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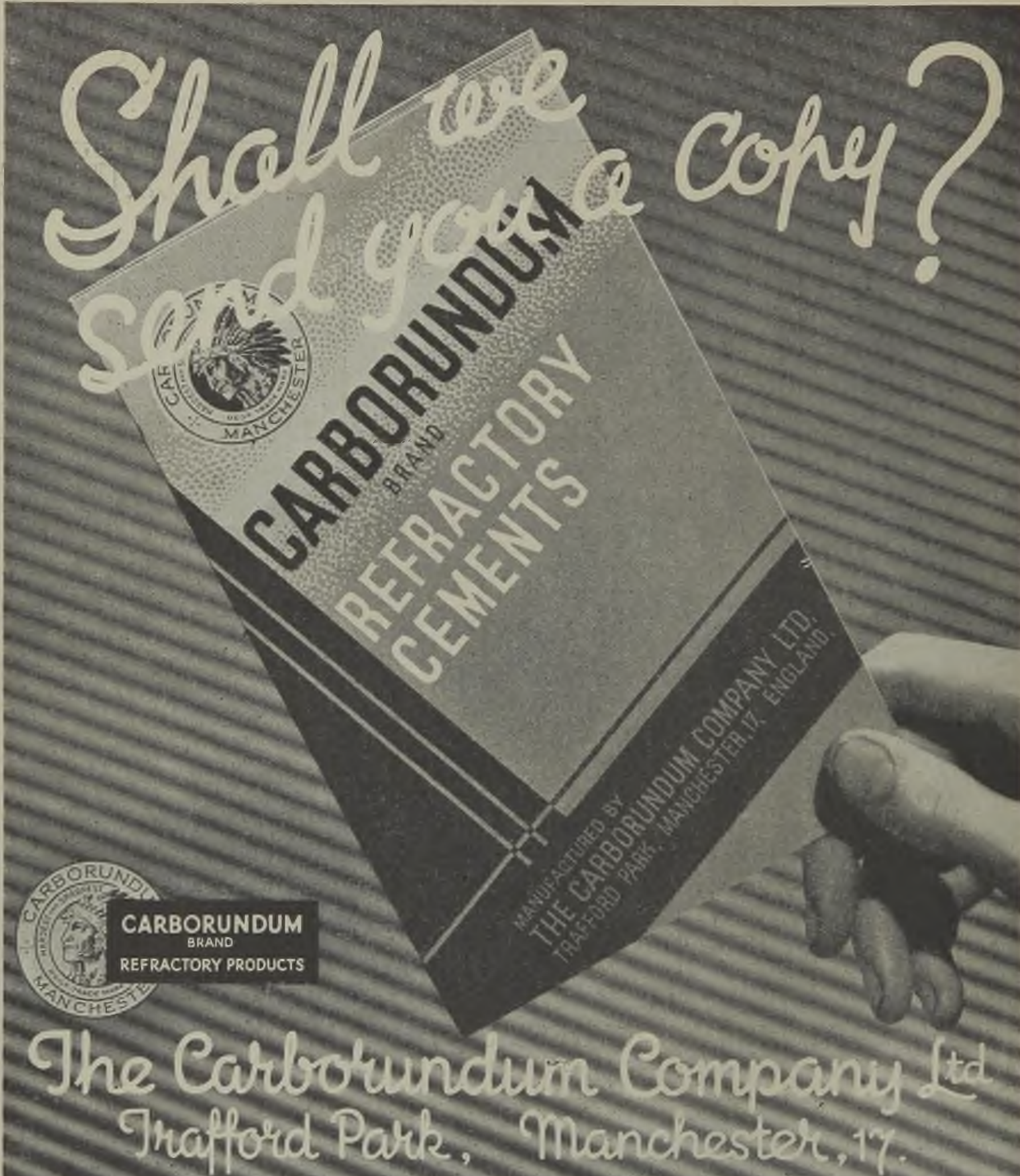
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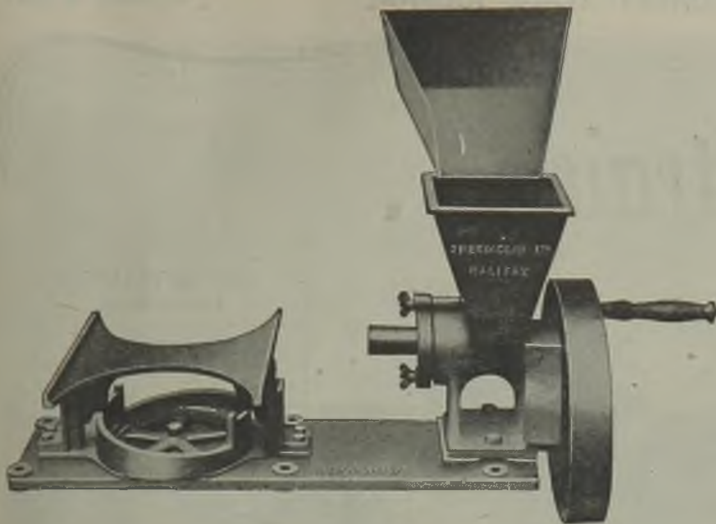

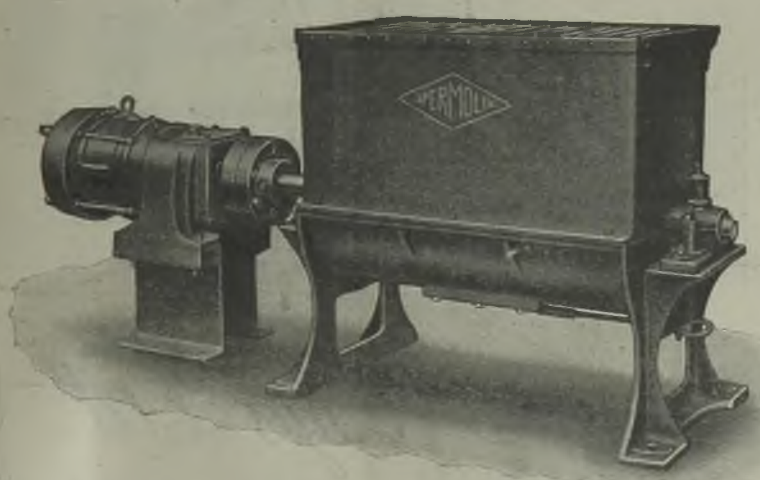

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In my train . . .

KAISER TRAINS
After the War

San Francisco, Tuesday — Mr. Henry J. Kaiser, the American record shipbuilder, said he is negotiating with a group of U.S. railway companies to build, after the war, fast, light-weight trains in yards now turning out ships. Some of these trains, built of new steel alloys and aluminium and magnesium, will have streamlined passenger coaches and will be so light that one engine will pull twice the number of cars now generally used —Reuter.

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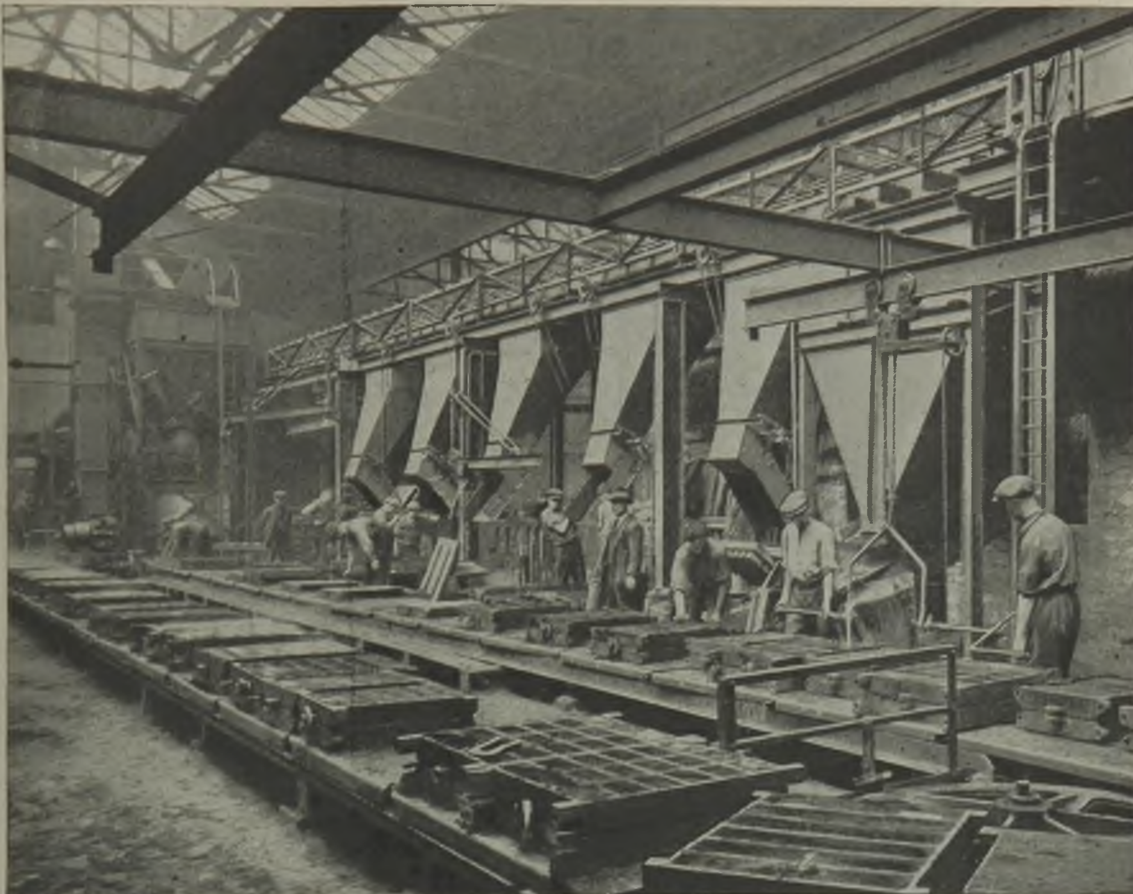

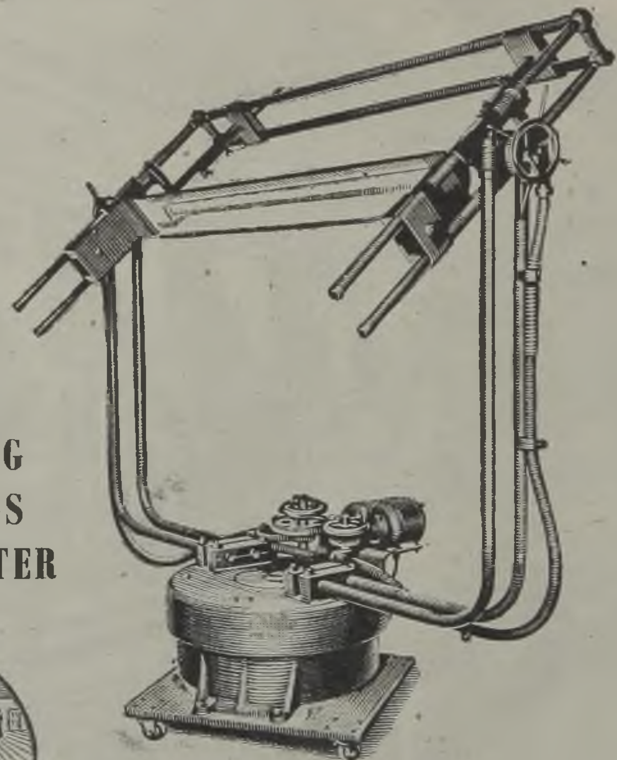

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Minimum Economic Manufacturing Capacity

In speeches dealing with post-war conditions, we have noted a tendency for the ominous phrase " minimum economic manufacturing capacity " to creep in. This can have no other implication that concerns below some unspecified size have no place in the future industrial set-up, because they cannot either make direct contribution to research programmes or indeed take advantage of published data, and therefore should cease to exist. This is pure nonsense, and makes us sceptical of such speaker's remarks as to the future welfare of this country being contingent on our ability to spend more money on research than the other fellow. A professor from a University in a country now in German occupation, recently made a plea for the provision of modern apparatus, thus re-echoing the demand of our own research workers for more and more instruments. Thus there is a second implication—equally ridiculous—that the value of research varies directly with the cost of the apparatus used for its prosecution. Yet it is an undeniable fact that some of the most valuable discoveries—radium, for example—were not made in white-tiled, air-conditioned, laboratories, but ill-equipped sheds. It is not only from the research angle that the efficiency of the small scale industrialist is being assailed, but also on the grounds that he cannot of himself be (nor can he employ specialists) so adaptable as to be expert in the multifarious activities demanded from a manufacturing concern. Only a superman could, at one and the same time, be a high grade technician, a cost accountant, a publicity expert, a sales manager, a buyer, a welfare officer, a canteen manager, and so forth.

In general, there is a belief that the back street industrialist does a few of these supremely well and neglects others. This is due to the assumption, not always well founded, that such people fall into one of two classes, the commercially-minded individual and the highly skilled technician. Yet a third is appearing, the young scientist who has set himself up in business, whilst the other classes are attracting his interest. This is a movement likely to gain ground. With the passing of time, every new piece of legislation impacts more drastically on the small scale manufacturer than on the larger concerns, yet with them come compensations. For instance, there has been, as a result, a definite increase in the value of the services rendered by the employers' associations. In this connection we need only cite the valuable work done by the Council of Ironfoundry Associations for the whole industry irrespective of whether a firm is or is not formally attached to one of its constituent bodies. Through its Fuel Committee consulting services of very great worth have been given quite freely to hundreds of small concerns. The greatest gains have not been reflected in a serious reduction in the actual fuel bill, but in a better technical appreciation of the various types of plant operated. Again, every ironfoundry should have by now received the post-war questionnaire issued by the C.F.A. Because of their quantity—for the small foundries vastly outnumber the larger concerns—this questionnaire should mirror the difficulties and ambitions of the rank and file of the ironfoundry industry. Especially important are the questions asked by Section V.

On completion, it should be interesting to compare the total expenditure deemed necessary to re-equip the ironfoundry industry with the five to six million pounds spent annually in recent years by the whole of the American foundry industry. In this connection it seems desirable to recapitulate what should be envisaged under this heading. Foundry equipment includes annealing ovens, wet and dry blast-cleaning equipment, briquetting plant

(*Continued overleaf, col.* 2.)

Contents

CORRESPONDENCE

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

"THE ECONOMIES OF THE SMALL CONCERN"

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I desire to challenge the statement made by Mr. D. Fleming, and published in THE FOUNDRY TRADE JOURNAL, dated May 4, 1944, that "a small business, no matter of what kind, could not be run at a high standard of efficiency."

Possibly many small foundry proprietors will assume that this is a rash statement by an inexperienced young man and think no more of it. But for many years your otherwise excellent Journal has spoken in a similar strain, if not perhaps so dogmatic, and maybe it is time the other side of the question was heard.

