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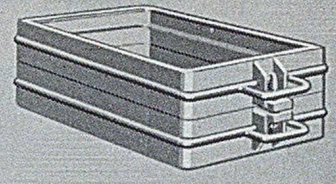

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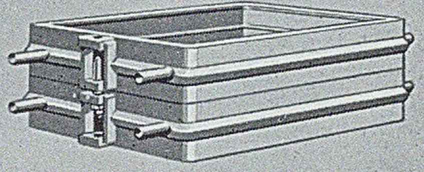

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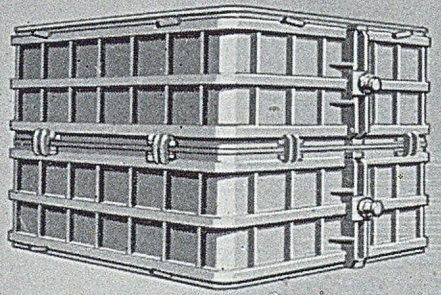

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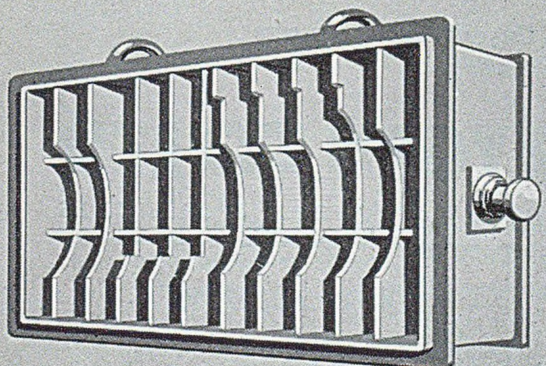

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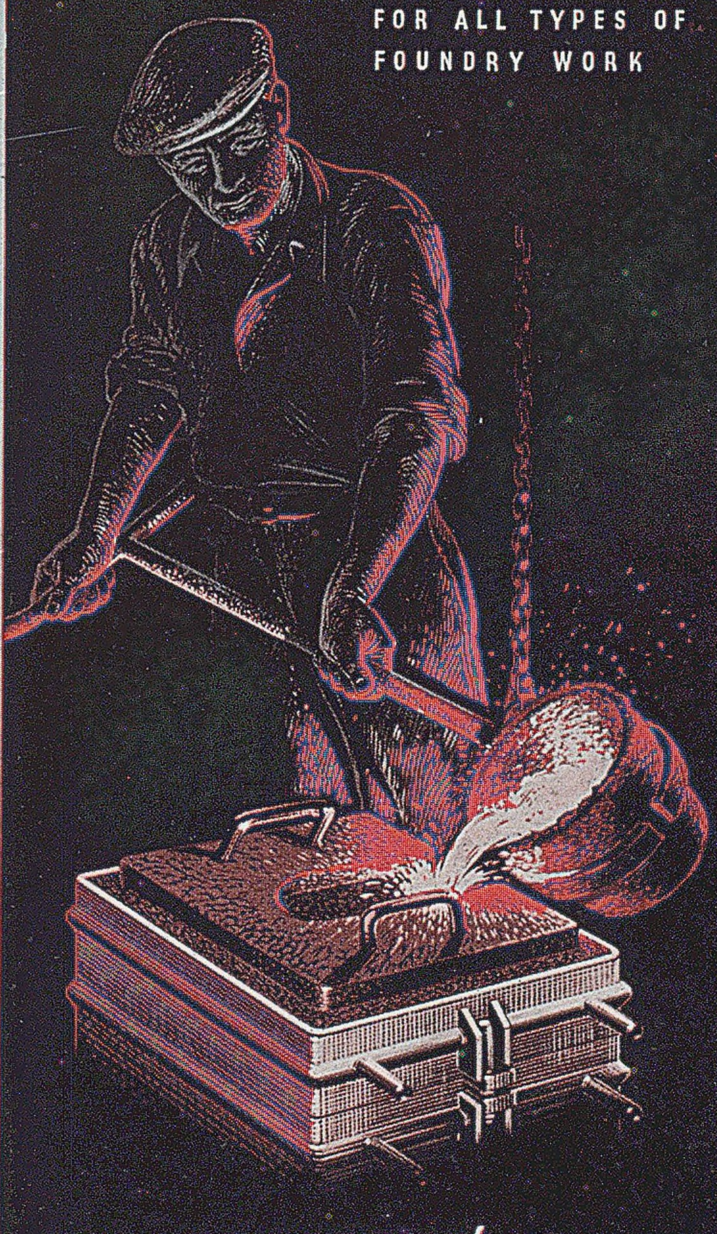

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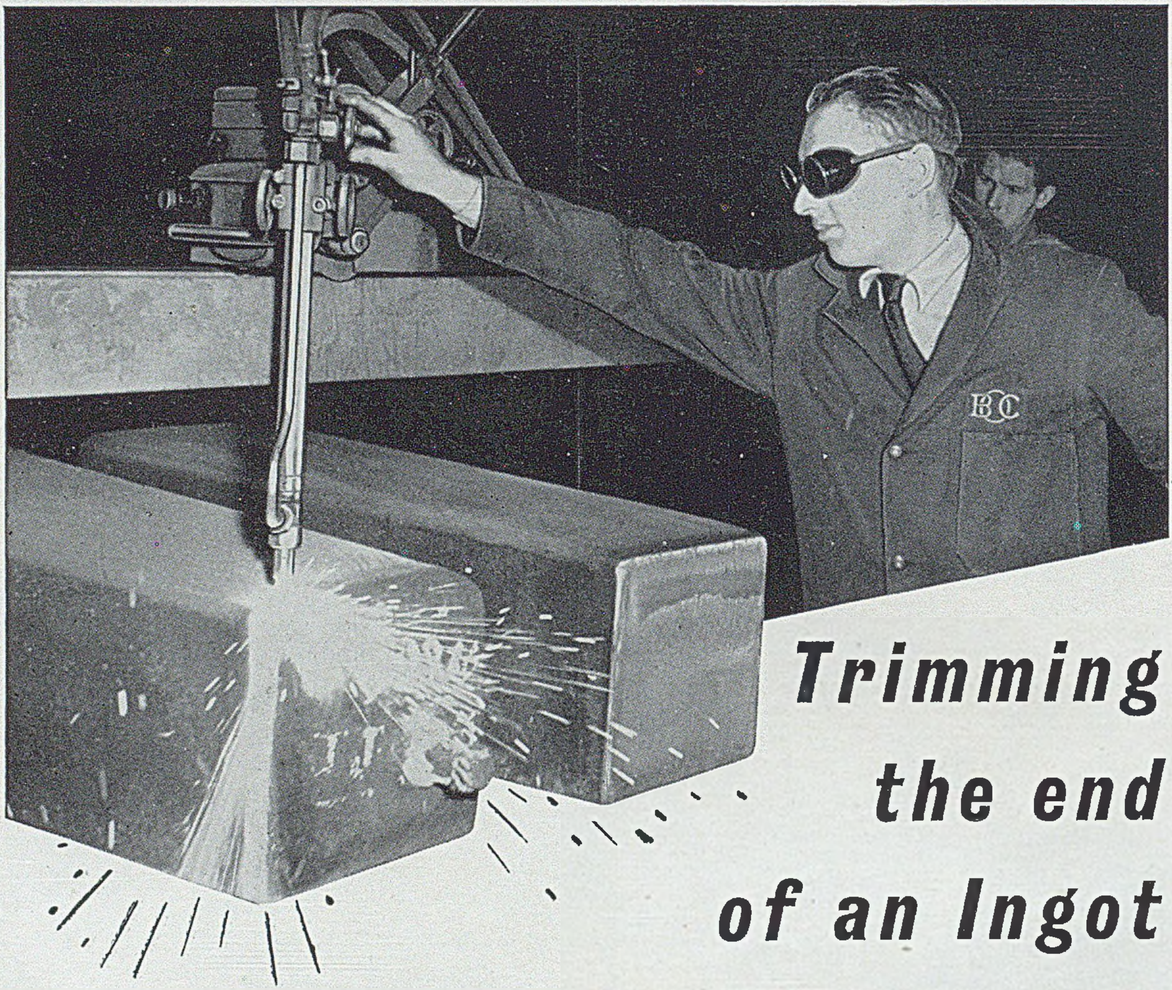

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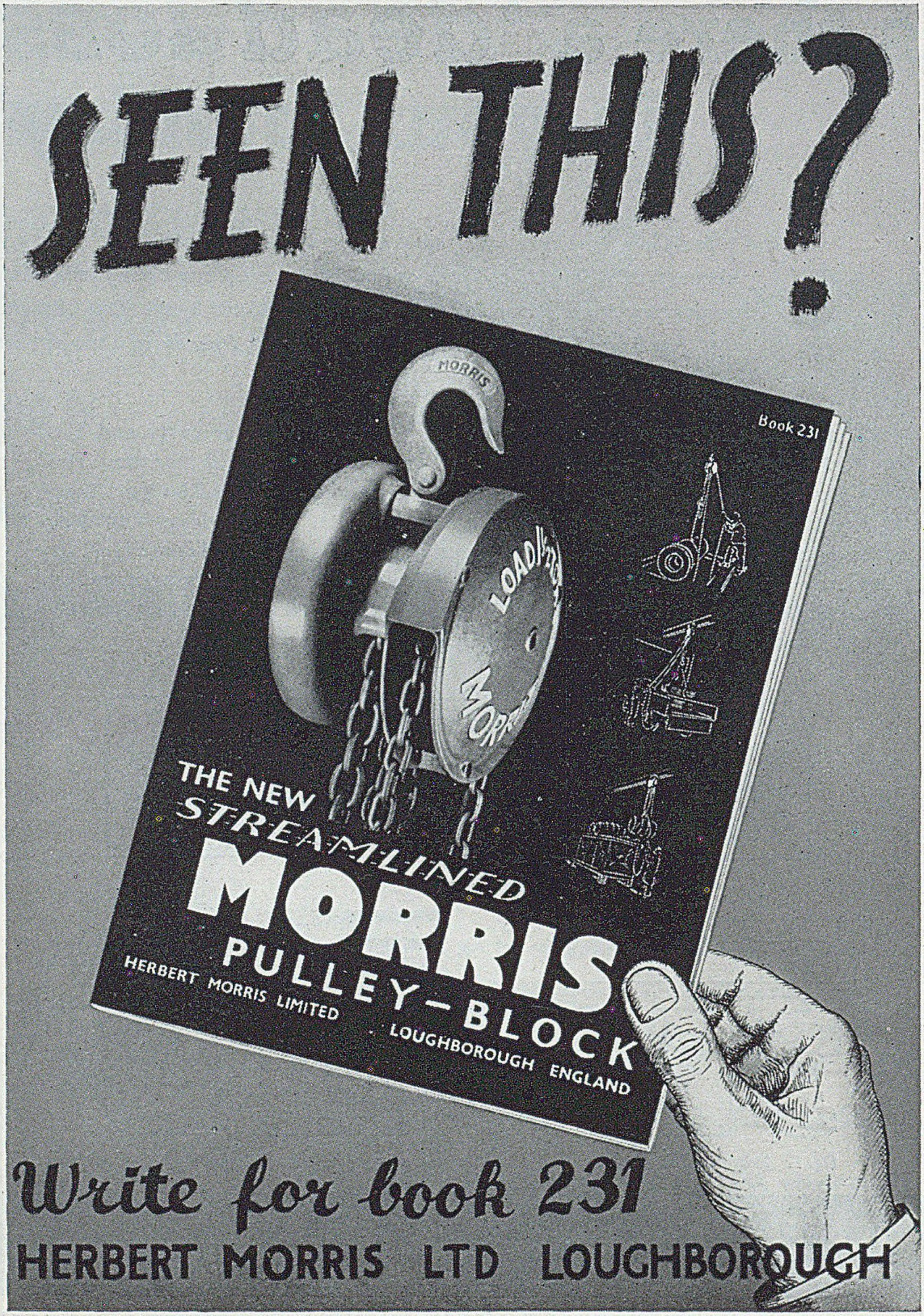
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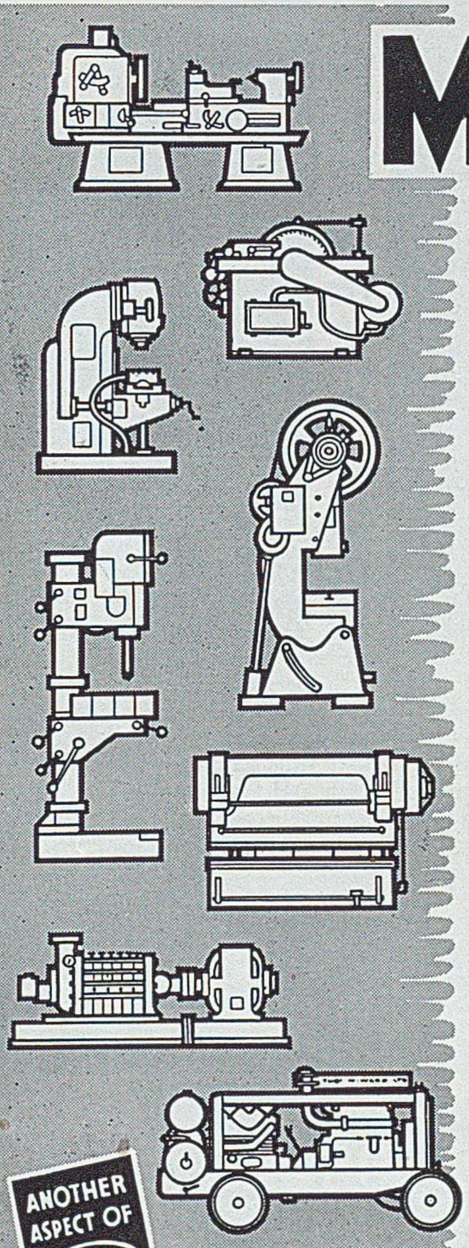

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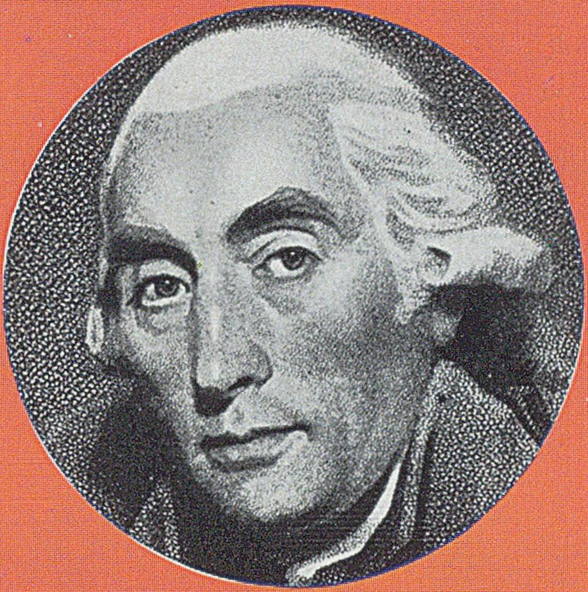

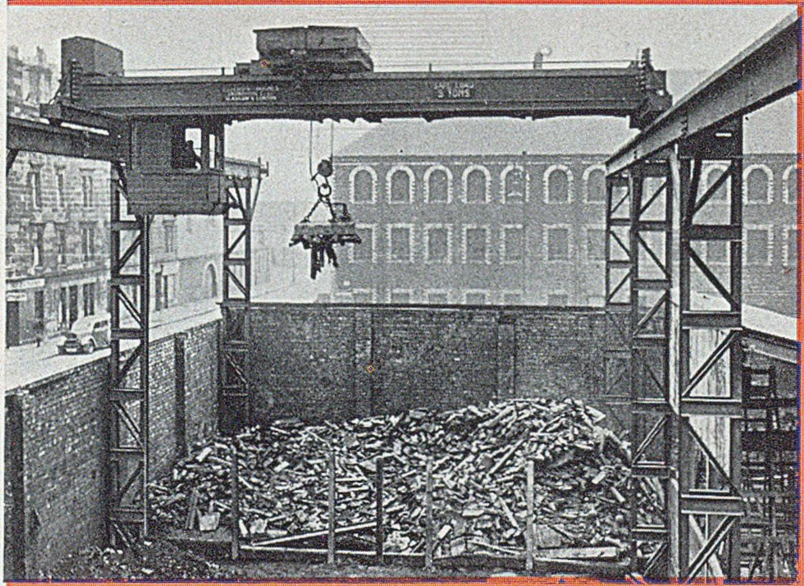

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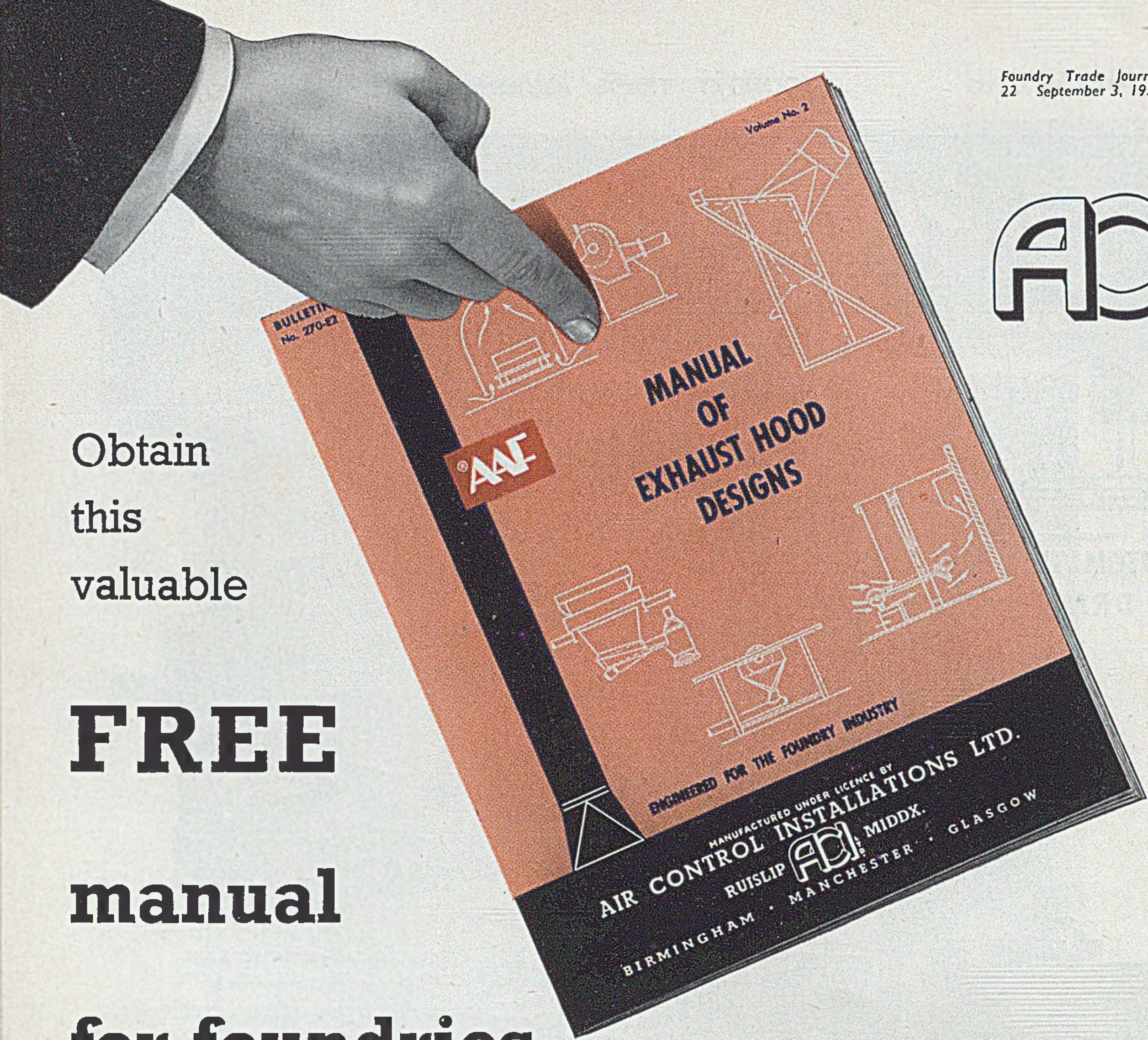

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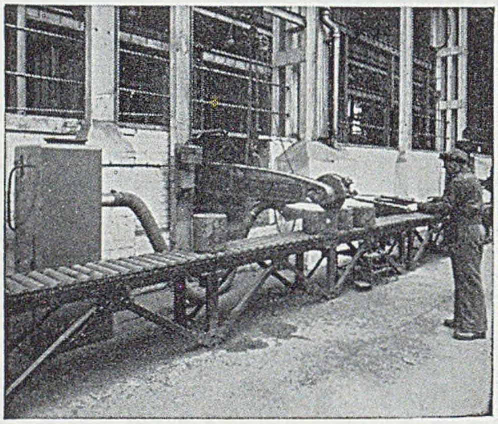

(Photo by courtesy of Messrs. Walter Somers Ltd., Birmingham.)

CONTEMPORARY METHODS of dust collection in use at works of a forging manufacturing company. A T. 1100-L type unit is installed here at a forge to collect dust from a swing grinder which is employed in the removal of the skin off die blocks.

Details of "T" type units are given in Publication No. 16/25

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PRINCIPAL CONTENTS

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Three Foundries

A few weeks ago, in this column we made extracts from Griffith's *Guide to the Iron Trade of Great Britain*, now we submit the Author's views on the foundries of 1873 which still exist to-day. Starting with Tangye Brothers [and Holman] we are told how 3,500 pumps invented by Mr. A. J. Cameron of New York had been "fixed and at work, all made at the great Cornwall Works." "In looking over the Soho Works the other day," says our predecessor, "we were more pleased than we can express. They are of immense size and employ 1,200 men; and the wholesale way in which the work is got through is marvellous. We should think there were 50 or 60 of these engines [pumps] of different sizes in course of erection." He does not say much about the foundries except to add that they were "abreast, if not in advance, of the day in which we live." After commenting on the offices and warehouses of this wonderful hive of industry to the effect that they were "admirable in the highest degree. He comments on the amenities of the concern. "There is likewise here a spacious dining hall for the men, with stoves and cooking apparatus under proper management, where the artisans may have tea and coffee for breakfast and their chop or steak cooked for dinner."

When dealing with "this highly respectable old firm of Thomas Perry & Sons," again he skates over the question of the foundry by just stating that it is of world-wide fame; that it stocks the finest brands of pig-iron—"mixed in proportions only known to Perry & Sons to make soft and chilled rolls" and that they supply several well-known firms. But it is when the author is describing people, that he gets quite lyrical. He writes, "Fifty years since, the firm was then Thomas Perry, the family resided at Bilston and as there were at that time numerous Perrys in business, Mr. Perry, to distinguish him, was always called 'Gentleman Perry' and was highly esteemed and loved by all classes. . . . He was quiet unostentatious, always a gentleman, was never known to forget himself or become agitated in business" and so on for another ten lines.

