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Lunacy

By their action in forcing through plans for the nationalisation of iron and steel, the Government has increased rather than decreased the feeling of frustration and doubt engendered by the original proposal. The foundry industry, being allied in many ways with iron- and steel-making, is fundamentally disturbed, as the co-operation between the two confers upon both many advantages of outstanding worth. The latter collects for the former much of its statistical data. By the pig-iron levy system, finance was made available for the intensive prosecution of research and education. The making of new arrangements for all these creditable activities will have a baleful influence on iron- and steel-founding.

The worst feature is the fear of ironfounders that it may be "our turn next." Then there is the worry of a new set-up in competition. Buyers, in general, prefer to place orders with free-enterprise concerns because in case of dispute the parties are more evenly matched. To bring an action at law against a Government department is not a step lightly to be undertaken. The fact that the existing firms will retain the established names will not mask their real ownership. Sales abroad will be jeopardised from this cause. Overseas buyers often need much "cultivating" and this in the hands of civil servants can easily give rise to international unpleasantness. For the home buyer, if there is the prospect of treatment such as is given by some Government monopolies, then it will be difficult to conduct one's business. Since the war, the installation of a new telephone has often been so difficult as to create a feeling of real helplessness.

The services so far given by the State monopolies have not been of such a character as to create enthusiasm for their extension. The productivity report of the grey-iron founders refers to the lowering of the quality of the coke since it became a State monopoly. There has been a deterioration in transport facilities associated with enhanced prices. Electric power is in short supply and cuts are frequent and expensive. With increasing State ownership there is a multiplication of bureaucrats, with the result that the producer has to contribute indirectly, but materially, to the upkeep of them and their families. Private industry keeps overheads down to a minimum, whereas, if a bureaucrat can surround himself with an ever-increasing staff, his personal position is improved. There is no case for making a State monopoly of iron and steel and to attempt it at the present juncture is, in the words of Lord Bruce of Melbourne, "sheer lunacy." Viewed from no-matter-what angle—labour relationship, enterprise, productivity, willingness to co-operate or quality of output—the iron and steel industry and, incidentally, its sister industry, ironfounding, have a magnificent record since the war. No special reasons have been put forward why a fundamental change should be imposed. Practice is being sacrificed on the altar of political theory—and an untenable theory at that.

We regret that owing to the continuance of labour troubles in the London printing industry this copy of the "Journal" is reduced in size and the position is uncertain as regards issues in the immediate future. Readers are assured, however, that normal publication will be resumed as soon as conditions permit.

Contents

Productivity Conference

Managerial Aspects Discussed in London

Last Wednesday ironfounders from all over the country met under the presidency of Mr. N. P. Newman, to hear the presentation of the Report on the Grey Ironfounders' productivity team which recently visited America. The benefit to be derived from the conference was materially enhanced by the presence of Mr. H. P. Good, the president of the Grey Iron Founders' Society of America, and later for but a short time of Mr. R. L. Collier, the executive vice-president of that body. Mr. Collier, unfortunately, was taken ill and had to return to America; he carried with him the warmest wishes of the conference for a speedy recovery. Generally speaking, the technical aspects of the Report were held over for discussion later at Ashorne Hill.

Many aspects were clarified, the interjections of Mr. Good being most helpful. Amongst the points brought out were the higher standing of the foreman in the States; the better supply of young, well-trained technicians; the stress laid on engineering rather than on metallurgy, and the results obtained from local, as opposed to national, labour contracts. It is obvious that Mr. Good is very keen on mechanisation, and the figures he disclosed showed that his firm had derived quicker and more material benefits from it than is usually the case in this country. When Mr. G. B. Judd introduced a case for increased simplicity such as is used in the States for ascertaining costs, he received quite a barrage of objections. Yet we think he was right for the industry as a whole.

The subject which gave rise to an equally animated discussion was that of the development of the market for iron castings. It is a very difficult problem and one which was brilliantly handled by Mr. K. Marshall, the director of the Joint Iron Council Associations. The two phases, prestige advertising and the direct appeal to designers, were dealt with logically and without bias. It was during this discussion that it was learnt that, through an alteration in specifications, the American railway authorities had ruled out the use of chilled car wheels, thereby cutting the output of the American ironfoundries by about 1,000,000 tons a year.

The Fourth Session of the Convention covered the problem of conditions in ironfoundries. The president's preliminary statement revealed the very considerable progress which had been made. This was very largely supported by Mr. H. A. Hepburn (H.M. deputy chief inspector of factories). He indicated, however, that there was still much need for the replacement of sand floors by concrete or the like where box parts are used; that properly maintained gangways between pouring station and cupola must be provided; that drastic steps must be taken to reduce the dust hazard, and that heating by coke fires must be reduced.

The conference ended with a dinner, at which Lord Bruce of Melbourne gave a brilliant address, which included a forthright condemnation of the Government action in converting the iron and steel industry into a State monopoly.

Implementation

Action to be taken immediately by the C.F.A. to further implement the findings of the Report will include:—

(*a*) Copies of the Productivity Report and a report of the conference will be sent to all ironfounders of Great Britain.

(*b*) Technical aspects of the Report will be discussed at the conference at Ashorne Hill, Leamington, on October 12 and 13, sponsored by the British Cast Iron Research Association.

(*c*) Branches of the Institute of British Foundrymen and constituent associations of the C.F.A. will hold local meetings for discussing the Report.

(*d*) The formation of local cost groups will be encouraged.

(*e*) All ironfounders are being encouraged to join constituent associations.

(*f*) Advisory teams operating through the B.C.I.R.A. will help ironfounders to improve productivity.

(*g*) The C.F.A. development panel will examine the Report in accordance with their principal terms of reference and will issue further recommendations.

(*h*) The problems of incentives and simplification of the wage structure will be investigated in consultation between the C.F.A. associations and the wage-negotiating bodies.