Now—what is the standard of efficiency?

Is it production per man? The small foundry proprietor knows his men and is able to get the best production possible. Investigation will show that Government departments or large firms with their own foundry for that matter, wanting a casting quickly, invariably go to the smaller concern. The necessary organisation of large firms prevents a job being taken into the foundry and made and cast while the customer waits in the office. Not only is a quick job more easily obtained from the small foundry, but job for job, man for man, and the small foundry will win on production. There is no room for anything "ca-canny" in the small shop. Alas! it is too often prevalent in large establishments.

Is is quality? Here you will find that the average small foundry makes an average casting in every way equal to the average large concern. Besides this there are as many specialities from the smaller foundries as from the larger ones. Admitted most larger concerns have their own laboratory staff—so have some smaller concerns, and some others make use of private consulting metallurgists.

Is it price? Here again there are equal pros and cons for both large and small foundries. Personally I am of the opinion that there are more price cutters amongst the large concerns than amongst the small. The worst price cutting in times of depression comes from the large engineering firm with its own foundry which takes in outside work in order to keep going.

This brings me to the subject of economies. Here is a pertinent question: Which foundries survived, paying 20s. in the £ during the 1930 slump? I give every respect to the large concerns that did this, but, generally speaking, it was the small concerns, with their low overheads, that weathered that terrible storm. Foundries run by one man or with the help of his family were here before the war, are here now, and will be here after the war, yes even after many larger concerns have amalgamated for "economic" reasons. Anybody can keep going during a boom—the acid test of economies is the time of depression.

I have written the above from experience, having run a prosperous small foundry in peacetime conditions as well as in war, and have also weathered the storm of trade depression, even though it meant myself being my own moulding department, core-making department, furnacemen, clerical staff, etc.—in other words, a one-man foundry. Don't let anyone despise the one-man foundry.

Apart from the above I have no wish to detract from the substance of Mr. Fleming's splendid Paper.

Yours, etc.,

V. MOYLE.

"Wistaria," 38, Park Road, Hampton Wick,
near Kingston-on-Thames.
May 8, 1944.

[EDITOR'S NOTE.—By a coincidence, we had chosen this very subject for an editorial before the receipt of Mr. Moyle's letter.]

B.C.I.R.A. ELECTS NEW MEMBERS

The following firms have recently been elected members of the British Cast Iron Research Association. The official representatives are shown between brackets:—Ordinary Members: Hamworthy Engineering Company, Limited, Poole, Dorset (Mr. P. F. Hall); William Harper, Son & Company (Willenhall), Limited, Willenhall (Mr. Fred Harper); and Horseley Bridge & Thomas Piggot, Limited, Tipton (Mr. A. Dyson).

As Trade or User Members: Enfield Cycle Company, Limited, Redditch (Mr. R. A. Wilson Jones); the Kennedy Press, Limited, Manchester (Mr. C. A. Otto).

At the end of 1943, American producers of jobbing equipment had sufficient orders in hand to keep them busy for ten months. Apparently the foundry industry in the United States is buying between £5,000,000 and £6,000,000's worth of new equipment annually.

MINIMUM ECONOMIC MANUFACTURING CAPACITY

(*Continued from previous page.*)

for borings, core-making and core-crushing machines, borings, *dust-collecting equipment,* ladles, moulding machines, conveyors, cranes, moulding boxes, core ovens and drying stoves, sand-reclaiming equipment, sand-handling and sand-preparation plant, including magnetic separators, knock-out equipment, modern tumbling barrels, core blowers, and core wire straighteners. This list is by no means complete, but any mental effort made towards elaboration will serve the purpose we have in mind. By co-operating to the fullest extent with the various bodies co-ordinated under the ægis of the C.F.A., the small scale foundry owner will find his difficulties a little easier of solution and his industrial ambitions a little less difficult to attain.

MECHANICAL AIDS TO CORE PRODUCTION*

Position of the foundry industry in the light of mechanical advancement during the last century

By J. BLAKISTON, A.I.Mech.E.

INTRODUCTION

Founding has always been a basic industry and shares with the forge the distinction of being the origin of mechanical engineering, all advancements being merely improvements and refinements of these methods of mechanical creation. With the vast mechanical advancement that has taken place during the last century, the necessity of the foundry has always been apparent, but, unfortunately, in some periods this branch of engineering science has had to be dragged along reluctantly to keep up with this progress, and, while new production methods and processes have been acclaimed to the skies and predicted to be the death-knell of founding, this old and tried servant still quietly remains, and is likely to continue in some form as long as this is a mechanical world.

During the last four decades the founding industry has passed through three upheavals, and after adapting itself creditably to the changed conditions, has successfully survived. The first great change was occasioned by the introduction of the steam turbine and the establishment of the electrical age. The massive reciprocating engines, with their huge cast components, were displaced by the light and simpler turbines. The solution of cheap electricity manufacture opened the field for the specialist electrical foundries, which more than compensated for the loss of the former bulky castings. This change saw the introduction of mechanised moulding and conveyor methods in the more advanced plants, but influenced general ironfounders very slightly, if at all.

The second occasion of note was the universal introduction of the motor-car, the engineering unit of which was designed from a production viewpoint, this being imperative in order to bring its selling price within the reach of the general public.

This trend in engineering led to a demand for very light, thin section, intricate cored castings; in many cases the core shop becoming the major and largest section of the foundry. This period witnessed the universal adoption of oil-sand practice, a practice which has enabled the foundry to meet the changing demands to an extent which is rarely realised. Motor-vehicle foundries are highly specialised plants fully mechanised in all sections, making as few as two or three types of intricate components at a time in thousands at extremely economical prices. Both ferrous and, subsequently, light alloys which were demanded by the rapid development of the aircraft industry have been adapted to these manufacturing methods.

* A Paper read before the East Midlands Branch of the Institute of British Foundrymen, Mr. W. H. Smith presiding.

The next change was more gradual and embraced a wider range of commodities, but can be summarised by the wider use of mechanical moulding and casting appliances. The most outstanding examples are the centrifugal casting of pipes with the elimination of cores, and automatic die-casting machines working increasingly higher melting-point alloys as metallurgical knowledge has advanced.

This development has eliminated sand moulds as known, but requires a technical combination of the foundry and the tool room. The plastic industry is an off-shoot of this development, phenolic resins, etc., being substituted as a casting medium, a trio being made up by the chemist.

Transitional Period

The transition which is at present taking place will not fully define itself until after the war, but appears to take three courses, firstly, the extension of machine and production moulding to larger components in both specialised and general foundries. This, even now, is extended to the mass production of gun turrets in armour steel formerly manufactured by fabrication methods. Figs. 1A, 1B and 1C show line production of heavy milling machines, every casting component being designed for and manufactured by mechanical moulding methods.

Secondly, the extension of centrifugal casting to a greater variety of components, utilising alloy steels, large gun barrels[1] down to small cluster gears being produced by this method.

Thirdly, the general use of high-duty grey iron in different forms irrespective of intricacy, retaining the primary moulding methods of production, but taking advantage of modern mechanised labour-saving devices, at the same time not losing sight of the prime asset of the general foundry, namely, adaptability.

It is the object of this Paper to record various methods whereby advantage can be taken along these lines, particularly in the core-making section of the general foundry, a section which has in many cases been lamentably neglected, forcing many foundries into liquidation.

The present trend is such that in many cases the tonnage of cores required exceeds the final tonnage of castings obtained, reducing the foundry output, on account of lack of core-making facilities, to uneconomic levels.

The older type of foundry has very limited facilities for core-making, a stove of doubtful thermal efficiency and limited capacity being placed in any convenient, or inconvenient, part of the building, small cores being carried from a lean-to shed, perhaps at the other end of the shop, the operators carrying their own cores

Mechanical Aids to Core Production

on completion into the stove, carefully avoiding their comrades dispersed about the floor in any open space available, and probably damaging their own and any other cores *en route*.

The above state of affairs is unfortunately not the exception, and is still tolerated in many foundries to-day, but latterly, happily, a greater effort, probably on account of proposed industrial legislation, has been made for this black section of the industry to rehabilitate itself. A foundry adapting itself to these new conditions should not decrease its productive mould area to assist core-making, but use available space conveniently adjacent to this area, and deliver the cores completely baked, inspected, and in sets, to the foundry proper.

FIG. 1A.—LINE PRODUCTION OF HEAVY MILLING MACHINE CASTINGS.

"Coreitis"

The use of electric man-operated cranes should be avoided on account of the capital and operating costs, if other suitable lifting devices can be used; the cranes should be confined to mould closing and casting operations. A constant watch should be kept against "coreitis," *i.e.*, the uneconomical use of cores to save some person the trouble of an efficient mould set-up.

Fig. 2 illustrates this term graphically; *A* shows a simple cover, which, irrespective of the number required, will mould quickly and strip itself. A component like this should not be cover or block cored under any consideration, as it will save neither pattern time, total moulding and core-making time, nor moulding material cost; *B* shows a similar cover with an internal return flange, and the same remarks apply, with the exception that, if large numbers are required, a cover core may be justified to facilitate a moulding machine set-up, but even this would be debatable.

Perhaps in this case the designer should be tactfully told that a large reduction in production cost would ensue if an external flange was substituted. Underneath is shown an intricate intermediate slide machined on most faces and containing numerous pocket cores. This casting was made in several foundries with little success from both the production and the soundness viewpoint. It is a case where a cover core was justified, and on introduction most of the early troubles were eliminated and a good production rate obtained.

A set-up of these cover cores is shown alongside with internal cores attached, so that the whole unit is ready for dropping into the mould. These moulds are made in tandem on a large moulding machine.

Internal Transport

The up-to-date core shop or portion of the foundry allocated for this purpose should have a concrete or

FIG. 1B.—MOULDING MACHINE FOR HEAVY MILLING MACHINE CASTINGS.

plated floor, first, to assist cleanliness which is essential for good workmanship and, secondly, to facilitate transport, even if this is only a pneumatic-tyred wheelbarrow or platform truck. Internal transport is the key factor for speedier production, and nowhere does this apply more keenly than in the core shop. There are many simple and well-tried systems, and in a well-conducted shop there should be no justification for skilled operators or labourers carrying either core materials or cores any distance.

On account of platform, pendulum and other power-driven forms of conveyor of these types being too expensive and elaborate for the general ironfounder, it is not proposed to go into the details of these.[2]

Steel Band Conveyors

Fig. 3 shows the flat steel band type of conveyor, which is about the only type of power conveyor suitable for the general foundry. This is a very simple piece of mechanism, consisting of a cork-coated driving pulley and a suitable belt pulley for tension. The steel belt is supported on wood skids, its drawbacks being that it will not turn from the parallel, and its susceptibility to heat which causes it to run out of alignment. It cannot be interrupted, and so forms a demarcation line which may or may not be an advantage in a building.

Gravity Roller Conveyors

Perhaps the most universal conveyor is the common gravity type of roller conveyor. This can be obtained from many sources in various sizes and quality. Curves, right-angle bends, turntables, hinged openings and single or tandem forms can be obtained in stock sizes, and no foundry could not justify its use, no matter how limited, in one of its departments. No power is required for its operation; considerable

Fig. 1c.—Standard Box Parts for Heavy Milling Machine Castings.

weights can be easily pushed along, or by a slight gradient made to travel by means of gravity.

The first observation made by the core-maker is that the vibration will shutter any core no matter how strong, but practice has proved that any core will stand an amazing amount of apparent rough usage on this type of conveyor, provided that certain precautions are taken. These are:—(*a*) The work should be planned so that the weakest cores have the shortest distance to travel; (*b*) correctly designed core plates; and (*c*) correct spacing of rollers—all assuming that the sand bond is correct.

Fig. 4 shows the spacing of rollers, which should be such that the shortest core plate in use will span three rollers, as shown in the topmost diagram. Too wide spacing causes the plate to strike the rollers, causing a jolting action, as in the central sketch, while too many rollers, apart from becoming uneconomic, create an unnecessary number of vibrations to the core when travelling a given distance. The coreplates should have machined runners underneath with a slight relief at each end to smooth the initial roller contact. The runners are placed a little distance from the sides of the plates, so that visible evidence of the core plate being too near the side of the conveyor is seen before it drops over the roller sides.

Core Plates

It is very important that a correct form of core plate is used, both to conform to the conveyor system and to suit the drying methods adopted. Standard size plates are to be preferred, made from cast iron so that breakage will occur in preference to warping. The core face of the plate should be machined as well as the runner strips, and suitably spaced holes distributed over the surface to facilitate the more efficient drying of the core. Corebox location and guide holes may also require to be drilled in these plates. The back setting of the runners is very beneficial for lifting plates from the ground or benches by hand or by means of claw hooks.

The foregoing core plate details, although referred

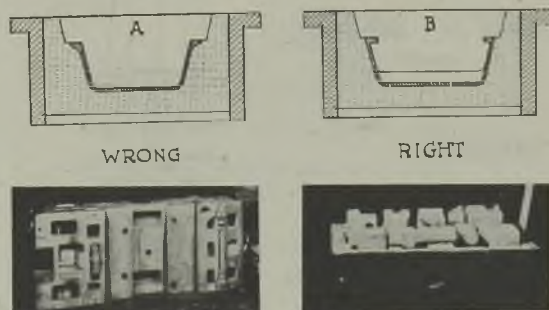


Fig. 2.—"Composite" Block Cores.

to in conjunction with conveyors, are vital to good quality core production. Sections of gravity conveyor can, if required, be mounted on transfer bogies which, apart from breaking the continuity of the conveyor and permitting freer movement of personnel, can be such that novel distribution possibilities can be developed.

Light Railways

The old seemingly forgotten system of light railways, common in nearly all engineering shops several decades ago, is still an excellent method of shop transport, and the decline of popularity is not easy to understand. Modern ball bearing bogies, low upkeep, operating costs and low first capital cost, appear to offer every financial incentive, while the complaint that they cause congestion in the floor space is hard to substantiate, as turntable side tracks are easily provided. Furthermore, the efficient operation of any system demands that the track and gangways must be kept clear. This system is incorporated into a shop layout shown and discussed later.

Mechanical Aids to Core Production

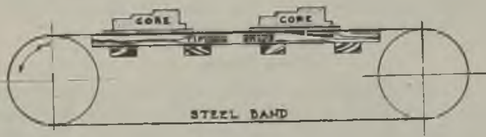


FIG. 3.—BAND CONVEYOR.

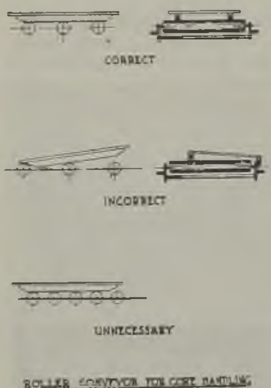


FIG. 4.—ROLLER CONVEYOR.