The third foundry with which the author deals is "the business of Messrs. Hayward-Tyler & Company. . . . It appears to have been established in 1815 by William Russell—a pupil of the celebrated Joseph Bramah, and for many years was conducted on a scale not very extensive in Clerkenwell, London. The branches of engineering carried on were those to which Mr. Bramah had given so much attention, and of which he may almost be named the founder, *viz.*, hydraulic presses and machinery for making soda water." After relating how the business passed on to a member of the Howard family, Mr. Griffiths turns to the firm's production of direct-acting steam pumps. "The accounts of their performance," he writes, "would be difficult to believe, if they were not confirmed by unimpeachable testimony, such as their continuing to work in repeated instances after they had been 'drowned out' by a sudden rise of water, and actually working themselves high and dry again." No wonder it received, against competition, the *grand prix* Medal for Progress at the 1873 Vienna exhibition. All these firms are still in existence, and the progress they have made show that they well merited the eulogies Mr. Griffiths accorded.

S.B.A.C. Exhibition

Stress-free castings produced by the Parlanti mould die-casting process, which embodies the use of "temperature graded" anodized aluminium-alloy dies, are to be shown by Carron-Parlanti, Limited, on stand 61 at the exhibition of the Society of British Aircraft Constructors to be held at Farnborough from September 7 to 13. The principal exhibit will be a reflector casting, 4 ft. 1 in. dia., cast in L.33 alloy, and weighing 550 lb. as cast and shown in Fig. 1. Other exhibits include compressor blades, aircraft tip-sections, male and female couplings, and many other

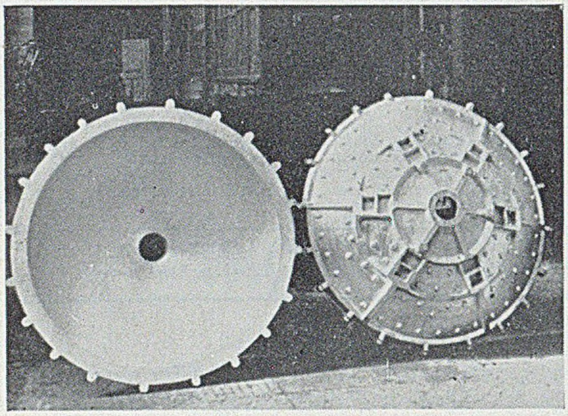

Fig. 1.—*Reflector Casting, 4 ft. 1 in. dia., weighing 550 lb., to be exhibited by Carron-Parlanti, Limited, at the S.B.A.C. Exhibition.*

castings in the aluminium range of alloys to specifications 3L33 and DTD 133C/304/424/300A. There are also three finished components, including a regulator-valve unit, a hydraulic unit, and Diesel pump unit, all designed to operate at pressures from 100 to 2,500 lb. per sq. in.

Other Castings on View

Interesting examples of castings produced for the aircraft industry by the centrifugal method will be shown on the David Brown stand (178). Arrester hooks, wing fittings, engine-mounting brackets and clutch housings, all produced to Ministry of Supply (Air) specifications DTD 666 and DTD 705, are among the products of the David Brown Foundries Company, who supply the bulk of the exhibits. A selection of turbine-shroud rings are arranged as typical examples of heat-resisting alloys developed by this company. Relatively light sections are involved in all these castings, and the metallurgical demands of such components are of interest in that the operating temperature is in the range of 650 to 900 deg. C. In addition to providing relatively high strength at these temperatures, the castings for this purpose demand accuracy, gas tightness, resistance to scaling, and must also meet machining requirements. These centrifugally-cast components have a marked advantage over composite welded structures in regard to resistance to distortion.

Castings of this type are subject to examination by X-ray, gamma-ray or isotopes for proof of pressure-tightness, and magnetic or fluorescent methods of testing are applied for surface inspection. Small components difficult to forge or machine are to be illustrated by the

(*Continued at the foot of column two*)

company's display of precision castings made by the investment process. In most cases, these weigh only a few ounces and can be produced in high-melting-point alloys, or in stainless steel and the more common types of steel and bronze. Miscellaneous castings in Taurus bronze will also be shown by the firm.

Conference Paper Author

J. W. Grant, a.m.i.mech.e., Author of the Paper "Growth Characteristics of Ingot-mould Irons in Air and Vacuum," the first part of which is printed on the adjoining pages, is on the staff of the development department of the British Cast Iron Research Association, having joined the Association as a laboratory apprentice in 1938. After his apprenticeship, which included a period at the foundry and works of Revo Foundry Limited, he became a member of the research staff, and was engaged in research on high-duty and nodular cast irons and the engineering aspects of these. Since he was transferred to the development department, early in 1952, he has been concerned principally with ironfoundry melting practice. He represents the B.C.I.R.A. on two technical sub-committees of the Institute of British Foundrymen and is himself an associate member of the Institute.

Guidance on Exports to America

Guidance to Midland manufacturers to develop sales on the American Continent was given by Sir Robert Hadow, British Consul General in Los Angeles, last month. Sir Robert attributes the substantial sales of British cars in California to the climate which makes sports cars popular. These were two vital points to be noted in machinery exports if we were to overcome a natural American belief that it was dangerous to buy relatively modest-sized, foreign-made machines, even though they might be more economical at the outset. Whatever his line of product, the manufacturer who wishes to enter the American market must be prepared to back his product with sufficient stocks, Sir Robert said, and to have on the spot depots which will cover both normal needs and sudden emergencies. The idea that air freight can be used to fly in stocks or spares has proved a fallacy.

Emphasizing that shortcomings in delivery dates and quality of goods or services do great harm to trade prospects, Sir Robert criticised the approach of some British manufacturers, saying that the American customer was not prepared to waste time listening to reasons for not being able to let him have what he wants. He stressed, too, that it is fatal for a British manufacturer to turn down an order because it is too large. Americans like to buy in big quantities. Sir Robert suggested that a firm offered a large order should combine with another firm to put it through in time. Too many firms in this country were too busy competing with each other to compete successfully with trade rivals in other countries. Where one firm was unable to stand the cost of sending out a representative to explore markets, several firms should co-operate. A touring van could be stocked with British manufactures for this purpose.

Growth Characteristics of Ingot-mould Irons in Air and Vacuum*

By J. W. Grant, A.M.I.Mech.E.

Growth of cast irons has been attributed mainly to three causes: carbide decomposition, oxidation, and bursting or cracking caused by expansions and contractions during the $\alpha \rightleftharpoons \gamma$ transformations. Initially these theories are discussed. Next, the oxidation products and growth of ingot-mould irons caused by long heat-treatments at 500 deg. C. in air, and repeated heating 650—900—650 deg. C. in air and vacuum were studied. In the vacuum tests, growth of as-cast and vacuum-annealed ingot-mould iron continued at a fairly uniform rate according to the number of heatings. A volume growth of 80 per cent. was obtained after 300 heatings, 650—900—650 deg. C. Pure iron/carbon and pure iron/aluminium/carbon specimens that were melted, cast and tested in vacuum had grown 44 and 153 per cent. respectively after 300 heatings, and were still continuing to grow. Annealing in air inhibited growth due to repeated heating in vacuum. The growth after 300 heatings in vacuum was completely arrested by annealing in air at 700 deg. C. for 20 hrs. The work gives strong support to the cracking theory. Annealing in air appears to cause a protective envelope to form around the graphite, which prevents the solution of graphite in the gamma iron at the austenitizing temperature, and thereby diminishes the intensity of the expansions and contractions during the $\alpha \rightleftharpoons \gamma$ transformation.

Introduction

Growth in cast iron is the permanent increase in volume that occurs when the material is subjected to an elevated temperature. It occurs in all grey cast irons and its magnitude depends upon the composition and structural stability of the iron, the temperature of treatment, the time held at temperature or the length and number of heating cycles, and the nature of the atmosphere or medium surrounding the iron. There have been many attempts to explain the growth phenomenon but none adequately accounts for all the anomalies encountered. Growth, other than that due to decomposition of pearlite or carbides, is mainly attributed to oxidation, but some of the work described here shows that appreciable growth can occur in vacuum or in inert gases, where all oxidizing influences are eliminated. Particular reference is made to the growth of ingot-mould irons, because they represent an example of severe growth in practice, their growth is not complicated by the presence of alloys, as in heat-resisting irons, and they have a coarse-graphite structure that is readily examined microscopically.

The purpose of this Paper is to review the theories of growth of cast iron, to consider the effects of growth in ingot moulds, and finally to give an account of some growth and other heating tests carried out in air and vacuum.

THEORIES OF GROWTH IN CAST IRON

Two factors that cause growth when cast iron is heated to temperatures in the vicinity of its critical temperatures are: (1) decomposition of carbides and pearlite with the consequent deposition of graphite, and (2) oxidation of the metallic matrix causing the formation of bulky oxides. Apart from these, there are theories regarding the formation of cracks due to differential expansions and contractions, and the part played by dissolved gases and also gases that have penetrated the metal during the early stages of growth.

Decomposition of Iron Carbide

When iron carbide decomposes into iron and graphite upon heat-treatment, there is a permanent expansion due almost entirely to graphite precipitation and proportional in magnitude to it. Ferrite, iron carbide and pearlite all have specific gravities between 7.5 and 7.9, and graphite has a specific gravity of 2.3. By calculation, the precipitation of 1 per cent. of graphite causes a volume increase of approximately 2 per cent. or a linear increase of 0.65 per cent. A pearlitic iron with 0.8 per cent. combined carbon cannot therefore grow more than 1.6 per cent., due to decomposition of its pearlite. The rate of growth depends upon the stability of the pearlite, and this is influenced directly by the presence of graphitizing and carbide-stabilizing elements.

Oxidation Theory

While there have been many attempts to explain the mechanism of growth in cast irons by the oxidation of their constituents, there is no rational explanation for the behaviour of all types of oxidizing atmospheres and all types of cast irons. When a flake-graphite iron is exposed to an oxidizing atmosphere at an elevated temperature, oxidation of the metal surface takes place, and, owing to the penetration of the atmosphere along the graphite flakes, a certain amount of oxidation occurs over a limited depth. It is reasonable to suppose that since the coefficient of expansion of graphite is considerably less than that of the metallic matrix (2×10^{-6} per deg. C. compared with 12×10^{-6} per deg. C. for alpha iron), a minute gap will form between the flake and the metallic matrix as the iron is heated, and will more readily permit the penetration of the atmosphere. Alternatively, if any gap does exist at room temperature, as some authorities believe, that gap will increase in size. Though graphite flakes in a cast

a

* Paper presented to the fiftieth annual meeting of the Institute of British Foundrymen.

Growth of Ingot-mould Irons

iron are not interconnected, the oxidizing gases appear to reach neighbouring flakes, possibly by diffusion through the matrix. Growth due to repeated heating through the pearlite/austenite critical range is much more rapid than when the cast iron is held at constant temperature. Repeated heating may cause a disintegration of the already-oxidized matrix, which then offers less resistance to penetrating gases.

The most outstanding early work on growth of cast iron was published by Rugan and Carpenter[1] in 1909, and two years later by Carpenter.[2] They concluded that the main factor causing the permanent increase in volume is the oxidation of the silicon, which is dissolved in the iron, with the formation of bulky silica. Oxidation of the iron itself, and of the graphite, also occurs at different rates, and sometimes at the same time as the silicon, depending upon the temperature, composition and constitution of the cast iron, and the nature of the surrounding atmosphere. Carpenter states that during repeated heating in air, oxidation of the silicon in the iron is accompanied by growth and incipient disintegration, and minute cracks are formed. If the cyclic heat-treatment is carried out in an oven where carbonaceous gases are present, there may be a series of minute explosions owing to the reactions between the dissolved hydrogen and the penetrating oxides of carbon. During subsequent heating and cooling cycles, the air penetrates a little further and more growth takes place.

The presence of graphite is essential if growth is to occur, otherwise there is only surface oxidation. Rugan and Carpenter showed that due to repeated heating between room temperature and 900 deg. C. a white iron scaled on the surface, but did not grow internally when no temper carbon was deposited; in many cases it diminished in size and weight, probably because of the gradual oxidation of the carbon at the surface. Tests on silicon steels confirmed that no growth takes place in the absence of graphite. The growths in a 0.18 per cent. carbon, 1.1 per cent. silicon steel, and a 0.19 per cent. carbon, 2.71 per cent. silicon steel, after 15 cycles of heat-treatment to 900 deg. C. were nil and 0.394 per cent. respectively. In a 3.97 per cent. carbon cast iron containing 2.96 per cent. silicon the growth due to the same heat-treatment was 31.35 per cent.

A close relationship between the silicon content of the cast iron and the amount of growth has been shown by many investigators. Rugan and Carpenter showed that in a series of grey irons having silicon contents varying from 1 to 6 per cent. and all having 3.8 to 4 per cent. carbon, the total growth during repeated heating from 10 to 900 deg. C. was approximately proportional to the silicon content (Fig. 1). Owing to the severe cracking that occurred, it was not possible accurately to measure the progress of growth, but in the three irons of lower silicon content no further growth took place after 16 heats (Fig. 2). Accompanying the changes in volume there were also changes in weight. In the three irons of lower silicon content, the weight increased up to the 12th heat, and then decreased. In

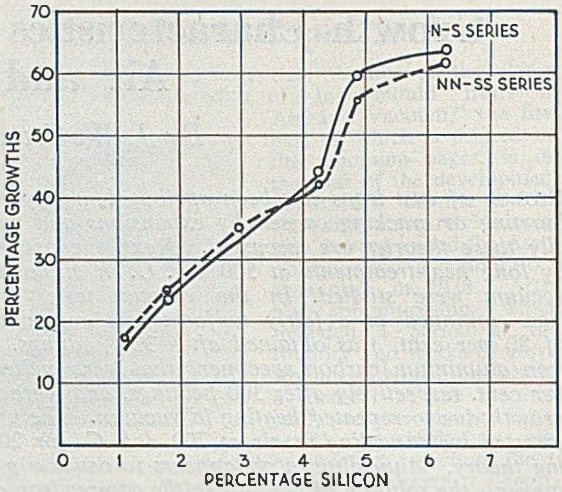

FIG. 1.—*Curves illustrating the Relationship between Growth due to Repeated Heating to 900 deg. C., and Silicon Content. (Rugan and Carpenter.[1])*

the three irons of higher silicon content the weight was still increasing after the 50th heat. According to Guillet[3] the silicon in irons of the type tested is present as iron silicide in solid solution. Where the iron silicide is oxidized to iron and silica, or iron oxide and silica, the theoretical increases in weight were less than those measured in the growth tests. Rugan and Carpenter therefore concluded that in addition to the iron silicide, partial oxidation of the iron uncombined with the silicon must take place.

The rate of oxidation, and the amount to which the iron, silicon and carbon oxidize depends upon the composition and constitution of the cast iron. It is interesting to note that although there had been severe oxidation in the iron containing 6 per cent. silicon, giving a growth of over 60 per cent, chemical analysis showed that there was no loss of carbon. Upon studying Rugan and Carpenter's results, it seems possible that if the cyclic heat-treatment had been continued a great deal further, growth might have recommenced and proceeded, due to the progressive oxidation of the ferrite.

A similar relationship between the silicon content and growth under oxidizing conditions was shown by Pearson[4] for silicon contents up to 2.5 per cent. When the graphite in the centre of his test-pieces became "swollen," growth slowed down, and it was not until then that decarburization of the graphite flakes took place. Andrew and Hyman[5] obtained greater growths in irons containing nickel and aluminium. They attributed this to the coarsening effect of these alloying elements on the graphite size, thus indicating the importance of the graphite structure.

The influence of graphite size, form and quantity on the growth properties of cast irons was not fully shown until the publication of a paper by Norbury and Morgan[6] in 1931, and the development at the British Cast Iron Research Association of high-silicon growth-resisting irons of the Silal type containing graphite in the under-cooled form. These authors showed that growth increased as the silicon

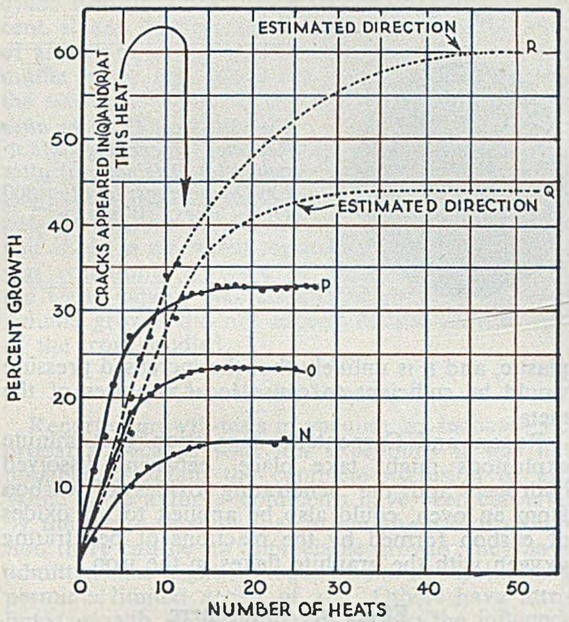

FIG. 2.—*Curves illustrating Rate of Growth with Silicon Contents: N = 1.07, O = 1.79, P = 2.96, Q = 4.2, and R = 4.83 per cent. (Rugan and Carpenter.*[1]*)*

content increased up to 3 and 4 per cent., but that with a higher silicon content the growth in irons having smaller amounts of carbon, all in the form of small graphite flakes, decreased to a very small value. The beneficial effect of the high-silicon content was attributed by the authors mainly to its marked effect in increasing the resistance to oxidation. This is in contradiction to Carpenter's findings. Norbury and Morgan's repeated-heating experiments were carried out at temperatures of 600, 700, 900, and 1,000 deg. C., mainly in an atmosphere of moist carbon dioxide. The greatest resistance to growth was obtained in irons with 6 per cent. silicon having carbon contents below 2 per cent., and their graphite in the under-cooled form.

In some growth tests on Silal, Hallett[7] observed an area near the edge completely free of graphite and merely containing coarse dispersed oxides beneath a heavily-oxidized zone. This in effect may behave as a protective zone against further penetration of the atmosphere. He attributed this graphite-free zone to the slow diffusion of oxygen inwards compared with the rapid migration of the carbon outwards, the pressure arising from the growth of the outside actually closing the holes.

Cracking or Bursting Theory

Kikuta[8] held the view that the greater part of growth is due to minute cavities and fissures, formed by the irreversible expansions in different microportions of the iron. Benedicks and Löfquist[9] have enlarged upon this theory that cracking or bursting occurs around graphite flakes due to stresses caused by volume changes resulting from heating and cooling through the critical temperatures. They believe that these formations of cracks are responsible essentially for growth in the early stages and that oxidizing gases can then penetrate into the interior of the metal and cause further growth. According to Benedicks and Löfquist's theory there are three causes of growth, quite apart from oxidation:—

(1) An increase in volume caused by the decomposition of cementite or of massive iron carbide.

As has already been stated, the permanent expansion due to the formation of 1 per cent. graphite is about 2 per cent. in volume.

(2) As shown by Whiteley[10] and Keller,[11] high stresses and local cracks can be caused by differential expansions and contractions upon cyclic heat-treatment.

A metal cylinder becomes shorter if it is rapidly quenched. The outer layer contracts suddenly and puts the inner layers into compression. These inner layers yield slightly under stress while they are at a high temperature and thus the length of the cylinder after cooling to room temperature will be less than before heat-treatment. The diameter simultaneously increases and after repeated treatment the cylinder tends to become spherical. This phenomenon was postulated by Stead and was admirably illustrated by Whiteley[10] (Fig. 3). The mild-steel cylinder illustrated was quenched and re-heated up to 800 times to between 700 and 850 deg. C. Conversely, due to suddenly repeated heating, the outside would expand and tend to stretch the core and the cylinder would elongate. As the inner portions would be at a lower temperature and more rigid, however, the resulting elongation of the cylinder would be less than the contraction on quenching. If the cylinder contained areas of weakness, as, for example, the graphite flakes in cast iron, there would be a tendency for cracks to form.

Benedicks and Löfquist regarded this action of crack formation as possible even under normal rates of heating and cooling, but unlikely to be appreciable, except when temperature changes took place very rapidly.

(3) Cracks can be caused locally by rapid expansions and contractions resulting from graphite precipitation and solution, and the $\alpha \rightleftharpoons \gamma$ transformation.

If 0.7 per cent. graphite dissolves in gamma iron, at the alpha-gamma change-point there would be a 1.9 per cent. decrease in volume. Since, upon heating, the outside of a cylinder transforms before the inside, there would thus be a tendency for a linear contraction of 0.63 per cent. as the alpha iron changes to gamma iron. The contraction will be opposed by the untransformed layers immediately below and the outer layer will therefore be subjected to a severe strain, giving rise to the formation of cracks in the metal, and consequently to permanent expansion.

In consequence of this restraining effect of the inner layers, the overall contraction of the cylinder at the alpha-to-gamma change is less than the theoretical value based on the relative densities of these two forms of iron. By similar reasoning, the

FIG. 3.—*Steel Cylinder after Repeated Quenching, left to right: (a) Original; (b) after 200 Quenchings; (c) after 800 Quenchings.* (*Whiteley.*[10])

expansions on cooling as the gamma changes to alpha iron may be anticipated. Again, the actual expansion is less than the theoretical, as in the initial stages the transformed parts are restrained by the untransformed parts.

Upon heating again, the circumstances are essentially the same, except that some cracking or internal bursting already exists due to the previous heating and cooling. The outer layers will have a lower strength owing to the cracking, and the resulting contractions in the alpha to gamma interval will accordingly be less than before. The presence of cracks will affect the amount and rate of solution of graphite in the austenite, and (upon cooling) the rate of precipitation of graphite from the austenite. The dilatation curves obtained from repeated heating and cooling cycles have been shown by Kikuta[8] (Fig. 4), and by Okôchi and Satô[12] and others. The size of the transformation kinks in the dilatation curve at the change-points diminishes as the number of heatings increases. After 10 to 20 heatings there is no change in dimension at the alpha-to-gamma change, whereas in the first heating there is a sudden contraction. On the other hand, there is still an expansion at the $\gamma \rightarrow \alpha$ change on cooling. By applying the cracking theory, Benedicks and Löfquist were able to explain all parts of the dilatation curves and diminishing rate of growth obtained by Kikuta.

Influence of Dissolved and Absorbed Gases

Theories regarding the physical influence of dissolved gases and gases absorbed from the surrounding atmosphere are obscured by the lack of knowledge on the occurrence and nature of gases in cast iron. There is evidence that upon heating a cast iron, gas is liberated, probably at the boundaries between the graphite flakes and the iron, and that its rapid expansion may cause an internal pressure sufficient to deform the metal permanently. It is conceivable that cracks or cavities could be formed due to this pressure. Okôchi and Satô measured changes in volume and weight during repeated-heating tests in air and in vacuum and attributed the growth in the initial stages to the expansion of the dissolved and absorbed gases. They estimated that the pressures of entrapped gases may increase four times by heating to 900 deg. C. Though the iron is very weak at such a temperature, it will, nevertheless, also be relatively plastic, and it is unlikely that the increased pressure would be sufficient to cause local ruptures of the metal.

Rugan and Carpenter's suggestion that minute explosions might take place between dissolved hydrogen and the penetrating oxides of carbon from an oven, could also be applied to the oxides of carbon formed by the reactions of penetrating oxygen with the graphite flakes in the iron.

