of Mo.

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

Ferro-tungsten.—80/85 per cent., 25s. 6d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 27s. 6d. per lb. of W.

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

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

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

Ferro-manganese (blast-furnace). — 78 per cent., £30 5s. 11d.

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

SEMI-FINISHED STEEL

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

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

Sheet and Tinplate Bars.—£16 16s. 6d.

FINISHED STEEL

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

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

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

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

NON-FERROUS METALS

Copper.—Electrolytic, £202; high-grade fire-refined, £201 10s.; fire-refined of not less than 99.7 per cent., £201; ditto, 99.2 per cent., £200 10s.; black hot-rolled wire rods, £211 12s. 6d.

Tin.—Cash, £1,240 to £1,245; three months, £1,240 to £1,245; settlement, £1,240.

Zinc.—G.O.B. (foreign) (duty paid), £151; ditto (domestic), £151; "Prime Western," £151; electrolytic, £155; not less than 99.99 per cent., £157.

Lead.—Good soft pig-lead (foreign) (duty paid), £136; ditto (Empire and domestic), £136; "English," £137 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, all English destinations, £170 17s. 6d.; rolled zinc (boiler plates), all English destinations, £168 17s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £170.

Other Metals.—Aluminium, ingots, £124; antimony, English, 99 per cent., £250; quicksilver, ex warehouse, £58 to £59; nickel, £406.

Brass.—Solid-drawn tubes, 21⅝d. per lb.; rods, drawn, 28¼d.; sheets to 10 w.g., 26d.; wire, 26⅜d.; rolled metal, 24¾d.

Copper Tubes, etc.—Solid-drawn tubes, 23¼d. per lb. wire, 226s. 6d. per cwt. basis; 20 s.w.g., 254s. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £255 to £265; BS. 1400—LG3—1 (86/7/5/2), £265 to £275; BS. 1400—G1—1 (88/10/2), £340 to £350; Admiralty GM (88/10/2), virgin quality, £340 to £350, per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £350 to £360; L.P.Bl, £270 to £285 per ton.

Phosphor Bronze.—Strip, 34d. per lb.; sheets to 10 w.g., 35⅞d.; wire, 36d.; rods, 33⅛d.; tubes, 38¾d.; chill cast bars: solids, 34½d., cored, 35½d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 2s. 3¼d. per lb. (7%) to 3s. 2½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 2s. 9¼d. (7%) to 3s. 8½d. (30%); to 12 in. wide × .056, 2s. 9½d. to 3s. 8¾d.; to 25 in. wide × .056, 2s. 11½d. to 3s. 10¾d. Spoon and fork metal, unsheared, 2s. 6¼d. to 3s. 5½d. Wire, 10g., in coils, 3s. 3d. (10%) to 4s. 2¼d. (30%). Special quality turning rod, 10%, 3s. 2d.; 15%, 3s. 6¾d.; 18%, 3s. 11d. All prices are net.

Forthcoming Events

JANUARY 15

Institution of Production Engineers

Sheffield Section :—" A Crane Builder's Outlook on the Design of Electric Overhead Cranes," by J. Baker, at the Royal Victoria Station Hotel, Sheffield, at 6.30 p.m.
Derby Sub-section :—" Tungsten Carbide," by B. E. Berry, at the School of Art, Green Lane, Derby, at 7 p.m.

Institute of Metals

Scottish Local Section :—Visit to Henry Wiggin & Company, Limited, Thornliebank, Glasgow.

JANUARY 16

Institute of British Foundrymen

Slough Section :—" Non-ferrous Production Methods in the U.S.A.," by F. Hudson, F.I.M., at the Lecture Theatre, High Duty Alloys, Limited, Buckingham Avenue, Trading Estate, Slough, at 7.30 p.m.

Institution of Production Engineers

Western Section :—" Electronics in Industry," by L. G. Ward, at the Grand Hotel, Broad Street, Bristol, at 7.15 p.m.
Coventry Section :—" Materials Handling," by W. M. Hiorns, at the Geisha Café, Hertford Street, Coventry, at 7.15 p.m.

Institution of Incorporated Plant Engineers

Glasgow Branch :—" The Work of the Department of Scientific and Industrial Research," by Dr. H. Buckley, at the Engineering Centre, 351, Sauchiehall Street, Glasgow, at 7 p.m.

Institution of Works Managers

Leicester Branch :—" Management and Productivity," by J. Ayres, at the Bull's Head, Loughborough, at 7 p.m.

Institution of Industrial Supervisors

Kidderminster Section :—Films " Steel " and " Chain Making," at Carpet Trades, Limited, Mill Street, Kidderminster, at 7.30 p.m.