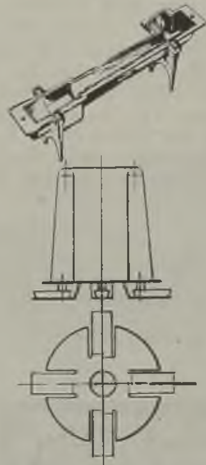


FIG. 5.—CORE CARRIERS.

Latterly there seems to have been a revival of this system in some of the newer American mass production foundries.[3] Gaps and diverting arrangements are made in a continuous bogie conveyor system linking it into a shop rail system, permitting lags in continuity to be neutralised by means of reservoir sidings.

The importance of correctly designed core plates has already been noted. Specialised types known as carriers are often used to eliminate the sand packing of special shaped cores and to minimise shuttering where large numbers and accuracy are required. These carriers also come into the same category as metallic inserts used to support overhangings, and are removed after the core is dried.

Fig. 5 shows two types of carrier. The upper serves the purpose of a half corebox as well as that of carrier, and is drilled to match the mating dowels of the other half which is common to all carriers for this component; the lower one serves the purpose of carrier only, and that depicted is for a blast-furnace tuyere core, a very difficult core to handle on account of its shape and friability. This is placed on the top of the core as made, and after turning over to the position shown, the special metal corebox is stripped away, leaving the core on the carrier adequately supported for drying and transport. The accuracy of the core can be held to very close limits by the general use of these carrier plates, particularly where the core has no flat face to place on a standard plate.

Core Benches

After the most convenient conveyor layout has been established, the disposition and fittings required by the core benches have to be considered. These should be adjacent to the reception conveyor, and the supply of material and core plates should be such that the operator has no need to leave his or her work. Benches can be very elaborately designed to cope with special components, but these points are common, irrespective of the work carried out. The bench should be the correct height, dependent upon the height of the average corebox used. It should be cut away underneath, so that the operator can stand close over the work and be in a position to lift weights without risk or strain. The bench may be fitted with shelves for hand tools and loose corebox pieces, and can have hoppers for sand, ashes, or any other material incorporated in its construction.

The bench may be fitted with small tools consisting of:—Pneumatic or mechan-

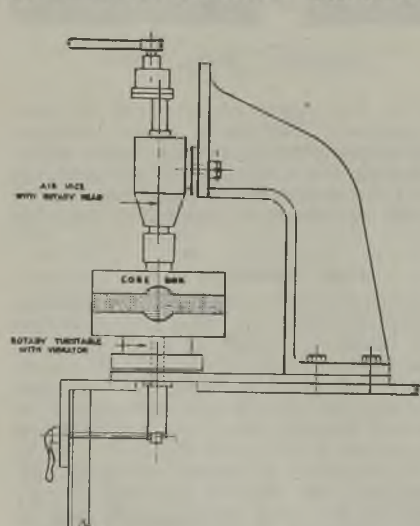


FIG. 6.—VICES AND VIBRATORS.

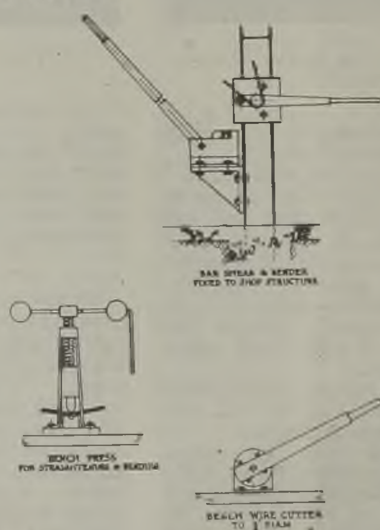


FIG. 7.—BENDING AND CUTTING MACHINES.

ical vices; pneumatic or mechanical clamps; wire cut-off machines; rod and wire benders; jolt plates; abrasive core-cutting machines; bench and stand vibrators; blacking spray guns; mallets; portable sanders; pneumatic rammers; pneumatic blow guns, etc.

Considering some of these small tools as listed; pneumatic vices and clamps are a great time saver and eliminate damage done to wooden coreboxes by the use of dogs, which rapidly disintegrate the strongest coreboxes. Fig. 6 shows a combined clamp and vibrator known as the Newman.[4] This device is particularly adaptable for valve and cock cores, the two half coreboxes being filled with sand, placed together and clamped in the machine, the ends being tucked, reinforcements inserted, and the necessary venting completed. The vibrator is then operated by knee pressure. After this operation the vice is released and the core stripped on to a convenient plate. It will be seen that no mechanical stripping takes place, but the hand operation of clamping and rapping is eliminated, giving a more consistent core without fatiguing the operator and so benefitting output.

FIG. 8.—BLACKING SPRAY AND BENCH JOLTER.

Core rods, wire and similar reinforcements are constantly used for all cores. These require cutting and bending to various shapes and sizes, and Fig. 7 shows typical machines for this purpose. They can be fitted to a convenient shop stanchion, or to any bench direct. Where reinforcements are required of a consistent shape, special bending jigs should be provided. These simple machines which are not often found in the average foundry are wonderful time savers; their first cost is negligible, being generally shillings.

There seems to be an accepted fallacy that cores, on account of the iron and internal ashes content, cannot be jolted, but with properly green bonded sands, small jolt plates will be found to be very efficient.

Spray Guns

Pneumatic paint spray guns will apply foundry blacking evenly and quickly to green cores without damage, but, unfortunately, some of the spray gun manufacturers have lately adopted a corrosive light alloy for their guns, much to their detriment for this purpose, as when they were made from bronze they gave years of trouble-free service. Fig. 8 shows one of these sprays in action; in the background can be seen a girl operating a bench jolter. There is some prejudice against blacking cores in their green state on account of there being no visible evidence of burning after they have been baked; this danger can be successfully overcome by pyrometer and temperature control of the drying stoves.

For dressing and cutting, abrasive wheels are used on portable machines or on fixed stands. Fig. 9 shows a typical core bench fitted with guide vibrators. These guides are in the form of a serrated plate with an angle corner against which the box is pressed when being lifted by hand, the vibrator being knee operated. This gives a straight draw with constant rapping.

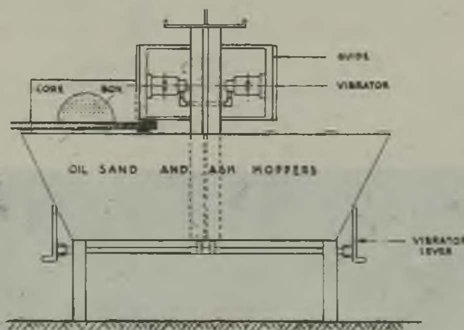


FIG. 9.—CORE BENCH.

Core Moulding Machines

As practically any type of the many foundry moulding machines can be adapted to coremaking, and as each type of machine warrants a Paper in itself, it is proposed only to generalise them for the purpose of this Paper. Moulding machines adapted for coremaking need only be of the light type, but a turnover motion is most important, as this saves a crane lift on the larger cores and eliminates distortion caused by this crude method of turnover. There are very few machines that can give greater production than hand methods on the small cores, especially when the auxiliary aids already described are used, though strip machines are sometimes justified when a difficult draw is encountered, or in all cases when the total weight of plate, corebox, sand contents, etc., is greater than can be handled manually.

A portable Farwell type of turnover machine is probably the most useful unit for the general machine

Mechanical Aids to Core Production

moulding of cores. A machine that can be truly called a 100 per cent. coremaking machine is shown of Fig. 10. Divers shaped dies with their corresponding

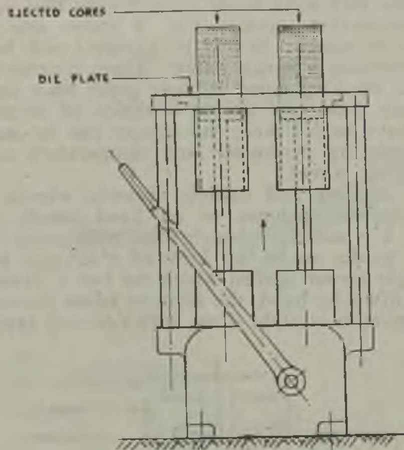


FIG. 10.—CORE MACHINE.

FIG. 11.—TURNOVER DEVICE.

shaped pistons can be readily interchanged, the core, which is rammed by hand, being ejected by movement of the lever which can be set to give any length of core within the capacity of the machine.

This machine can also be used for force-venting, the core already rammed in the corebox being clipped on the table and rods of small diameter used in place of the pistons. These rods are forced through the core by operating the hand lever, both venting and packing the sand tighter in the corebox.

When a core is made, the various parts and tackle, *i.e.*, core plate, box, sand, irons, etc., can be generally handled manually until the turning over operation is reached when the cumulative weight has to be handled; this generally necessitates a crane lift, which, apart from the financial outlay, is likely to cause waiting time. After this turnover takes place, the normal operations can proceed by manual handling until the completed core has to be moved for drying.

Turnover Cages

A mechanical turnover cage which has proved extremely successful in operation is shown in Fig. 11. After the core has been rammed and the plate has been placed on the box, the unit is pushed into the cage and two clamps are brought down to it by means of a handwheel, the machine having a capacity for accommodating boxes of widely varying depths without any additional setting. The cage then revolves through 180 deg. and the clamps are released lowering the plate with the core now on top to the level of the exit roller track. The corebox, if desired, can be attached before turning over, which enables the clamp release to act also as a stripping motion. This turnover gear will operate on cores up to 10 cwts. with ease, and no power assistance is needed. The illustration also shows a jolter operating in conjunction with this set up, the whole unit forming a station for the speedy manufacture of medium weight cores.

FIG. 12.—CHARGING DEVICE.

The next crane lift would normally be that required to place the core into the stove, or on to a stove bogie. This crane lift can be eliminated by means of a charging machine, as illustrated in Fig. 12. This charging machine consists of a stepped fork which can drop below the level of the conveyor rollers, or be otherwise conveniently inserted under a core plate. This fork is cantilevered in front of a rack friction hoist which operates on the same principle as a crane brake, insomuch that it locks automatically in any position. The structure is suspended from an overhead runway, and the cantilever portion can project some distance inside

(*Continued on page* 56, *col.* 1.)

CUPOLA PRACTICE*

By DONALD J. REESE

(Chief, Manufacture and Foundry Products Section, Metallurgical and Conservation Branch, Steel Division, War Production Board, on loan from the International Nickel Company and a member of the Technical Committee, Gray Iron Founders' Society, Inc.)

The author reviews some phases of cupola practice worth checking and suggests that any deficiencies in the standards outlined should be made good

The cupola has always been the standard melting furnace in the grey-iron foundry, and it is felt that many foundrymen have been apologetic, from time to time, for continuing to use this type of furnace when finances and competition have given them cause to look into the possibility of using some other type of melting furnace. Twenty years ago one would look far and wide to find a cupola anywhere except in a grey-iron foundry or in melting iron for the Bessemer charge in a steelworks producing Bessemer steel. To-day, the cupola is not limited to the grey-iron industry. Close on 90 per cent. of this year's total production of malleable iron will be produced by the duplexing process involving cupolas. Numbers of steelworks are using cupolas to produce hot metal for electric or open-hearth furnaces or triplex steel-making processes. It is being used to melt bronze, insulating materials as "mineral wood" and elsewhere, such as in the production of wrought iron. Foundrymen might be less apologetic for using a cupola to melt grey iron if they realised that its field of use was broadening, but even this increased use of the cupola would not justify their continuation of its use to melt grey iron. That it is eminently adapted to melting the iron-carbon-silicon alloy in the percentages of elements which make grey iron, and that it probably is better adapted to melting this type of alloy than any other type of melting furnace, is sufficient reason why this type of furnace should continue to be the standard melting furnace of the grey-iron foundry industry.

The reasons for using cupola melting equipment are many and diverse, and not all reasons may be pertinent to any one application, but all these reasons should be known to the cupola operator in order that each one may be employed as the occasion may require.

Continuous Melting Furnace

The cupola is the only melting furnace which may be accurately termed a continuous melting furnace. After a brief adjustment period at the start of melting period, usable metal is being produced every minute the furnace is in service and the continuity of this melting operation may continue for hours or days, weeks or months. Most grey-iron foundry operations are based on working one or two 8-hr. shifts a day and, consequently, the need for metal may be satisfied with a few hours' melting up to 16 hours of melting, but where there is a need for metal over a 24-hr. day for long periods of operation, the cupola can be, and has been, employed in this service. Blast furnaces are frequently in continuous service for three to seven years before they are shut down for relining, and should the occasion ever arise to employ a cupola in continuous operation for periods equivalent to those of a blast furnace, it will only be necessary to select the proper refractories and provide sufficient water cooling of refractories. The Author recently saw a cupola that had seen several thousand hours of continuous service. Fireclay refractories were used.

The Cupola's Ability to Do Work

The cupola's nominal melting performance is 0.75 ton of metal per sq. ft. of cupola area per hr. Many cupola operations are directed to the production of 1.0 ton of metal per sq. ft. per hr. Any other type of melting furnace is a very poor second to the cupola on the basis of work done per unit of area per unit of time when converting cold metals to fluid metal at high temperature of the desired analysis and cleanliness. It was not uncommon in the motor-vehicle industry for a medium-size cupola, 72-in. inside diameter, to melt 500 tons of metal in a 16-hr. day. To-day there are some larger cupolas, lined to 103-in. inside diameter; and if one of these cupolas was operated as the motor-vehicle industry has operated its cupolas, it could melt 1,500 tons of metal in a 24-hr. day. When one envisages the melting of 100, or 500, or 1,500 tons of metal a day in one cupola, all one needs do to appraise the cupola's ability to do work is figure out how many furnaces would be needed to do this job if some other type of furnace was used. The ability of the cupola to do work is something like 8 or 10 times other types of furnaces.

The cost of converting cold materials into hot metal of the desired analysis and temperature is less than any other type of melting furnace, and is usually of the order of 7s. to 12s. 6d. per ton of hot metal, being lowest when large tonnages are melted. Comparable convertions costs in other types of melting furnaces range from £1 to £8 per ton of hot metal.

The capital investment in cupola melting equipment is low, but when the operations are large enough to justify materials handling equipment in the form of mechanical charging equipment or when the cupola air supply is preheated or conditioned to a uniform moisture content, the capital investment can be a very appreciable figure.

A corollary to the cupola's ability to do work is that

* Extracted from an Address given before a Meeting of the Quad City Chapter, American Foundrymen's Association, April 17, 1944, Hotel Fort Armstrong, Rock Island, Illinois.

Cupola Practice

it is a high-speed melting process. The time that metal at high temperature is exposed to the influence of hydrogen or other gases is very, very brief in the cupola melting process and is more favourable than the air furnace or electric furnace. The quality of the product made in the cupola is partially dependent on the analysis of this product, particularly carbon. When there is a failure to grasp the importance of synchronising various operating details to the high-speed melting operations, there is also a failure to produce products of consistent carbon contents, whatever the desired level of carbon may be, and subsequently one fails to produce the higher quality products that can be produced in this type of melting furnace.