Effect of Atmosphere

A number of investigators have shown the effect of various atmospheres on the rate and magnitude of growth due to repeated heating. Pearson[4] showed that in strongly-oxidizing atmospheres the rate of growth increases with the greater oxidizing power of the atmosphere in which the heatings are carried out, but that the final growth is not appreciably affected. The growths he obtained in

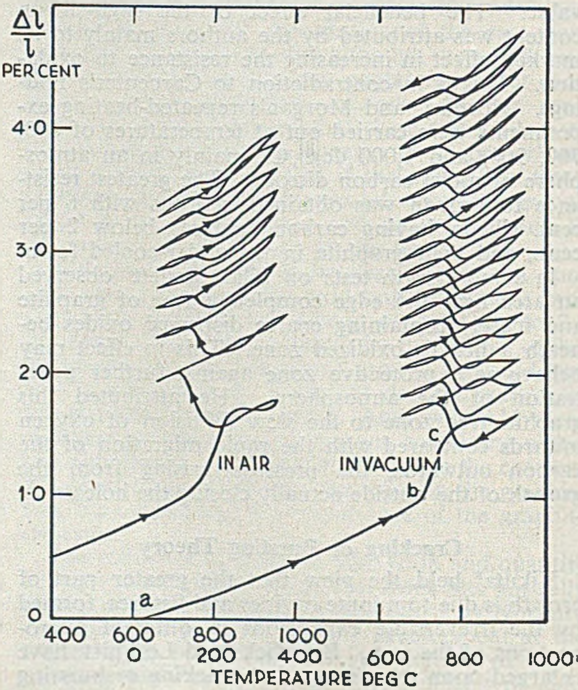

FIG. 4.—*Variations in Length of Cast-iron Specimens during Repeated Heatings and Coolings.* (*Kikuta.*[8])

cyclic heat-treatment 10 to 900 deg. C. on a 2 per cent. silicon iron are illustrated in Fig. 5. The rate of growth in carbon dioxide was greater than in the muffle gases, but, when the iron was fully grown, the total growth in carbon dioxide was a little less than in muffle gases.

The growth in non-oxidizing gases appears to depend largely upon the effectiveness with which the gases can be dried and the oxidizing influences eliminated. Pearson obtained total growths of about half those in air, when repeatedly heating in hydrogen containing a trace of water-vapour. When the water-vapour was eliminated entirely, the total volume growth did not exceed 1.2 per cent. in any of the irons studied.

Growth in Vacuum

Reported growth-tests in vacuum are inconsistent, probably because with few exceptions it was not possible to obtain the complete exclusion of air. While some authors' comments have been coloured by the desire to show that in the absence of oxidation there can be no appreciable growth, they have admitted that slight leakages of the apparatus may permit a limited access of air. Others have attributed growth in vacuum definitely to the influence of occluded gases, and considerable support is given to the cracking or bursting theory.

Probably, the recent work by Rocquet and Olette[13] is the most reliable. Their tests were carried out in a vacuum in which the pressure was maintained at 10^{-3} mm. of mercury. In these tests, a 3 per cent. carbon, 1.6 per cent. silicon iron was repeatedly heated to 850 deg. C., and a volume growth of 4.6 per cent. was obtained after 70 heatings (Fig. 6). As this was an effective vacuum, and as the combined-carbon content of the original iron was only 0.41 per cent., this growth must have been due substantially to a cause other than graphitization and oxidation. Tests described later in this Paper show that growths of over 100 per cent. can be obtained by repeated heating and cooling in a vacuum of this order.

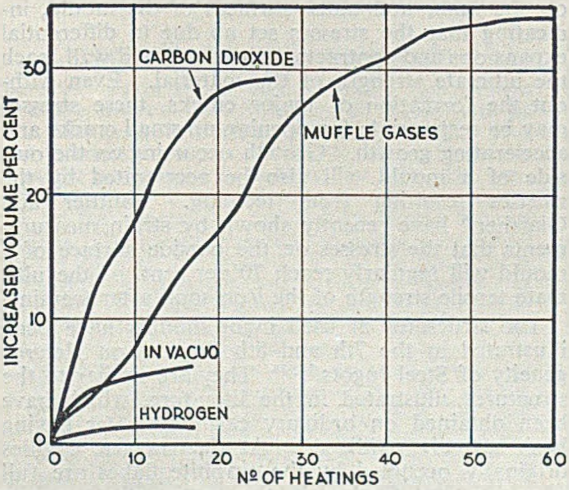

FIG. 5.—*Curves illustrating Growth in Different Atmospheres.* (*Pearson.*[4])

Other Considerations

The magnitude of the microstructural transformations have an important influence on the growths occurring during each heating. When dilatation measurements have been recorded for repeated heatings in air, the kinks at the alpha-to-gamma change on heating have diminished, and after 10 to 20 cycles they have vanished. Similarly, on cooling, the magnitude of the expansion at the gamma-to-alpha change has continually decreased. This suggests that the respective solutions and depositions of graphite at the change-points are restricted as the cycles proceed, and might easily be due to the effect of isolation of the graphite from the matrix by cracks or by a protecting envelope of oxide. As there would eventually be neither solution nor precipitation of graphite, no dimensional change would be expected from this cause, but a contraction upon heating would be expected as the alpha iron changed to the more compact gamma iron.

Another consideration is the influence of gases on the intensity of transformation. Sawamura[14] has carried out dilatation tests in a high degree of vacuum, and in atmospheres of hydrogen, nitrogen, carbon monoxide and air, and studied the expansions and contractions on passing through the critical temperatures during six heatings. He found that the surrounding atmosphere had little influence on the decreasing volume at the A_c temperature on heating, but a great influence on the increase in volume at the A_r temperature on cooling.

Some elements can have a direct and indirect effect on growth. Silicon, for example, can affect the amount of silica formed by oxidation, the size of the graphite flakes, and the critical temperatures and transformation characteristics. An iron with 5 per cent. silicon, for example, has its critical points above 900 deg. C. Growth due to repeated heating to 900 deg. C. of an iron of this composition is slow, as it does not pass through the critical temperatures, but as oxidation proceeds and silicon is extracted from the matrix, the critical temperatures of the remaining metal are lowered to below 900 deg. C. The matrix then passes through the critical temperatures on each heating, and growth proceeds more rapidly.

A carbide-stabilizing element such as chromium would also have more than one effect. It would provide pearlite more resistant to oxidation and with more stability, and in some cases diminish the size of the graphite flakes.

In measuring the strengths of grey cast irons that have grown, reductions in tensile strengths of up to 75 per cent. have been registered. In white irons, a slight increase in strength can occur, but if growth occurs due to formation of temper-carbon there is usually a weakening of the iron.

Summing up the Theories of Growth

There is no theory of growth that accounts satisfactorily for all the phenomena associated with the growth of cast iron. There is no doubt that the decomposition of carbides in a cast iron causes growth due to the formation of the more bulky

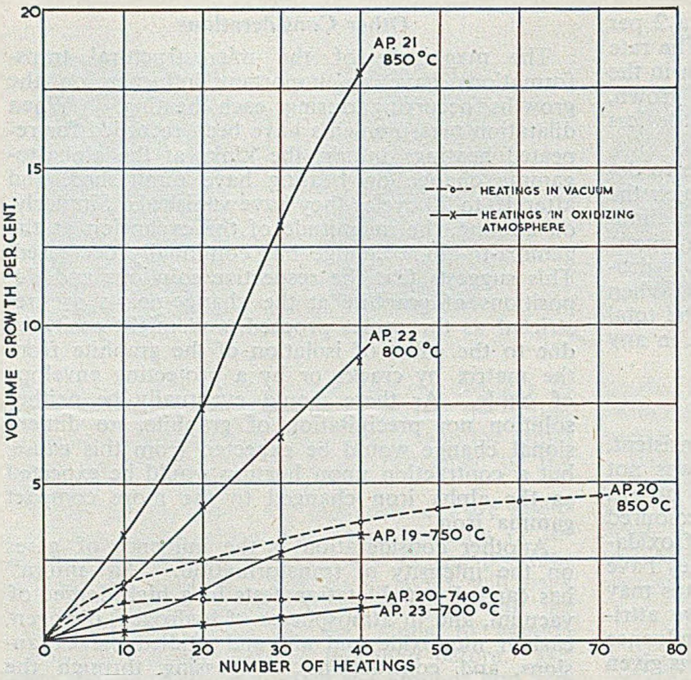

FIG. 6.—*Relationship of Volume Growth v. Number of Heatings—Rocquet and Olette.*[13]

graphite. This can occur concurrently with the growth from other causes and it does not account for more than 2 per cent. volume increase for the formation of 1 per cent. graphite.

While the oxidation theory undoubtedly explains much of the growth observed in cast iron due to constant temperature and to repeated heating in oxidizing atmospheres, it does not account for the differences observed between the findings of different investigators, particularly where high-silicon irons have been tested. Such differences are associated with variations in graphite structure, but the influence of this factor is not clear.

The cracking or bursting theory can explain many observations of growth, but has the disadvantage that the alleged cracking cannot be observed visually. The influence of dissolved and absorbed gases is very uncertain. While they appear to have an influence on growth, the proportion of growth attributable to this cause is probably very small. Experimental work in which gases are claimed to be responsible for growth is not very convincing, as the observed growth might easily be due to other causes, and there is in any case only a limited knowledge of the amounts of gases involved. Although useful information can be obtained from tests in vacuum and inert atmosphere, the degree of vacuum and the purity of the inert gases in most of the cases referred to in the literature, raise doubts whether oxidizing gases are adequately excluded.

Growth in Ingot Moulds

In service, an ingot mould is subjected to repeated heating and relatively slow cooling in an oxidizing atmosphere. The inside and outside of the mould can reach temperatures of over 900 deg. C. and 700 deg. C. respectively, and therefore many parts of the mould may pass through the $\alpha \rightleftharpoons \gamma$ transformation temperatures each time the mould is used. Furthermore, the microstructure of the mould contains large graphite flakes which can offer long channels for penetration of oxidizing gases. These factors promote growth and it is not surprising, therefore, when moulds have been used 50 or more times, that growth is severe and is a major cause of their eventual withdrawal from use.

The amount of growth occurring in 16 ingot-mould irons during constant temperature annealing and repeated-heating tests up to 850 deg. C. in laboratory conditions has been investigated dilatometrically by Heselwood and Pickering.[15] Most of their repeated-heating tests were carried out in a vessel evacuated to a pressure of 0.1 to 0.5 mm. of mercury. This was not considered as a vacuum, but only as a condition permitting a limited access of air. As in Rugan and Carpenter's, and Pearson's tests, the amount of growth increased as the silicon content increased. The maximum linear growth recorded after 100 cycles, to 600—850—600 deg. C., was 6 per cent. These workers attributed the growth mainly to the progressive deposition of graphite upon cooling, following a re-distribution in the austenite of the carbon from the remaining pearlite during each cycle, but oxidation was obviously also having an effect.

The nature and occurrence of oxidized products in an ingot mould are complicated, because the temperature of the mould fluctuates a great deal. The products can form at any temperature up to 900 deg. C. The tendency to grow is enhanced by the stresses that are set up in the mould wall during teeming. Major cracks are known to have started on the inner and outer surfaces of the mould, indicating that the stresses set up due to differential expansions and contractions in the mould wall reach the ultimate strength of the material. Even without the formation of major cracks, these stresses may be responsible for opening-up small cracks and accelerating growth. Growth occurring on the outside of a mould will also be accelerated by the stresses resulting from teeming. Buttler and Glaisher[16] have recently shown by strain measurements that the stresses on the outside surface of a mould will regularly reach 70 per cent. of the ultimate tensile strength of the iron soon after teeming

The structures of used ingot moulds have been illustrated in the 7th and 8th Reports on Heterogeneity of Steel Ingots.[17, 18] They are similar to the structures illustrated in the literature, which have been obtained on ordinary cast iron after having been severely oxidized. At the surface, cavities originally occupied by the graphite flakes are full of oxide, but further in the casting the graphite flakes still remain, and are surrounded with oxidized metal. The most comprehensive account of the structures of used ingot moulds is given in a recent paper by Lismer and Pickering.[19] In one of the moulds they examined, crazing cracks had extended $1\frac{1}{2}$ in. from the inside surface into the wall of the mould. The recent publication by Rocquet and Olette[13] also illustrates the microstructures of two used ingot moulds.

(*To be continued*)

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Everest Model at Vienna Fair

There will again be an official British Government stand at the International Autumn Fair which is to be held in Vienna from September 6 to 13, 1953. This will be in addition to participation by about 75 British firms in the commercial sections of the fair. The central theme of the British Government stand was inspired by the success of the British Mount Everest expedition. Dominating the stand will be a scale model of Mount Everest, constructed by the craftsmen of a London firm of designers and modellers, working in collaboration with Eric Shipton, the famour Himalayan explorer, and the Royal Geographical Society. The model shows clearly the successful western route partially explored for the first time by Mr. Shipton and his party during the 1951 reconnaissance, used for the 1952 Swiss attempts, and again by Colonel Sir John Hunt in the successful bid to conquer the mountain. The route taken by the successful team, including camp sites, is plotted in detail. The model, which is placed in the centre of the stand and it visible from all gangways, measures 9 ft. 2 in. by 8 ft. 6 in. overall, and was made to a scale of 10 in. to the mile.

Publications Received

Facts and Figures about British Railways. 1953 edition. Published by the Railway Executive, 222, Marylebone Road, London, N.W.1.

The reviewer always feels, like many others, a little superior if he knows the length of the longest tunnel or station platform. This pocket-book-size pamphlet gives a mass of interesting data so precious to small boys, and as only a few are available for free distribution we advise father to write to the address in Marylebone Road for a copy.

Magnuminium—Technical Data. Issued by High Duty Alloys, Limited, 89 Buckingham Avenue, Trading Estate, Slough.

This booklet is very well presented. The artistic blue-grey stiff covers are spirally hinged, and the contents being mainly in tabular form are neatly set out The matter is prefaced by a list of the various standard specifications correlated with the firm's own numbered indentifications. Thereafter very comprehensive data are given for the alloys both in the cast and wrought states. They should materially assist designers to select the most suitable magnesium alloy for particular requirements.

Technical Survey, No. 2, July. Issued by the Copper Development Association, Kendals Hall, Radlett, Herts.

This 32-page booklet covers recent (1952-3) developments in various fields into which copper enters as a major constituent. Pages 7 to 10 cover foundry practice—a section which includes ingot making. Most of the important contributions are noted, but neither the brassfoundry productivity report nor the symposium held in Harrogate is mentioned. It may be the former was reviewed earlier, as it was issued late in 1951. The list of B.S.I. publications involving copper and its products issued during the last six months is valuable. The major worth of such a publication as this is continuity, and that the reviewer really welcomes.

The Stockton Test. An experiment in British Housing. Published by Allied Ironfounders, Limited, 28, Brook Street, London, W.1.

It should by now be widely known, since it has been on television, that the "Stockton Test" refers to the partial modernization of four old-fashioned terraced houses by Allied Ironfounders, Limited. They undertook this experiment because the fabric of these cottages was substantial, but the sanitary, heating and cooking arrangements were, though not quite primitive, certainly of low standard compared with a modern council house. Sanitation was provided by an external water closet; the scullery was off set; there was neither bathroom nor hot water supply. By building in the yard an extension to form a modernized scullery and contain a bath and w.c. and installing in the kitchen a new type of combination grate with a back boiler (serving the triple purpose of heating the room, cooking and providing a constant supply of hot water), a complete change has been made. It is unfortunate that on account of the present restrictive legislation, such undertakings are not economic for property owners, yet it is the type of enterprise, considered from no matter what angle merits the approbation of all right-thinking individuals. Readers can be favoured with a copy of this well-produced and thought-provoking booklet by writing to Mr. N. C. Street at the Brook Street address of the firm.

Conditional Aid—Revolving Fund for Industry

As briefly announced in the JOURNAL of August 13, notes exchanged in February between the Foreign Secretary and the U.S. Ambassador established a programme for the expenditure of the counterpart funds from American economic aid under the Mutual Security act of 1952 (Cm. 8776). As part of this programme a revolving fund of £1 million has been set up for short term loans to industry and agriculture. Agriculture receives £300,000, and the balance of £700,000 is available for short-term loans to industry for the purpose of increasing productive efficiency.

The President of the Board of Trade has appointed an independent Committee to advise him on the administration of the industrial portion of the Revolving Fund. This Committee is now ready to examine individual applications from industry and will make recommendations thereon to the Board of Trade.

In principle, any project which has as its object the raising of productive efficiency in industry, is eligible for consideration. This includes, of course, any project arising from the recommendations of the Anglo-American Productivity Council reports or of the advisory service provided under the Conditional Aid programme (see paragraph 3(a) of the Exchange of Notes in Cmd. 8776 and paragraph 5 of Cmd. 8918). As the amount of money available is limited, it will, however, be necessary to restrict loans to projects which will contribute quickly to achieving the purposes of the Fund as set out in the White Paper and it is expected that most of the loans will be made for new equipment and improvement of plant layout. Preference will be given to small and medium sized firms who can show that the benefits they expect to accrue from a loan will enable them (or their customers) to expand their export trade or to meet essential home requirements more efficiently. Loans will not normally be granted for periods of more than three years, though in exceptional circumstances up to five years may be considered. Applications are unlikely to be entertained for large sums. No fixed minimum or maximum has been laid down, but first consideration will be given to loans which do not exceed £30,000. The amount and period of the loan and the rate of interest and the security required will be matters for negotiation, but it is the intention that the terms for approved projects shall not be less favourable than those which the applicant can obtain from other sources. An explanatory leaflet setting out the form in which applications should be made can be obtained from the Board of Trade, Industries and Manufactures Division 2 (Revolving Fund for Industry), Horse Guards Avenue, London, S.W.1, or from Board of Trade Regional Offices.

Latest Foundry Statistics

According to the Bulletin of the British Iron & Steel Federation there was at June 6, a further decline in employment in the ironfoundry industry. The total was then 143,362 as against 144,034 in May and 155,455 a year ago. Steelfoundries on the other hand showed a gain, there being 20,843 at work on June 6 as against 20,756 in May and 20,534 in June 1952. During July the average weekly quantity of liquid metal melted was 10,500 tons as against 11,100 in May and 10,600 in June.

The *Foundry* has announced the number of foundries in the United States of America has increased during the last two years by 88 giving a total of 5,387. The Canadian total declined by 17 to 551.

Shipbuilding Returns

June Quarter, 1953

Lloyd's Register shipbuilding returns relating to merchant ships of 100 tons gross and upwards, for the quarter ended June, 1953, show that in Great Britain and Northern Ireland at that date, steamships and motorships under construction totalled 317 ships of 2,123,565 tons gross, a decrease of 9,338 tons compared with the previous quarter. Ships under construction in the principal districts in Great Britain and Northern Ireland are shown in Table I.

TABLE I.—*Ships under Construction in Principal Districts of Great Britain and Northern Ireland.*

District.	June 30, 1953.		March 31, 1953.		June 30, 1952.	
	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Aberdeen ..	14	26,761	13	25,730	18	23,171
Barrow ..	4	85,340	4	85,340	4	74,550
Belfast ..	16	188,400	20	226,330	20	209,790
Bristol ..	4	2,050	4	2,040	4	1,630
Glasgow ..	79	534,107	76	539,731	82	524,630
Greenock ..	31	204,860	29	189,430	31	230,400
Dundee ..	7	49,010	6	41,960	6	47,100
Hartlepool ..	9	51,750	9	46,930	9	50,780
Hull	25	15,032	33	15,584	39	14,788
Leith	11	37,420	12	39,154	15	42,354
Liverpool ..	16	141,441	15	124,082	17	124,030
Middlesbrough	16	189,030	15	185,560	16	157,536
Newcastle-upon-Tyne	42	390,555	43	399,998	39	373,610
Southampton	9	7,764	11	9,241	8	7,718
Sunderland ..	28	198,120	28	199,981	29	192,005

City and Guilds Students Honoured

Five past students of the City and Guilds College (the engineering section of the Imperial College) have had conferred upon them the Fellowship of the City and Guilds of London Institute this year. The council of the institute has announced the names of those honoured as:—Sir Robin Rowell, chairman and managing director of R. & W. Hawthorn, Leslie & Company, Limited; Mr. John Davidson Peattie, who is deputy chief engineer (generation) of the British Electricity Authority; Mr. L. P. Coombes, chief superintendent, Aeronautical Research Laboratories, Department of Supply and Development, Commonwealth of Australia; Brigadier L. H. Harris, Controller of Research, General Post Office; and Mr. R. T. James, partner of R. T. James & Partners, consulting civil engineers, London, S.W.1.

The British Standards Institution Monthly Information Sheet for July lists under "Future Publications": 1121:1953 Methods for the analysis of iron and steel; Part 2. Determination of nickel in permanent magnet alloys, 2s.; Part 4, Determination of aluminium in permanent magnet alloys, 2s. 6d.; Part 5, Determination of copper in permanent magnet alloys, 2s.; and Part 29, Determination of sulphur in basic steelmaking slags (gravimetric method), 2s. Under " New Work Started " there is high purity zinc and zinc alloys for die casting (revision B.S. 1003 and 1004). Amongst " Reprints " there is now available B.S. 1130:1943, Schedule of cast iron drain fittings, spigot and socket type, 4s.; B.S. 1211:1945, Centrifugally cast (" spun ") iron pipes, 4s.; and B.S. 1291:1946, Ferrous traps for baths, 2s. 6d.

"Foundry" Development in the Textile Industry*

Discussion of Mr. B. Gale's Paper

When Mr. Gale presented his Paper at the Blackpool conference of the Institute of British Foundrymen he added by way of an Appendix an account of further experiences with the melting of borings. The discussion which followed concerned early experiences with plate moulding parallel with those of the Author. Most enlightening were the comments on the technique of impellor ramming and further practices with regard to the use of swarf, the former being dealt with at length by several speakers.

APPENDIX

In introducing his Paper "Foundry Development in the Textile Industry," Mr. Gale said the coverage of the entire process must, of necessity, be rather sketchy. There were, however, one or two points to which he must refer and these have now been collated in the following remarks.

It should be emphasized with regard to Figs. 15 and 16 that the pattern shown in Fig. 15 is not the pattern used on the rail-line system as shown in Fig. 16. Fig. 15 is the oldest method of plate moulding this type of casting by ordinary floor/plate moulding methods, and Fig. 16 showed a development to mechanize partially the production on a rail-line system, and in this case the patternplate was made with the vertical web of the casting stripped through the pattern to ensure more positive and clean lifts from the pattern during moulding. It was perhaps of interest to note that this rail-line system was in operation for many years, and production was so high that many attempts at mechanization in full were discarded as modern mechanized methods did not show enough advantage to cover the installation of expensive plant. However, as time went by and the demands for production increased, it was eventually mechanized using the impellor-rammer method as depicted in Fig. 17, and this later method did show a slight increase in productivity over the former method.

Progress with Carburization

The only other point to be elaborated was the question of melting borings in the electric furnace. It would be noted that on page 13 of the preprint there was a note to the effect that the matter published was, of necessity, the early experimental work on the subject, and that this would be enlarged upon on the presentation of the Paper. There had now been six-months' continuous working of the furnace and a considerable amount of experimental work had been done to produce metals suitable for direct running into castings, both in the general-iron class and the high-duty variety.

For the general-iron metal the major concern, as stated in the Paper, had been the maintenance of a reasonable carbon figure, and since the publication of the Paper which referred to the use of charcoal blacking, the management had now made considerable strides to improve the carbon figure.