(*i*) The adverse effect of taxation on the financial incentives intended to increase productivity will be impressed on the Government by the ironfounding employers at every opportunity.

(*j*) The C.F.A. will review the system of training and education in the light of the Report and will submit early recommendations.

I.B.F. Golfing Society

The fifth annual Golf Competition organised this year for the Institute of British Foundrymen by their newly-formed Golfing Society was held at Woodhall Spa last Saturday. The winner of the Scratch Cup was Mr. L. A. Bailey, of the East Midlands branch, with a gross score of 83; Mr. Crompton J. Lake (London branch), was runner-up with 88. The I.B.F. handicap cup was won by Mr. H. Oliver (West Riding of Yorks) with Mr. J. Bell (Birmingham branch) second; the net scores being 78 and 79 respectively. There were 28 competitors and the match was played in fine weather through the afternoon, but the Sunday games were marred by torrential rain. The cup winners were each presented with souvenir tankards, the gift of the Society's president, Mr. R. B. Templeton.

After Mr. Templeton had presented the prizes, a business meeting of the Golfing Society was held at which the president was re-elected; Mr. J. J. Sheenhan, Mr. P. H. Wilson, O.B.E., and Mr. V. C. Faulkner were elected vice-presidents. The re-election of Mr. F. Arnold Wilson as honorary secretary and treasurer was accompanied by a well-earned vote of thanks, and the small committee, Mr. J. Bell and Mr. E. A. Phillips, was asked to continue in office.

Repair and Reclamation of Castings

Joint discussion at the Buxton Conference of the Institute of British Foundrymen of two technical sub-committee reports—T.S.23, Repair and Reclamation of Grey-iron Castings by Welding and Allied Methods, and T.S.26, Repair and Reclamation of Non-ferrous Castings.† The first report, covered two main sections, welding (including bronze welding) and burning-on, and the second gave in addition recommendations on brazing and soldering, impregnation, caulking and plugging, plating and metal spraying. Each was introduced at the meeting by the respective chairman of the sub-committee.*

THE REPORT relating to grey-iron castings, presented by DR. A. B. EVEREST (chairman of sub-committee T.S.23), gave the results of the committee's work covering two or three years. Unfortunately, he said, much reclamation work had been in the past regarded as a hole-in-the-corner business, as something which must be done " under the counter." As a result, the work of reclamation suffered. Therefore, it was felt that the whole question of the reclamation of castings should be aired and placed on a sound footing, and it had been considered by a strong sub-committee whose members included some of the best welding and burning-on experts in the country. The report might eventually form the basis of a British Standard Code of Practice.

He urged that the report, as well as that dealing with the repair and reclamation of non-ferrous castings (that of sub-committee T.S. 26) should be presented and discussed also at Institute branch meetings.

MR. G. ELSTON, chairman of the sub-committee which prepared the report on the reclamation of non-ferrous castings, said that he wished to endorse all the remarks made by Dr. Everest regarding the need for open discussion on the problem of reclamation work and supported Dr. Everest's plea that both reports should be discussed at the branch meetings of the Institute.

THE CHAIRMAN (Mr. D. H. Wood) recalled that many years ago he was elected to represent the Institute on a committee called together by the City and Guilds of London Institute to consider welding. At the first meeting he had said that the I.B.F. greatly appreciated the honour of being asked to send a representative to the committee, but they had wondered what interest the subject could have for the members of the Institute. Nobody present at that meeting could answer the question; it was not suggested then that castings could be reclaimed.

Again, he recalled that years ago, in a foundry which he knew very well, a new managing director had been appointed, and after eight or ten weeks he had claimed that output had increased by 70 per cent. Incidentally, they were making castings about 6 ft. 6 in. long, very light and very thin, which were subsequently enamelled. When the managing director was asked how he had increased production so enormously he had said that he had bought a second-hand welding plant having a tramway-car controller, by means of which weak spots in the castings were welded up; castings which formerly would be broken up were thus repaired, and sold.

Speaking of the process of welding in the fire—which was a very skilled job—to ensure that there was no cold shut, Mr. Wood said that perhaps the operator was the only man who knew immediately whether or not he had made a sound job. An observer, however, might be able to come to a conclusion if he were watching very closely.

Finding the End of a Crack

MR. L. W. BOLTON, congratulating the two sub-committees on having brought their work to a satisfactory conclusion, said that the reports represented a considerable amount of work and met a very definite need at the present time. Costs of labour and materials used in the manufacture of castings were still increasing, and the need to minimise waste and so keep down prices was more and more pressing. It was obviously in the interests of all concerned, to avoid rejecting a casting if it could be successfully reclaimed, and undoubtedly in large numbers of cases this was possible by the use of the methods described. The use of unskilled labour in the foundry and the drive for increased production both tended to cause higher foundry scrap figures. By the careful application of reclamation methods, considerable savings were possible. He personally would like to see the reports accepted by the British Standards Institution and put forward officially by that organisation as Codes of Practice.

Asking for further information in connection with the reclamation of iron castings—he had no major criticism of the report—Mr. Bolton said that in connection with the welding of cracked castings, stress was admittedly laid on the necessity for ensuring that the end of a crack was drilled and that there should be proper preparation. His own experience was that it was extremely difficult to make sure that the end of a crack had been found. In putting forward an official recommendation to foundrymen that cracked castings could be welded, he felt that greater caution than was suggested in the report was necessary.

Hardness at Weld/Parent Metal Junction

With regard to the use of non-ferrous electrodes for the arc-welding of grey iron to produce a machineable weld, he said that nickel or nickel alloys

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*Printed in the JOURNAL August 24 and †September 14.

were suggested as suitable materials and were in fact widely used. If a satisfactory weld was to be obtained, it was necessary to fuse the surface of the parent metal. The fused metal would then take nickel into solution, and this would produce a martensitic layer. The report stated that the weld should be "tempered" down. His own experience with small castings was that it was impossible to ensure that an arc-weld made without preheating would be machineable. Perhaps that was particularly noticeable in the case of small castings, for they were usually machined at high speeds by mass-production methods, and the quite thin but hard layer at the joint between the weld and the parent metal gave trouble at high machining speeds. He asked whether sub-committee T.S.23 had given consideration to that particular point.