The cupola has an unusual ability to convert the less desirable forms of scrap into usable products. long ago the Author inspected a cupola melting several hundreds of tons a day, in which 80 per cent. of the charge was loose steel turnings and flashings. Steel turnings alone amounted to 65 per cent. of the charge. At this time of the operation the cupola pressure was 24 ozs., but it had been higher than 48 ozs. Melting losses of iron, silicon and manganese were no more than normal. The roof around the cupola (or any other place) was not covered with these finely divided materials. This is not a recommendation that foundrymen should utilise large percentages of finely divided materials in melting operations, as it is thought this operation is probably beyond general willingness to accept as fact. For those who accept the Author as an honest reporter, it will point the way to what can be done as future operations may require.

It was less than three years ago that the speaker was in the foundry of a company producing considerable structural steel scrap in their manufacturing operations. At the same time that every pound of this structural steel scrap was being sold, the purchasing department was scouring around the countryside trying to get steel rail for the foundry's melting department. This foundry could have utilised every pound of the structural steel scrap this company generated, and it would not only have stopped selling one type of steel scrap at a low price while buying another type of steel scrap at a higher price, but the structural steel scrap was a more desirable scrap for their end product.

The essentials of good cupola practice are of such an elementary nature that an adult mind is hardly willing to give them the thought and rigid adherence in practice that they deserve.

Accurate Weighing of Raw Materials

The Author has been in a great many foundries, and in some other industries utilising cupola melting equipment, and the simple function of accurate weighing of materials just does not exist. A few years ago he had occasion to help to correct a very bad cupola melting practice and, before taking on the job of operating the cupola, he spent the previous day rehearsing the essentials of good cupola practice with the various men in the organisation concerned with the troubles they were having. They had a yard foreman who was responsible for making up the cupola charges. When challenged on his ability to weigh materials accurately, the Author unwittingly accepted his declaration that he would guarantee to weigh materials within a 2 per cent. weighing error. It was desired to use 75-lb. coke charges and his guarantee to weigh within a 2 per cent. weighing error meant that this fuel charge would be within 73.5 and 76.5 lbs. The next day, to the charging floor they were sending coke charges up in industrial cars holding four coke charges per car, and there seemed to be a tremendous difference in the visual size of one coke charge with another; and when the Author re-challenged the yard foreman, he insisted on the accuracy of the weights of the 75-lb. coke charges. In desperation four burlap sacks were obtained and all four coke charges were taken from one industrial car and each charge put in a separate bag and another scale was found on which to weigh them. Not one of the four charges weighed as much as 75 lbs., and some as little as 37 lbs. When the importance of weighing is emphasised, it is not only because a personal examination has been made into foundry methods of weighing, but in this work the Author has had to take the bitter with the sweet.

There is no desire to give the impression that all charging scales are not good; they actually may be brand new scales of the best type that money can buy. Just as important in the problem of accurate weighing as a deficient scale may be the technique employed in weighing on a very fine scale. For example, if it is necessary to weigh 100 lbs. of coke, one might place the coke directly on a scale platform, and if the scale was reasonably well serviced and of low enough capacity to weigh 100 lbs., there might be little doubt about the 100-lb. weight of coke. In this case everything, or 100 per cent., of the scale load is "live load." But usually coke is not weighed directly on a scale platform, and a common method is to put coke in a wheelbarrow and weigh both coke and wheelbarrow. Let it be assumed that the wheelbarrow weighs 100 lbs. and 100 lbs. of coke is desired. The total weight on the scale platform is 200 lbs., but the live load is only 50 per cent. of the load actually weighed. Let it further be assumed that one does not weigh the wheelbarrow after each weighing, and also that the dead weight of the wheelbarrow is accounted for by a counterweight on the scale. Even this reasonably satisfactory method of weighing develops inaccuracies if there are five or six wheelbarrows whose weights range from 90 to 110 lbs. and they are all averaged at 100 lbs. In this case the live sale load of coke intended to be 100 lbs. may be as much as 110 lbs. or as little as 90 lbs. Next, suppose there is an industrial car or charging bucket which weighs 1,000 lbs. and it is desired to weigh 100 lbs. of coke. The total weight on the scale is 1,100 lbs., but only 9 per cent. of this load is the live load the weighing operation hopes actually to weigh. Now suppose there are a number of industrial cars or buckets. Can one assume each one actually weighs 1,000 lbs. each? Might they, too, range in weight from, say, 900 lbs. to 1,100 lbs. each? Then there might still be another condition where the dead load on the scale mechanism is of the order of 10,000 lbs. and one still desires to weigh this little 100 lbs. of coke; the total weight amounts to 10,100 lbs., of which the live load only amounts to 1 per cent.

Such conditions are not so absurd as would appear. Not many months ago the Author was asked to check up on a foundry experiencing trouble with their cupola operations and the quality of their product—a foundry melting 300 tons a day. They were using an industrial truck on the cupola charging platform to handle all raw materials going into the cupola. One component of the iron charge, for example, was placed on a tray that weighed 10 cwts., and this tray was picked up by the industrial truck weighing 3 tons, and all three—component of iron charge, tray and truck—went on to the scale platform. One component of the iron charge weighed 500 lbs., so when this was weighed the total weight on the scale was 500 lbs. plus 10 cwts. for the tray plus 3 tons for the truck, a total of 8,400 lbs., and the live load was only 6 per cent. of this total. No matter how ridiculous these conditions may be thought to be, they are to be seen in hundreds of foundries.

It is not difficult to weigh 1,000 or 2,000 lbs. of pig-iron, but it is an entirely different thing to weigh 25 lbs. of silvery pig-iron or 75 lbs. of coke or 12 lbs. of ferro-manganese. In modern good cupola practice most fuel charges and many components of the iron charge are small-weight units, and they are not easy to weigh accurately with the facilities often available.

One time the Author had occasion to expose an employee of a foundry equipment manufacturer to a cupola operation that was thought to be outstanding. It was a 48-in. diameter cupola, melting up to 150 tons a day and using a 67-lb. coke charge. As this friend of the Author's was observing their weighing operations, the melting foreman passed by and remarked, "That's gold we're weighing." That is the simple story on weighing that needs such a long time to tell, and an assurance is given, unreservedly, that if foundrymen weighed their cupola charge materials as though they were gold, a great many of their problems would vanish into the night.

The cupola is not capable of receiving whatever happens to be charged into it and also to deliver what is desired from it, but it has the capacity to deliver what is sought if it is supplied with the proper ingredients. There is a proper weight of fuel charge for every size of cupola, and a proper weight of metal charge for the size of the cupola and the type of iron being made in that cupola.

Correct Weight of a Fuel Charge

Please note that reference is made to the fuel charge before the metal charge. A proper fuel charge, and by that is meant the intermediate coke charge, might well be based on 7.5 lbs. of coke per sq. ft. of cupola area. For example, a 48-in. inside diameter cupola has an area of 14.57 sq. ft. and, at 7.5 lbs. of coke per sq. ft., the fuel charge might well be 95 lbs. A 72-in. inside diameter cupola has an area of 28.3 sq. ft., and a proper fuel charge might well be 210 lbs.

Actually, if practical considerations such as accurate weighing and the limitations of facilities to move raw materials from the yard to position in the cupola permitted, the Author would prefer to recommend smaller fuel charges based on a unit of 5 lbs. of coke per sq. ft. of cupola area, but under no conditions would he expect to keep within the limits of good cupola practice if this fuel unit exceeded 10 lbs. of coke per sq. ft. of cupola area.

In this there is a fuel unit which has a great deal to do with the thermal efficiency of the cupola, that is, whether each pound of carbon is going to combine with the oxygen of air to generate 14,500 heat units (B.Th.U.) or whether each pound of carbon, in combining with oxygen, will only generate 4,000 heat units (B.Th.U.). These are the respective heat releases for perfect combustion and incomplete combustion.

Those who operate numbers of cupolas, regardless of whether they are all of one size, or if no two are of the same size, might check the areas and fuel charges of each cupola and determine this fuel unit for each cupola. If this fuel unit is one figure for one cupola and quite another figure for some other cupola, it must have some bearing on the different operations obtained on these cupolas. One time the Author has asked to discuss cupola practice with a foundry organisation that called its technical talent together once a month to discuss problems that would make them better men in the organisation and make a better organisation, too. On agreeing to discuss cupola practice, he stated that he could make his remarks of much greater value if he discussed their own operations rather than theory, and they agreed to furnish the ammunition. They were operating three 72-in. dia. cupolas, producing a different type of iron in each cupola. On one cupola they used a 400-lb. coke charge, on another 500 lbs., and on the other 600 lbs. The iron charge in each case was 4,000 lbs. Whereas a 7.5-lb. coke unit per sq. ft. of cupola area is now recommended, their minimum unit was 19, the maximum was over 27 and the intermediate one was about 24. The performance from each cupola was different from the other two, and they recognised the cupola using 400-lb. coke charges as the best. It was pointed out to these men that one could not expect to duplicate performance in cupolas if one treated each one differently and that their best performance might be considerably improved if they worked toward smaller fuel units per sq. ft. of cupola area, at least to a unit of 10, but preferably to a smaller unit, but that all cupolas should use the same fuel unit.

The Carburising Action of Coke

Not all of the coke which goes into the cupola in intermediate coke charges takes part in the chemical reaction with oxygen to generate heat, as some

Cupola Practice

of the coke, and in some cases quite a bit of the coke is dissolved in the iron. Most modern grey iron qualities are achieved by utilising steel scrap as one of the components of the iron charge, and the intended result is to produce grey irons of 3.5 or 3.25 or 3.0 or 2.75 or 2.5 per cent. or less carbon in the product. The cupola is a carburising furnace, and it is always found that the cupola charge contains less carbon than the cupola product for those irons of 3.5 carbon or less.

The difference between the amount of carbon in the product and the amount of carbon in the charge comes from the coke. For example, if it be desired to produce a low total carbon iron from the cupola of, say, 2.5 per cent., the ingoing cupola charge could not exceed 1.3 per cent., and the amount of carbon absorbed in the melting process would not be less than 1.15 per cent. Thus 1.15 per cent. carbon is equivalent to 23 lbs. of carbon per 2,000 lbs. of metal and, if the coke contained 90 per cent. carbon, 23 lbs. of carbon would be equivalent to 25.6 lbs. of coke.

Reference is made to the intermediate coke charge when it is associated with the weight of the metal as the "apparent fuel ratio," and after this coke charge has been credited with the amount of coke dissolved by the metal, then reference is to the net quantity which unites with oxygen to generate heat as the "actual fuel ratio."

Size of Metal Charges

Assuming that a case is established for the selection of a 7.5-lb. coke unit per sq. ft. of cupola area, how does one determine the size of the metal charge? There are two methods of approach, one "cut and try" method, and another based on the amount of coke which combining with air to generate heat will melt and superheat iron to a satisfactorily high temperature, to which there will be added the exact amount of coke that will be dissolved in the melting operation.

In the "cut and try" method it may be assumed that the "apparent fuel ratio," which includes coke for heat and for solution, need not be less than 8.5 to 1, and over a period of time one would gradually improve this ratio in small steps from 8.5 to 1, to 9 to 1, to 9.5 to 1, stopping only when there is a certainty that the optimum performance has been achieved. In this procedure the coke charge is always the same, say 95 lbs. for a 48-in. cupola, while the iron charge is changed to increasing amounts.

The other method means that it must be established how much coke which, when combining with oxygen to generate heat, is required to melt and superheat iron, and also how much coke will be dissolved in the melting process. It takes close on 140 lbs. of coke reacting with oxygen to generate heat, to melt and superheat 2,000 lbs. of iron to 1,565 deg. C. Thus if no coke were dissolved in iron the "actual fuel ratio" might be 14.3 to 1. In most cupola operations the metal will dissolve from 0.75 to 1.5 per cent. carbon. This is from 15 to 30 lbs. of carbon or from 16.7 to 33.3 lbs. of coke. The 140 lbs. of coke reacting thermally must be fortified with some 16.7 to 33.3 lbs. of coke totalling 156.7 to 173.3 lbs. of coke per ton of iron, and though the "actual fuel ratio" is 14.3 to 1 the "apparent fuel ratio" varies from 12.7 to 1 to 11.5 to 1. Many founders will insist that they are not getting fuel ratios anything like 11.5 to 1 or 12.7 to 1. Yet they should. In the first place they are not using fuel units of 7.5 lbs. of coke per sq. ft. of cupola area; they are using fuel units of 19 or 24 or 27 lbs. or something less, as was the case in the three 72-in. cupola operations previously discussed. It may be that the charges are not being weighed accurately. Much more carbon can be absorbed in the cupola melting process than the 16.7 to 33.3 lbs. per ton of metal which has been used to illustrate the point. For example, the carbon content of a complete cupola charge may be 0.5 per cent., and the carbon content of the cupola product 3.6 per cent., an absorption of 3.1 per cent., which is equivalent to 70 lbs. of coke per ton of iron; and then foundrymen probably favour a heavy hand on the coke fork because fuel is one of the less costly items making up the cost of grey iron castings, so that fuel is burned in incomplete combustion rather than in perfect combustion.

Physical Condition

In addition to accurate weighing of materials and the use of proper weights of fuel and metal charges, materials should be of reasonable physical dimensions. For instance, the maximum linear dimension of the materials in the iron charge might not exceed 30 per cent. of the cupola diameter or 14.5 in. for a 48-in. cupola. It should be realised that a cube, 12 in. by 12 in. by 12 in., does not mean a maximum linear dimension of 12 in., for the maximum diagonal of this cube is about 21 in. A good guide on the physical size of coke is that an individual piece of coke should not weigh more than 1.5 lbs. for a 72-in. cupola, and might well be of the order of 0.75 lb. for 48-in. cupolas. It would be desirable to have screened coke of uniform particle size. Do not be shocked, however, if on visiting the coke pile, and after selecting some pieces to weigh, it is found that they weigh 5 to 10 lbs. or more. This being so, then do not complain if there be trouble with the cupola bridging or with cold iron, etc., for the weights of the pieces in the coke pile will provide the clue.

Much attention has been given to the materials that go into the cupola, but is it not sound reasoning that, if a campaign is carefully planned, then the execution of it should be a relatively simple matter? Most of the essential elements of good practice are incorporated in the three fundamentals so far discussed.

Mechanical Charging

When these materials are placed in the cupola, they must be uniformly distributed over each sq. ft. of area, or the melting performance will be below par and poor charging can certainly drag the operations down to an unbelievably low level. The hazard of poor charging is not so great with hand charging as it is with mechanical charging. By "hand charging" is meant the positioning of all the materials in a complete charge in the cupola from some position outside the cupola by hand. All other methods of positioning materials in the cupola fall under the term "mechanical charging." One may be up-ending an industrial car or using an industrial truck, or putting some materials in by hand and others by some mechanical device, or using a skip charger or a bucket charger with the many modifications of this type of equipment. If coke is all on one side of the cupola and iron on the other side, it might be wondered how the heat from the coke is ever going to melt the iron, but do not apply to the Author for the answer, for it is a mystery to him also. The only way that heat from the combustion of coke will melt iron is to distribute coke uniformly over the cupola area, and do the same thing with metal.