The experiments had led to the replacement of the charcoal blacking by anthracite. The anthracite was added at the rate of 2 lb. to 1½ cwts. of borings, and no other carbonaceous material was used. It was found that the carbon pick-up from anthracite was much better than from blacking; in fact, as stated in the Paper, it was not claimed to have had a pick-up of carbon from the charcoal but rather that the addition of charcoal blacking prevented the burn-out in the furnace of carbon originally present. With the anthracite, however, there was a definite pick-up of carbon and the material was now controlled at a carbon content averaging 3.25 to 3.3 per cent. This had the additional advantage of economy, as the price of anthracite was in the region of £5 per ton as against £30 per ton for charcoal blacking.

Other metallurgical considerations had been maintained as stated in the Paper, and this general iron was used for casting all types of light castings, and the machine-shops reported no difficulty whatever in machining thin sections of metal.

Silicon Reduction

On the high-duty iron side it would be noted that the Paper referred to the use of steel scrap in order to lower the silicon content of the metal and this, of necessity, also lowered the carbon content. Experiments have been made to try to reduce the silicon without reduction of carbon and it had been found that this could be done by the addition of hematite ore to the bath of metal instead of steel scrap. This had been very advantageous in producing an iron with low silicon and phosphorus, but with a normal carbon content. The addition of hematite ore had been in the region of from 40 to 50 lb. to from 12 to 15 cwt. of metal.

Running costs were not yet available as the furnace had not been running continuously on a 24-hr. system, but by recording consumption against melt, it had been proved that the consumption of electricity was mainly high when starting from cold, and that the longer the run, the lower the overall consumption of electricity per ton of metal melted, and in the very near future the furnace would be working continuously for 24 hrs. per day.

Electrode consumption had been maintained at just under 4 lb. per ton of metal melted; refractories had shown that the roof required partial replacement after a melt of 150 tons of metal, and total patching of the lining since installation had been somewhat lower than 1 cwt. of patching material per week, or an approximate figure of 8 lb. per ton of metal melted.

* Paper printed in the JOURNAL, August 20 and 27.

Foundrywork for the Textile Industry

DISCUSSION

The chairman, Dr. A. B. Everest, thanked the Author for his interesting introduction to textile casting. He knew from his own work that in the industry there were plenty of technical problems, from enquiries that came in to the Institute's Technical Council.

Early Plate Moulding

MR. H. HAYNES, opening the discussion, thought the Paper a splendid one for the class of work which Mr. Gale was doing, and he appreciated it very much. There was one thing to which he would draw Mr. Gale's attention. On page 5 of the preprint he referred to plate moulding. Mr. William Fowler, foundry manager at Platt Bros., had introduced plate moulding many years ago, whereupon the cost of the castings was materially reduced. It was his son Henry who edited the Mechanic's Pocket Book. To-day there was much talk of shell moulding, but if it was to beat plate moulding it would have a long way to go.

Figs. 19 and 20 showed two long castings, the first being made from a plate mould and the second made on a machine. On the plate mould he had noticed that the two runners were situated in the " windows " of the casting. He would like to know if those two runners interfered with directional solidification. For impellor-ramming the runners had been changed to the side and he asked why this was so.

His other point was whether that plate had been cambered and, if so, was the moulding box shaped for the camber? Also, did any cracked castings result? Was the sand a unit sand, or was a special sand used for the job?

MR. GALE found it interesting to have confirmation of his statement on the early plate moulding. Referring to the question on the frame side in Figs. 19 and 20, the difference in running systems was an example of the sort of thing which happened in all foundries, for he had yet to meet two foundries which made a job and ran it in the same way. All had their own ideas and cast in different ways and no doubt got good results. It so happened that in the case mentioned the job was made in one foundry and when transferred to the mechanized foundry, under a different management, they had different ideas on runners. Both gave good results. He himself was in charge of the foundry which made the plate job and they used that rather complicated running and rising system, two of the channels were runners and the other two risers. They were put in deliberately to prevent camber and distortion and to give equalized cooling throughout the casting. He believed it true to say that the impellor-rammer plant, with the method of running that they used, produced straight castings, and there was no camber in the pattern.

With regard to cracking he had never had any trouble of that nature with those particular castings and it had always been regarded as a fairly simple job from that point of view. As to the sand, there were two different operational methods when the two frames were made. The first was made on the foundry floor by the ordinary plate-moulding method and the moulder used a natural-bonded facing sand and filled in from the floor by the shovel for backing sand. The other was made on the mechanized system which utilized a synthetic unit-sand, all of which passed through the preparation plant.

MR. GREAVES was very interested in the Paper because he had felt for a great many years that the textile-casting manufacture had been somehow neglected. He could tell a story of one of the foundries of which Mr. Gale was now in charge. At one period, some end castings for a machine were required. It was known that they had been made because a broken casting had been sent as a sample, but the firm searched through the pattern store without success. Eventually an old man said the job had been made in a certain foundry. They went to that foundry and dug in a heap of sand and there found not only the pattern but the moulding machine to which it was still attached.

He regretted to note there was not in any of the illustrations a single moulding box shown. There were many patterns but no moulding boxes that would give a clue as to the method of securing, or the type of bars. Were they all flat boxes, or were they shaped to the profile of the casting? The ramming of vertical walls (on similar castings to those shown) had been found difficult to accomplish with an impellor-rammer. Was a layer of sand put on the patternplate first; did an operator hand ram to the full depth of the vertical walls, and did the management get those peculiar joint lines showing where the rammed sand from the impellor made contact with the original body sand? Finally, had Mr. Gale found any effect from the alteration of the height of the impellor head from the patternplate?

Technique of Ramming

MR. GALE agreed that the older practice was to cast special boxes in the foundry for each special job, making them to go round the contours of the pattern so that in the top-part box there was only a limited amount of space between the bottom of the bar and the pattern face, and pretty well every job in the foundry had a special moulding box designed for it.

On the impellor-rammer plant, however, it was rather a difficult proposition. There, they used a steel box and on the deeper castings, particularly those referred to in Fig. 23, the top-section was really made in two parts—a mid part and a top part. His practice was to put on a plain section and run sand from the impellor-rammer without its going through the impellor head, so providing a cushion of sand to cover the entire face of the patternplate. That was not done with a view to lining the walls but was done purposely to prevent hard ramming which they had found happened if they impellor-rammed direct on to an iron patternplate. Having filled the mid-part with loose sand, they then put on a top part and clamped them together and from then onwards the sand was supplied through the impellor head. There was no ramming at all, other than impellor ramming. The only extra thing the moulder did, was to draw up the sand with his hands and pack it round the vertical walls.

The height of the impellor head had not yet been established by the Author at an optimum distance. In fact, he had worked on the height of the job as specified by the suppliers of the machine. However, they were at present investigating the height of the head over the pattern, with the object of ascertaining whether it should be adjustable or not.

Use of Borings

Mr. T. R. Twigger said that his comments would relate solely to that part of Mr. Gale's Paper dealing with the melting of borings in a direct-arc furnace, but he found comment a little difficult because of much later information, not available when the Paper was printed, had now been given by Mr. Gale.

Continuing, Mr. Twigger said that his firm had had to give very serious consideration to the question of carbon loss, which was one of the points which also caused Mr. Gale a considerable amount of trouble. He mentioned, however, that they were using a continuous process involving regular additions of molten cupola metal and solid borings to the electric furnace, thus the conditions in their case were rather more favourable to minimizing the loss of carbon, the borings being absorbed more by solution than by direct melting in the vicinity of the arc. Mr. Twigger said that both he and Mr. Gale were mainly concerned in preventing loss of carbon rather than actual re-carburization. They both thought they did quite well to avoid serious loss and maintain the carbon at around the eutectic point; possibly it would be very difficult indeed to increase the carbon to something over the eutectic figure, although on occasions that would be useful; also there were occasions when the bath of metal was rather low in carbon where some quick and efficient means of bringing it up to the eutectic carbon content would be an advantage. At the moment it seemed that there was nothing for it but to add a large amount of carbonaceous material merely to prevent any appreciable loss in carbon content.

Mr. Twigger then asked if Mr. Gale used his borings wet or if he had tried partially drying them by centrifuging, and did he think this worth while? Also, had he had any trouble with sulphur content from the cutting oil? Were the borings used in a fresh condition from the machine-shop or, if they were kept in store for any length of time, was trouble found through the oxidation of the borings reducing the carbon content? Lastly, with regard to shovelling the borings into the centre of the furnace, had any mechanical means been found for dispensing with this rather tedious operation?

Mr. Gale replied the question of carburizing the charge was a most difficult one and as Mr. Twigger had stated they had not been able to effect carbon addition. What they had tried to do was to maintain the proportion of carbon originally in the borings. They had found that without any addition at all there was a loss of carbon which was mainly a mechanical loss through machining.

The answer to the question, as to whether wet or dry borings were used, was that dry borings were charged—dry in that they were straight out of the machine-shop and not subjected to any wet weather. They were kept carefully under cover, but of course there would be the normal atmospheric moisture in them. They had not tried any method of drying them out, but used them as they were received from the machine-shop and charged them directly into the furnace.

They had used some borings wet from machining operations (though, generally speaking, grey-iron borings arrived dry) and they had had no difficulty. They had a large source of borings in their own works and they removed them daily from the machine-shop to the furnace and used them almost immediately, avoiding storage. They adopted the practice of melting in stages and started off with a molten bath to which the borings were added. They were using clean borings and, as they could get them fairly easily from the works, they had not as yet run into trouble with rust or oxides.

Shovelling them into the furnace was rather exacting work, but they had not found it too difficult and although the firm had considered mechanization, a solution of how to feed the borings right into the centre of the arc had not been discovered.

Mr. T. H. Weaver said he could not support the contention as to modifications and risks when a job was changed from one foundry to another. The company with which he was associated made a minimum of hundred tons of castings a week each weighing approximately 20 lb. They made them on ordinary machines having no sand hoppers. For some 40 yrs. the runners remained consistently the same, providing the metal specification remained the same. Some few years ago, the firm decided to put down a completely mechanized foundry and in that change-over some 3,000 new patterns were required to meet the new conditions, hardly any of the running technique remaining the same.

"Know-how" of Impellor Ramming

Mr. Kennedy spoke of non-uniform ramming with impellor rammers giving rise to soft spots in the moulds. For the most part, non-uniformity was bound up with the technique of ramming and there were one or two points which, if attention were paid to them, would make the technique relatively simple.

The first was that the operators had to be taught to keep the impellor-head moving as fast as the job would permit. The tendency was for operators to use the impellor rammer as a filling machine, *viz.*, they went along the vertical side of a pattern, moving the head slowly and allowing the sand to fill the space between pattern and box side. Such procedure was almost certain to lead to soft spots and scabbing. It was essential that the head should be moved as quickly as possible and the ideal of hand ramming should be kept in mind, where one built up course by course. The faster the head was moved the thinner the course laid down and the more uniform it was. There was an optimum space between the pattern and the box side for effective deep ramming. It worked out at about 4 in. and, if this minimum was adhered to, it was not difficult to get good results.

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It was possible, Mr. Kennedy continued, by proper control of the head, to get either hard or soft ramming, as might be necessary. Also, there was an optimum quantity of sand which might be fed into the impellor head and still maintain a good, clean stream of energised sand free of any kind of spillage. This optimum quantity would obviously not be the maximum the machine would be capable of, but it would result in better working as regards uniformity of results.

As to the height of the head from the box, experience had shown that there was no material difference between ramming about one foot below the head and seven to ten feet. It was quite common practice to ram moulds seven to ten feet deep without any recourse to ramming by hand.

If it were realized by founders that the theory of ramming was to energise the sand by putting kinetic energy into it, then over a distance of eight or ten feet the loss of kinetic energy with a vertical stream would be seen to be relatively small, so that even from a theoretical point of view there should be very little loss. There was a slight tendency for the sand stream to spread out, but so far no great difficulty from that cause had been found.

Range of Work

MR. BURROWS said he had never been connected with the textile-machinery industry, but in the days when one could choose what type of scrap they bought, the firm he was connected with was always very careful about the quality of scrap purchased, and he was always very happy when textile-machinery scrap was available. The contribution made by Mr. Kennedy on the subject of the height of the impellor-head was very interesting. He had not found it possible to establish any fixed rule. His firm was impellor-ramming moulds for various castings in small boxes, up to others made in boxes measuring 17 to 18 ft. long by 5 ft. and more in width and up to 2 ft. in depth, all cast in green-sand, and every job had to be studied in very close detail. It was also found that it was not satisfactory to make a box part which would cover the entire range of castings. Experience had shown that, wherever possible, it paid to design moulding-box parts to suit a specific pattern and that the design of bars was most important. At first, it was thought it would be necessary to have more bars than was usual in the jobbing foundry in order to hold the sand in without any reinforcement and that it would be necessary to cross-connect the bars. It was quickly found that this was quite wrong. In all long boxes, the practice now was to have bars running across only and to rely on the depth and thickness of section of the sand for rigidity.

There was another interesting point in that, if the impellor head was too high, there was a tendency for the sand to spread or fan out instead of keeping in a concentrated stream, the latter being highly desirable in green-sand work in order to prevent moulds from "swelling."

He could not emphasize too strongly the necessity of keeping the impellor head on the move. The Americans did it by specifying a path to be traced by the head for every job and they did not allow the operator to guide the machine—they controlled it by motor and cams. In operating the head, it was essential to determine a correct path and to maintain it; sometimes this was difficult, but it could be done. Again, after having established the path, speed was essential; there was nothing worse than idling with the impellor head. A further interesting factor when impellor-ramming long work from plate patterns was that it was difficult to camber these plate mould patterns. All the box parts used by his firm had machined faces, and it was very difficult, if not almost impossible, to machine a camber on the joint face, especially, as would be appreciated, the correct camber was very often only found by trial and error. All the long castings were made with perfectly straight joint faces. The necessary camber was found by trial and error and allowed for by judicious methods of stripping or baring and holding down after casting.

It was interesting to know that Mr. Gale had found out in a mechanized age that old-fashioned methods sometimes were hard to better—it was difficult sometimes to get higher executives to appreciate this fact! People were now operating foundries where there were both old-fashioned methods and fully-mechanized units, and it was gratifying to have his opinions backed by so competent authority as Mr. Gale that certain parts of old plant were still highly efficient.

MR. GALE strongly confirmed Mr. Burrows' views on the critical study of box parts. It had been found that it was most important. He remembered a case where ordinary purchased steel moulding boxes were purchased with the ordinary type of bar, and due to the spreading effect of the impellor they had a mass of sand lying on top of the bars to the extent that tucking beneath the bars had to be resorted to. He thought box parts were a very neglected part of foundry plant and, with Mr. Burrows, agreed that firms should spend more money on getting good box parts. Certainly the joints of every box he used were machined.

Time for Silicon Addition

MR. HUGHES referred to the question of melting borings in the electric furnace and said it had been realized that re-carburizing to compensate for loss of carbon was difficult. He thought it might help if the time at which the silicon addition was made was changed. To add silicon when there was only about 4 cwt. of metal in the furnace would obviously give an excess of silicon and thus tend to throw some carbon out of solution. He would suggest the introduction of silicon at a later stage in the melting operation and thereby a little more of the carbon would be retained.

The Author had mentioned the difficulty of getting a suitable compound for re-introducing carbon. One mentioned was carbon black and another anthracite, but he would suggest for future investigation the use of amorphous carbon. On the question of carbon equivalent, a figure of 4.4

was given as representing a normal value for light castings. However, in what was termed an iron of special composition and one with a very close-grain structure a suitable carbon equivalent was 4.2. Was it possible to show such a difference with what appeared to be only a variation of 0.2 to 0.3 per cent. silicon?

MR. GALE admitted that in the pre-print on the question of the melting of borings he had not emphasized silicon control, but in the Appendix he had. The position had now been reached that for ordinary general iron it was not found necessary to add silicon. The silicon in the borings from the normal castings was maintained without any loss whatever and it could now be stated that a slight silicon pick up was found which, it could only be assumed, arose from the reduction of some of the fine sand that entered along with the borings. Therefore a silicon addition was not now used.

He had not tried amorphous carbon and thanked Mr. Hughes for that hint. They were endeavouring to get a controlled carbon figure. The variation of the carbon equivalent he thought should be explained, for, whilst he did not claim to be working to a fine limit, he did keep a strict control on cupola melting, and the metallurgical staff had that in hand.

There was a point, however, where he did deal with two different carbon equivalents. There were two different foundries and two different cupolas; the one using metal of lower carbon-equivalent was a foundry that made one type of casting only—the long rails or beams for textile machinery. That foundry ran on one class of work and never altered. In the general foundry, they were producing a very wide range of castings and these were made with an iron having a higher carbon equivalent, to save cracking troubles on the larger castings. He would prefer a lower figure on some of the thick castings, but he could not do it out of the same cupola, so they had to do it by runner and riser technique and chilling.

A vote of thanks to Mr. Gale for his most interesting Paper, proposed by the chairman and carried by a hearty round of applause, concluded this session.

House Organs

Carron Cupola. Vol. IV, No. 2. Published by the Carron Company, Falkirk, Scotland.

This issue carries Part 2 of the Cavalcade of Carron, and covers that section of the firm's history when they were busy making carronades and the earliest types of steamships. It makes fascinating reading.

Stantonian, Vol. 18, No. 7. Issued by the Stanton Ironworks Company, Limited, near Nottingham.

With this issue is included a supplement giving a list of recipients of gold watches for 30 yrs' service with the company which names 1,263 persons. This year the award was made to 118 people who had qualified during 1952. The issue also describes the opening ceremony carried out in connection with a new sports ground for use by the employees at the Riddings Works.

Staveley News. Issued by the Staveley Iron & Chemical Company, Limited, Hollingwood, near Chesterfield.

The cover picture of this Coronation issue is the reproduction of a painting of Her Majesty, by Mr. Ian Cleland, of the foundry sales department. This gives the keynote for the rest of the contents, even the weddings pictures are headed Coronation Brides, but everything has been well done, and is worthy of the great occasion it commemorates.

Steel Horizons. Vol. XV, No. 3. Issued by Allegheny Ludlam Steel Corporation, Pittsburg, Pa.

This gay and distinctive house organ tells of the reintroduction to the American car market of the wire-spoked wheel. The development is consequential upon the export of British cars to the States in recent years. There it is made of stainless steel in various designs, nine of which are illustrated. Another interesting story is the construction of a safe to contain the Declaration of Independence, the Constitution of the United States and the Bill of Rights.

Steel Rate Production

Pig-iron Output also Higher

Although production of steel and pig-iron was affected by normal holidays in July, both showed an increase over output in the same month of last year, the rate of steel production being the highest ever recorded for that month. The monthly average of 276,600 tons a week compared with a rate of 273,800 tons a week last year, and with 276,300 tons a week in July, 1950, the previous record. Last year, annual holidays at some of the works, normally taken in July, were taken in August. This year, however, they were put back to July, which makes the annual rate of 14,383,400 tons compare even more favourably with last year's rate of 14,236,000 tons in July.

Pig-iron production in July averaged 202,400 tons a week, compared with 201,600 tons in July, 1952.

The production of steel in the first seven months of the year averaged 338,100 tons a week, compared with 303,000 tons a week last year, an increase of nearly 11.6 per cent.

Latest steel and pig-iron output figures (in tons) compare as follow with earlier returns:—

—	Pig-Iron.		Steel Ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1953—May	214,700	11,165,000	350,700	18,236,000
June.. ..	210,000	10,949,000	337,700	17,559,000
July.. ..	202,400	10,524,000	276,600	14,383,000
1952—May	201,100	10,456,000	312,400	16,245,000
June.. ..	199,700	10,384,000	312,500	16,252,000
July.. ..	201,600	10,482,000	273,800	14,236,000

Back numbers required. Back numbers of the FOUNDRY TRADE JOURNAL are often in demand and even the records at 49 Wellington Street are incomplete, the volumes for 1904, 1905 and 1908 when the JOURNAL was a monthly—being missing. If any reader has any knowledge where separate issues of that period or the complete volumes may be borrowed or purchased, the information would be much appreciated by the Editor.

Nodular Graphite in Cast Iron

Factors Influencing its Formation

Nodular-graphite iron is discussed by V. A. Alterkar in a paper entitled "Formation of Nodular Graphite in Cast Irons," published by the Colorado School of Mines (No. 1, 1953) in which he states that approach to the problem of graphitization in cast irons has been made hitherto on the basis of binary or ternary equilibrium diagrams involving iron, silicon and carbon. The ternary system itself has been shown to need careful revision. The metastability anomaly, by which the system can freeze either in the stable iron-graphite system or in a metastable iron iron-carbide system, is considerably enhanced in the case of cast irons. This is due to the presence of several elements with diverse influences on freezing.

The mere presence of a stable graphite phase in cast irons, states the author, is of little value to the man in industry. It is the size, shape, distribution and orientation of these graphite masses with which he is most concerned. On these depend the quality and physical strength of his products. The existence of nodular graphite structure in as-cast condition in cast irons has caused voluminous and diverse explanations to justify the structures obtained, but none of them has been successful in explaining the phenomena observed in cast irons. This failure has, in the author's opinion, pointedly brought out the inadequacy of present-day knowledge of factors which influence graphitization. Among these factors may be included: (1) Mode of occurrence of carbon in cast-iron melts; (2) possibility of bringing about molecular groupings in the melt; (3) mechanism of formation of carbides; (4) mechanism of stabilization of carbides by the presence of carbide-stabilizing elements; (5) mechanism of decomposition of carbides, in and without the presence of graphitizers; (6) control of the freezing of the eutectic; (7) phenomena of undercooling in cast irons.

Interrelationships

It has been established for some time, the author observes, that various types of graphite bear a definite relation to each other. The conditions which gradually change one graphite type to the other can be classified into two main sections—chemical factors and thermal factors. A combination of these two can give any size, distribution and orientation of graphite flakes. A critical study of present theories on the formation of nodular graphite reveals that this phenomenon is being treated as an extraordinary case of graphitization. As a consequence, it becomes necessary to assume some special conditions to explain it. Existence of such conditions, the author says, is neither borne out by experimental evidence nor is compatible with known facts. He goes on in the remainder of his paper to attempt to prove, by logic and by experimental evidence, that nodular graphite is formed by the manipulation of the same factors which cause normal graphitization in the most compact and desirable form. He concludes that the graphitizing reaction in the potentially nodular cast iron melts starts at a higher temperature of about 1,190 deg. C. or so, than the temperature at which normal flake graphite is originated.

Mechanism of Initiation of Graphitizing Reaction

Discussing the mechanism of initiation of graphitizing reaction, the author observes that the microstructural evidence is of little help. In all the experimental work, no phase was claimed as graphite which did not show the characteristics of graphite under plane-polarized light. Such an identity could be established only when the graphite nodule was more than about 8μ dia. In such sizes the nodules are always surrounded by austenite, and it becomes difficult to ascertain the original surroundings in which the first graphitizing nuclei were born. Extrapolation of lamellar structure of alternate plates of carbide and austenite which represent the frozen melt, generally leads one to believe that the nucleus existed at the austenite-carbide interface. Such a suggestion, however, lacks direct experimental support. The graphite nuclei may be precipitated directly in the cooling eutectic, as in the case of flake graphite, or the graphite may originate in decomposition of the carbide in the eutectic. The presence of graphite nuclei in direct contact with the eutectic melt is not impossible. Such a condition has been shown to exert a tremendous urge for almost instantaneous graphitization of the eutectic. The growth of a graphite flake in contact with the melt is a process which, as compared with the growth of a nodule, takes much less time. The fact that in nodular iron graphitization is stretched over an extended range of eutectic freezing suggests that the graphite nuclei are not likely to be precipitated directly in the eutectic melt. The possibility of initiation of graphitization through decomposition of the carbide phase of the eutectic thus gains prominence.