Dr. Everest, after assuring Mr. Bolton that his remarks would be greatly appreciated by the committees, said the finding of the end of a crack was largely a matter of experience; a man working on a particular type of castings could judge for himself and would allow the extra ¼ or ½ in. beyond the point at which he could actually see the crack. In the case of a really important casting one could use crack-detection methods and allow a little extra margin for safety. One could drill-out the end of a crack with a round hole, which was a good shape for relieving stresses and preventing the crack from spreading further.

With regard to the martensitic layer, he said it was obvious that there would be a tendency to produce such a layer. He suggested, however, that the hard zone in an arc weld was not due to an alloy band (for he believed it was accepted that an alloy band having a martensitic structure would be very narrow) so much as to thermal effects. There was cold metal a short distance from the weld, and the welding was carried on at well above the critical temperature. It was the rapid cooling after welding that tended to produce hardening, rather than alloying, although the two effects would to some extent combine.

Oil/Chalk Test

Mr. G. G. Musted (Quasi Arc Company, Limited, and a member of sub-committee T.S.23), responding to an invitation to comment further on the questions raised, said that a very simple method of ascertaining the start and finish of a crack, and a method which was very often sufficient, was to apply the oil/chalk test. One used paraffin or other very thin oil and smeared it over the part where the defect was known to exist, wiping it away after it had seeped into the crack. Then one should rub chalk over it very thoroughly and peen it or hammer it very lightly. Immediately the oil would come through and show quite distinctly on the chalked surface. Then one could drill a hole at both ends of the crack and repair the casting as required, whether by gas or arc.

Discussing the preparation of a cracked casting for welding, he assumed the use of a copper-nickel electrode, which was as good as any, with a good stabilising agent and the necessary fluxes to make a good weld. He suggested that, before welding commenced, a few pieces of red-hot scrap metal laid around the casting would definitely reduce the possibility of creating hardness in the casting. Alternatively one could use the blowpipe to preheat the casting. However, the human element was important, and a man with an oxy-acetylene blowpipe did not know what amount of heat he was putting into the casting. If, instead, a piece of red-hot or "black-hot" metal which was gradually getting cooler was used, a certain amount of the heat permeated the casting and prevented the creation of a hard zone without the danger of excessive heat causing further cracks.

Importance of Supervision

Mr. Musted emphasised that the manager or foreman or engineer in charge of the job should have sufficient experience to be able to decide whether it would be cheaper to scrap a damaged casting, or whether it could be salvaged by the oxy-acetylene fusion method, the oxy-acetylene non-fusion method (bronze welding) for the metallic arc. He also emphasised the very great importance of supervision of all welding, whether in the foundry or in connection with maintenance.

Mr. J. A. Reynolds, commending the sub-committees on their work in correlating the information gained on the reclamation of castings, said there were still many odd ideas on reclaiming castings, and having put the correct methods on to paper and having indicated the necessary safeguards, the founding industry in general should be able to reclaim castings with greater success in the future than in the past.

Commenting on the statement by sub-committee T.S.26, that "aluminium bronze may be soldered satisfactorily with soft solder using phosphoric acid as a flux," he said that in the electrical trade, in connection with the wiping of lead joints on certain metals, aluminium bronze in particular, several different fluxes had been tried with indifferent results. Possibly by a chat with one of the members of the sub-committee he might be able to secure help in that connection.

Impregnation of Porous Castings

Discussing impregnation, he referred to compounds used in the electrical industry for sealing high-tension joints on terminal boxes. A number of castings which had failed through micro-porosity had been impregnated, but one was perhaps still a little worried lest the impregnating material might itself have some ill effect.

Mr. Elston replied that sub-committee T.S.26 had not sought to get down to the details which Mr. Reynolds had mentioned, and he would not be prepared, on behalf of the sub-committee, to give any definite assurance as to the effect of the impregnating material on sealing media for high-tension joints. But most of the recommended sealing media would stand up to all the conditions of temperature and service which could be applied safely to the castings themselves, so that if the point was reached at which the sealing media were attacked one was also at the point where the castings themselves were adversely affected. By and large, therefore, due to the inert character of the cured sealant, there would be no attack under service conditions. On the question of choice of sealants the sub-committee had recommended that the manufacturers should be consulted as to the behaviour of their products in specific circumstances.

He was not familiar with the process of wiping lead on to aluminium bronze, and he was not sure that it could reasonably be regarded as the reclaiming of a casting. Presumable, even when a casting was good, the lead had still to be wiped on to make a joint. In no case did the sub-committee suggest that lead should be wiped on to repair an aluminium-bronze casting, and he did not think any of the members of the sub-committee had experience of that particular application.

Customs of the Trade

MR. G. BLANC (*Centre Technique*, Paris), asked to what extent it was necessary, before repairing a raw casting, to obtain the agreement of the user. One solution would be for the user to specify in his order that repairing should be done only with his agreement. But it would seem to him that if a code of procedure such as the sub-committees had produced were followed, no previous agreement was envisaged.

DR. EVEREST said it was standard practice in this country for specifications to provide that no welding should be carried out except by agreement between the purchaser and the manufacturer. That meant that in certain cases the manufacturer could quite rightly tell the purchaser that he would like to weld and, with proper inspection, the casting could be accepted. Such treatment must not be carried out except by agreement.

MR. ELSTON associated himself with that reply and said he saw no reason at all why the inspector should not be consulted every time. The manufacturers had nothing to lose thereby, but everything to gain.