JANUARY 17

Institution of Production Engineers

Birmingham Section :—" The Machine Tool Industry," by W. J. Morgan, M.B.E., at the James Watt Memorial Institute, Great Charles Street, Birmingham, 3, at 7 p.m.
Edinburgh Section :—" Some New Materials and their Applications," by R. F. Archer, at the North British Station Hotel, Edinburgh, at 7.30 p.m.

Institution of Incorporated Plant Engineers

Western Branch :—" Non-ferrous Metals," at the Grand Hotel, Broad Street, Bristol, at 7.15 p.m.

Manchester Metallurgical Society

Visit to the Department of Metallurgy, Manchester University.

JANUARY 18

Purchasing Officers' Association

Northern Ireland Group :—" Britain and her Overseas Customers," by the Earl of Verulam, at the Queen's Hotel, Victoria Street, Belfast, at 7.30 p.m.

Institution of Production Engineers

Glasgow Section :—" Fine Finishes by Machining Techniques," by P. Spear, at the Institute of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, at 7.30 p.m.

JANUARY 19

Institution of Mechanical Engineers

Western Branch :—" Naval Gearing—War Experience and Present Development," by Cdr. (E) J. H. Joughlin, D.S.C., at the Royal Naval Engineering College, Manadon, Plymouth, at 6 p.m.

JANUARY 20

Institute of British Foundrymen

Bristol and West of England Branch :—" American Non-ferrous Foundries," by D. Potts, at the Grand Hotel, Broad Street, Bristol, at 3 p.m.

Institution of Mechanical Engineers

North-Eastern Graduates' Section :—Visit to Noble & Lund, Limited, Felling-on-Tyne, at 10 a.m.

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

WORKS AND FOUNDRY MANAGER, experienced in fully mechanised or floor moulding up to 3 tons. Standard mass machine shop practice. Conversant with cupola and sand control.—Box 456, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER (39), sound practical and technical experience, metallurgy, moulding (mechanised, jobbing up to 20 tons), sand control, pattern-making, keen, reliable, excellent organiser, commercial knowledge, desires change and permanent progressive position, preferably South, South Midlands. Excellent references. A.M.I.B.F.—Box 464, FOUNDRY TRADE JOURNAL.

ASSISTANT or FOREMAN. 16 years' practical experience, including Assistant Foreman. All classes of work. Age 32, married. Keen and intellectual. Highest references. M.I.B.F.—Box 470, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

BOX No. 966.—The Advertiser would like to thank all applicants answering the advertisement for a Technical Representative. All applications have been kept strictly confidential, but owing to the Managing Director being out of the country all applications have not yet been acknowledged. The post has now been filled.

FOUNDRY METALLURGIST required for Works situated 20 miles west of London. Good practical knowledge of Non-ferrous melting and Foundry work essential. Experience in H.F. melting and Steel Foundry practice an additional advantage. State standard of education, experience and salary required to Box M.175, WILLINGS, 362, Grays Inn Road, W.C.1.

METALLURGICAL ASSISTANT required for Foundry Technical Control Department. Applicants should be of graduate standard, with knowledge of foundry practice and experience of research on steel castings preferred. Good opportunity for advancement.—Write, stating age, which should be between 25/30 years, education, and past experience, to Box 468, FOUNDRY TRADE JOURNAL.

FOUNDRY METALLURGIST, preferably with academic qualifications, required for large Engineering Concern in South Africa. Successful applicant must have practical knowledge of all aspects of steel, iron and non-ferrous Foundry Operations, including sand and sand treatment. Juniors will not be considered. Salary £1,080 per annum, plus cost-of-living allowance, which is at present £216 for married men. Future prospects good for right man.—Apply in writing before 15th February, 1951, quoting reference "V/30," to: The London Representative, VANDERBIJL ENGINEERING CORPORATION, LTD., 535/546, The Adelphi, London, W.C.2.

SITUATIONS VACANT—*Contd.*

WORKS MANAGER required for Australian Light Castings, Engineering and Sheet Metal Fabricating Works. 2,500 hands. Salary offered £2,000 upwards, according to experience. Applicant's age should not greatly exceed 45.—Apply, giving full details of experience and position held, which will be treated in the strictest confidence, to Box 476, FOUNDRY TRADE JOURNAL.

YOUNG ASSISTANT FOREMAN required for Textile Machinery Foundry, 12 miles north of Manchester. Man with knowledge of plates and machine moulding preferred.—Apply Box 448, FOUNDRY TRADE JOURNAL.