There is no intention to discredit mechanical charging of cupolas, for it is possible for mechanical equipment to do a completely satisfactory job of cupola charging, and if it is economically sound to utilise machinery to move huge quantities of materials, the Author would not want to be the one to throw this unnecessary burden on a human being. However, there are a great many mechanical devices that do not do a satisfactory job of charging, and they have been serious grindstones around the neck of cupola operators.

Proper Coke Bed Height

By coke bed height is meant the distance in inches from the top of the main row of tuyeres upwards to the top of the coke bed. If there be upper tuyeres or several rows of upper tuyeres, the dimension is still measured from the top of the main row of tuyeres. Bed heights in cupola practice range anywhere from 24 in. to 80 in. and, depending on the type of operation, any one of these dimensions might be proper for a specific operation. The Author prefers to determine the bed height by a formula $BH = 10.5 \sqrt{P} + 3$ when the object is to produce low total carbon irons on first iron out of the cupola, or $BH = 10.5 \sqrt{P} + 6$ for medium carbon irons, P being pressure as measured at the cupola windbox, in ozs. With windbox pressure of 9, 16 or 25 ozs., the respective bed heights would be 24.5, 45 and 55.5 in. for low carbon irons, or 37.5, 48 and 58.5 in. respectively for medium carbon irons. The coke bed height is measured after the whole coke bed has burned through white hot and with a tolerance not exceeding $\pm$ 2 in. It will be noted that the coke bed height is deemed to be considerably important in making low carbon irons in the first iron melted. There are numerous other ways to establish a proper coke bed height by "cut and try" methods. If iron begins to accumulate at the tap hole 8 min. after the wind goes on, by stopwatch timing, the bed is of the proper height. If more than 8 min., the bed is too high, and this time may actually be 20 or 30 or 40 min. On looking through the peepholes in the tuyeres, iron should be seen 4½ min. after the wind goes on and, if the time is shorter or longer, the bed is too low or too high. The Author has used the formula for a number of years and, as it has never failed, it is recommended as a very satisfactory method of determining the proper bed height for any cupola operation. It is essential, however, to know the cupola pressure.

Technique for Burning in the Coke Bed

It is of no concern whether the coke is ignited with a wood fire or an oil torch. As the tuyeres are some 12 to 24 in. above the sand bottom, and as combustion air enters at the tuyere level, how can one get coke as hot in the lower portion of the well zone, particularly at the sand bottom, as it is just above the tuyeres? The coke cannot burn at the level of the sand bottom unless it can get fresh air. If the tap-out block or breast is put in after the bed is burned through, this large opening helps to get fresh air where it is needed, or two or three openings can be provided at this level which can be filled up with refractory before the cupola goes into service. A firegrate may be made by putting bars through the tuyeres to support the coke at and above the tuyere level, and these bars can be removed after the bottom coke has reached incandescence.

The cupola refractories in the well zone, both side walls and cupola bottom, are insulating materials, and they must be exposed to incandescent coke for a period of time before their "heat capacity" has been reached and the surface temperature is as hot as one can get it with coke. When iron melts it accumulates in the hearth or well zone, and if temperatures in this zone are considerably less than that of the iron, the heat capacity of the molten iron will be used to heat refractories, and some or much of the first iron tapped will be too cold to use. Refractories in the well zone of a cupola should be exposed to high temperatures for 5 or 6 hrs. if optimum metal temperatures are to be attained on first metal tapped.

Zones in the Cupola

There are five zones in a cupola, the first zone from charging door down to melting zone is a preheating zone where stock is preheated by the cupola's waste gases. The next zone is the melting zone, where metal is converted from the solid phase to the liquid phase, with metal leaving this zone at its fusion temperature. If a piece of metal is suspended so that it would be heated from underneath and then applied a melting flame, such as an acetylene torch, little globules of metal would drop off when it reached its melting point and, unless it dropped through a zone of high temperature, it would revert back from the liquid phase to the solid phase, *i.e.*, it would freeze. The fusion plant of ferrous metal melted in a cupola ranges between 1,220 and 1,260 deg. C., depending on its analysis. The third zone is a superheating zone, and this zone is modified when sized coke is used or the amount of air going into the cupola varied. As iron is dropping down through this zone, by gravity, the amount of superheat added to the iron whether it be 250 or 300 or 350 per cent. will depend on the tem-

Cupola Practice

perature in this zone and on the time (that is distance) it takes from iron to pass through this zone. When an effort is made for perfect combustion or the maximum heat release per lb. of coke, or to preheat air, the object is to reach the optimum temperature possible from the combustion of coke. When the proper bed coke height is established for the type of operation, actually one uses less bed coke when one uses low quantities of air, and more bed coke as the quantity of air is increased. Actually such conditions are either decreasing or increasing the time (*i.e.*, the length of the superheating zone) that iron is exposed to superheating temperatures. With the time short the degree of superheat is low, and when the time is long the degree of superheat is high.

The fourth zone is the tuyere zone, and this should be considered as a drastic cooling zone, for approximately 1 lb. of room or outside temperature air (or possibly some preheat temperature of the order of 260 deg. C.) enters this zone for each pound of metal passing downward through this zone. It is quite possible that this zone depresses the metal temperature by 90 deg. C. Some might question whether the Bessemer reactions of air (oxygen) with the carbon and silicon content of the metal might not actually raise the temperature of metal in this zone, but the Bessemer reactions take time, and the interval of metal passing through this zone is too brief. It is also known that no appreciable Bessemer reactions take place, otherwise silicon losses would be great and the cupola melting process would not be equally adaptable to melting 0.5 per cent. silicon metal to 14.0 per cent. of silicon metal.

The fifth zone of the cupola is the hearth or well zone. This zone is a "cooling zone" to an appreciable degree, and is also a zone where the carbon content of the metal tends to reach the saturation point.

The Cupola Air Supply

Probably more engineering mistakes are made in selecting a sufficient blower and motor, and in the design of the piping between the blower and the cupola than in any other part of the engineering work concerned with a cupola installation. A satisfactory blower should be capable of delivering the maxima in quantity of air that good cupola practice will ever require of it for the size of the cupola it serves, and to be able to deliver this quantity of air against whatever resistance is encountered in good cupola practice and to be driven by a motor of sufficient horse-power for the maximum work load of the blower.

One could build the best motor-car engine in the world, but it would still be a practically useless machine if a deficient carburettor would not permit air and petrol to become properly proportioned and mixed over the complete fuel consumption range.

The rate of fuel consumption in the cupola is a variable thing, somewhat like the rate of fuel consumption in a motor-car. In the car the rate is varied by calling for more or less fuel with automatic adjustment of combustion air, while in the cupola the rate is varied by adjusting the air input with an automatic increase or decrease in the rate of fuel charges reaching the combustion zone.

Nobody would condone a deficient carburettor on a motor-car engine, nor would the foundryman condone a deficient cupola blower if he had enough facts on the requirements to enable him to select between a satisfactory and unsatisfactory blower. To many air is not only odourless and colourless, it is also mysterious. It has weight, 1 cub. ft. weighing about 0.075 lb., or about 13 cub. ft. of air to the lb.

A cupola will melt 0.75 ton of iron per hr. per sq. ft. of area, though some types of cupola operation are of the order of 1.0 ton of iron per hr. per sq. ft. Moreover, close on 1 lb. of air enters the cupola for each pound of metal melted. Thus the air requirements might be stated as 0.75 to 1.0 ton of air per sq. ft. of cupola area. This figure reduced to lbs. of air per min. would mean from 25 to 34 lbs. of air per min. per sq. ft. of cupola area, or in cub. ft. from 325 to 440 cub. ft. of air per min. per sq. ft. of cupola area. For a 48-in. dia. cupola, having an area of 12.57 sq. ft., this would mean a nominal requirement of close to 4,000 cub. ft. per min., or a maximum requirement of 5,500 cub. ft. per min.

The resistance of this 48-in. cupola, with its nominal air supply of 4,000 c.f.m., would be close to 16 ozs. If this air supply was reduced by 50 per cent., the pressure would vary as the square of the volume, for example, $(0.5)^2$ or 25 per cent. of 16 ozs., namely, 4 ozs., but if the volume was increased 50 per cent. to 6,000 c.f.m., the pressure would vary as the square, for example, $(1.5)^2$ or 2.25 times 16 ozs., namely, 40 ozs. With a 50 per cent. increase in the load and a pressure of 2¼ times the normal load of 4,000 c.f.m., and normal pressure of 16 ozs., the motor horse-power at maximum conditions would have to be something like 3.3 times the motor horse-power sufficient for nominal conditions.

It may not always be sound to provide blower capacities and horse-power to suit the maximum conditions, but it certainly would be sound judgment to provide for some contingencies above and beyond normal requirements. In most cases the provision made for the blower and motor is hardly sufficient for normal demands, and there are a great many deficient installations.

The subject of cupola practice is so broad that nobody could hope to do it justice in one lecture, and, it will be noted, many items as tapping methods, fluxing, preheating, air conditioning, carbon control, relationship of mixing ladle capacity to size of cupola, desulphurising, possible mixtures and types of iron that are cupola melted, slag-handling systems, air quantity controls and a great many other phases of interest in the melting of grey iron. However, one must begin and end somewhere, and it is felt that the phases touched upon are worth checking and, if any given cupola practice does not meet these standards, that steps will be taken to meet them.

UTILITY BRIQUETTES FROM WASTE SLACK

Substitute for large coal in foundry processes

By H. B. FARMER*

FOREWORD

By J. G. PEARCE, Chairman, Ironfounding Industry Fuel Committee

The fuel economy campaign aims, of course, at effecting the maximum possible economies in the use of all fuels. Variations in the supply position as between various fuels lead, however, to a natural tendency, which is also a correct one, to concentrate on saving the greatest possible amount of those fuels which are in particularly short supply. That is, fuel substitution must be considered, as well as fuel economy. Those fuels in short supply at present are large and graded coals, gas and electricity. Supplies of coal to industry have already suffered two official cuts, while reductions in supplies of gas and electricity have recently been announced.

The following report by Mr. Farmer shows how a fuel which is in relatively good supply can be used to replace either large coal or gas for such foundry purposes as cupola lighting, ladle drying, the lighting of stove fires, etc. (to say nothing of the office fires). Firms already using large coal in the works (whether deep-mine or open-cast) will probably have a sufficient source of slack for the manufacture of "utility briquettes," while firms wishing to replace gas firing by briquettes and not having any slack in the works will doubtless be able to obtain some from an external source.

Commercial briquettes are made from selected coals ground to fine dimensions, and bonded with soft pitch or other tar derivatives heated in jacketed pans. The mixture of coal and pitch is pressed in moulds at an approximate pressure of 500 lbs. per sq. in. The result is a smooth-looking nugget, comparable with coal for purposes of combustion, strength and freedom from ash.

The following experiments were carried out to utilise slack coal which was accumulated waste from the large coal previously used for cupola lighting, ladle drying, etc. It was decided to use simple appliances which were readily available, and a method which entailed the minimum preparation of the slack.

It was also considered desirable to eliminate Government controlled ingredients and to concentrate on waste materials where possible. Various mixtures of coal, cement, sawdust and water were tried, with varying results until ultimately the following batch mix was decided on:—

Coal ...	... 48 lbs.
Cement ...	... 6 lbs.
Sawdust ...	... 3 pints.
Water ...	... 7½ pints.

During these experiments supplies of sawdust ran out, and a straw-like substitute named "shives" was found to be more efficient in the same proportion as sawdust. "Shives" is the term applied to the small cuttings or trimmings of flax, which are a waste product of the flax industry, and their availability was made known by the good offices of the Ministry of Fuel and Power.

Equipment.—A ¼-in. riddle, a mould in hard wood, as shown in the accompanying sketch, a rammer, shovel or spade, and some plates or boards, are all that is necessary.

Preparation.—Riddle the small coal and take all that passes through; mix the cement, coal and sawdust in the dry state, sprinkle the water over the mixture, and turn over the damp mixture twice with a shovel. Place the mould on a board or plate, largest rectangle uppermost, add the mixture to the mould, and ram hard during filling. Turn the mould over on the board and draw off the frame mould. The resultant briquette should be left to air-dry, this usually taking 5 to 6 days, depending on weather conditions.

Time.—Working alone a youth can produce 30 briquettes per hr., but if the materials are measured by volume instead of by weight, production reaches 40 per hr. Should the various operations be divided between three operatives and a concrete mixer em-

(*Continued overleaf, column* 1.)

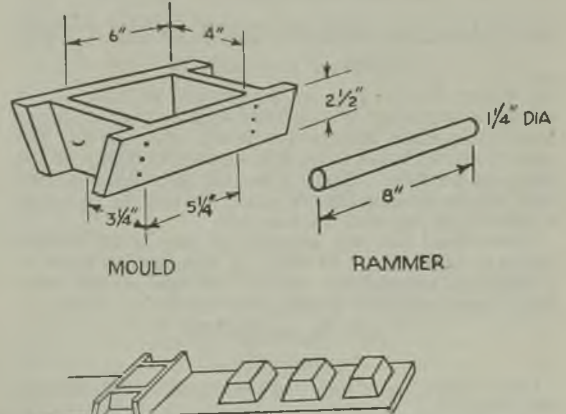


FIG. 1.—TOOLS USED FOR THE PREPARATION OF BRIQUETTES.

* Rice & Co. (Northampton) Ltd.

UTILITY BRIQUETTES FROM WASTE SLACK

(*Continued from previous page.*)

ployed, the quantity per youth per hr. rises considerably.

Uses.—These briquettes have been used successfully in the Author's foundry for all applications where large coal was formerly used. These operations include cupola lighting, ladle and spout drying, lighting up core ovens and space heating stoves, and for the last two months the foundry has been operated without the use of any large coal. An important feature in use is that the briquettes must not be poked but allowed to burn naturally without disturbance. Similar briquettes made from waste slack coal, but incorporating some tar, have been used as a substitute for large coal by Mr. H. Bunting at the Rutland Foundry Company, Limited, Ilkeston.

General

Those fortunate enough to have pitch, tar or other such combustible materials available can considerably improve their products by such additions. Should it be decided to use a finer riddle, the bond, *i.e.*, cement, can be reduced without impairing strength, as coal passed through $\frac{1}{16}$-in. sieve needed only 3 lbs. of cement to 48 lbs. of coal, as against 6 lbs. of cement with below $\frac{1}{4}$-in. sieve materials. Briquettes are readily split by impact on the edge of a peice of sheet iron.