MR. F. C. EVANS (member of sub-committee T.S.26) pointed out that in the report dealing with non-ferrous castings there was reference to B.S. 1367, a code of procedure for the inspection of castings, and he asked if there was available a similar code of inspection for iron castings. If so, he suggested, it would be well to link the repair of iron castings with that code, as had been done in the case of the non-ferrous castings.

Inspection Code for Iron Castings

DR. EVEREST replied that from the point of view of the reports, cast iron was a simpler material to deal with than the non-ferrous materials, for the report on those materials covered a whole range of non-ferrous alloys. In paragraph II of the report on grey-iron castings it was stated: "This code of practice applies to general grey-iron castings such as, for example, those in which the material conforms to B.S.1452:48 . . . " and there was no attempt to define it further, except in the various conditions set out in the following paragraphs, where reference was made to the forms of the castings and other factors, including commercial factors, which would determine whether or not reclamation was to be carried out.

There was a general iron-castings specification and the general classifications for pipes, valves and other things, and the code of inspection and methods of testing were laid down in the specifications. But there was no code of inspection for iron castings corresponding to that for the inspection of non-ferrous castings. He asked that Mr. Bolton might include the matter in the agenda for the next meeting of the Technical Council, so that consideration might be given to the possibility of appointing members to study the development of a code for the inspection of cast iron, for it seemed to him that that would be quite useful.

MR. F. GREAVES asked whether such a code would deal with inspection of welds in cast iron, or cast iron generally.

DR. EVEREST said he understood it would be for the inspection of cast iron generally, but he imagined there would be automatically a subsection on welds.

MR. EVANS agreed that this would meet the case.

THE CHAIRMAN, expressing the Institute's thanks to the chairmen and members of the two sub-committees, said they were appointed in September, 1947, so that their reports represented nearly three years of work. It was quite obvious that a vast amount of time and labour had been devoted to the preparation of the reports, which were extremely valuable to the industry and ultimately to the national economy in the saving of materials and, even more important, the saving of skilled labour.

The thanks of the meeting were heartily accorded and at this stage Mr. D. H. Wood vacated the chair, and Mr. Colin Gresty, senior vice-president, presided during the remainder of the session.

"Burning" more Satisfactory

MR. W. THOMSON complimented the sub-committees on having produced such good reports and related some of his experience of the burning-on and welding of non-ferrous castings. He mentioned the case of two cylinder rams weighing about 7 cwts., both of which had contained a blowhole of about ½ in. dia. and ⅛ in. deep, as disclosed by machining. The first was sent to the welding shop but was welded unsuccessfully. The second was repaired by burning-on and was perfectly sound. Referring to Table I in the report on non-ferrous castings, giving the comparative results for as-cast and "burned" test-bars of various alloys, he drew attention to the figures for cast manganese bronze, and said his experience with that type of metal was that if the tensile strength were high the elongation was very low, and *vice versa*. He asked how the sub-committee had managed to obtain the results stated—33.5 tons per sq. in. tensile and 40 per cent. elongation for the burned bar, and 35 tons per sq. in. tensile and 33 per cent. elongation for the as-cast bars. He asked whether the bars were chill cast or sand cast. He and his colleagues, when working with that type of metal, simply could not obtain such results. Again, in the case of the cast phosphor-bronze the figures were very high; he asked whether the bars were chill cast, because inspectors were very loth to accept chill-cast bars.

Mr. Elston said Mr. Thomson's observations on the two cylinders which were welded and burned respectively, reflected in a practical way, precisely that which committee T.S.26 had endeavoured to imply in its report, namely that burning was the more preferable of the two processes, where it could be used. But he did not know where, in relation to the boundaries of the castings referred to by Mr. Thomson, the ½-in. blowholes were situated. No doubt Mr. Thomson would agree that if one had a large casting with a ½-in. blowhole in the middle of it, unless special precautions were taken, it would be almost impossible to burn that without giving rise to cracking. In the experience of the committee where a large casting was to be burned and required preheating, that preheating should be carried to a boundary of the casting. If the defect were somewhere near the end, well and good, but if it were inside, it was necessary to heat all the way to a boundary to allow slight movement from that boundary. If the blowhole were well into the casting it would be almost impossible to burn it, so that welding would be the only alternative, except possibly plugging. But his impression was that burning should be considered first. There were occasions, however, when burning would produce cracking, whereas arc welding would have a reduced tendency to do so, due to the extremely localised heat input.

High Test Results

Dealing with the question as to how the results for cast manganese-bronze and phosphor-bronze, given in Table I, were obtained, he said the figures were those attained by the member of the sub-committee who did the tests. Not all the members of the sub-committee verified the tests. Mr. Elston agreed that the results appeared somewhat on the high side, but they were submitted to the sub-committee in good faith as being accurate. The manganese-bronze referred to was a high-tensile material chill-cast in the form of a keel bar; the phosphor-bronze bar was sand cast.

Mr. H. Booth, reverting to the question of the hard zone around a weld in cast iron when using a nickel type of electrode, said he understood from previous answers that the sub-committee T.S.23 considered it to be due to chilling, and not to combination with the nickel.

Dr. Everest said he had stated that there was some combination, but that chilling was perhaps the major cause of the hardening.

Mr. Booth commented that, in that case, the chilling would be dependent on the composition of the iron; if that were so, it was not quite brought out in the Appendix to the Report, dealing with the effects of elements on weldability of iron castings.

Effect of Cooling Conditions

Dr. Everest said the point he had tried to make was that the rate of cooling of the metal around the weld would be not only a function of the welding operation, but also of the mass of metal adjacent to it. For example, if there were a very heavy mass of metal on either side of the weld, obviously the rate of flow of heat into the mass would be high, and after the operation probably there would be quicker cooling of the metal around the weld than if the weld were in the middle of a relatively thin section.

Mr. Musted added that, after the weld had been completed, the body of the casting should be kept relatively warm to enable the weld to cool slowly. Then hardening would not occur to the same extent as it would if the weld were rapidly cooled.

Mr. Reynolds said the whole point was to control the cooling in order to prevent sudden contraction.