REPRESENTATIVE required by Non-ferrous Foundry. Light alloy, sand and gravity die casters, engineers and pattern makers. Liberal commission to the right man.—Box 450, FOUNDRY TRADE JOURNAL.

THE DAVID BROWN FOUNDRIES COMPANY, Penistone, near Sheffield, require a METALLURGICAL ASSISTANT for research laboratory. Applicants should be of graduate standard, with experience of non-ferrous metals or steel preferred. Good salary to suitable person.—Reply, stating age, experience, and education, to the PERSONNEL OFFICER.

NON-FERROUS and CAST IRON MOULDERS required. Good rates. Canteen, etc.—Apply S.E.M., LTD., Pitsea Street, Stepney.

MOULDERS.—Iron Foundry requires skilled jobbing Moulders. Piecework or bonus. Good wages can be earned by first-class workers.—HOLLAND FOUNDRY, LTD., 157, Clapham Road, S.W.9.

FOREMAN required for London Iron Foundry. Capacity up to 80 tons per month, medium and light castings. Age 30-40 preferred. Good organiser, capable of fixing piecework prices. Apply, giving age and full experience. Salary can be arranged at interview.—Apply Box 492, FOUNDRY TRADE JOURNAL.

MEDIUM size modern Factory, South Midlands, requires DEPARTMENTAL MANAGER for Foundry (Cupolas, Moulding, Core-making, Annealing). Applicants should be Engineers, aged 25 to 30, with good personality and education. Twelve months' training would be given by present executive. Some Foundry practice desirable, but not essential. Starting salary £650.—Replies, Box 488, FOUNDRY TRADE JOURNAL.

WANTED.—ASSISTANT or SENIOR DRAUGHTSMEN, with general engineering experience. Experience in estimating and weight calculating an advantage. Wages according to age and qualifications.—Applicants send particulars to: THE MANAGING DIRECTOR, Glanmor Foundry Co., Ltd., Llanelly, South Wales.

SITUATIONS VACANT—*Contd*

REQUIRED, for specialist vitreous enamelling firm, North-West London, keen young technician, to act as SHOP FOREMAN. Must have drive, organising ability, and be able to handle labour. Excellent prospects for right man.—Box 480, FOUNDRY TRADE JOURNAL.

ASSISTANT ANALYTICAL CHEMIST required for Works' Laboratory. Aged 24-28 years.—Apply, giving full particulars of training and experience, to PERSONNEL MANAGER, Fraser & Chalmers Engineering Works, Erith, Kent.

ASSISTANT FOUNDRY MANAGER required for Foundry in the South Wales area. Applicant must have good technical knowledge of Core Shop, Fettling, Jobbing and Mechanised Foundry Work. Single man preferred. Salary £500-£600, according to experience.—Apply, giving details of age, education, experience, etc., to Box 490, FOUNDRY TRADE JOURNAL.

FINANCIAL

ENGINEERING OR ALLIED INDUSTRY.—Industrial Syndicate, with substantial financial resources, desire to acquire part or whole interest in an established concern with a good profit-earning record. An investment involving from £20/100,000 is envisaged.—Address "Consultant," Box 454, FOUNDRY TRADE JOURNAL.

MACHINERY WANTED

IRON CASTINGS wanted by London Firm of Pattern Makers with good connections. Prompt and regular delivery to London essential.—Box 442, FOUNDRY TRADE JOURNAL.

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CUPOLA wanted, 3 ft. 6 in. diameter, inside shell, complete with motor blower; also small Sand Mill, "Jackman" type.—Write Box 484, FOUNDRY TRADE JOURNAL.

ELECTRIC Tilting Furnace required for Brass Billet production, capacity 25/30 cwt.—Full particulars to Box 486, FOUNDRY TRADE JOURNAL.

WANTED.—Good secondhand D.E. Grinder. Approx. 14 in. wheels, with dust extractor, suitable for grinding small iron castings.—LEICESTER FOUNDRY CO., LTD., South Wigston, near Leicester.

WANTED, immediately batch type Core Stove for small cores. Please state price, size, condition, makers, and where can be inspected.—Box 478, FOUNDRY TRADE JOURNAL.

MACHINERY WANTED—*Contd.*

WANTED.—A No. 1 or No. 2 Royer. Must be in good condition.—Reply to BATH FOUNDRIES, LTD., Walcot Foundry, Bath.

WANTED.—Cupola, complete with electric motor and fan, and preferably with staging and hoist. Output 3 to 4 tons per hour.—Full details and price to HENRY MCNAIR & CO., LTD., Ryhall Foundry, Stamford, Lincs.