The fact that addition of magnesium alone causes the melt to solidify with a white eutectic is illustrated by the author who also points out that Morrogh's cerium process also is sensitive to the amount of cerium added—an excess causing persistence of carbides. All other known nodularizing elements are carbide stabilizers by themselves and either need a secondary inoculation by a graphitizer like FeSi or they have to be added in conjunction with a graphitizer. This carbide-stabilizing action of the elements points to an initial existence of austenite-carbide eutectic, decomposition of which starts at around 1,180 deg. C. The presence of such a eutectic would explain the ever-present ring of austenite, its simultaneous growth with that of the nodular graphite, and the graphitization taking place over an extended range of temperature instead of being instantaneous. Necessity of a graphitizer like silicon or nickel or copper can be understood in the light of the subsequent decomposition of the austenite-carbide eutectic.

Summarizing, it is suggested that formation of nodular graphite involves an ordered decomposition of an austenite-carbide eutectic initiated at a temperature of about 1,190 deg. C. and extended over a range of temperature down to about 1,120 deg. C., the growth of the nodules taking place over this range by a process of two-way diffusion.

Mechanical-handling Systems, with particular reference to the Vitreous-enamelling Industry*

By J. Bain, A.M.I.Mech.E. M.I.B.F.

Very many excellent Papers have been presented on this subject. Some of them have classified handling as a new technique, some have tried to define it in a few words, others have attempted to sub-divide it under various headings, such as "materials handling" or "bulk handling," "process handling," etc. The subject is so vast and industry so complex that these definitions and sub-divisions are all unsatisfactory. It cannot be a new technique, as mechanical aids have been used since man first found means of moving and lifting loads beyond his strength. These aids have been developed throughout the ages, and even before the industrial era man found profit in bartering and later selling them to his fellow men. Britain as an industrial nation has for generations pioneered most new developments with which the manufacturers of mechanical aids have had to keep in step. As each industry grew, the need for greater production at lower cost gave scope for the ingenuity of the manufacturers of mechanical-handling equipment. More and more firms specialized in the design and manufacture of these tools and this has now become a very important industry on its own. It should be remembered that mechanical-handling equipment, like a production drawing, is not an "end product" but merely a means to an end. It is not the plant itself which is important but what it produces.

It is not true to say that this country as a whole has not studied or applied mechanical handling in industry or that it is just waking up to the need for it, but it is true that many industries have been slow to avail themselves of the benefits of modern equipment and are now finding it harder to sell their higher-priced products even though of better quality. It is not the intention of this Paper to preach productivity, but if it is desired to compete for orders in the markets of the world it is necessary to cheapen the product by all the available methods. It has been said many times over that all the aids are in this country that are available elsewhere but that there is reluctance to make full use of them. Too often, it is said that handling equipment is not worth while because a man can do the job just as quickly, labourers are, therefore, employed to lift, carry or wheel the products about the factory. This may at first sight appear economical but many other factors must be taken into consideration, only a few of which need be stated:—

(1) Supplies, due to the human element, may not reach a machine exactly when required.

(2) The operator has to pick them up, which usually involves stooping.

(3) Floor space required in the form of passage ways and stacking areas could be used for productive purposes.

(4) A greater incentive to keep pace with a conveyor is given to machine operators.

(5) Damage to work in progress due to mishandling is reduced.

(6) There is a reduction in industrial accidents due to strain.

(7) A labourer used as a human conveyor would be better employed as a productive unit.

Assessment of Handling Systems

None of these advantages can be readily assessed in £ s d., but they all add up to efficiency, increased output and lower final cost. The effect of item (4) has been proved many times and a very simple example can be taken from the clothing trade. Normally, sewing machines are placed close together so that it is a simple matter for one girl to hand an article to the next or lay it on her worktable. Though the articles only weigh a few ounces and the movement is only about a couple of feet, the psychological effect of keeping pace with a conveyor belt is enormous and operators develop a rhythm in their work which increases their output without additional effort or fatigue. This may seem a very simple illustration and one which the reader may at first sight find difficulty in applying in his own works. When it is realized, however, that the same principles have been applied to all sorts of operations and manufactures from the filling and packing of cosmetics and foodstuffs to the assembly of motor cars, it should be worthwhile thinking again about production problems in relation to the amount of handling which is done to produce any finished product. The amount of this handling varies considerably in different industries and in different factories. Many figures have been published relating handling hours to production hours. The "mechanical handling" productivity team stated that the cost of handling varied between 15 and 85 per cent. of the cost of production. The 15 per cent. figure is very low indeed and must relate to factories which have been designed to mass-produce a standard article or series. While the 85 per cent. figure is a high one it is not unknown in this country, particularly in those industries similar to foundries which require large quantities of materials such as moulding boxes and sand as well as the raw materials which have to be processed. It will be seen from these figures that this is one of the most fruitful sources of study for the reduction of costs. Mr. W. Puckey in a Paper on this subject, "Material Handling—A Job of Production Engineering," gave details from his own experience of the actual working time on a part as only 45 per cent. of the floor-to-floor time. Only 45 per cent. of the machine value was being utilized.

* Paper presented to the Institute of Vitreous Enamellers at their Spring conference, 1953. The Author is associated with Paterson Hughes Engineering Company, Limited.

FIG. 1.—*Portable Sack Elevator—Delivery Height Fixed.*

Examples of this can be chosen from all industries. An operator should always have his next part ready to hand and should be able to pass it on to the next operation without waste of time. In some instances, the simplest, though not necessarily the best way, is to put the work in a box beside the machine to be trucked or lifted away when filled, and this in many shops has been accepted as being the only way. Manufacturers have provided some elaborate machines designed for high-speed operation. Large sums of money are invested in these, planning departments have worked out schedules for the various operations, the time-study expert has done his job and the cost of the operation has been worked out in decimal fractions. Yet, how often is it found that the same care is taken with the handling of the product to and from the machine so as to insure full utilization of the plant?

Initial Study

In the ideal case of a simple-purpose factory, the handling of materials during processing can be reduced to a minimum. In most factories where plant has to be or has been installed in an existing building, much can be done to reduce handling by careful study of the layout and correct positioning of machines. The purpose of mechanical handling thus becomes a method of linking the various processes and providing storage and buffer stocks at strategic points. This latter function is of the utmost importance, as it gives the plant flexibility which cannot be obtained otherwise.

One of the reasons given against the installation of mechanical handling is the prevalent one that it is not flexible enough to cope with a large range of products. A properly-designed handling system can be devised to suit nearly every site, provided some

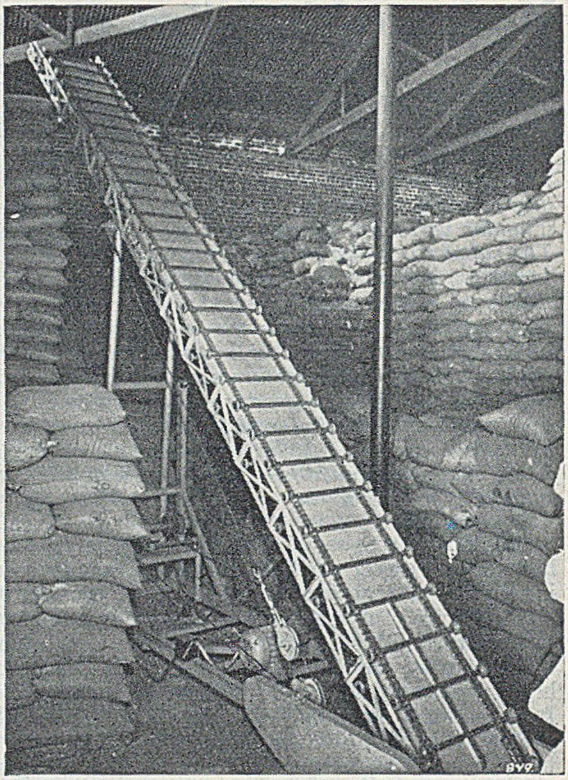


FIG. 2.—*Portable Sack Elevator—Delivery Height adjustable.*

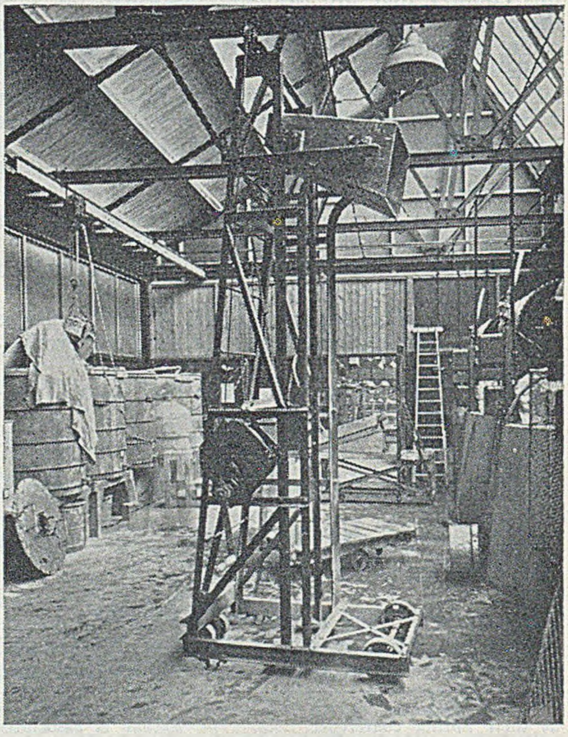


FIG. 3.—*Portable Skip Hoist for Charging Frit Mills.*

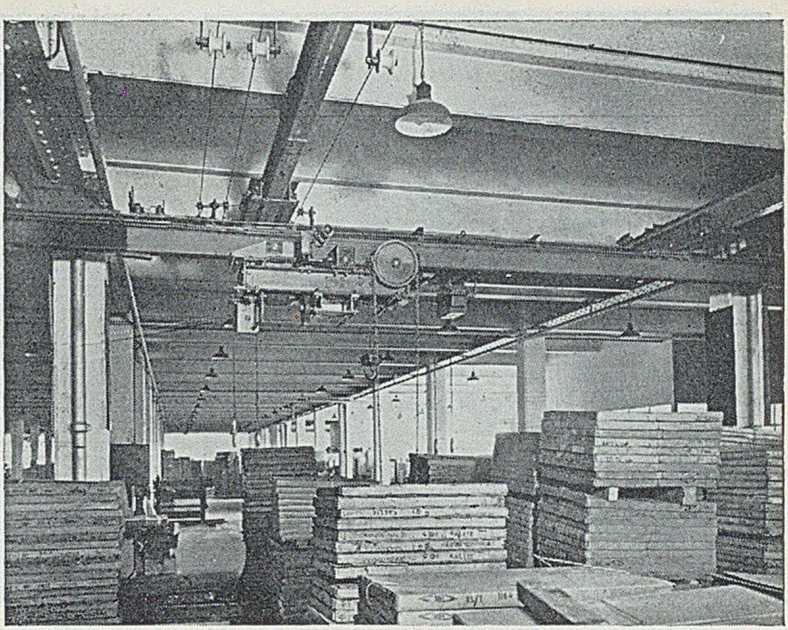


FIG. 4.—*Underhung Crane System used in a Sheet-metal Store.*

idea can be given regarding the amount of flexibility required. The conveyors themselves need not be considered as immovable or permanent fixtures. In most cases they can be moved just as easily as the machines, to suit a plant re-arrangement. If the machines are bolted down, the work and trouble involved in moving them is apt to obscure the virtues of the ideal layout and to encourage working with heaps on the floor or in boxes. There are other well-known methods of fixing which simplify and speed up a change-round, but the idea of glueing the machines to the floor may be new to some. A special machine-fixing glue is made for this purpose and with sound, level, floor surfaces good results have been obtained. On floors constructed on the hollow-block system, this method of fixing is particularly valuable.

It must be appreciated also that most conveyors can readily be altered to suit changed conditions and that the alterations, if properly planned, need not stop production. A fairly long and heavily-loaded overhead chain conveyor installed as a process conveyor some time ago has had its route altered on three or four occasions to cut out some machine operations and add others. These alterations have not involved loss of production, as the new material was installed during nights and the final coupling into the main line was effected over a weekend.

Sources of Difficulty

When dealing with the very many different parts and materials which he has to handle, a mechanical-handling engineer must study very carefully their behaviour under all conditions. Most of the mistakes which are made are due to insufficient time being spent on this. One or two examples of the unforeseen snags which are apt to trip up the designer are as follow:—

(1) Folded newspapers are reasonably stiff and easy to handle in bundles, but these same papers when they come off the presses have a texture resembling wet blotting paper. This can cause a great deal of trouble at the transfer points between conveyors and elevators.

(2) Metal plates and strips slide fairly easily over one another but when they are hot from the mill or furnace the coefficient of friction is much greater. In fact, they will not slide over one another until tilted to about 90 deg., though when cold they will slide at about 20 deg.

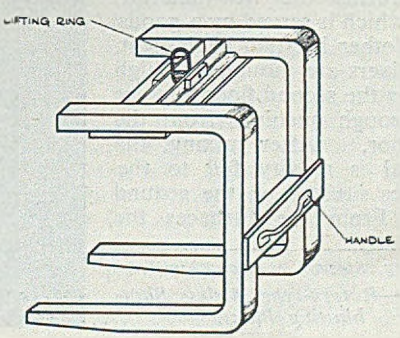
(3) Foundry sand flows quite freely when it comes from the knock-out, but after milling it has to be treated with great respect as it can build up even on a vertical surface.

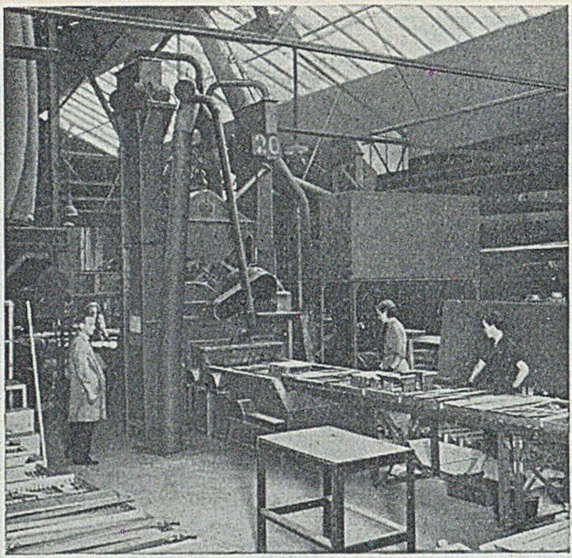
This list, of course, is endless and such points have to be watched continually to avoid expensive alterations.

Suiting the Job

Problems associated with mechanical handling, as pointed out above, differ with the different materials to be handled and in different industries. While this entails modifications to standard types of conveyors, elevators, etc., it does not change their basic principles. The answer to a specific problem may be found in a factory producing an entirely different product. It is for this reason that "works visits" are so useful. Much of the antagonism to these visits was dispelled during the war but there is still too much secrecy in some quarters. These tours, if undertaken in the right spirit, are far from being the time-wasters that many managements imagine them. Visitors arrive with the purpose of picking up ideas and very often leave behind many of their

FIG. 5.—*Sling for Bundles of Plates, for use on the Crane illustrated in Fig. 4.*





[Courtesy, Stewart & Gray, Limited.

FIG. 6.—*Conveyor-type Airless Shotblasting Plant.*

own, along with an invitation to " come and see how we do it."

The layout of a new enamelling plant for standard production in a building specially-designed to house it is a fairly straightforward job, but in this, as in the case of the improvement in handling in an existing plant, the first consideration should be the *elimination of handling* as far as possible. The position of the furnace, once installed, cannot easily be altered, but in many cases the re-arrangement of spray booths, driers, etc., to suit flow production would reduce the amount of putting down and picking up of work and the transport of it between operations.

Frit Manufacture

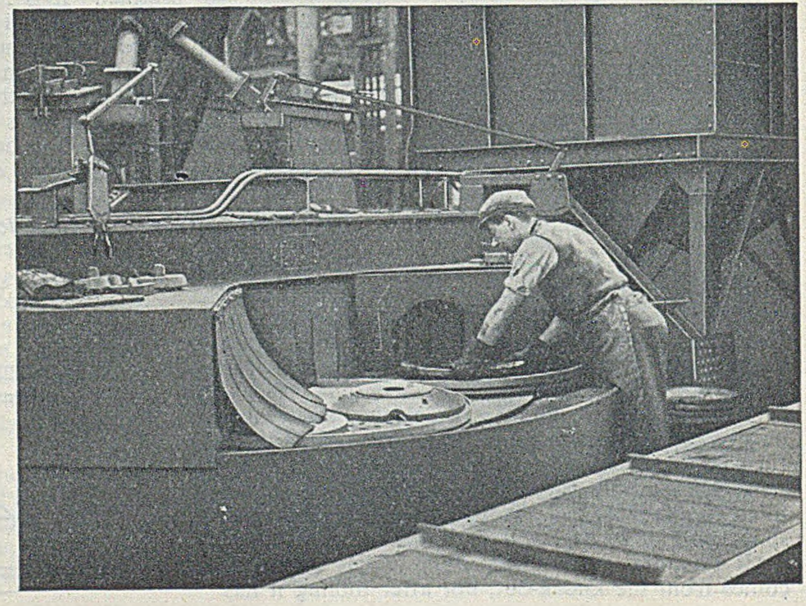
As many companies now buy their " frits " from specialist manufacturers, it is not proposed to deal with this branch in detail, but a three-storey manufacturing building provides a good example of an arrangement where the minimum amount of handling is necessary. The top floor forms the raw-materials store, which is served by a goods lift or other hoisting equipment. The mixers are mounted at high level on the second floor and are fed through openings from the top floor. After mixing, the material is gravity fed to the furnaces situated on the ground floor. From the furnaces the enamel runs straight into the quenching tanks. From this point mechanical devices can be used to extract and feed to the driers. A three-storey building to suit the above arrangement is an expensive item, but has a big influence on the cost of the product due to the elimination of much of the handling, which would be necessary in a single-storey factory.

The opportunity to design new plant for a standard product in a building specially designed to house it occurs so seldom that it may be of greater value to study some individual units which manufacturers have found useful. Manufactured frit is packed in 100-lb. bags and a considerable amount has to be stored. Figs. 1 and 2 show such stacking machines suitable for use in the frit store. These machines, which are made in many sizes, enable the full height of the building to be used and reduce the manual labour of building the stacks. They are made reversible and are used for reclaiming the bags as required.

Mill-room and Sheet Metal Practice

In many mill rooms, it is still common practice to charge the mills by hand from a ladder placed beside the mill. Fig. 3 shows a portable skip hoist designed for this job. The illustration is of a hand-operated machine but this can also be supplied with an electric-motor drive. An overhead runway system is also used for this purpose, the charging skips in this case being of the bottom-opening type, and arranged to discharge direct into the mill, with the door in its top position.

An awkward handling problem also exists in the sheet-metal store. As the sheet metal is required in bundles at the presses, the system illustrated in Fig. 4 is an extremely flexible one. Good coverage of the area is provided by one or more underhung transfer cranes which are latched to an overhead runway system. By this method, the load, once picked up, can be taken straight to the press shop



[Courtesy, Stewart & Gray, Limited

FIG. 7.—*Rotary-type Airless Shotblasting Plant.*

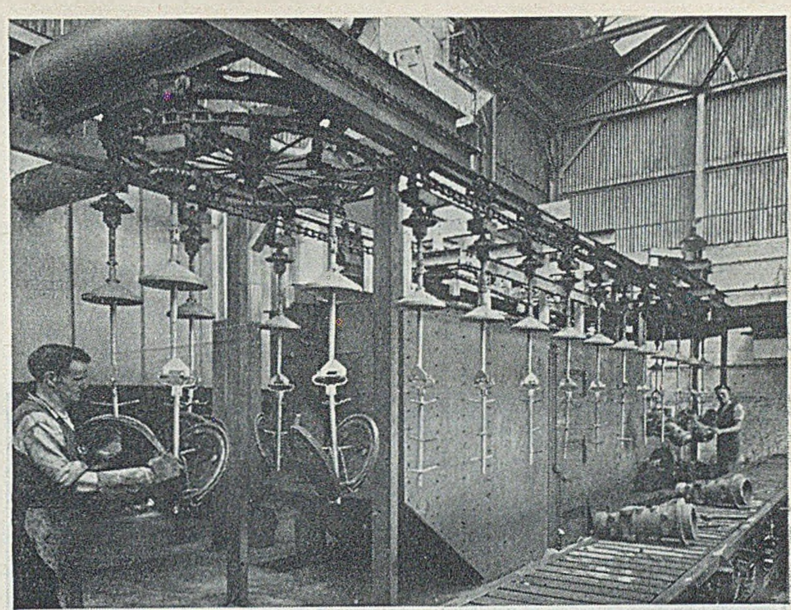


FIG. 8.—*Overhead Chain-conveyor-type Airless Shotblasting Plant, with Rotating Carriers.*

without re-slinging. The type of sling used on this system is important. The one shown in Fig. 5 has proved very satisfactory. The scheme illustrated is electrically-operated throughout but many hand-operated systems and combinations of hand and electric are in operation.

Fork-lift trucks are frequently used in this department with satisfactory results. Generally these require wide gangways in which to operate but this is not a serious matter if sufficient storage area is available.

Shotblasting and Pickling

Three different types of airless cleaning machines for castings are shown on Figs. 6, 7 and 8. These are replacing the blasting method and are much more congenial and safer to operate. With the conveyor and rotary-table type, it is necessary to pass the castings through two or more times to treat all faces. The overhead chain type shown on Fig. 8 is suitable for most castings and cleans all faces in one cycle. The carriers are rotated during their passage between the streams of shot, so that all faces are presented for treatment.

Conditions in the pickling shop demand the installation of some type of overhead crane and while many shops use hand-operated tackle, the work is slow and laborious. The simple two-motor crane with double hooks as shown in Fig. 9 is a fast and not-too-expensive device which is easily operated by one man. It has been stated that the mechanical and electrical parts on such a crane are subject to acid fumes and that maintenance is unduly heavy. This can be practically overcome by suitable enclosure and the use of acid-resisting paint. The crane shown has been in continuous use for many years and the replacements on it have not been excessive.

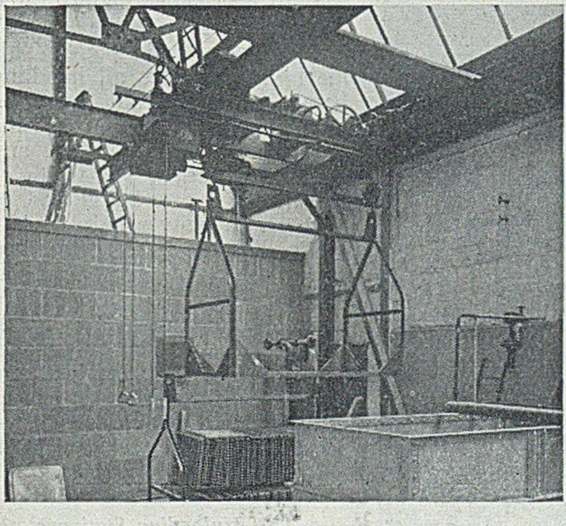


FIG. 9.—*Underhung Crane in use in the Pickle Shop.*

Flow-production Methods

The examples given so far are principally suitable for jobbing and semi-mechanized plants. The operations in these departments do not lend themselves easily to continuous flow production. In a few instances flow production has been accomplished in the enamelling shop but many responsible executives will not take the trouble to study the problem fully. They insist on adequate stacking areas so that, even though they have continuous driers and furnaces, they still batch the work between these processes. It is certainly easier to run a plant this way, as planning schedules, where they exist, are of the simplest character. Where continuous equipment is available, flow production of the main items being processed should be possible. Stacking areas are essential for buffer stocks, dealing with special work, etc., but there should be no need to use these areas as accumulating points between processes for the bulk of the work being handled.