The Chairman agreed, and recalled Dr. Everest's point that if there were a large mass of metal in the casting there would be rapid heat conductivity away from the weld and very rapid flow of heat, giving an effect somewhat similar to that of an outside chill.

Mr. F. Dunn also congratulated the sub-committees on their reports, which he thought should form basis for B.S.I. Codes of Practice. He emphasised that welders should work in a properly-equipped shop with adequate lighting, space and ventilation and that the welders must be skilled.

Strength of Welds

The section concerning the mechanical properties of welds, in the report on iron castings, he suggested should be treated with a little caution; indeed, he had gathered that Dr. Everest was a little dissatisfied about it. As indicated in that section, it had been stated as long ago as 1933, at the American Society for Testing Materials Symposium on Cast Iron, that properly-made welds in grey cast iron had practically the same strength as the base metal, but he thought that this statement should be interpreted with caution, especially when considering the higher grades of B.S.S. 1452:1948. The British Cast Iron Research Association was very much aware of the problem and of the lack of knowledge concerning the strength of welds, and a panel dealing with the welding of cast iron was at present carrying out an investigation into the matter.

Discussing the effect of phosphorus on the weld and its mechanical properties, Mr. Dunn asked if the sub-committee T.S.23 could indicate the maximum phosphorus content that could be tolerated in iron welded by the metallic-arc process, using non-ferrous electrodes, before cracking or brittleness in the weld could be expected. Could it be assumed, for example, that there was some danger of brittleness or cracking in metallic-arc welds made using certain non-ferrous electrodes when an iron containing, say, 0.8 to 1.0 per cent. phosphorus was welded?

Difficulty of Obtaining Adequate Data

Dr. Everest said the sub-committee's difficulty when considering the mechanical properties of welds lay in the fact that experience in making welds for test purposes, and the testing of them, was very limited. The B.C.I.R.A. had done some work on the matter, the Institute of Welding had done very little indeed, and the amount of work on the matter that had been done in the industry was practically nil. Again, only a little had been done in America. Thus, there was very little information available on which to draw, and that was the fundamental difficulty. But the tone which the sub-committee had tried to adopt and would like to put over was that we should not worry too much, for there was sufficient evidence that, if the weld were properly made, the strength across the weld would be equal to, and in some cases in excess of, that of the parent metal. He emphasised, however, that the operative words were "if the weld is properly made." He believed that much of the industry's trouble due to the suspicions of engineers and inspectors would pass when welding operations were placed on a really scientific basis; when it could be said that a weld had been made by a certain method and that it was, as far as humanly possible, a good and sound weld; then the foundry industry need not worry too much about mechanical properties. Any slight tendency to brittleness could be relieved by low-temperature annealing or stress relieving.

Influence of Phosphorus

A matter which had given rise to some doubt in people's minds was that certain welding rods had been developed in America and had been successful, but when brought to this country they were found sometimes to be not so successful. The sub-committee believed that quite often the problem was one of phosphorus content, because in the United States the phosphorus content used was about one-third of that used here; that is, of the order of 0.4 or 0.45 per cent.—a percentage deemed in that country to be associated with a high-phosphorus iron. He believed several members of the sub-committee would feel that it was not advisable to attempt to weld very-high-phosphorus iron, largely on account of its very poor resistance to thermal shock. After all, in welding, intense thermal stresses were communicated to the casting. The casting might be pre-heated to 500 deg. or whatever other temperature was chosen, but when the arc was put on the surface temperature would rise to 1,500, 1,700 and perhaps 2,000 deg. C. So that one would not generally consider it advisable to try to weld an iron containing 1.0 per cent. of phosphorus.

With regard to maximum phosphorus allowances, he said that some of the rods used in the United States were proving successful with irons containing 0.25 per cent. of phosphorus, but might give trouble with irons of 0.4 per cent. phosphorus. However, much depended on the rods involved; some British welding rod makers had produced modified rods which were more successful, or less "phosphorus-sensitive."

Danger of Laxity in Founding

Mr. H. Haynes, as a foundryman, disliked the application of welding to castings, and urged that gas holes, draws, and so on, could be avoided in the foundry. He felt that all the discussion about reclamation by welding, etc., created a difficult situation, for there would be a tendency, as a result, for foundrymen to become careless and to lose their skill; if something was likely to go wrong they might be led to take the view that it did not matter, for the casting could be made good by welding.

Dr. Everest fully sympathised with that point of view; one reason why, he said, in the last 10 or 20 years, the whole question of the welding of castings had got into disrepute was that foundrymen had felt it was bad policy to admit that they could ever make a bad casting. But it was obvious that reclamation must have advantages. For example, if a casting, worth hundreds of pounds sterling, were dropped before it left the foundry, and if the dropping resulted in the development of a crack or if a piece of a flange had broken off, would it be wise to scrap that casting when one knew that, for the expenditure of a small sum, and with the agreement of the inspector, one could make it good by welding? Nobody would claim that every casting made was perfect, and there were many cases where reclamation was possible. But it should not be suggested that reclamation was an easy matter, nor should there be any suggestion that foundrymen would get careless because a reclaimed casting would always be accepted. The decision must be the result of serious deliberation between the management, the inspectors and the purchaser, and would not be taken lightly. But when reclamation was undertaken it was important that the whole thing should be done openly. If welding and its limitations were properly understood by the inspectors they would never allow the welding of a casting such as a flywheel, for example, except under the strictest possible supervision.

Cases to be Judged Individually

Mr. Elston, who also commented on the point, said the decision in regard to reclamation was purely a matter of degree. The sub-committees were putting the matter forward as one to be decided upon according to the circumstances, and suggesting a variety of methods to meet a variety of conditions. Reclamation could be applied to castings found to be damaged when machining, or to castings which had become worn or broken in service.