The Author would like to thank Mr. H. Bunting, who has been using briquettes with tar additions for some years past, Mr. W. L. Turner, of the North Midland Fuel Efficiency Committee (Ministry of Fuel and Power), members of the East Midlands Regional Panel of the Ironfoundry Industry Fuel Committee, Rice & Company (Northampton), Limited, and others, for their kindly interest and encouragement.

MECHANICAL AIDS TO CORE PRODUCTION

(*Continued from page* 48.)

the stove. In the case of the vertical or tower stove shown, every other tray is fitted with two raised strips to accommodate these extra heavy core plates, and permit the withdrawal of the supporting forks of the charging machine. Every other tray is utilised to prevent the stove being thrown out of balance by too great a load being imposed on one side.

From these last two coremaking aids it will be seen that any core up to 10 cwts. in size can be made to completion successfully without the use of any overhead crane or other similar type of lifting device.

(*To be continued.*)

REFERENCES

[1] C. T. Harris, Jnr., "Guns Cast Centrifugally," *The Machinist*, 1942, November.

[2] H. Schulze-Manitus, "Suspension Conveyors for Foundries, *Die Giesserei*, vol. 29, page 273.

[3] P. Dywer, "Malleable Foundry Keeps them Rolling," *Foundry*, 1942, September.

[4] British Patent No. 378085.

OBITUARY

MR. JAMES MELVIN, a director of Melvin & Gillespie, Limited, engineers, St. Rollox, Glasgow, died on May 8.

MR. EDWARD BARBER, managing director of Edward Barber & Company, Limited, engineers and non-ferrous metal founders, of Tottenham, London, died recently, aged 65.

MR. GEORGE GATHERAL PATON died in Glasgow recently. He was for many years export sales manager of Stewarts and Lloyds, Limited, and latterly interim assistant secretary of the firm, a post which he had to relinquish for health reasons about a year ago. He had been with the firm for about 45 years.

SIR CLEMENT HINDLEY, who died at Hampton Court recently, aged 70, was the first Chief Commissioner of Railways for India. Altogether he spent more than 30 years in India as a railway administrator. After his return to England in 1928 he took up new activities. He was a member of the Channel Tunnel Committee, of the Development (Public Utility) Committee, of the Building Research Board, of the General Board of the National Physical Laboratory, and of the Advisory Council for Scientific and Industrial Research, and he was chairman of the Steel Structures Research Committee. Sir Clement Hindley was also chairman of the research committee established by the Institution of Civil Engineers in 1935, and in 1939 acted as chairman of the Professional Advisory Committee (Shelters) in connection with air raid precautions. In the same year he was elected president of the Institution of Civil Engineers. He was knighted in 1925.

IRONFOUNDRY FUEL NEWS—III

The recent instruction to reduce industrial gas consumption by 25 per cent. has not affected the majority of ironfounders as much as firms in some other industries. Founders using gas for major processes such as annealing, heat-treatment, core-dying, etc., are, of course, the hardest hit, and in these cases a study of Fuel Efficiency Bulletins, Nos. 5, 14 and 17, issued by the Ministry of Fuel and Power, is to be recommended. Your local supply undertaking will probably, if so requested, arrange for a service engineer to inspect your gas-burning plant and make any recommendations with a view to obtaining the maximum production with the allowable gas consumption.

A larger number of foundries use gas only for subsidiary purposes, such as cupola lighting and ladle drying. In almost every case coke may be substituted as a fuel for these purposes. Information on this subject is contained in the booklet "DON'T USE COAL for Cupola Lighting, Ladle Drying, ..." recently sent to every ironfoundry in Great Britain. If you would like an additional copy of the booklet, please write to the Ironfounding Industry Fuel Committee, Alvechurch, Birmingham.

SAVE PAPER WHEN YOU CAN

NEWS IN BRIEF

The Board of Trade, it is understood, has agreed to the siting of a factory in Middlesbrough with a floor space of 50,000 sq. ft. to deal in products allied to iron and steel.

W. J. Molineux (Foundry Equipment), Limited, Marlborough Road, London, N.19, announce a change of name to the simplified title, "Molineux Foundry Equipment, Limited."

Unemployed on the registers on April 17 last numbered 74,690, which compared with 79,037 on January 17, 1944 (a decline of 4,347), and 80,091 on April 12, 1943 (a fall of 5,401).

The North-Eastern Midlands and Staffordshire district office of the National Union of Blastfurnacemen, Coke Workers, Ore Miners and Kindred Trades has been transferred from 65, Doncaster Road to 36, Oswald Road, Scunthorpe.

The London Local Section of the Institute of Metals is holding its June meeting on June 8 at the Junior Institution of Engineers (Inc.), 39, Victoria Street, London, S.W.1, at 6.30 p.m., when a Paper by Dr. W. A. Wood will be given on "Some Recent Views on the Structure of Metals in Relation to their Physical Properties."

Mr. Hugh Dalton, President of the Board of Trade, conferred recently with a deputation of representatives of local authorities, trade unions, and business interests of the Tees-side and Cleveland area. The deputation protested against their non-inclusion in the Government's industrial development plans after the war for the north-east coast, claiming that this would leave them in an "industrial wilderness."

The directors of the Shotts Iron Company, Limited, propose to repay at 104 on November 11 next the outstanding £57,000 4 per cent. debenture stock. The company is prepared to repay the stock of any holder at an earlier date on request, at the redemption price of 104, plus interest to the date of repayment. The stock was issued in 1897 to a total of £65,000, and has been made redeemable at any time on six months' notice.

A meeting of the Institution of Engineering Inspection will be held in London on Thursday, May 25, at St. Ermins Hotel, Westminster, London, S.W.1, at 5.30 p.m. when a lecture, "Some Applications of X-rays in Engineering," will be delivered by L. Mullins, M.Sc., Ph.D., A.Inst.P., of Kodak Research Laboratories. The lecture will be illustrated, and there will be a small exhibition of radiographs, sectioned specimens and equipment for making radiographs.

Mr. George A. Dudley, for 25 years district manager and representative at the Wishaw works of Thos. W. Ward, Limited, Sheffield, died at his home at Uddington, Glasgow, on May 11. He was well-known in Scottish industrial circles, especially in the iron and steel trades. Before going to Wishaw he was South Staffs representative for Thos. W. Ward, Limited, and had been in their service for 33 years.

PERSONAL

Col. Philip Johnson, D.S.O., M.I.Mech.E., is the President of the Maudslay Society for the coming year.

Mr. Alan Graham has retired from the position of Director of Light Metals Control (Castings) to resume service with Birmid Industries, Limited.

Mr. T. J. Wragg, who has been elected chairman of Thos. A. Ashton, Limited, of Sheffield, has severed his connection with the Northern Malleable Foundry Company, Limited, in order to devote the whole of his time to the Sheffield business.

Wills

Moyes, J. W., chairman of Mechans, Limited, Scotstoun Ironworks, Glasgow	£44,036
Gilchrist, J. McA., of Newton Mearns, Renfrewshire, retired shipbuilder and engineer	£27,468
Hopkins, A. E. A., of Harpenden, director of Ironside, Limited, iron, steel and metal merchants ...	£13,859
Habershon, A. R., of Rotherham, director of J. J. Habershon & Sons, Limited, and Arthur Lee & Sons, Limited, steel rollers	£152,547
Smallwood, A., of Handsworth, founder of the Incandescent Heat Company, Limited, and a director of other companies	£118,004
Cutler, E. E., managing director of Samuel Cutler & Sons, Limited, and a director of C. & W. Walker, Limited, gas engineers	£19,184
Ralph, J. J., of Wolverhampton, chairman and managing director of A. E. Ralph & Company, Limited, iron and steel merchants	£66,911
Crawford, E. W., chairman of the Briton Ferry Steel & Tinplate Agency, Limited, and a director of the Briton Ferry Steel Company, Limited, and the Neath Steel Sheet & Galvanising Company, Limited	£1,950
Straker, E. C., of Hexham, chairman of R. & W. Hawthorn Leslie & Company, Limited, and Robert Stephenson & Hawthorns, Limited, a director of the North British Locomotive Company, Limited, and Strakers & Love, Limited	£218,764

F.B.I. AND INDUSTRIAL RESEARCH

The Federation of British Industries has decided to strengthen its organisation on the research side by making its Industrial Research Committee a permanent Standing Committee of the Federation with its own fully-qualified secretariat. The Federation, while not itself engaging in research, will, through the work of its Standing Committee, do all in its power—in collaboration with existing organisations in this field—to promote the interests of industry in relation to research and its application. At the same time, it will make every possible effort to secure the success of any wider or more comprehensive organisation which may result from the present widespread interest in the problem of research.

"Nickel Bulletin."—The April issue includes abstracts on the electrolytic polishing of metallographic specimens, the influence of cobalt and nickel oxides in enamelling, black nickel plating, the influence of alloy elements on hardenability, and the spot welding qualities of aircraft steels. Copies may be obtained, free of charge, from the Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1.

COMPANY RESULTS

(Figures for previous year in brackets)

Mason & Burns—Dividend of 20% (same).

Bairds & Scottish Steel—Dividend of 6% (5%).

Harrison (Birmingham)—Dividend of 20%, tax free (same).

Ransomes & Rapier—Net profit for 1943, £25,187 (£26,008); final dividend of 4%, tax free, making 6% net (same).

Associated Clay Industries—Profit for 1943, £42,470 (£30,276); depreciation, £5,000; taxation, £20,800; debit balance brought in, £2,808; credit forward, £13,862.

Samuel Heath & Sons—Profit for 1943, £5,202 (£6,130); ordinary dividend of 10%, tax free (same); to war contingencies, nil (£3,000); forward, £18,227 (£17,550).

Quirk Barton—Profit, after depreciation, £6,848 (£7,618); taxation, £2,600 (£2,500); war damage insurance, £125 (£175); interim dividend of 2½%, £1,417 (same); final dividend of 6%, £3,401 (same); forward, £19,685 (£20,380).

James H. Lamont—Net profit for 1943, £26,617 (£52,083); tax, £9,936 (£35,266); written off goodwill, etc., £2,000 (£2,097); reserve, £3,000 (same); ordinary dividend of 25% (same) and a participating dividend of 2% on the preference shares (same); forward, £2,011 (£1,975).

W. Canning & Company—Profit for 1943, after charging depreciation and A.R.P. expenditure and providing for taxation, £68,498 (£67,501); to general reserve, £25,000; final dividend of 5%, making 10% (same), plus a bonus of 2s. 6d. per share (same); employees' benevolent fund, £5,000; forward, £52,571 (£47,823).

Amalgamated Metal Corporation—Net profits of constituent companies for 1943, £217,980 (£283,717); dividends to parent company, £217,563 (£217,562); administration and other expenses, £2,684 (£3,053); tax, £3,364 (£3,095); net profit, £212,617 (£212,347); preference dividend, gross, £54,000 (same); ordinary dividend of 3½% (same), subject to tax, £155,253 (same); forward, £42,484 (£39,120).

Stewarts and Lloyds—Trading profit, including dividends from subsidiary and allied companies, after providing for E.P.T., income-tax, war damage insurance and £127,500 for debenture interest, £1,599,075; depreciation, £638,609 (£630,183); contributions to employees' funds, £129,499 (£121,668); directors' fees, £15,000 (same); net profit, £1,016,057 (£1,155,458); dividend on the deferred and liaison deferred shares, 12½% (same), £544,993; preference dividends, £123,685; to reserve for contingencies, £250,000 (same); reserve for special depreciation, £100,000 (£250,000); forward, £190,460 (£193,081).

Campbell, Wyant & Cannon Foundry Company, of Muskegon, Michigan, the largest jobbing ironfounders in the United States, has been charged before the Regional War Labour Board "that in numerous cases it has put wage increases into effect without permission."

NEW COMPANIES

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

Pax Metal Products, 388, Park Road, Hockley, Birmingham—£1,000. R. T. Parkes.

Bruff Manufacturing Company—Agricultural and general engineers, etc. £10,000. A. E. and B. J. Brookes.

Allen Bros. Company (Metalcrafts), 109, New Bridge Street, Newcastle-upon-Tyne—£6,000. W., S., T., F., J., and E. Allen.

Church Hill Forge (Midhurst), Church Hill, Midhurst, Sussex—Founders, engineers, etc. £1,000. F. E. and E. L. Davis.

Burnt Oak Forge—Engineers, metal workers, etc. £500. A. H. D. Fairbarns, 11, Sheffield Street, London, W.C.2, subscriber.

H. W. Kiddle & Sons, Iford Lane, Southbourne, Bournemouth—Engineers, etc. £3,000. H. W., H. H., C. E., and G. F. Kiddle.

Bramwell Manufacturing Company, 10, Avenue Road, Grantham, Lincs—Engineers, etc. £2,000. G. B. and N. H. Goulden.

J. E. Taylor & Company (Engineers), St. Thomas' Road, Longroyd Bridge, Huddersfield—£5,000. J. E., H., and J. Taylor and H. Driver.

John Venning & Company, Station Road, Alton, Hants—Engineers. £5,000. J. D. E. and L. A. Venning, A. M. Potter, and J. W. Goodinson.

John Metcalf—Ironfounders, engineers, etc. £100. G. R. Addie, F. Bowden, A. Dodgson, and J. A. Morris, 83, Lodge Lane, Hyde, Ches.

J. C. Balmforth & Company, 23, Union Street, Nottingham—Engineers and patternmakers. £3,000. W. L. Winterton, E. O. Ellis and E. Winterton.

H. Dunning & Company, Stamford Works, Stamford Road, Audenshaw, Manchester—Engineers, etc. £1,500. H. Dunning, G. Dewsnap, and A. Knight.

Pearson General Engineering Company, The Quarry, Hainton, Middlesbrough—£5,000. J. W. Pearson, H. Wilson, L. R. Marshall, and J. Brundenall.

Froggatt & Hennell, Alexandra House, Star Road, Peterborough—Engineers, etc. £1,000. H. Froggatt, C. H. Hennell, W. M. Uglow, and F. S. Salter.