The appearance of some enamelling shops would indicate that the essential plant has been installed well spaced out to provide ample space for racks which are suitable for transport by stillage trucks. Spray booths, driers, etc., have been added from time to time to cope with increased requirements, without any attempt having been made at re-planning the area to keep the work on the move. This has resulted in:—

(1) Too much partly-processed work being in the shop at any one time; (2) individual lines taking too long to complete; (3) the work being liable to

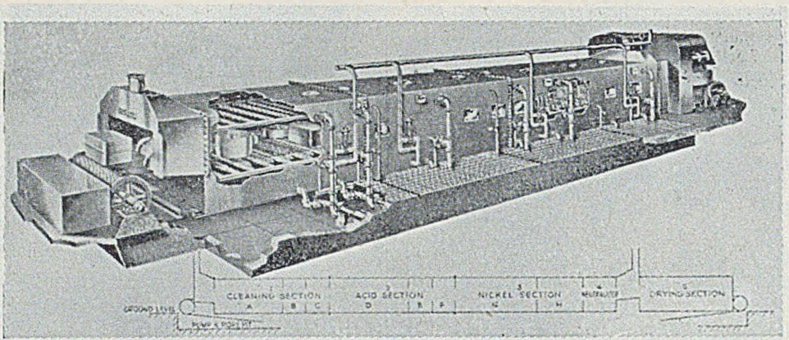


FIG. 10.—*Continuous Spray-type Pickling and Washing Plant.*

damage when being inserted and removed from racks; (4) men being required to wheel the racks around the shop, and (5) the goods not always being on the spot when they are required. When this stage has been reached, the executives in charge are fully engaged in production, so the new layout, which is always at the back of their minds, keeps on being shelved until they have time to get down to it—just another of the jobs that don't get done.

While the above situation is all too common, a few well-known manufacturers have gone a long way towards the ideal layout. In nearly all these cases

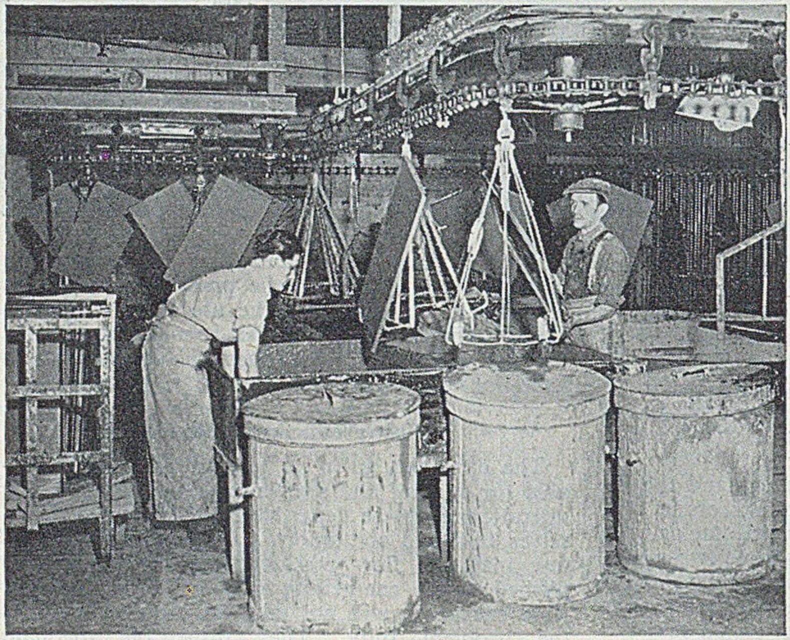


FIG. 11.—*Swilling Section of the Cover-coat Drying Conveyor.*

the overhead chain conveyor has been found to be the best type of transporting unit.

Continuous Plants

The next series of illustrations shows examples of continuously-operated machines, all designed specifically for flow production. The continuous spray pickling and washing plant illustrated in Fig. 10 overcomes many of the disadvantages of the "vat" system illustrated in Fig. 9. This machine eliminates all handling between vats and can be adapted to suit the specific requirements of almost any enamelling shop. The width of the machine can be altered to give the capacity required while sections can be added or omitted to suit the number of operations desired. It is claimed that in addition to reduced labour charges, a much better product is obtained. The machine can handle a wide variety of shapes and sizes of articles and dispenses with the need for load-

FIG. 12.—*Unloading Station at the Continuous Fusing Furnace.*

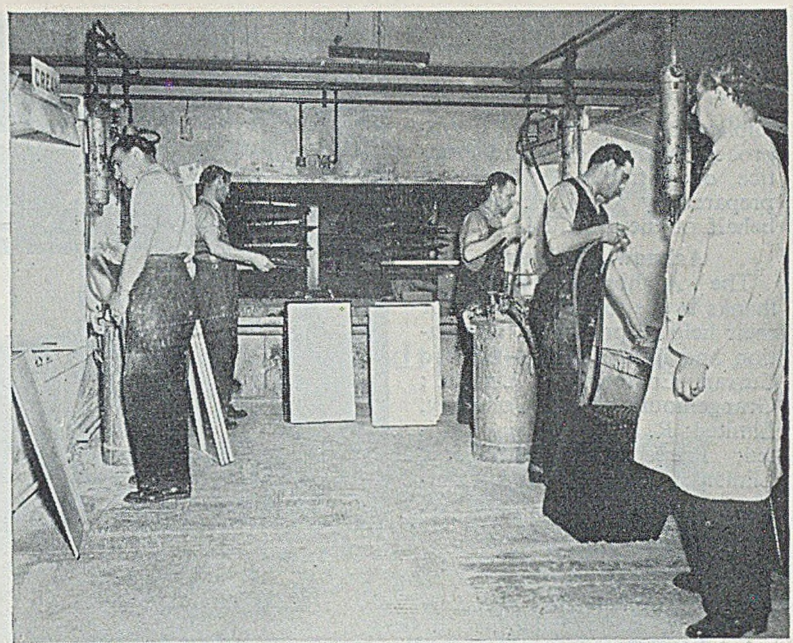


FIG. 13.—*Spray Booths arranged for Loading direct into Vertical-type Drying Chamber.*

ing and unloading the special baskets or containers used in a vat-type pickling plant.

As the articles from the above machine are discharged singly, they can be transferred directly to the overhead chain conveyor illustrated in Fig. 11. This carries the work to the operators for application of the ground-coat enamel and thence through a tunnel oven for drying.

Fig. 12 shows the discharge or unloading point of a continuous furnace also of the overhead chain type. Fig. 13 shows the spray booths for applying the colour coat and the ware being loaded directly into a vertical-type drying chamber.

Figs. 14 and 15 show the ware being loaded on the carriers of a continuous furnace conveyor. The design of the carriers should be noted, as these are suitable for a very wide variety of articles. They are easily detachable and other types can be hung on at short notice to deal with jobs of a different nature.

The equipment illustrated is all of the continuously-operating type which cannot work at full efficiency unless it is linked up, so that the work can be passed directly from one item to another. The versatile nature of the overhead chain conveyor is of great assistance in this respect. The carriers can be designed to take a wide range of articles and different types of carriers can be used on the conveyor at the same time. As the track can be curved in two planes it can be elevated to clear gangways, machines or other obstructions. Articles can be taken off for processing and returned as required, so that any article not requiring treatment can be left on the conveyor without hindrance to the operators. The route of the conveyor can be arranged to serve the various machines and benches and articles requiring additional operations can travel round the circuit as often as required for completion.

Possible Savings

It has been estimated that a saving of fifty million pounds could be made by British Industry by the development of materials handling. A proportion of this sum could be saved by the vitreous-enamelling industry and it is gratifying that the Institute of Vitreous Enamellers is giving attention to this problem.

This Paper does not attempt to give solutions to the many handling problems which exist in enamelling departments, as they are different in nearly all works. It would not be complete, however, without the inclusion of a typical layout showing how the various processes can be linked up by conveyors to achieve flow production. The layout shown in Fig. 16 is taken from the

FIG. 14.—*Ware being loaded on to the Continuous Furnace Conveyor.*

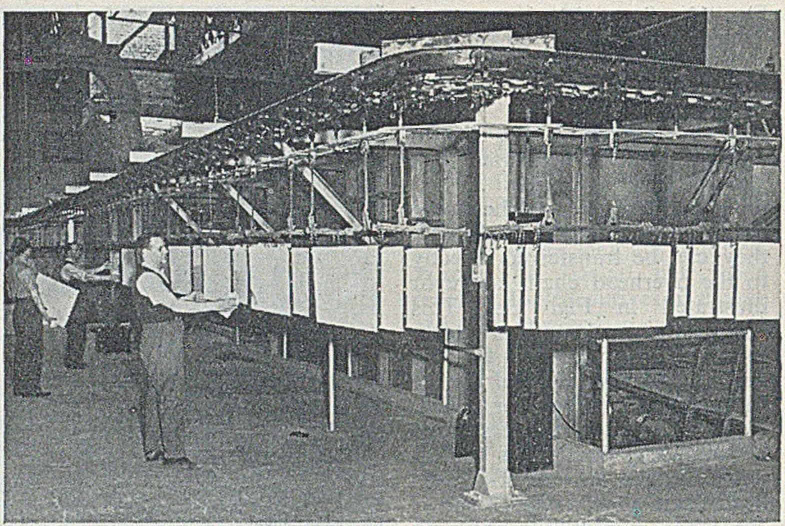


FIG. 15.—*Ware being loaded to the Continuous Furnace Conveyor from the Brush-off Tables.*

publication "A Student's Approach to the Theory and Practice of Vitreous Enamelling" prepared by Mr. J. H. Gray on behalf of the Institute.

Acknowledgments

The Author expresses his thanks to the following firms for their help in providing information and illustrations:—Edward Curran Engineering, Limited; Grangemouth Iron Company, Limited; R. and A. Main, Limited; Pressed Steel Company, Limited; John Wright & Company, Limited; and Stewart & Gray, Limited.

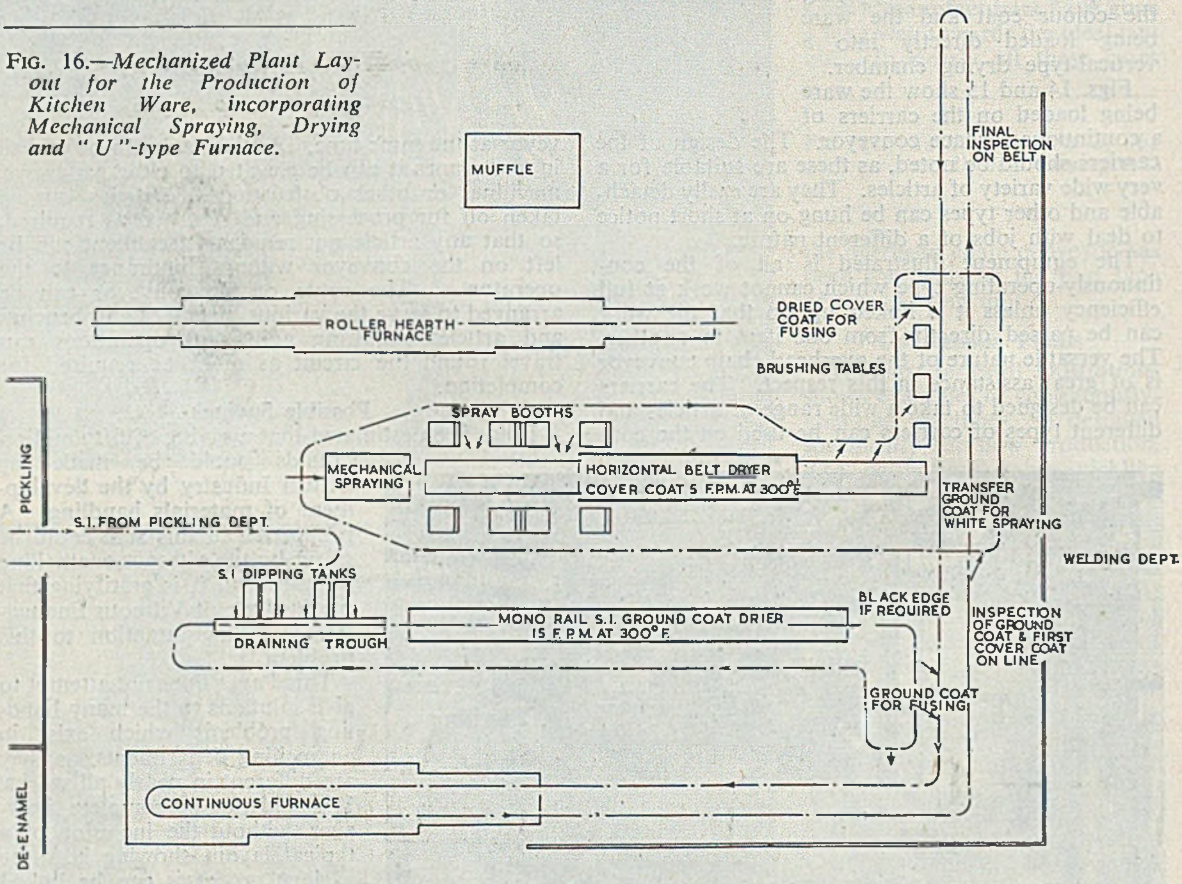


FIG. 16.—*Mechanized Plant Layout for the Production of Kitchen Ware, incorporating Mechanical Spraying, Drying and "U"-type Furnace.*

A CONTRACT valued at £286,000 has been received by Metropolitan-Vickers Electrical Company, Limited, from British Railways for the manufacture and supply of electrical equipment for new rolling stock. The order covers traction motors and control equipment for a total of 24 motor coaches, 26 trailers, and 26 driving trailer coaches.

THE NORTHERN REGIONAL BOARD FOR INDUSTRY has announced that no formal electricity load-spreading arrangements are to be made in the north-east for the coming winter. Manufacturers with their own generating plants are being urged to keep these in operation during the usual peak hours between 8 a.m. and noon and between 4 p.m. and 5.30 p.m.

Pig-iron and Steel Production

Statistical Summary of June Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activity during the previous six months. Table II gives production of steel ingots and castings in June, and Table III, deliveries of finished steel in June, 1953. Table IV gives the production of pig-iron and ferro-alloys in June, 1953, and furnaces in blast. (All figures weekly averages in thousands of tons.)

TABLE I.—*General Summary of Pig-iron and Steel Production.*

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (all qualities). Imports.[1]	Output of ingots and castings.	Deliveries of finished steel.	Stocks.[2]
1951	284	170	206	186	175	8	301	244	585
1952[3]	306	190	228	202	171	29	310	252	739
1953—January	325	199	234	214	188	25	346	279	770
February	328	194	234	214	193	19	352	272	770
March[4]	334	197	237	216	194	23	351	261	804
April	319	189	242	213	189	20	349	270	868
May	319	198	243	215	190	19	351	263	902
June[4]	301	202	238	211	188	14	338	—	912

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in June, 1953.*

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex	—	4.7	9.4 (basic)	1.9	0.2	15.3	0.9	16.2
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (excl. N.E. Coast and Sheffield)	1.5	23.7	—	1.7	0.6	26.3	1.2	27.5
Lincolnshire	—	35.3	—	—	0.1	35.3	0.1	35.4
North-East Coast	1.3	62.6	—	1.2	0.5	63.8	1.8	65.6
Scotland	4.4	39.3	—	1.6	0.8	44.0	2.1	46.1
Staffs., Shrops., Worcs. and Warwick	—	16.8	—	1.0	0.6	16.8	1.6	18.4
S. Wales and Monmouthshire	5.2	61.5	5.7 (basic)	1.0	0.1	72.9	0.6	73.5
Sheffield (incl. small quantity in Manchester)	8.4	29.0	—	9.2	0.5	45.0	2.1	47.1
North-West Coast	0.6	1.4	5.3 (acid)	0.5	0.1	7.8	0.1	7.9
Total	21.4	274.3	20.4	18.1	3.5	327.2	10.5	337.7
May, 1953	24.5	283.0	21.6	17.9	3.7	339.6	11.1	350.7
June, 1952	22.9	246.7	22.1	17.1	3.7	301.9	10.6	312.5

TABLE III.—*Weekly Average Deliveries of New Non-alloy and Alloy Finished Steel.*

Product.	1951.	1952.[3]	1952. May.	1953. April.	1953. May.
Non-alloy Steel :					
Ingots, blooms, billets and slabs[5]	4.0	4.5	5.2	5.4	4.1
Heavy rails, sleepers, etc.	10.1	9.8	9.6	11.0	10.2
Plates ⅛ in. thick and over	41.0	41.4	42.1	46.2	48.9
Other heavy prod.	39.9	39.0	40.9	44.6	44.6
Light rolled prod.	46.7	46.0	46.3	54.4	53.5
Wire rods	15.9	15.9	16.6	16.1	15.7
Bright steel bars	6.5	6.5	6.6	7.4	7.5
Hot rolled strip	19.5	18.8	19.4	18.8	16.2
Cold rolled strip	6.0	6.1	6.6	4.9	4.6
Sheets, coated and uncoated	30.4	31.6	31.8	32.3	31.9
Tin, terne and blackplate	13.8	16.0	16.5	15.5	14.9
Steel tubes and pipes	20.3	20.1	22.3	20.7	20.7
Tubes, pipes and fittings	0.5	0.4	0.5	0.4	0.4
Mild wire	11.6	12.2	13.7	10.9	10.8
Hard wire	3.5	3.6	4.2	3.8	3.6
Tyres, wheels and axles	3.7	3.5	3.7	4.0	4.1
Forgings (excl. drop forgings)	2.3	2.8	3.0	3.4	3.2
Steel castings	3.8	4.2	4.4	4.2	4.2
Tool and magnet steel	[8]	0.3	0.4	0.3	0.3
Total	279.5	282.7	293.8	304.3	299.4
Alloy steel	11.4	13.7	15.5	15.3	13.3
Total deliveries from U.K. prod.[6]	290.9	296.4	309.3	319.6	312.7
Add : Imported finished steel	5.8	13.8	17.2	7.6	5.3
	296.7	310.2	326.5	327.2	318.0
Deduct : Intra-industry conversion[7]	55.0	60.2	63.6	59.1	56.6
Total net deliveries	241.7	250.0	262.9	268.1	261.4

TABLE IV.—*Weekly Average Production of Pig-iron and Ferro-alloys during June, 1953.*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	26	0.4	17.3	24.7	1.1	—	43.5
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (incl. Sheffield, excl. N.E. Coast)	8	—	14.7	—	—	1.4	16.1
Lincolnshire	13	—	30.9	—	—	—	30.9
North-East Coast	24	4.6	43.7	—	—	1.4	49.7
Scotland	9	0.7	13.3	2.4	—	—	16.4
Staffs., Shrops., Worcs., and Warwick	9	—	6.9	1.5	—	—	8.4
S. Wales and Monmouthshire	7	3.8	24.3	—	—	—	28.1
North-West Coast	8	17.4	—	0.1	—	—	17.5
Total	104	26.9	151.1	28.7	1.1	2.8	210.6
May, 1953	101	25.5	157.3	28.3	0.9	2.7	214.7
June, 1952	103	26.5	139.2	29.7	1.4	2.9	199.7

[1] Weekly average of calendar month.

[2] Stocks at the end of the years and months shown.

[3] Average 53 weeks ended January 3, 1953.

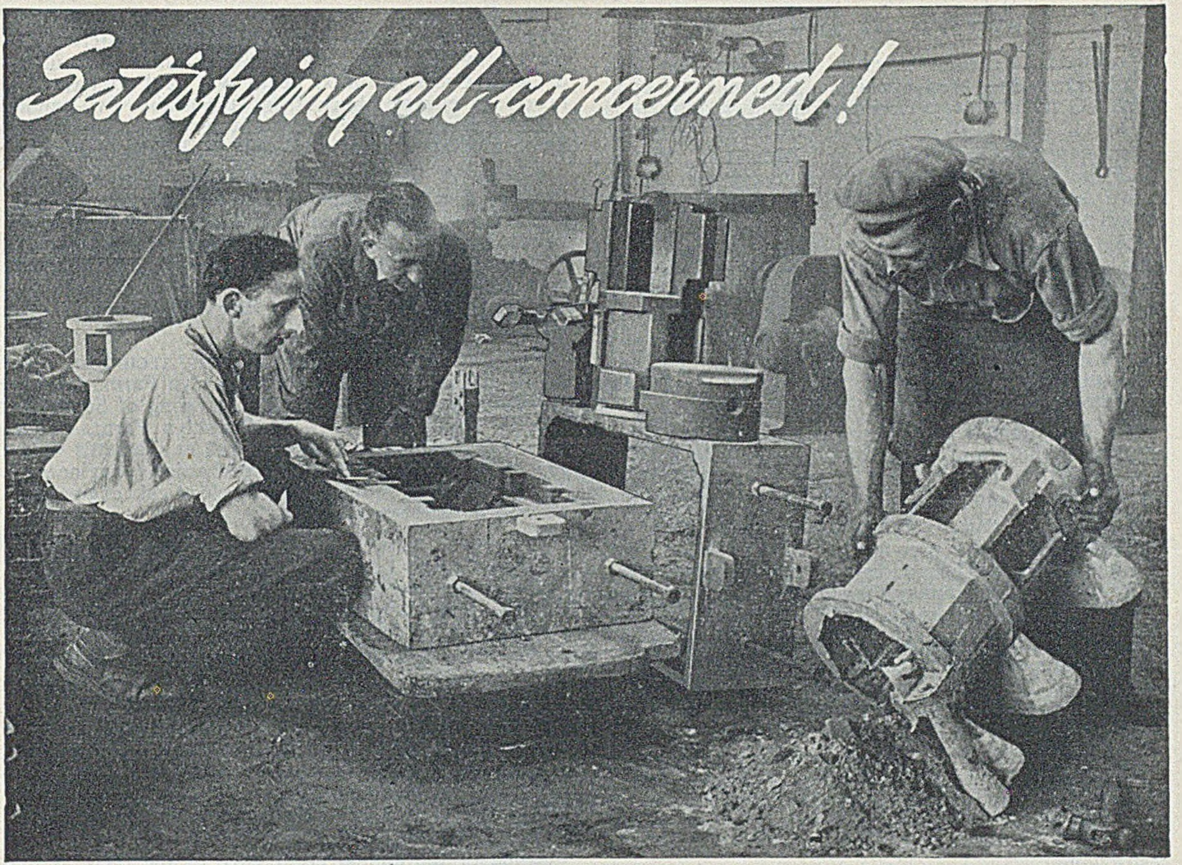
[4] Five weeks all tables.

[5] Other than for conversion into any form of finished steel listed above.

[6] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

[7] Material for conversion into other products also listed in this table.