WANTED.—Core Blowing Machine. Must be in first-class condition.—Box 474, FOUNDRY TRADE JOURNAL.

WANTED.—No. 3 size "August" Sand Mixer, with 50 h.p. Motor if possible; also two Belt Feeders with Hoppers for use with this machine, if available. Urgent.—Box 472, FOUNDRY TRADE JOURNAL.

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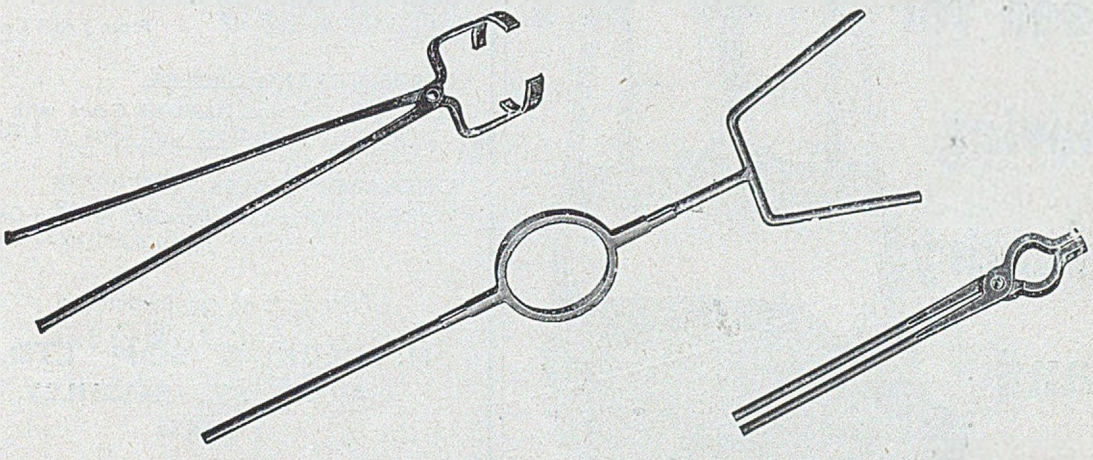

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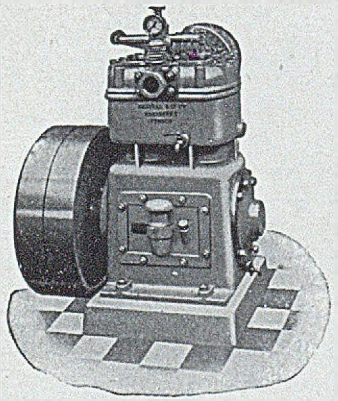