Mr. J. Hird welcomed the fact that the sub-committees had brought the problem of reclamation into the open. If a foundryman made a bad casting, he was loth to talk about it; if a bad weld were made on a bad casting, he was even more loth to talk about it. One method of salvaging castings (which he did not think had been mentioned in the report) was possible when a casting was knocked-out hot. A tell-tale dark patch indicating a hidden blow-hole was sometimes visible on the surface of the red-hot casting. If the casting was welded immediately before it was allowed to cool, one had an excellent chance of making a good repair.

I.B.F. Discussion—Reclamation of Castings

Dr. Everest commented that that was implied in the report, even if it were not specifically mentioned.

Other Methods of Reclamation

Mr. F. Greaves, recalling the reference to the repairs of worn castings, asked if repair by metal spraying was suggested, for he had not noticed reference to it in the report.

Dr. Everest said that perhaps Mr. Greaves was a little confused by the fact that the Non-ferrous Sub-committee's report had a wider basis than the report on iron castings; the latter was definitely confined to welding and allied methods, which T.S.23 interpreted as meaning hot methods, and they did not include metal spraying or plating.

Mr. Elston added that in the report on non-ferrous castings it was stated definitely that metal spraying might be used for building up a worn surface.

Mr. J. Stott said that whereas Mr. Haynes belonged to the older generation of foundrymen and he himself belonged to the younger generation, he found himself in complete agreement with Mr. Haynes. He had begun to recover castings by welding largely because a customer had pressed for a better finish on a complicated machine-tool casting, where a blemish would cause trouble. Productivity campaigns were bringing pressure to bear on foundrymen to produce castings having a higher finish and to reduce the amount of machining and filing required. The result of allowing reclamation by welding was a reduction in the quality of castings; there was no doubt that unskilled or semi-skilled labour became careless, in spite of keen supervision. So that he felt that Mr. Haynes was right; Dr. Everest had also indicated that the casting which should be welded was the one which had been broken or which had failed outside the actual moulding floor. A casting broken in fettling could be recovered in that way.

Quality Checking of Welds

As one who could speak with some experience of welding, and of work which had to take considerable pressures, Mr. Stott could say with feeling that the man who carried out the welding was entirely capable of either ruining the job or making a good job. For example, in producing welded-steel pressure vessels to the current specification it was customary, where joining two steel plates together by welding, to extend the weld seam beyond the end of the plates and then to make tests on the extended seam of weld. That might give a perfectly good test specimen; but unless there were careful checking, there was no guarantee, even with a perfect test result, that there was not a shocking blowhole inside the welded seam. The only real test was x-ray or gamma-ray tests, although such tests were expensive and, so far, the equipment was beyond the scope of the average small foundry except in cases where the problem arose very frequently.

It was essential that the operator employed on the welding of castings must be really fully trained and must be given all facilities. The ordinary welder had no experience of welding cast iron and required final training, for it was quite impossible to achieve the results required without that real training and long experience. Welders in training should be instructed to drill out their own welds in order to see the results of their work, for incredible failures could sometimes be found in the bodies of welds. Beauty is only skin-deep, and a perfect-looking weld might have serious defects below the skin which would mean that the weld would not withstand any stress. All concerned with welding must cultivate the habit of chipping out their own work to see what serious holes and slag inclusions could be found in an innocent-seeming run of weld metal.

Training of Welders

Mr. Musted also emphasised that the welding of cast iron required an entirely different technique from that employed in the welding of steel, and it was advisable, wherever possible, to train men specially for welding cast iron. In a good many foundries to-day where successful welds were produced, the welders had either been trained in a special welding school for that work, or had been trained in the foundries concerned under a supervisor, foundry manager or engineer who really knew the job.

Relating his own experience to show that men were prone to become careless in their work, he recalled that about 22 years ago, when he was in the shipyards, the platers who assembled the structures had become very careless. In some cases they would think nothing of leaving plates 1 in. short. The trouble had been cured by subsequently cutting away and putting on an extra plate, charging the cost of it to the plating squad!

Effect of Peening

Mr. V. C. Faulkner (past-president) said it was well known that a deposited weld on steel increased in strength if it were peened; the tensile strength increased by 1 or 2 tons per sq. in. A welder had once told him that a casting must not be peened, because then an inspector could not see whether or not the weld was properly deposited. But surely, bearing in mind that nowadays we had available so many resources for conducting non-destructive tests, the question as to whether or not a weld should be peened should be re-examined. He asked, therefore, whether the sub-committees had given attention to the matter.

Dr. Everest said the point as to whether or not peening would hide a defect had not been taken up by T.S.23. The relief of internal stress by peening or hammering would account for the increased strength.

Mr. Elston said it was stated, in the report dealing with non-ferrous castings, that peening of welds should be carried out.

Service Temperatures and Bronze Welding

Mr. E. J. Brown said he had been concerned during the war with the manufacture of stressed castings for aircraft, which were more or less integral parts of the machines. Had these failed in service the consequences might have been very serious. Welding repairs were only carried out by men approved by the A.I.D., after which castings were put into service, with confidence, which eventually proved to be completely justified.

He expressed surprise that there was no mention in the report of the use of the Thermit process for the welding of cast iron. He said that like other methods it had its limitations, but at the same time had definite applications. He could mention references which threw some light on the question.

With regard to bronze welding of cast iron. He understood that if parts so treated were subjected in service to temperatures of 300 deg. C. or more, they would fail—furnace frames might be a typical example. If this was so, he urged that the fact should be more clearly emphasised as a limitation to this methed of repair.

Dr. Everest said he believed T.S.23 committee had made a passing reference to the Thermit process in their report. He felt that the situation with regard to bronze welding was easily understandable. Generally speaking, a bronze weld was not so strong as a fusion weld, and there was obviously an intermetallic mixture between the bronze and the metal to be welded. There might be a certain amount of contamination of the bronze welds, so that there were brittle zones, and the stress due to temperature, and so on, would probably cause failure. So that he did not think bronze welding could be used for conditions of stress of the sort mentioned. He asked if Mr. Elston would agree that, where bronze was contaminated with a certain amount of iron absorbed during brazing, there would be a brittle zone.