[8] Included with alloy steel.


Satisfying all concerned!

News in Brief

VAUXHALL MOTORS LIMITED announce that Mr. Harold Drew has been appointed assistant chief engineer of General Motors Corporation with headquarters at Detroit.

THE 1954 CONVENTION AND EXHIBITION of the American Foundrymen's Society is to be held in the Public Auditorium at Cleveland, Ohio, during the week May 8 to 12.

THE INSTITUTE OF METAL FINISHING will begin its 1953-54 session at the James Watt Memorial Institute, Birmingham, on September 1. The new chairman is Mr. J. M. Sprague.

A RECORD weekly average of 13,200 cars was produced in British factories in July—almost five cars a minute during the working period—states the Society of Motor Manufacturers and Traders.

THE NORTHFIELD FOUNDRY, LIMITED, Brixham, one of the leading ironfounders in the south-west, have now opened a non-ferrous foundry, equipped to turn out castings in gunmetal, brass, bronze and aluminium.

CHAPMAN & SMITH, LIMITED, announce that the address of their new premises is Holders Hill Circus, London, N.W.7. The address of their Scottish agent, L. A. Witham & Company, has also changed, and now is 59, Vine Street, Glasgow, W.1.

The Treasury has announced that restrictions on the used of molybdenum is case-hardening and constructional steels in member countries of the Organisation for European Economic Co-operation have been suspended by a decision of the O.E.E.C. council.

The restrictions were imposed in May, 1952, as a result of shortages of molybdenum and nickel on world markets. The new decision, it is stated, does not apply to nickel, for the present improvement in the supply situation is not sufficient to justify the abolition of the restrictions.

STEEL SHELVING, partitions, workpans, bin units and clothes lockers are among the standard items described and priced in a catalogue issued by the Welconstruct Company, Limited, Grenville Buildings, 12 Cherry Street, Birmingham, 2, and available to readers on writing to Birmingham.

MR. R. I. TAYLOR, the inventor of the instrument for measuring the height of the charge within the cupola, informs us that he personally and not his firm is making arrangements for its manufacture. Thus all correspondence should be addressed to him at 4, St. Peters Road, Stowmarket, Suffolk.

IT IS REPORTED in *Materials and Methods* that a gas-fired spray gun is under test for the application of molten vitreous enamel direct to metal surfaces. If successful, it is claimed that this device could eliminate the need for two separate operations—application and firing—and the need for furnaces.

FIVE BRASS MOULDERS were injured on August 25 when a fractured crucible sent a spray of molten metal over their clothing in the workshop of Gray & Company, Anderston. The men had taken the crucible from the furnace in the workshop when the bottom fell out and the molten metal showered on to the floor and splashed on to their clothing.

GEORGE BROWN & COMPANY (MARINE), LIMITED, Greenock, have received confirmation of an order for a 900-ton coasting vessel from Coast Lines, Liverpool. About three weeks ago an order for a ship of a similar type was received from Belfast Steamship Company, which is associated with Coast Lines. Both vessels are to be fitted with Sulzer Diesel engines.

AT THE INQUEST at Halifax last week on Bernard John Redfearn, a 24-year-old Halifax plasterer, employed by F. Watmough & Sons, Limited, builders, of King Cross, Halifax, death was said to have followed an electric shock from a portable two-handed drill, alleged to have had a faulty plug, which was being used at the premises of T. G. Binner, Limited.

FRASER & CHALMERS ENGINEERING WORKS of The General Electric Company, Limited, are to supply to the order of Guest Keen Baldwins Iron & Steel Company, Limited (Consulting Engineers, McLellan & Partners), a 5,000-kW. turbo-alternator set, complete with condensing plant. This set is for an extension to the existing power station at their East Moors Works, Cardiff.

BIRMINGHAM'S TWO NEW BRANCH TECHNICAL COLLEGES at Garrett's Green and Brooklyn Farm, Aldridge Road, are to be opened at the beginning of September for the 1953-54 session. At Brooklyn Farm, courses in engineering will be offered, and at Garrett's Green the courses will include mechanical engineering, machine-shop, production and electrical engineering, as well as sheet-metal work.

CAMPBELL, GIFFORD & MORTON, LIMITED, of 17, Victoria Street, London, S.W.1, have been appointed consulting engineers for the construction of a plant for the continuous casting of steel, which is being installed in Sheffield by a group of members of the British Iron & Steel Research Association. The plant is to be in the works of William Jessop & Sons, Limited, one of the members of this group.

MR. N. W. R. MAWLE, managing director of British Typewriters, Limited, West Bromwich, left London Airport on August 26 on a two-month journey to explore export markets. Within a few days of his return, he is to meet the President of the Board of Trade (Mr. Peter Thorneycroft) on the eve of the opening of the annual conference of the Incorporated Sales Managers' Association, at which Mr. Mawle will become national chairman.

AT THE INVITATION of the United Steel Companies, Limited, 35 boys from the 16 public schools are to spend a week in Sheffield as the guests of the company in order to take part in a short course on iron and steel making. The aim of the course is to give an insight into the manufacture of iron and steel and the manipulation of steel, the manufacturing uses of high-quality steels, some characteristic problems in research, and the opportunities available for careers with a large steel company.

"Business as Usual"

Following last week's fire at Penistone which destroyed the main pattern store at David Brown Foundries Company, the management issued on the following day a statement that every possible effort was being made to reduce to an absolute minimum the effect on production. From a preliminary investigation it would appear that 50 per cent. of the patterns in current production have not been affected, as these were stored in other sections of the foundry. It is further anticipated that there will be very little interference with export contracts. A number of customers have indicated their desire to be of the maximum assistance and have already arranged to replace some of the patterns destroyed. Moreover, work on replacing patterns lost in the fire is already going on in the Penistone company's own patternshop, which escaped damage.

Personal

MR. N. J. FREEMAN has been appointed head of I.C.I.'s insurance department and managing director of Imperial Chemical Insurance, Limited, in succession to the late Mr. A. Hadden.

MR. FRED A. KETTLE, of Kidderminster, has been appointed general manager of the Redditch Indicator Company, Limited, on the retirement of Mr. T. P. Austin, who has held the position for the past 22 yrs.

MR. W. WEARING, having been appointed to the permanent staff of the Wednesbury Technical College, has relinquished his position as foundry manager to the Chaseside Engineering Company, Limited, of Hertford.

MR. SYDNEY S. GUY, chairman and managing director of Guy Motors, Limited, and the Sunbeam Trolley Bus Company, Limited, has been presented with a certificate of membership of the American Society of Automotive Engineers, etc., recording that he has been a member for over a third of a century.

J. C. ABBOTT & COMPANY, LIMITED, coal, coke and pig-iron merchants, of Birmingham, announce that, following the death of Mr. A. E. Bond, MR. R. W. RUTLEDGE, who has been deputy chairman since 1936, has been appointed chairman of the Board; the executive directors being MR. C. H. HERBERT, MR. R. W. NEALE and MR. F. K. ROBERTSON.

MR. HARRY WINDLE, manager of the blast furnaces, has retired after 45 years' service with the Sheepbridge Group, Chesterfield. To mark his retirement, the management, staff, and workmen presented him with an oak dinner wagon and a Crown Derby tea service. The presentation was made by Mr. E. Marvill, general manager of the Sheepbridge Company, at the blast furnace offices.

ON AUGUST 21, Wing-Commander Aiton, chairman and managing director of Aiton, pipe founders, Stores Road, Derby, presented long-service awards to employees who had completed 25 yrs.' service. These included Mr. C. M. Buckland (manager, Sunderland works); Mr. F. A. Lightbown (erection, area manager); Mr. E. C. Lovatt (accountant, Sunderland works); and Mr. E. J. W. Dean (deputy chief draughtsman).

MR. J. A. BESS, B.SC. (ENG.), A.C.G.I., who has been principal of Rosyth Dockyard Technical College for the last six years, is to take up duty at Chatham in a similar capacity. Mr. Bess went to Rosyth originally from Chatham, and for a year before being appointed principal was senior master at the college. Mr. Bess is being succeeded by Mr. W. Scott, B.SC., who has been head of a department at Portsmouth Dockyard Technical College.

MR. J. SAVAGE, B.SC., F.INST.P., has been appointed head of B.I.S.R.A.'s Physics Department, with effect from October 1, 1953. As head of the general physics section of the Physics Department since 1947, Mr. Savage has been closely associated with the Association's work on continuous casting. He has been deputy head of the Department since 1948. Mr. Savage was educated at Nottingham University, where he took a 1st class honours B.Sc., London, degree in physics and mathematics in 1936. After a period in industry he took charge of spectrographic research at the Royal Aircraft Establishment, Farnborough, in 1943, where he remained until he joined B.I.S.R.A. in 1947. Mr. M. W. Thring, whom Mr. Savage succeeds in October, was appointed the first head of B.I.S.R.A.'s Physics Department in 1946. He leaves to become professor of Fuel Technology at Sheffield University.

Institute of Vitreous Enamellers

Annual Conference Programme

The 1953 annual conference of the Institute of Vitreous Enamellers will be held in Cheltenham from September 30 to October 3, with headquarters at the Town Hall, and some of the social functions in the Queen's Hotel. A full programme of works visits and technical sessions has been arranged and those wishing to attend should complete a reply form and return it not later than September 4 to the secretaries, John Gardom and Company, Ripley, Derbyshire. The conference registration fee will not be charged for ladies. Hotel reservations should be made individually as soon as possible. All technical meetings will be held in the Town Hall.

Programme

Final arrangements will be shown in the Conference Handbook which will be sent with tickets.

Wednesday, September 30.
9.0 p.m.—Reception and dance by invitation of His Worship the Mayor of Cheltenham and the Mayoress in the Montpellier Rotunda, Cheltenham (members and ladies, evening dress optional).

Thursday, October 1.
9.30 a.m.—Annual general meeting, Town Hall, Cheltenham. 10.30 a.m.—Works visits. Members may participate in one only of the following. Coaches will depart from the Town Hall promptly. (1) Pressed Steel Company, Limited, Oxford; (2) Thomas De La Rue & Company, Limited (luncheon and tea by courtesy of the companies. All coaches will return to Cheltenham for approximately 6.30 p.m.) 8.0 p.m. to midnight.—Informal dinner in the Ballroom, Queen's Hotel followed by dancing (dress informal).

Friday, October 2.
9.30 a.m.—Technical sessions: "A." "Recent Developments in the Technology of Porcelain Enamelling on Steel in the United States" by E. M. Hommel; "B." "The Human Factor in the Enamelling Industry," by R. C. M. Callaghan. 12.30 p.m.—Luncheon at the Queen's Hotel, followed by technical session "C," "Economies of Pickling and Pickle Liquor Disposal," by Dr. P. de Lattre; "D," "Tone and Brightness Variations of Titanium-oxide Self-opacified Enamels," by N. S. C. Millar, and "E," "Survey of the Vitreous-enamelling Industry in Sweden, Finland and Denmark," by J. H. Gray. 7.30 p.m.—Reception by the president and Mrs. H. Hartley and the chairman of Council and Mrs. S. Hallsworth. at the Town Hall (members and ladies) and (8.0 p.m. to 1.0 a.m.) annual banquet, followed by dancing (members and ladies, evening dress and decorations).

Saturday, October 3.
10.0 a.m. to noon.—Technical session "F." Reports from sub-committees; question box and general discussion.

Forty Years Ago. In our issue of September 1913, that very knowledgeable old foundryman, Mr. S. G. Smith, has one of his really practical articles on the moulding in dry-sand of vertically-cast hydraulic pipes. Mr. David McLain gives an account of how he became interested in "semi-steel" and of the importance of manganese additions. There is an announcement by the Carborundum Company that the Trafford Park Works were completed and stocks were being removed there from London.

Raw Material Markets

Iron and Steel

The shrinkage in the volume of work in hand at the light foundries, linked with holiday stoppages at the steelworks, has reduced the consumption of pig-iron and led to some increase of stocks. This is probably only a temporary phase. The expansion of pig-iron production this year has not kept pace with the use in the output of steel. The number of blast furnaces now operating is only one more than a year ago, and although some of the older units have been replaced by others of larger capacity, the indications are that a speedy expansion of pig-iron production will soon be necessary. In the meantime, however, supplies are reasonably adequate, though hematite makers are hard pressed to satisfy the current demand.

A sharp contraction in the volume of imports of steel semis from Western Europe is foreshadowed. Re-rollers have ample supplies in hand, and are less inclined to seek additional deliveries, since their order-books are thinning out. There is still a fairly active demand for the smaller sizes of billets, but the larger sizes, together with slabs and sheet bars, are now freely offered and defectives and crops attract little attention.

Business in finished steel products is quickening, but there is still scope for considerable expansion. The mills have plenty of work in hand to keep them busily engaged for the next few weeks and known requirement of the engineering, shipbuilding, and motor industries assure the continuance of strong support. Plate mills are working to the limit of their capacity and so also are the rollers of heavy joists and sections. The export trade is still sluggish, trade with Egypt, Finland, Brazil, and Argentina having suffered a marked decline. On the other hand, relaxation of Australian import restrictions is promised in October, and business with South Africa is showing signs of resilience.

Non-ferrous Metals

The non-ferrous metals last week for the most part showed a firm front, although a serious setback in copper was followed by a quick recovery. The turnover in lead and zinc was somewhat above the average, but the volume of business done in copper was rather disappointing. Tin was fairly active, the firmness last Friday being due perhaps to a report that some Chinese owned Malaya mines may have to close down if the price of the metal does not improve. A backwardation seems once again to have become a feature of the market and it is worth noting, but not with any sense of pleasure or approval, that each of the four metals closed last week with a premium ruling for the early position.

Consumer demand for copper does not seem to be over good, for, in spite of the establishment of the free market, there is apprehension about the future and the fluctuations of the price do not help matters. The fact is that while all are agreed about the downward trend of the copper price, there is diversity of opinion about how quickly the fall will come. Again, all do not see eye to eye about the ultimate level of the metal, some believing that the brake will be put on at £200—as, indeed it, was early in August—while others feel that £180 will be the first stopping point. The fact is, of course, that nobody knows just what is going to happen and so guesswork attempts to take the place of knowledge; 24 cents have been mentioned as the likely " low " for copper and this would mean a sterling equivalent of about £190. But it may well be many months before this level comes in sight, although we must remember that so far the London market has ruled below New York.

Official prices were as follow:—

COPPER, Standard—*Cash:* August 27, £226 to £230; August 28, £226 to £228; August 31, £225 to £228; September 1, £228 to £230; September 2, £225 to £230.

Three Months: August 27, £211 10s. to £212; August 28, £211 to £212; August 31, £211 10s. to £212; September 1, £214 to £215; September 2, £216 to £217.

TIN, Standard—*Cash:* August 27, £602 10s. to £605; August 28, £607 10s. to £612 10s.; August 31, £611 to £612; September 1, £617 10s. to £620; September 2, £622 10s. to £625.

Three Months: August 27, £600 to £602 10s.; August 28, £602 10s. to £605; August 31, £605 to £607 10s.; September 1, £610 to £612 10s.; September 2, £615 to £617 10s.

ZINC—*August:* August 27, £72 15s. to £72 17s. 6d.; August 28, £72 12s. 6d. to £72 17s. 6d. *September:* August 31, £72 7s. 6d. to £72 10s.; September 1, £72 10s. to £72 12s. 6d.; September 2, £72 7s. 6d. to £72 10s.

November: August 27, £72 7s. 6d. to £72 12s. 6d.; August 28, £72 to £72 5s. *December:* August 31, £72 7s. 6d. to £72 10s.; September 1, £72 10s. to £72 12s. 6d.; September 2, £72 5s. to £72 10s.

LEAD—*August:* August 27, £97 15s. to £98; August 28, £96 5s. to £96 10s. *September:* August 31, £95 15s. to £96; September 1, £95 15s. to £96; September 2, £95 15s. to £96.

November: August 27, £91 10s. to £91 15s.; August 28, £90 10s. to £90 15s. *December:* August 31, £91 to £91 5s.; September 1, £91 5s. to £91 10s.; September 2, £91 15s. to £92.

Fatal Furnace Explosion

The cause of an explosion in a five-ton furnace at the works of Norton Aluminium Products, Limited, Norton Canes, Cannock, was not discovered at a Birmingham inquest held recently. A verdict of "Accidental death" was returned on Jeremiah McCarthy (aged 51), a furnaceman, of Brownhills Road, Norton, who received such severe burns that he died in hospital a month afterwards.

Mr. Charles Philip Rowe, maintenance engineer, saw the pistons before they were put into the furnace and said there was nothing inside them to cause trouble. He could find no reason for the explosion. The pistons were made of aluminium alloy. They were scrap rejects which had not been used.

Leslie Jack Cutler, works director, thought that the explosion was not a blow-back, nor due to the use of a wet rake. He was forced to the conclusion that in a patch of coating inside the pistons of some non-metallic substance there must have been something which was normally harmless, but which could cause an explosion when heated to 650 or 700 deg. C. He was not convinced about that theory, and had no real evidence for it. In answer to the Coroner, he said that tools left in the furnace would not cause an explosion. It seemed unlikely that any pocket of gas could have formed inside the pistons.

Correction.—We regret that in our last issue, the portraits of Mr. Taylor and Mr. Stokowiec were transposed and thus the biographical notes applied inversely. Moreover Mr. Taylor is not a member of the Institute of Metals but a Fellow of the Institution of Metallurgists. To both these gentlemen we offer our apologies.

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

(Delivered unless otherwise stated)

September 2, 1953

PIG-IRON

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

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £16 14s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 0s. 3d.

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

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

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 3s.; South Zone, £19 5s. 6d.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent. :—N.-E. Coast and N.-W. Coast of England, £16 12s.; Scotland (Scotch iron), £16 18s. 6d.; Sheffield, £17 13s.; Birmingham, £17 19s. 6d.; Wales (Welsh iron), £16 18s. 6d.

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

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered).

Ferro-silicon (6-ton lots).—40/55 per cent., £53 10s., basis 45 per cent. Si, scale 21s. 6d. per unit; 70/84 per cent., £82 10s., basis 75 per cent. Si, scale 23s. per unit.

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

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

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

Ferro-tungsten.—80/85 per cent., 21s. 4d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 24s. 3d. per lb. of W.

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

Cobalt.—98/99 per cent., 20s. per lb.

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

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

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

SEMI-FINISHED STEEL

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

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

Sheet and Tinplate Bars.—£25 11s. 6d.

FINISHED STEEL

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

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 4s. 6d.; flats, 5 in. wide and under, £32 4s. 6d.; hoop and strip, £32 19s. 6d.; black sheets, 17/20 g., £41 6s.; galvanized corrugated sheets, 24 g., £49 19s. 6d.

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

Tinplates.—57s. 9d. per basis box.

NON-FERROUS METALS

Copper.—Cash, £225 to £230; three months, £216 to £217; settlement, £237.

Tin.—Cash, £622 10s. to £625; three months. £615 to £617 10s.; settlement, £625.

Zinc.—September, £72 7s. 6d. to £72 10s.; December, £72 5s. to £72 10.

Refined Pig-lead.—September, £95 15s. to £96; December, £91 15s. to £92.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £101; rolled zinc (boiler plates), all English destinations, £98 15s.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Other Metals.—Aluminium, ingots, £150; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £69 to £70 10s. (nom.); nickel, £483.

Brass.—Solid-drawn tubes, 21½d. per lb.; rods, drawn, 31⅜d.; sheets to 10 w.g., 244s. 3d. per cwt.; wire, 29¼d.; rolled metal, 231s. per cwt.

Copper Tubes, etc.—Solid-drawn tubes, 26⅜d. per lb.; wire, 258s. 9d. per cwt. basis; 20 s.w.g., 287s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £157 to £170; BS. 1400—LG3—1 (86/7/5/2), £170 to £190; BS. 1400—G1—1 (88/10/2), £252 to £285; Admiralty GM (88/10/2), virgin quality, £252 to £300 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £265 to £295; L.P.Bl, £215 to £240 per ton.

Phosphor Bronze.—Strip, 342s. 3d. per cwt.; sheets to 10 w.g., 364s. per cwt.; wire, 43½d. per lb.; rods, 37½d.; tubes, 35¾d.; chill cast bars: solids 37d., cored 38d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Rolled metal, 3in. to 9in. wide × .056, 3s. 0¼d per lb.; round wire, 10g., in coils (10 per cent.), 3s. 5¼d.; special quality turning rod, 10 per cent. ½in. dia., in straight lengths, 3s. 4½d. All prices are net

Board Changes

D. Napier & Son, Limited—a subsidiary of the English Electric Company, Limited—announce the appointment of Mr. R. M. Hiliary as commercial manager.

Enfield Rolling Mills, Limited—Mr. J. Grimston, M.P., has been appointed managing director following the death of Mr. C. E. Frederick Plutte. Mr. A. Lane, Mr. F. Cockayne, and Mr. B. Powell, secretary, have been appointed directors.

Lilleshall Company, Limited—Mr. H. Watson Smith, C.B.E., has succeeded the late Earl Granville, K.G., as chairman of the Lilleshall Company, Limited, and the Lilleshall Iron & Steel Company, Limited. The present Earl Granville has been appointed deputy chairman.

Midland Motor Cylinder Company, Limited—Mr. Edward Player, managing director of Birmid Industries, Limited, the parent company, has joined their Board. Mr. Harold H. Hopkins and Mr. Robert S. Waterhouse have also been appointed directors of the company. Mr. Hopkins has been sales manager of the company for 28 yrs. and Mr. Waterhouse chief buyer for 32 yrs.

The Brush Electrical Engineering Company, Limited, announce that Mr. G. C. R. Eley has been appointed a director and deputy chairman of the company. He is a director of the Bank of England and is chairman of British Drug Houses, Limited. Major Noel E. Webster has also joined the board. He is president-elect of the Institution of Mining Engineers and holds directorships of a number of industrial concerns.

Obituary

Mr. Charles Y. McArthur, late of Alley & MacLellan, Limited, engineers and ironfounders, etc., of Glasgow, died on August 20.

The death is announced of Mr. Arthur Peake-Jones, advertising manager of the British Tyre and Rubber Company, Limited, and its subsidiary companies—(the B.T.R. Group). He was 68 years old.

Mr. Hugh W. Wilson, manager of the Zenith Works, Thornliebank, near Glasgow, of Henry Wiggin & Company, Limited, died on August 19. Educated in Glasgow, his early interests were in engineering. He had experience with Wm. Beardmore & Company, Limited, and also with G. & J. Weir, Limited, Glasgow. He was on the staff of the nickel and alloy side of the latter company when it was transferred to Henry Wiggin & Company, Limited, in 1922.

Recent Wills

Ouston, R. L., of Moseley, Birmingham, founder and managing director of Hill-Ouston Company, Limited, Phoenix Works, Bradford Street, Birmingham £42,462

Milnes, Mark Radcliffe, of 2, Prospect Road, Stubley Estate, Heckmondwike, chairman and managing director of Heywood and Porteus, Limited, hydraulic engineers and ironfounders, Gomersal, near Leeds £6,115

Spedding, H., of Girvan House, Pembroke Avenue, Morecambe and Heysham, formerly managing director of Hawkhead, Bray & Son, Limited, coppersmiths and sheet metal workers, of Siddal, Halifax, a director of Yorkshire Die-Casting Company, Limited, Elland, and formerly owner of Sowerby Bridge Laundry £17,522

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

VITREOUS ENAMEL FOREMAN seeks position. Home or abroad. Experienced cast iron, sheet metal, hollow-ware enamelling. Good organiser. Strict disciplinarian.—Box 3732, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN (age 49) requires position with small Ferrous and Non-ferrous Foundry. Accustomed to full control. Available at once. A.M.I.B.F.—Box 3729, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER requires change. Conversant with all aspects of modern production methods and techniques also rate fixing, estimating, pattern shop and plant engineering.—Box 3697, FOUNDRY TRADE JOURNAL.