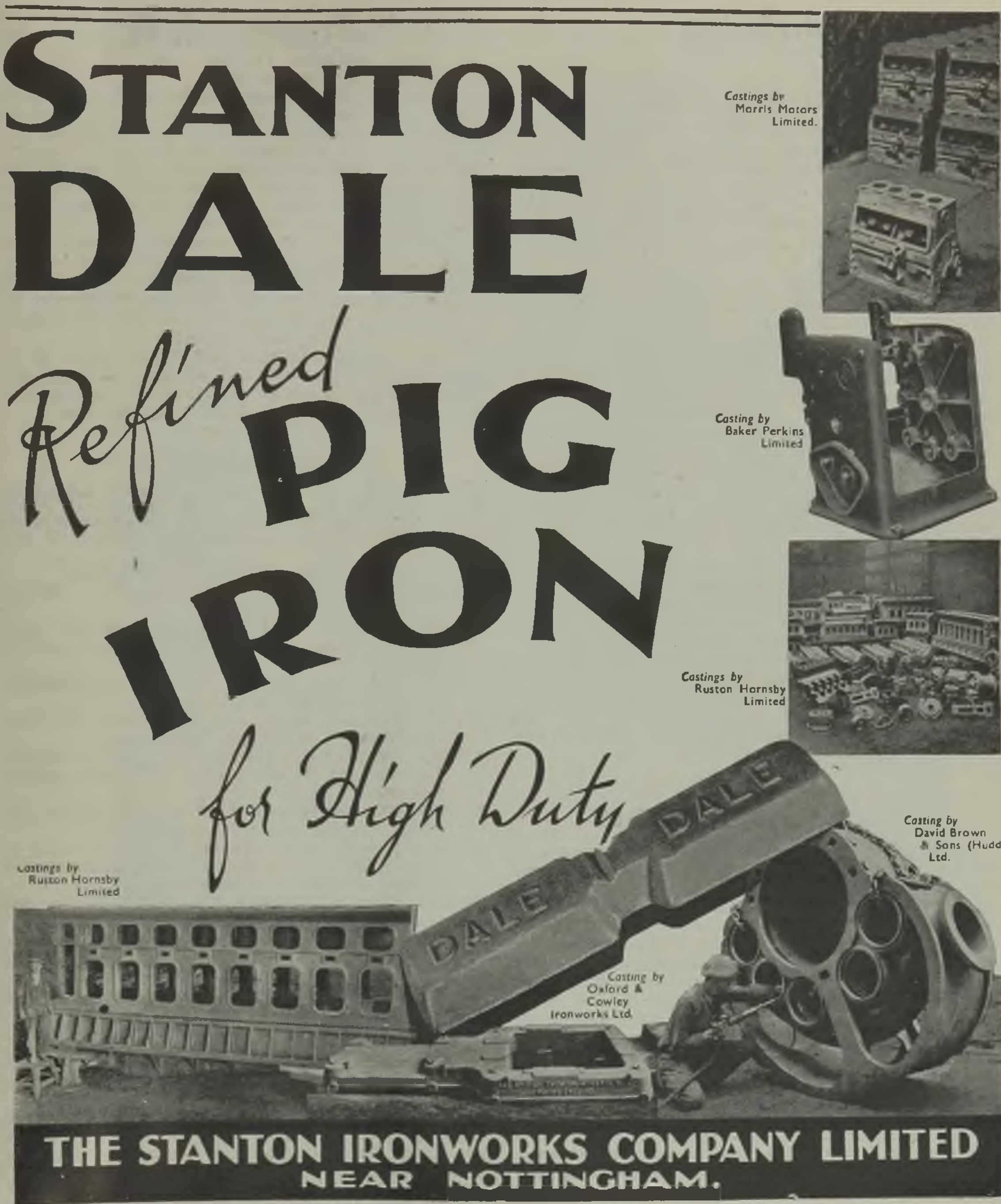
Mileo Midland Products (Birmingham), 60, Villa Road, Handsworth, Birmingham—Ironfounders, engineers, etc. £1,000. M. Mico and A. Leonidou.

Edgar C. Burrell & Sons, Victoria Engine Works, Southtown, Great Yarmouth—Marine and general engineers. £2,100. E. C., F. M., and W. E. Burrell.

William Coupe (Higher Walton), Moonsmill Foundry, Higher Walton, Preston—Ironfounders, etc. £5,000. S. J., F., R., J., A. H., A., and W. Coupe.

Eutalloy & Welding Processes—To take over the business of the Engineering Supplies Agency carried on at 10, Bentley Road, Chorlton-cum-Hardy—£5,000.

Cox & Company (Watford), Watford By-pass, Bushey, Herts—Manufacturers of steel furniture, etc. £52,500. R. W. and S. Cox, C. Toon, and E. H. Wilton.



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Refined PIG IRON
for High Duty
Castings by Morris Motors Limited.
Casting by Baker Perkins Limited
Castings by Ruston Hornsby Limited
Casting by David Brown & Sons (Hudd.) Ltd.
Castings by Ruston Hornsby Limited
Casting by Oxford & Cowley Ironworks Ltd.
DALE
DALE
DALE
THE STANTON IRONWORKS COMPANY LIMITED
NEAR NOTTINGHAM.

Raw Material Markets

IRON AND STEEL

Demand for common foundry pig-iron is on a somewhat smaller scale, reflecting the continued slackness in the light-castings trade. There has not been so marked a shrinkage in the call for low- and medium-phosphorus irons, as the engineering and allied foundries are still generally busy. Refined-iron makers, though not so hard pressed, are still disposing of substantial tonnages.

The consumption of steel semis at the re-rolling works is round about peak levels, but the Control appears to have the supply position well in hand. Producers of billets, blooms and slabs have not recently been able to maintain maximum deliveries, though, curiously enough, sheet bars are still available in adequate tonnages. Possibly the existing circumstances were not unexpected. At all events, the Control has in hand fairly substantial reserves of imported material, which is being issued as the need arises. Prospects of full employment for the mills engaged on light and special sections are highly favourable, and it is already difficult to place orders for sheets—unless they are first priority—even for delivery in the third quarter of the year.

The capacity of the plate mills is still taxed to its utmost limits, but the machinery of allocation and distribution is working smoothly, and satisfaction of the swollen needs of the shipbuilders does not preclude the delivery of considerable tonnages to the engineering works, tank builders, boiler makers and builders of rolling stock. Interest in sections is still focussed on the lighter sizes, and if collieries and railway companies are not getting all the maintenance material they ask for, the weight of steel supplied for these purposes is very substantial.

NON-FERROUS METALS

Although in this country war needs of copper are definitely not as large as they were during the early part of last year, American consumption seems to be sharply increasing. A major factor in this increase has been the expansion in the production of large-calibre brass shell cases in place of the steel cases formerly used. U.S. production of crude copper during April, according to the Copper Institute of New York, totalled 92,037 tons, and of refined copper 95,280 tons. Domestic deliveries stood at 155,087 tons, and at the end of the month stocks of refined copper (excluding those held by the Government and consumers) amounted to 38,382 tons. In the home markets there has been little of interest regarding copper supplies.

For essential needs there seems to be no shortage of tin on either side of the Atlantic, although total consumption is far below that of the pre-war level. Substantial quantities of Bolivian tin ore originally destined for this country for treatment have been diverted to the United States. This is probably due to better transport facilities and the need for economising in shipping space. The United States, although the world's largest tin consumer, produces no tin ore. As Bolivia is the main source of tin in the Western Hemisphere, it is likely that all the ore produced will now be sent to the Texas City smelter. Before the American smelter was built, all Bolivian ore came to this country for treatment. It remains to be seen what the effect will be on the post-war tin-smelting industry in this country.

The demand for lead is concentrated mainly in the cable and battery trades. Normally the building industry is the largest lead consumer; a fair amount is still being used in military construction, but after the war, with the vast housing plans in view, the demand is likely to be very heavy indeed.

Zinc is in good supply, and there appears to be no difficulty in satisfying all priority needs and also to provide limited amounts for the more urgent civilian requirements, galvanised products in particular.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

559,475 LORANT, H. Hydraulic forging press.
559,497 FORD MOTOR COMPANY, LIMITED. Method of magnesium production.
559,498 SUMMERS, J. M. Manufacture of soft metal articles having a sheath of hard wear-resisting metal.
559,573 BENJAMIN ELECTRIC, LIMITED, and SKINNER, G. D. Luminous vitreous enamel.
559,605 GIBBONS BROS., LIMITED, MARLE, M. VAN, and WEBB, A. W. OGILVY-. Furnaces.
559,610 CHURCHILL MACHINE TOOL COMPANY, LIMITED, and WHIBLEY, R. J. M. Roll grinding machines.
559,635 BRITISH TIMKEN, LIMITED, and KILAYIN, E. Roller bearings and roller cages therefor.
559,640 HARVEY, A. G. Device for filling a cavity or recess with sand or the like and particularly for filling a moulding box for a core.
559,687 MORGAN CRUCIBLE COMPANY, LIMITED, and MARSHALL, S. C. Charging of crucibles.
559,695 STONE & COMPANY, LIMITED, J., WITTON, G. A. J., and HENDRA, A. C. Metal-casting machines.
559,715 MEEHANITE METAL CORPORATION. Magnetic bucket and method of conveying material.
559,786 BROWN & SON (HUDDERSFIELD), LIMITED, D., and JACKSON, J. F. B. Centrifugal metal-casting machines.

Erratum.—In our leading article on "Foundry Dust Hazards" (May 11), a misprint appears in the eighth line from the end; the word laconically has been printed instead of "logically."

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, May 17, 1944

PIG-IRON

Foundry Iron.—CLEVELAND No. 3: Middlesbrough, 128s.; Birmingham, 130s.; Falkirk, 128s.; Glasgow, 131s.; Manchester, 133s. DERBYSHIRE No. 3: Birmingham, 130s.: Manchester, 133s.; Sheffield, 127s. 6d. NORTHANTS No. 3: Birmingham, 127s. 6d.; Manchester, 131s. 6d. STAFFS No. 3: Birmingham, 130s.; Manchester, 133s. LINCOLNSHIRE No. 3: Sheffield, 127s. 6d.; Birmingham, 130s.

(*No. 1 foundry 3s. above No. 3. No. 4 forge 1s. below No. 3 for foundries, 3s. below for ironworks.*)

Hematite.—No. 1 (S & P 0.03 to 0.05 per cent.): Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, 140s. 6d., delivered Birmingham.

Scotch Iron.—No. 3 foundry, 124s. 9d.; No. 1 foundry, 127s. 3d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, 174s.; South Zone, 176s. 6d.

Refined Malleable.—North Zone, 184s.; South Zone, 186s. 6d.

Cold Blast.—South Staffs, 227s. 6d.

(NOTE.—*Prices of hematite pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton.*)

FERRO-ALLOYS

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

Ferro-silicon (5-ton lots).—25 per cent., £21 5s.; 45/50 per cent., £27 10s.; 75/80 per cent., £43. Briquettes, £30 per ton.

Ferro-vanadium.—35/50 per cent., 15s. 6d. per lb. of V.

Ferro-molybdenum.—70/75 per cent., carbon-free, 6s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, 1s. 3½d. lb.

Ferro-tungsten.—80/85 per cent., 9s. 8d. lb.

Tungsten Metal Powder.—98/99 per cent., 9s. 9½d. lb.

Ferro-chrome.—4/6 per cent. C, £59; max. 2 per cent. C, 1s. 6d. lb.; max. 1 per cent. C, 1s. 6½d. lb.; max. 0.5 per cent. C, 1s. 6¾d. lb.

Cobalt.—98/99 per cent., 8s. 9d. lb.

Metallic Chromium.—96/98 per cent., 4s. 9d. lb.

Ferro-manganese.—78/98 per cent., £18 10s.

Metallic Manganese.—94/96 per cent., carb.-free, 1s. 9d. lb.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms and Slabs.—BASIC: Soft, u.t., 100-ton lots, £12 5s.; tested, up to 0.25 per cent. C, £12 10s.; hard (0.42 to 0.60 per cent. C), £13 17s. 6d.; silico-manganese, £17 5s.; free-cutting, £14 10s. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £15 15s.; case-hardening, £16 12s. 6d.; silico-manganese, £17 5s.

Billets, Blooms and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £13 17s. 6d.; basic hard, 0.42 to 0.60 per cent. C, £14 10s.; acid, up to 0.25 per cent. C, £16 5s.

Sheet and Tinplate Bars.—£12 2s. 6d., 6-ton lots.

FINISHED STEEL

[*A rebate of 15s. per ton for steel bars, sections, plates, joists and hoops is obtainable in the home trade under certain conditions.*]

Plates and Sections.—Plates, ship (N.-E. Coast), £16 3s.; boiler plates (N.-E. Coast), £17 0s. 6d.; chequer plates (N.-E. Coast), £17 13s.; angles, over 4 un. ins., £15 8s.; tees, over 4 un. ins., £16 8s.; joists, 3 in. × 3 in. and up, £15 8s.

Bars, Sheets, etc.—Rounds and squares, 3 in. to 5½ in., £16 18s.; rounds, under 3 in. to ⅝ in. (untested), £17 12s.; flats, over 5 in. wide, £15 13s.; flats, 5 in. wide and under, £17 12s.; rails, heavy, f.o.t., £14 10s. 6d.; hoops, £18 7s.; black sheets, 24 g. (4-ton lots), £22 15s.; galvanised corrugated sheets (4-ton lots), £26 2s. 6d.; galvanised fencing wire, 8g. plain, £26 17s. 6d.

Tinplates.—I.C. cokes, 20 × 14 per box, 29s. 9d., f.o.t. makers' works, 30s. 9d., f.o.b.; C.W., 20×14, 27s. 9d., f.o.t., 28s. 6d., f.o.b.

NON-FERROUS METALS

Copper.—Electrolytic, £62; high-grade fire-refined, £61 10s.; fire-refined of not less than 99.7 per cent., £61; ditto, 99.2 per cent., £60 10s.; black hot-rolled wire rods, £65 15s.

Tin.—99 to under 99.75 per cent., £300; 99.75 to under 99.9 per cent., £301 10s.; min. 99.9 per cent., £303 10s.

Spelter.—G.O.B. (foreign) (duty paid), £25 15s.; ditto (domestic), £26 10s.; "Prime Western," £26 10s.; refined and electrolytic, £27 5s.; not less than 99.99 per cent., £28 15s.

Lead.—Good soft pig-lead (foreign) (duty paid), £25: ditto (Empire and domestic), £25; English, £26 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, ex works, £37 12s. 6d.; rolled zinc (boiler plates), ex works, £35 12s. 6d.; zinc oxide (Red Seal), d/d buyers' premises, £30 10s.

Other Metals.—Aluminium, ingots, £110; antimony, English, 99 per cent., £120; quicksilver, ex warehouse, £68 10s. to £69 15s.; nickel, £190 to £195.

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11⅝d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 10⅞d.; wire, 10⅝d.; rolled metal, 10¼d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15¼d. per lb.; brazed tubes, 15¼d.; wire, 10d.

Phosphor Bronze.—Strip, 14d. per lb.; sheets to 10 w.g., 15d.; wire, 16½d.; rods, 16½d.; tubes, 21½d.; castings, 20d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in wide, 1s. 4½d. to 1s. 10½d.; to 15 in. wide, 1s. 4½d. to 1s. 10½d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5½d. to 1s. 11½d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6½d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9½d. Wire round, to 10g., 1s. 7½d. to 2s. 2½d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6½d. upwards.