Mr. Elston said that definitely that was so.

A Speaker pointed out that the point was mentioned on the second page of the report on iron castings, under the heading "Choice of Method," section (*c*).

Thermit Welding

The Chairman asked for a little more information concerning the use of the Thermit process for the welding of cast iron. Members would no doubt like to know whether it was or was not a reasonable method for that purpose.

Mr. Musted said that Thermit welding was not included in the report on iron castings, although it was discussed at length by the sub-committee. It had special disadvantages, of which, he believed, the most important was the cost; the Thermit welding of cast iron was very expensive. In the Thermit process a sand mould was built around the chipped or machined fracture and the parts are preheated. Molten metal from the Thermit mixture was then run into the mould. Thermit suitable for cast iron was plain Thermit (a mixture of finely divided iron oxide and aluminium) to which 3 per cent. ferro-silicon and 20 per cent. mild-steel punchings were added.

Mr. G. Skript felt that scrap would always be produced in foundries and that there would always be reclamation of castings which would otherwise be scrapped if foundries were to remain profit-making institutions. He considered that the reclamation of castings by welding was preferable to reclamation by impregnation, for welding had made very great strides in recent years, and he urged that it must be pushed a little further. He much appreciated the work of the sub-committees.

Studding

Mr. G. Foster commented on the excellence of Mr. Bolton's idea that the reports might well be converted into educational documents and, in a slightly modified form, into Codes of Practice. In the Report on the reclamation of grey-iron casting he could not find a reference to the use of studding as an adjunct to welding, which he considered to be most important. It made possible in many cases the provision of a tight arc-welded joint; and studs were useful as starting and finishing places for arc welding. Another criticism was that although most of the possibilities of the repair methods were mentioned, there was not that link-up between the possibilities and the technique to be adopted that one would consider desirable.

Dr. Everest, whilst thanking Mr. Foster for his comments, pointed out that the sub-committees had attempted an enormous job. T.S.23 had had masses of Papers, photographs, etc., before them; but they had tried to make their Report as condensed and as general as possible. They had covered themselves by advising, "for further details refer to the literature," which was enormous. Certainly he had had many Papers dealing with studding, and he agreed that it was a matter which the sub-committee should consider. He took the opportunity to say that the sub-committees appreciated all the comments and criticisms made, which would all be considered in connection with any further edition of the Reports. If it were considered to be worthwhile, the Reports would no doubt be revised and passed to the British Standards Institution.

Expense of Failure

Mr. C. T. Tenison, speaking from the point of view of the person who paid for the welding, urged that unless a finished article could be welded successfully, one tended to throw money away. For example, not very long ago a heavy bedplate had fractured, and he had agreed to have an extensive weld made. The welding was done by a reputable and experienced firm of welders, and as a result he had sent a considerable cheque to the welding firm, and later a very much bigger cheque to the founders for a new casting. In the first case the time and money was wasted, and a good deal of irritation was caused to the men who were concerned with taking out the welded bedplate and replacing it with another.

He wondered whether it might be possible to make some investigations into these questions along the lines of the present Report, whereby information upon the behaviour of various castings under welding treatment could be collated and studied. Eventually some broad conclusions might emerge which would enable welders and welding firms to offer advice to would-be customers whether a casting was likely to be successfully repaired by welding or not.

Dr. Everest replied that he could only hope that, as the result of reports such as those before the meeting, welding would become better understood and applied, so that customers would not have to buy replacement castings.

Reluctance to Guarantee Welds

The CHAIRMAN said he did not think that even a reputable firm of welders would be quite prepared to guarantee a job unless they had done a job exactly similar previously and had a complete record of how it was done. There must be many cases where a firm would be prepared to give every consideration to a job, but where somebody had to take a risk; it seemed difficult to avoid that state of affairs.

MR. MUSTED said that he had welded quite a number of bedplates. But he did it by reinforcing with steel sections, welding them to the casting and so distributing the stress over an area, whereas if he had tried to weld in the position of the fracture he would probably have been unsuccessful. This was common practice and generally termed "make do and mend."

Application to Production-line Castings

MR. O. L. POLLACK asked what was regarded as the lower limit of size of casting where pre-heating might not be necessary. Secondly, he said that in the discussions stress had been laid rather on welding as applied to the repair of castings produced in the jobbing foundry, and he invited Dr. Everest to enlarge on the welding of castings produced in mechanised foundries. He mentioned the case of welding cylinder blocks coming off a highly mechanised plant, where the aspect of skilled craftsmen did not arise so much as in the jobbing foundry, and where the welding of minor blemishes on castings could be of very great value. In the particular case he had in mind there was a very elaborate layout for the continuous pre-heating of castings for welding, the castings being sent afterwards to a second furnace, where they were cooled gradually.

It seemed to him that the technique of welding lay very much in the hands of the craftsman. That was borne out by experience in the Services during the war, when most unusual breakdowns and failures had occurred and repairs were effected in the desert and the jungle. In one case the clutch housing of a heavy lorry was broken into a very large number of pieces, and was put together again by welding.

DR. EVEREST said the minimum size of casting which could be welded without preheating was very much a question of design, and so on, and was one which the experienced welder must decide for himself. The smaller the casting, the easier it was to preheat, and if one could preheat it, so much the better.

With regard to reclamation in mechanised foundries, he said the Ford Company had a reclamation section for everyone to see, with its preheating furnace and post-heating furnace. They had the definite policy of reclaiming a proportion of castings; the onus was on the inspector who saw the castings coming off the foundry line to say which castings were perfect, which could be reclaimed and which should be scrapped. It was an interesting fact that the reclamation part of the foundry was quite open; and one of the objects of the sub-committee was to ventilate the subject so as to pave the way for the provision of similar facilities at other foundries where they were needed.