PATTERNMAKER, age 39, first class experience; present position, Chief Patternmaker with textile firm in India. Returning U.K. first week in October, 1953, requires responsible position, pref. Representative position. — Box 3679, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

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

FOUNDRY TECHNICIAN required for modern Non-ferrous Foundry in West Riding of Yorkshire.—Apply, stating age, experience, etc., to Box 3727, FOUNDRY TRADE JOURNAL.

WELL - ESTABLISHED Ironfoundry, producing high grade Castings for the General Engineering and Electrical Trade, requires REPRESENTATIVE to cover the London and Home Counties.—Apply Box 3730, FOUNDRY TRADE JOURNAL.

FOREMAN wanted for small but expanding firm of Iron and Non-Ferrous Founders. Extensive experience of floor and machine moulding essential, and some knowledge of centrifugal casting preferred. Excellent prospects for right man. Age 25/35 years of age. State experience, salary required and when available.—Box 3710, FOUNDRY TRADE JOURNAL.

YOUNG TECHNICIAN (preferably aged 23/28) required by a large Steel Foundry for technical control (and possibly, later on) development work. The initial duties would consist of the running of a radiographic department and experience of industrial radiography would be a great asset. Replies stating educational details, experience to date and salary desired should be sent to Box 3708, FOUNDRY TRADE JOURNAL

SITUATIONS VACANT—*contd.*

FOUNDRY FOREMAN, age 30/35, experienced in ferrous and non-ferrous machine moulding, hand moulding and sandrammer practice, required for Middlesbrough Foundry. — Box 3706, FOUNDRY TRADE JOURNAL.

FOREMAN PATTERN MAKER required by old established South Wales Foundry. Must be fully experienced in all classes of Jobbing Pattern Work, including Pattern Plate Work. Pension scheme in operation. Full details of experience to Box 3718, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for partly mechanised Foundry. Rainwater and Engineering Castings up to 6 tons. Approximately 500 employees. Applicants must have excellent production and administrative ability, with good technical background. State age and full details of experience and salary expected. House goes with the appointment.—Write 2587, WM. PORTEOUS & Co., Glasgow.

A SUBSTANTIAL Engineering Company in the North of England requires a first-class and fully qualified CHIEF TECHNICAL OFFICER, whose duties will be to control metallurgical activities and to supervise the development of processes chiefly connected with the heavy industries.—Applicants are requested to send full particulars in confidence to MANAGING DIRECTOR.—Box 3728, FOUNDRY TRADE JOURNAL.

TECHNICAL REPRESENTATIVE required by Vitreous Enamel and Ceramic Colouring Oxide Manufacturers. Knowledge of Enamelling Trade essential. Position Superannuated. Applicants should state in confidence: age, their complete experience and salary required to MESSRS. MAIN ENAMEL MANUFACTURING CO., LTD., Gothic Works, Angel Road, Edmonton, London, N.18.

SALES MANAGER

required by well-known ironfounders producing light and medium grey iron engineering castings.

Applicants should be between 35 and 55 years of age, have an all-round knowledge of the trade and be able to obtain substantial orders. A first-class man is required.

Salary according to qualifications and experience.

Our own staff are aware of this advertisement, and all replies will be treated in the strictest confidence.—Box No. 3720, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

METALLURGIST wanted for Tyneside Jobbing Ironfoundry making High Duty Castings to specifications. Please state experience, salary required, and when available.—Box 3731, FOUNDRY TRADE JOURNAL.

DIE DESIGN DRAUGHTSMAN required. Fully experienced on gravity and pressure die design.—Write giving full details of experience and salary, to MARSHALL CASTINGS, LTD., Mount Street, Nechells, Birmingham, 7.

STEEL FOUNDRY FOREMAN required for a well-known Midland Steel Foundry. Must have served apprenticeship. Please state age, experience and salary required.—Box 3721, FOUNDRY TRADE JOURNAL.

YORKSHIRE STEEL FOUNDRY requires experienced man for sand control and experimental sand mixtures. Full details of experience, age, etc., to Box 3717, FOUNDRY TRADE JOURNAL.

TECHNICAL AND SALES REPRESENTATIVES for Scotland, Wales and Manchester districts for Industrial Furnaces, especially Foundry Drying Equipment and all kinds of Heat Treatment and Reheating Furnaces. Excellent position for keen engineer. Salary plus commission offered.—Box 3726, FOUNDRY TRADE JOURNAL.

ELKINGTON & CO., LTD., Goscote Works, Walsall, require SHIFT SUPERVISORS for employment in their Refining Department and in their Blast Furnace or Cupola. Applicants should be fully experienced in the production of fire-refined copper and to mechanised plant. They should be able to maintain discipline and take full control if required.—Applications in writing, stating age and experience, to PERSONNEL MANAGER.

FOUNDRY PRODUCTION MANAGER wanted by Company operating both Floor and Mechanised Foundries in London area. Successful applicant must be a first class foundry technician with progressive ideas and the technical knowledge and experience to back them up. Diploma of National Foundry College or Degree in Metallurgy an advantage but not essential. A salary of not less than £1,000 per annum (more for special qualifications) plus bonus on results and generous conditions of service will be given to successful applicant. First application to include (in confidence): (a) Experience, positions held, salary received, and description of duties carried out. (b) Special knowledge, *e.g.* (i) Mechanical Plants, (ii) Machine Tool Work, (iii) Rainwater and Soil, etc., etc. (c) Education, course of study or apprenticeship. (d) Degrees and Diplomas held. (e) Membership of Professional bodies, etc. (f) Age. (g) Salary expected. (State existing). (h) When available for interview and commencement if successful.—Box 3707, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

OLD ESTABLISHED Midlands Ferrous Jobbing Foundry requires Representative on Commission basis for London and South Areas.—Box 3724, FOUNDRY TRADE JOURNAL.

DRAUGHTSMAN required with General Engineering Experience, Estimating and Weight Calculating an advantage. Wages according to age and experience. Staff Pension Scheme. Applicants send full particulars to The Managing Director, GLANMOR FOUNDRY CO., LTD., Llanelly, Carms.

ASSISTANT TECHNICAL SECRETARY: To assist in the provision of secretarial services to the Association's committees and panels and with the production of its internal publications. Applicants should be educated to degree standard, and experience in the field indicated will clearly be an advantage.
Applications, which in the first instance will be treated as confidential, should be addressed to: The Director, BRITISH STEEL CASTINGS RESEARCH ASSOCIATION, Broomgrove Lodge, Broomgrove Road, Sheffield, 10.

A COMPANY located near Niagara Falls requires a GRAVITY DIE DESIGNER for Non-ferrous Castings, with a minimum of five years' experience of actual design work in this field. A practical shop or toolroom background is essential with foundry experience desirable. Successful candidates will be interviewed in London during August or September. Reply, stating experience, age, and availability.—Box 3725, FOUNDRY TRADE JOURNAL.

APPLICATIONS are invited from foundry engineers, approximate age 30 to 35 years, prepared to accept a supervisory position on the staff of a company operating on the Continent, with headquarters in Paris. It is essential that the applicamts have a good general education to engineering degree standards, with basic training in foundry practice, and with some metallurgical training. Direct grey iron foundry experience is essential. Full details of education and industrial experience should be addressed to Box 3690, FOUNDRY TRADE JOURNAL.

PROPERTY FOR SALE

SMALL, BLACK COUNTRY FOUNDRY; Grey Iron; well laid out; fully equipped; floor and stump moulding. Low figure for quick sale.—Box 3713, FOUNDRY TRADE JOURNAL.

AGENCY

WELL-ESTABLISHED London company, with West End office and sales staff, sole Representatives for well-known provincial ferrous foundry, will consider similar appointment for Die Casting Foundry with machine shop having London and Home Counties connections.—Box 3667, FOUNDRY TRADE JOURNAL.

WANTED

WANTED, 4,000 lb. Pneulec-Herman Jarr Rollover Pattern Draw Machine. State age, condition and price required to K. & L. STEELFOUNDERS & ENGINEERS, LTD., Letchworth, Herts.

10 MOULDING BOXES, 30 in. by 36 in. by 6 in. by 3 in., required for machine moulding. Must be in excellent condition. — Box 3714, FOUNDRY TRADE JOURNAL.

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RETIRED GENTLEMAN desires to purchase Moulds, Patterns Garden Ornaments and Illustrations of Bronzes, Medieval Knights in Armour, Cavaliers in ½ and ¾ life size. Ex Film Studio Models in Wood, Metal, etc., of early Elizabethan and Cromwellian Period. — Apply to S.M. & R., Hooper Street, Cambridge.

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GRAPHITE / PLUMBAGO: Qualities available for every industry; special Foundry Plumbago; your enquiries are welcomed and will receive personal service.—WOODSTOCK (LONDON), LIMITED, 33, The Little Boltons, London, S.W.10. FREmantle 6646-7.

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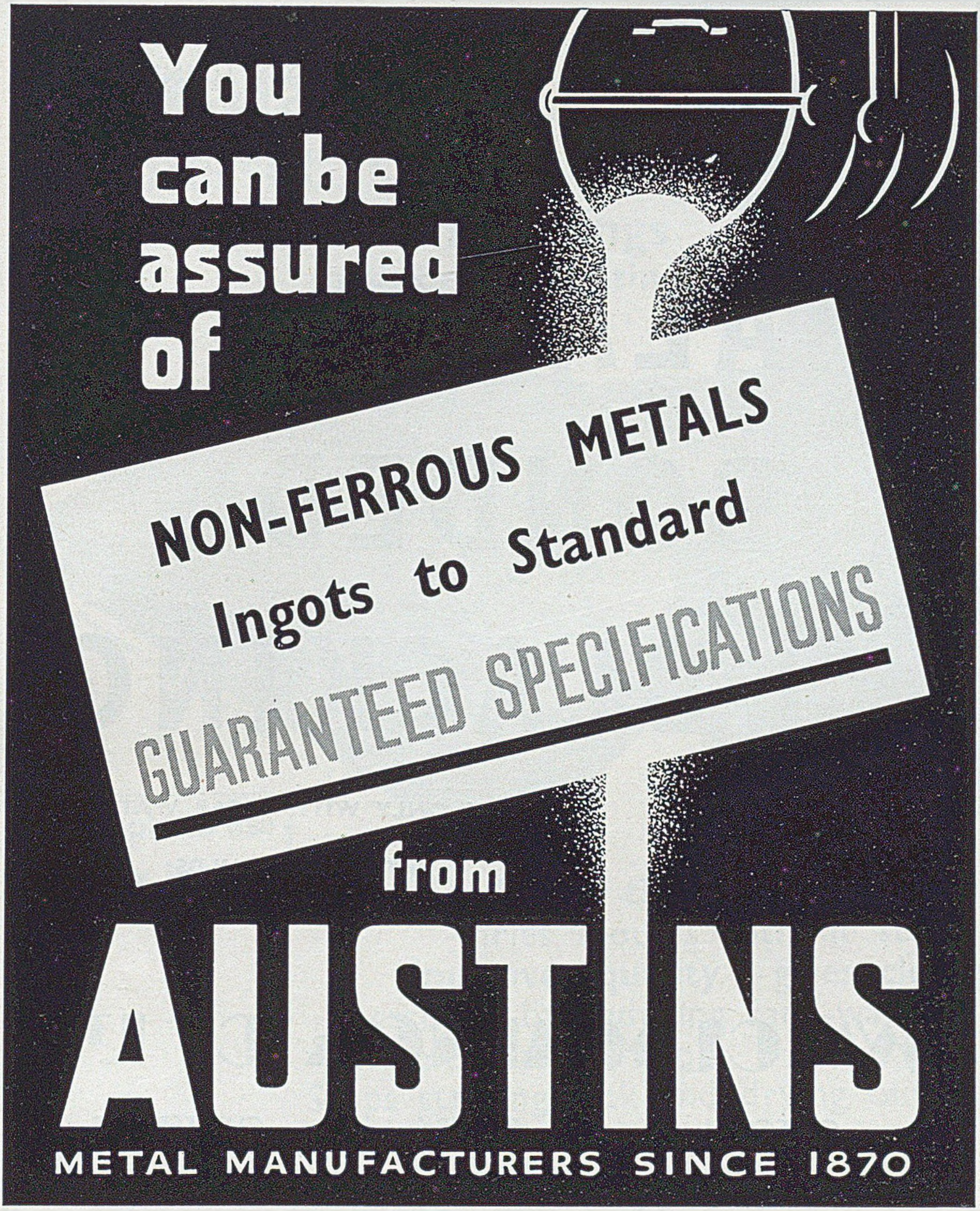
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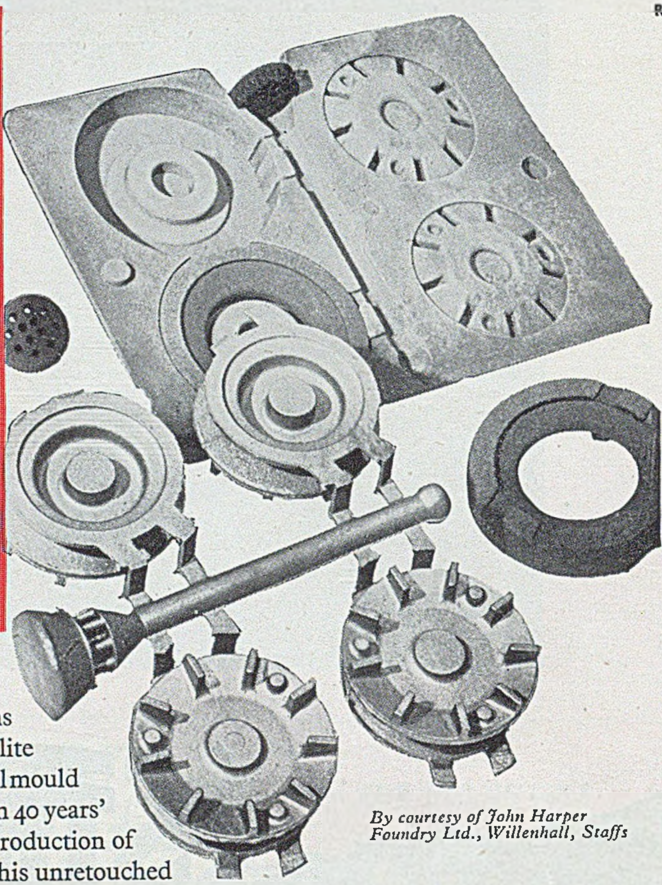

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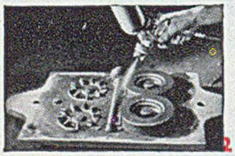

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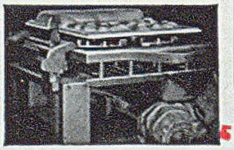

5

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1 The mixture of BAKELITE Resin and sand is poured into the Dump Bucket.
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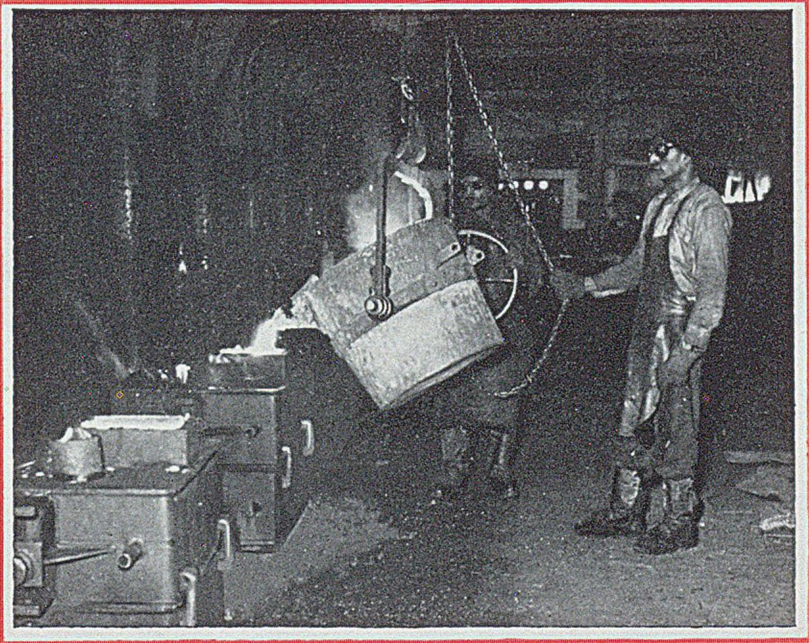

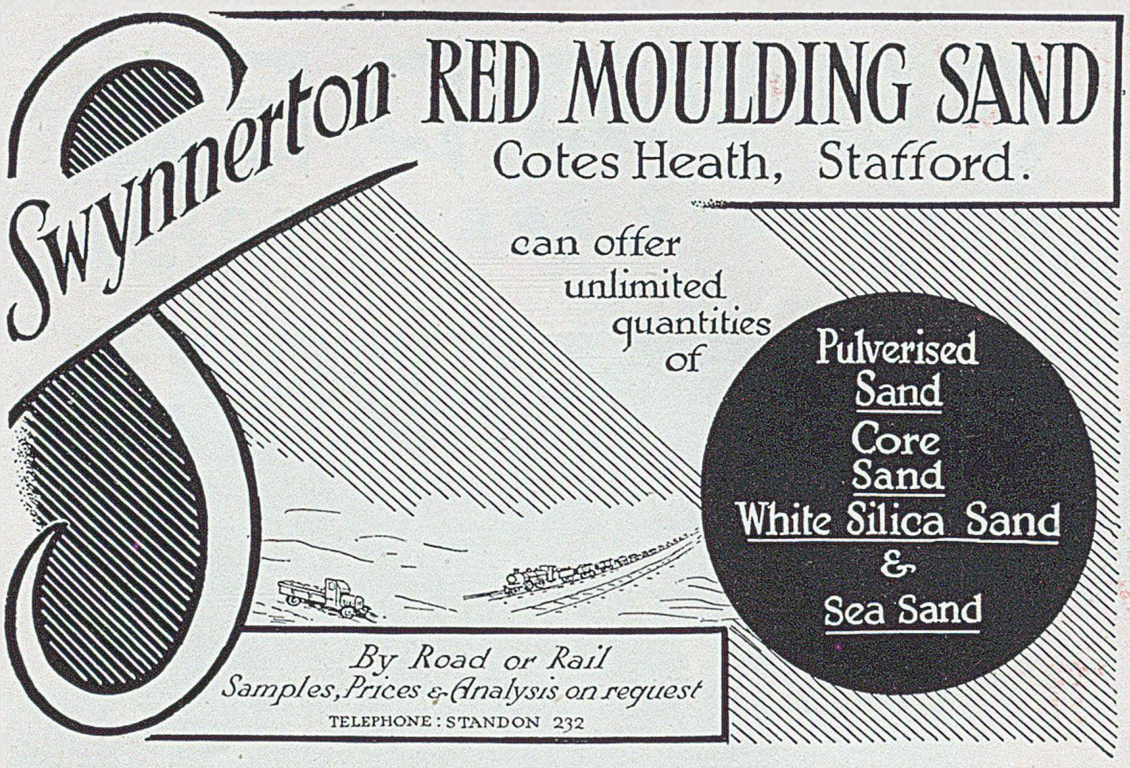
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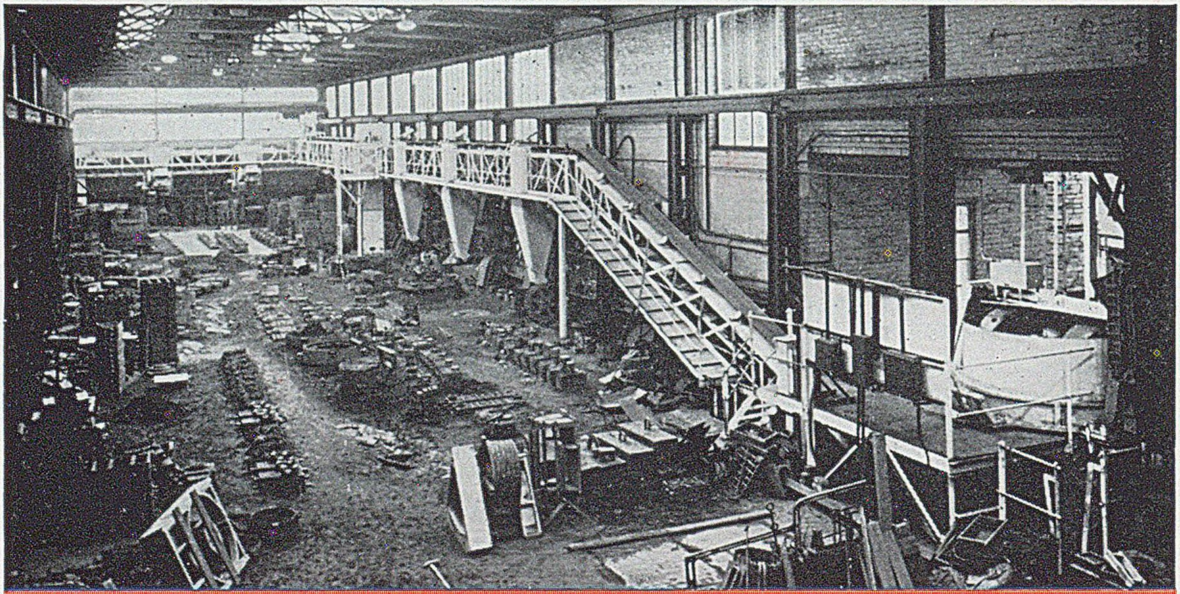

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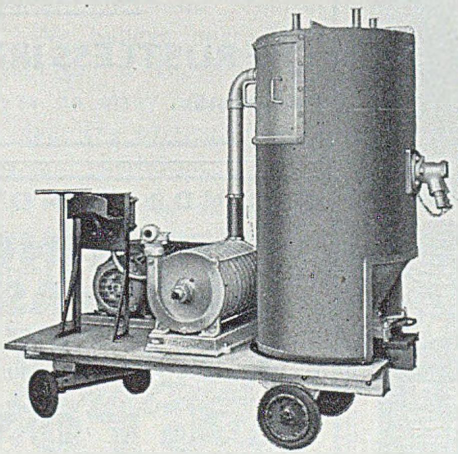

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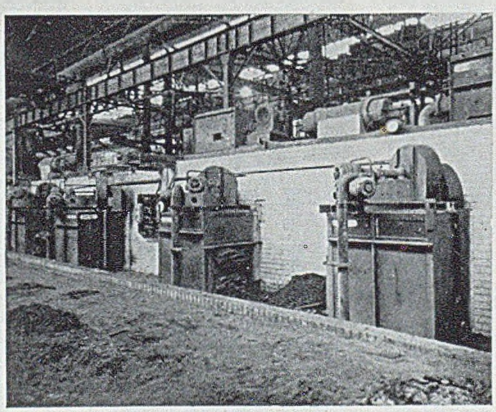

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