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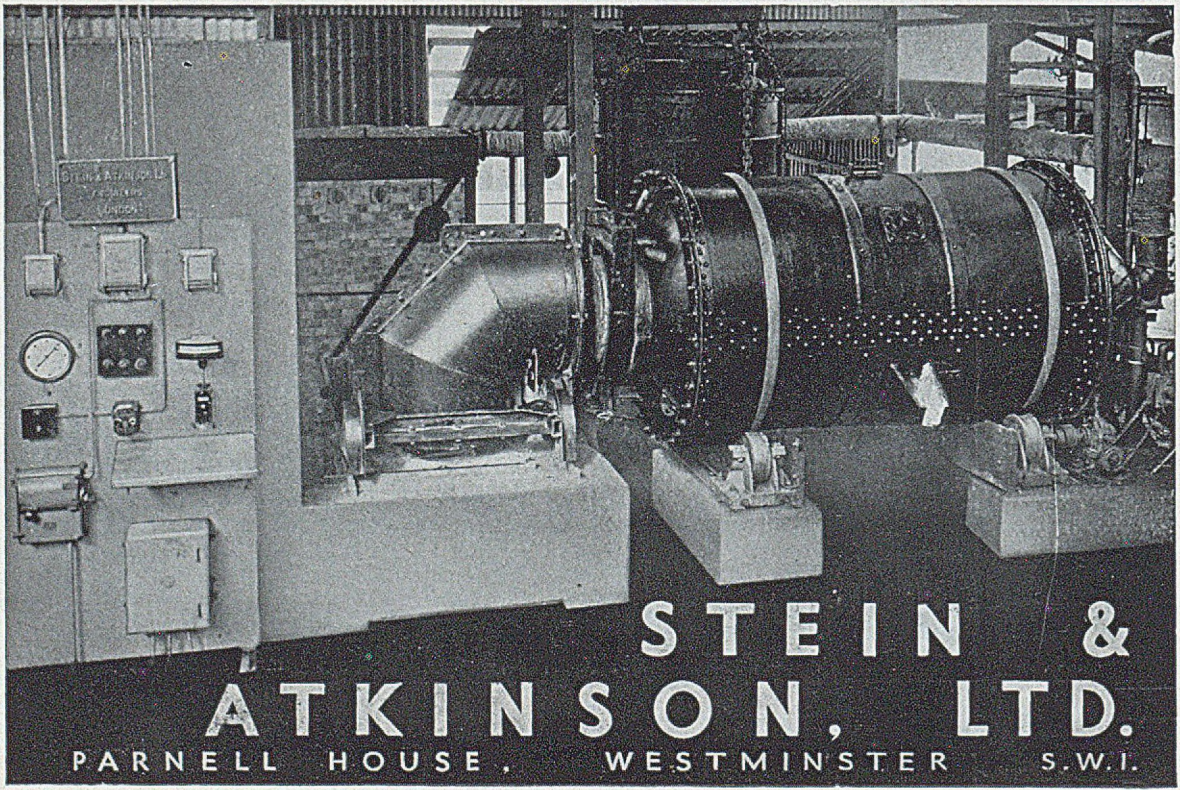
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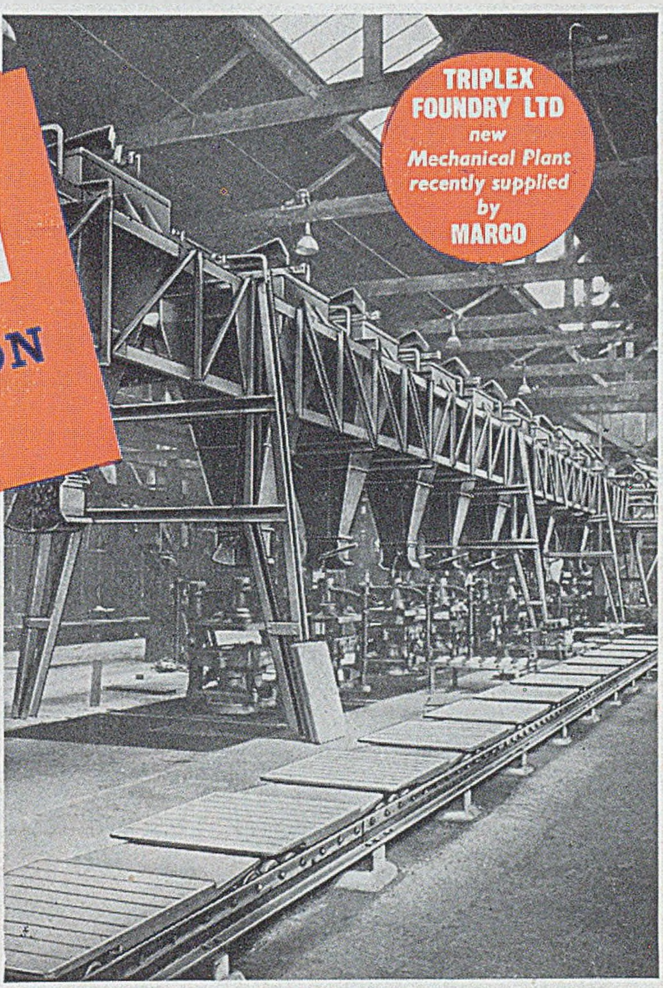
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GR

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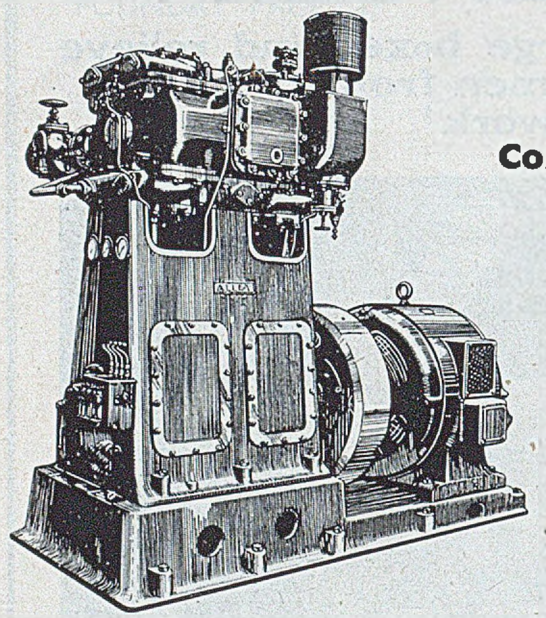

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