NON-FERROUS SCRAP

Controlled Maximum Prices.—Bright untinned copper wire, in crucible form or in hanks, £57 10s.; No. 1 copper wire, £57; No. 2 copper wire, £55 10s.; copper firebox plates, cut up, £57 10s.; clean untinned copper, cut up, £56 10s.; braziery copper, £53 10s.; Q.F. process and shell-case brass, 70/30 quality, free from primers, £49; clean fired 303 S.A. cartridge cases, £47; 70/30 turnings, clean and baled, £43; brass swarf, clean, free from iron and commercially dry, £34 10s.; new brass rod ends, 60/40 quality, £38 10s.; hot stampings and fuse metal, 60/40 quality, £38 10s.; Admiralty gunmetal, 88-10-2, containing not more than ½ per cent. lead or 3 per cent. zinc, or less than 9½ per cent. tin, £77, all per ton, ex works.

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended May 13, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

Brass.—S.A.A. webbing, £48 10s.; S.A.A. defective cups and cases, £47 10s.; S.A.A. cut-offs and trimmings, £42 10s.; S.A.A. turnings (loose), £37; S.A.A. turnings (baled), £42 10s.; S.A.A. turnings (masticated), £42; Q.F. webbing, £49; defective Q.F. cups and cases, £49; Q.F. cut-offs, £47 10s.; Q.F. turnings, £38; other 70/30 process and manufacturing scrap, £46 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. Cu, £43 10s.; ditto, over 58 per cent. to 62 per cent. Cu, £38 10s.; 85/15 gilding metal webbing, £52 10s.; 85/15 gilding defective cups and envelopes before filling, £50 10s.; cap metal webbing, £54 10s.; 90/10 gilding webbing, £53 10s.; 90/10 gilding defective cups and envelopes before filling, £51 10s.

Cupro Nickel.—80/20 cupro-nickel webbing, £75 10s.; 80/20 defective cups and envelopes before filling, £70 10s.

Nickel Silver.—Process and manufacturing scrap: 10 per cent. nickel, £50; 15 per cent. nickel, £56; 18 per cent. nickel, £60; 20 per cent. nickel, £63.

Copper.—Sheet cuttings and webbing, untinned, £54; shell-band plate scrap, £56 10s.; copper turnings, £48.

IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3¾ per cent. dealers' remuneration.* 50 *tons and upwards over three months,* 2s. 6d. *extra.*)

South Wales.—Short heavy steel, not ex. 24-in. lengths, 82s. to 84s. 6d.; heavy machinery cast iron, 87s.; ordinary heavy cast iron, 82s.; cast-iron railway chairs, 87s.; medium cast iron, 78s. 3d.; light cast iron, 73s. 6d.

Middlesbrough.—Short heavy steel, 79s. 9d. to 82s. 3d.; heavy machinery cast iron, 91s. 9d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 89s. 3d.; medium cast iron, 79s. 6d.; light cast iron, 74s. 6d.

Birmingham District.—Short heavy steel, 74s. 9d. to 77s. 3d.; heavy machinery cast iron, 92s. 3d.: ordinary heavy cast iron, 87s. 6d.; cast-iron railway chairs, 87s. 6d.; medium cast iron, 80s. 3d.; light cast iron, 75s. 3d.

Scotland.—Short heavy steel, 79s. 6d. to 82s.; heavy machinery cast iron, 94s. 3d.; ordinary heavy cast iron, 89s. 3d.; cast-iron railway chairs, 94s. 3d.; medium cast iron, 77s. 3d.; light cast iron, 72s. 3d.

(Note.—*For deliveries of cast-iron scrap free to consumers' works in Scotland, the above prices less 3s. per ton, but plus actual cost of transport or 6s. per ton, whichever is the less.*)

SITUATIONS

PATTERNSHOP MANAGER (age 39 years) seeks similar position; 15 years' experience in executive position; good organiser and planner; highly specialised knowledge of piston trade.—Box 470, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MANAGER, Malleable Iron Works (aged 39), practical and technical man, 23 years' experience patternmaking and malleable founding, desires change; Midlands preferred.—Box 484, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY SUPERINTENDENT MANAGER (age 39), M.I.Brit.F., Inter.B.Sc., practical foundryman and patternmaker, expert repetition light castings, grey and malleable; accept full control; rates, costs, organisation, metallurgist, metal control, annealing; commercial experience; energetic; good record; opening wanted with medium progressive Midland Foundry; salary results basis; principals only.—Box 494, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY MANAGER required by established General Engineering Co. in Midlands, to take charge of Foundries producing wide range of castings up to 12 tons, with a capacity of 5,000 tons per annum; good technical qualifications and experience essential.—Write, stating age, experience, and salary required, to Box 498, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

FOUNDRY SUPERINTENDENT required for Non-ferrous Foundry, London area, to supervise production of light and medium size castings; capable of planning and progressing work through all stages; a good disciplinarian; salary, £500-£600 per annum.—Write, stating age, experience, and qualifications, to Box 500, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

STEEL FOUNDRY MANAGER; thoroughly capable of taking control, and with up-to-date experience of castings up to 5 tons; also mass production with power moulding machines; output 3,000 tons yearly; full particulars in confidence, and salary.—Box 478, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

THE Directors of a modern well-established Steel Foundry wish to make contact with men, aged 30/40, having first-class technical knowledge and practical experience in steel foundry work, who are desirous of taking up the career of Technical Representative, post-war, or immediately if release can be obtained; permanent position; adequate remuneration and excellent prospects.—Full details of career, age, and salary required, to Box 490, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MACHINERY

WANTED.—Turnover Power Operating Moulding Machine, to take boxes approximately 18 in. square.—Particulars to Box 488, FOUNDRY TRADE JOURNAL, 3, Amersham Road, High Wycombe.

MACHINERY—contd.

FOUNDRY PLANT FOR SALE.

ONE CUPOLA; 42 in. dia., inside lining, complete with mechanical drop bottom, spark arrester and catcher; eight tuyeres, wind belt and air piping; capacity 6-7 tons per hr.; complete with one size 28 type JB 13 KEITH BLACKMAN FAN, having C.I. housing with 12 in. dia. flanged outlet and 20 in. dia. impellor; capacity 4,500 cub. ft. per min. at 24 in. w.g.; Fan direct coupled to 33 h.p. variable speed MOTOR, by Maudsleys, for 220 volts d.c.; 2,000/2,500 r.p.m.; mounted on combined baseplate, and complete with wall mounting starter and shunt regulator (new 1939).

ONE CUPOLA; 60 in. dia. inside lining, complete with spark arrester, catcher and chimney; eight tuyeres, wind belt and air piping; capacity 14-15 tons per hr.; complete with one No. 40 Fan, with welded casing; capacity 8,000 cub. ft. per min. at 28 in. w.g.; direct coupled to 65 h.p. screw protected Motor, by Lancs. Dynamo, 215 volts d.c.; speed 1,300/1,600, by shunt control; all mounted on fabricated baseplate, and with floor mounting totally enclosed starter; Cupola reconditioned 1938; Fan and Motor new 1938.

ONE SAND MILL, by Whittaker; pan 7 ft. dia., rollers 48 in. dia., with renewable bottom, power raising and lowering gear, and V rope drive from 24 h.p. Motor, 220 volts d.c.

ONE SAND MILL, by Pratchitt Bros.; pan 7 ft. dia., rollers 40 in. dia., with renewable bottom, power raising and lowering gear, and V rope drive from 15 h.p. Motor, 220 volts d.c.

ONE SAND MILL, with pan; 6 ft. rollers, 32 in. dia., with renewable bottom; belt driven from 20 h.p. Motor, 220 volts d.c.

TWO PORTABLE MOULD DRYERS; coke fired; having C.I. body, with lining and variable horizontal or vertical discharge; temperature regulation by dampers, and Fan Motor and Starter for 400 volts, 3-phase, 50 cycles (new).

ONE DRAWER TYPE, DRYING OVEN; coke fired; 7 ft. 3 in. high, 4 ft. 3 in. wide, 6 ft. 6 in. deep, with channel frame and 16 g. casing lined with 2 in. thick silicate cotton; top fitted with ventilator and regulator and bottom with M.S. Furnace, with firing and ashpit doors; the whole lined with refractories; oven fitted with four drawers, each 3 ft. 6 in. by 6 ft. 1 in., one 14 in. deep and three 9 in. deep clear; thermometer (very little used).

ONE PASSENGER AND GOODS LIFT, by Keighley Lift Co. (1938), for a safe working load of 30 cwts., and complete with 7.5 h.p. Motor, 220 volts, d.c., with push-button control from cage.

ONE EMERY WHEEL, with 30 in. stone 2¾ in. wide, by Mitchell; direct belt driven from 10 h.p. Motor, by Lancs. Dynamo; 950 r.p.m.; 220 volts d.c.

ONE 25-Ton LADLE; built by Foster, Yates & Thom, 1939.

ONE 17-Ton LADLE.
ONE 15-Ton LADLE.
ONE 8-Ton. LADLE.
ONE 6-Ton LADLE.
ONE 3½-Ton LADLE.
ONE 1½-Ton LADLE.
10 Tons (approx.) DURSAND.

A large quantity of C.I. and "STERLING" steel MOULDING BOXES of various types and sizes.

FOSTER, YATES & THOM, LTD., BLACKBURN.

MACHINERY—contd.

SKLENAR Patent Melting Furnaces; coke- or oil-fired; capacity 2 tons, 1 ton, ½ ton, 500 lbs.—SKLENAR PATENT MELTING FURNACES, LTD., East Moors Road, Cardiff.

SOLE AGENTS FOR :—
"POLFORD" CORE-SAND MIXERS, TILTING AND CRUCIBLE FURNACES, MOULD DRYER, RIDDLE, SCREEN, etc.

Write for Prices and Particulars.
THOS. W. WARD LTD.
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PNEUMATIC MOULDING MACHINES.

Tabor (Macnab) Vert. turnover, table approx. 40 in. by 30 in.
Darling & Sellars turnover, table 64 in. by 20 in.
Adaptable Rollover Core - Making Machines, hand operated.
Mumford Type (Jackman) Swing Head-press, 13 in. by 15 in.
Mumford Pneumatic Core Jolters, tables 24 in. by 18 in.
Britannia No. 1 "Coventry" Turnover Jar Ram, table 30 in. by 28 in.
Universal Plain Jolt; 1-ton capacity; table 37½ in. square; one machine unused.
Sandblasting Plant; 50 Air Compressors; 500 Electric Motors, Dynamos, etc.

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CROSSWELLS ROAD, LANGLEY,
NR. BIRMINGHAM.
Broadwell 1359.

MISCELLANEOUS

PATTERNS for all branches of Engineering, for Hand or Machine Moulding.—FURMSTON AND LAWLOR, Letchworth.

"GO TO WARWILL, LTD., ABERTILLERY, MON., FOR NON-FERROUS CASTINGS UP TO 1 CWT.; GOOD DELIVERIES.

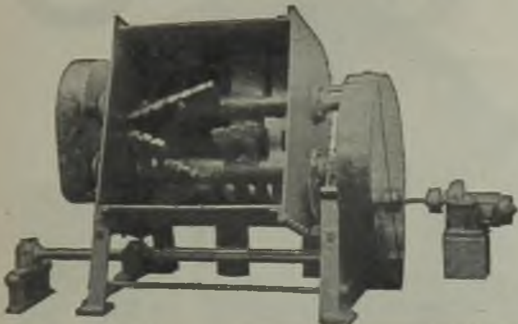
JOHN REDGATE (IRONFOUNDERS), CROCUS STREET, NOTTINGHAM, will have capacity available shortly for 1 or 2 tons of Engineering and Machine Tool Castings weekly, and will be glad to receive enquiries.

'Phone : 22877 SLOUGH

NEW SHOT BLAST CABINET PLANTS
with motor driven Exhaust Fans, complete, all sizes ; air compressors to suit in stock, also motors if required.
Britannia large size plain jolt and pattern draw moulding machine, 8" diameter cylinder, table 4' x 3', reconditioned.
Pneulec Royer Sand Thrower.
Coleman Prosama Sand Thrower.
Jackman taper roll Sand Mill.
New 600 lb. oil or gas-fired centre axis tilting furnace complete with bar burner and equipment, £220.

Alex. Hammond, *Foundry Machinery Merchant.*
14 AUSTRALIA Rd. SLOUGH
BUY FROM ME AND SAVE MONEY

DO all mixers really mix?



. . . or is it just a glorified stir? For real mixing means the bringing of the various ingredients into a true homogeneous batch, with the proportions of the materials correctly maintained throughout. Comparison of ordinary mixer blades of fanciful shapes with the scientifically designed intermeshing blades of the Beken Duplex Mixer explains the difference. The work is done between the blades of the Beken Duplex Mixer and *not* between the blades and the pan . . .

A foundryman writes: "I am pleased to state I am convinced the Beken Duplex machine is very suitable for mixing oil sand. The results prove that the mixing action is very thorough."

BEKEN DUPLEX MIXERS *do*

Sole Distributors: **LAVINO (LONDON) LTD.** 103 KINGSWAY, LONDON, W.C.2

Sole Makers: **E. HUNT & CO., LTD.** RIPPLE ROAD, BARKING, ESSEX

Telephone: Chancery 6137 (3 lines)

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Here is the answer—the quickest method of loading and unloading road and rail vehicles ever placed at the disposal of industrial and transport undertakings. For stacking and handling, too, this practical loader is helping to solve the man-power problem for a host of industries. Let us tell you more. We are specialists in all kinds of conveying schemes.

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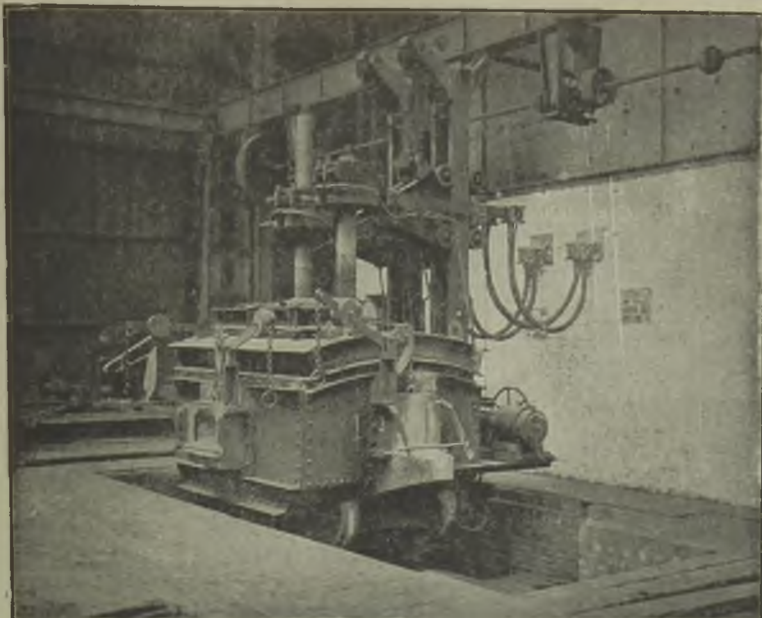

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