MR. V. C. FAULKNER (past-president) recalled that about 15 years ago he had represented the Institute on a committee which was organising an international convention on welding, and he was asked to obtain a Paper on the reclamation of iron castings. He had written to a number of friends in the foundry industry to ask if they would prepare such a Paper, but he had received no response, and finally he had written a Paper himself.* He considered that that Paper was worth recalling, and he would like to see the reference to it included in a bibliography at the end of the report on the reclamation of iron castings.

Burning-on Propeller Tips

The CHAIRMAN, discussing burning-on, said it was part of the business of his company, as marine engineers, to repair broken cast-iron propellers; they were very much cheaper than bronze propellers, and for economic reasons they were still used. If such a propeller hit a piece of wreckage, for instance, so that a piece was broken off the end of a blade, it was almost standard policy to return it to a foundry so that a new tip could be burned on.

In the report on the reclamation of iron castings, Section XVI, it was stated definitely that alloy additions in the ladle were not recommended in the case of burning-on. It was the definite experience of his company, however, that an addition of ferro-silicon at the last moment was of tremendous help in burning-on at the tip of a propeller; he wondered, therefore, whether the statement in the Report was desirable.

DR. EVEREST said that, in burning-on, one needed the maximum possible temperature in the metal that was being added; that was why the sub-committee had stated that alloy additions in the ladle should be avoided. If burning-on was applied to a nickel-chromium iron casting, the composition of the burning-on metal should be the same as that of the parent metal; but the nickel and chromium should not be added in the ladle, thereby cooling the metal. If, on the other hand, one was using an alloy which did not cool the metal, or which gave an exothermic reaction and heated the metal, it did not come within that limitation. Ferro-silicon in the conditions quoted, he suggested, could be regarded as falling within that class. The main point was to get the metal as hot as possible.

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* "Some Notes on the Reclamation of Grey-iron Automobile Castings by Welding," by V. C. Faulkner. [A Paper presented to the International Welding Symposium on behalf of the Institute of British Foundrymen.] FOUNDRY TRADE JOURNAL, Vol. 52, May 2, 1935, page 302.

M.I.T. Extensions

Through a gift by Mr. Alfred P. Sloan, junr., of $1,000,000, the Massachusetts Institute of Technology is building a new block of buildings to house a metal processing laboratory. On the top floor, there is to be a model foundry.

"Soro" Process for the Casting of Bars

By R. Genders, M.B.E., D.Met.*

The name Soro is derived from the words Schutz, Oederlin and rotation. Developed originally to meet special circumstances which required the production of brass bars without facilities for working-down ordinary ingots, the process has been commercially established but has not been widely known or studied from the technical aspect. Although having certain features common to all centrifugal-casting processes, the proportions of the Soro casting and its utilisation in bar form introduce new points of interest. Some works observations and experiments are described. The usefulness of the process for brasses, for alloys not easily obtainable in bar form, and for possible other types of product, are briefly discussed.

THE METHOD OF CASTING, developed in 1937 by E. Schutz and termed the Soro process, represents an unusual combination of metallurgical factors and is a process of considerable technical interest as well as a successful example of inventiveness in producing a useful material of special qualities with the minimum of plant and space. It was introduced in commercial production shortly before the outbreak of the 1939 war and was used mainly for one type of material, namely, brass and bronze bars for forging and machining. The method employs the centrifugal principle as a means of converting liquid metal directly to the semi-finished condition in the form of bars suitable for machining in automatics or for cutting into forging billets. The bar is cast in the form of a ring or hoop. Thus the process does not properly fall into the general category of centrifugal casting methods in which the casting is a cylinder of fairly small diameter, but is more akin to the continuous casting of a bar in a long channel shaped mould.

From time to time, various methods have been developed with the object of short-circuiting part of the normal sequence of casting and working operations by means of specially designed concentrated plant. The Soro process, however, goes direct to the final size of the bar, which may be round, square, hexagonal or strip section, and can also deal with materials which are otherwise difficult to roll or extrude into bar form. Although the process is working in several European countries, and in at least two works is producing between 1,000 and 3,000 tons of bars per annum, it has not yet been studied in detail from the points of view of evaluating its possible scope, and of explaining some of the characteristics of the product. The method does not appear to have been previously described in British journals and the present account of it as recently seen in routine operation in Switzerland (Oederlin, Baden), together with the results of some experiments and tests made by the writer may be of interest.

Outline of the Process

The alloy to be used is melted in an electric-induction or hearth furnace or in a crucible. A given quantity of alloy is poured from a ladle into a casting machine (see Fig. 1) which consists of a split-ring mould, 39 in. dia., driven at a speed of about 350 r.p.m. (*i.e.*, a peripheral speed of about 1,000 ft. per min.). Two moulds are normally driven by the one motor spindle. The molten metal is poured through a porthole in the cover of the machine and reaches the mould down an inclined chute so that the stream strikes the periphery of the mould at an angle and moving in the same direction as that of the rotation. The rate of pouring is not constant. The initial rate is rapid, after which it is slowed down progressively. After about one minute, the casing is removed and the mould is opened as shown in Fig. 2. The cast ring or hoop

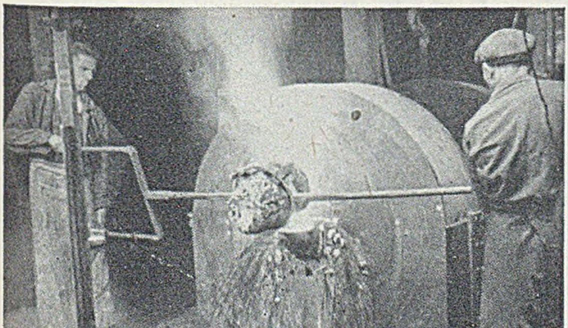

FIG. 1.—*Pouring the Molten Alloy into a Split-ring Mould Casting Machine.*

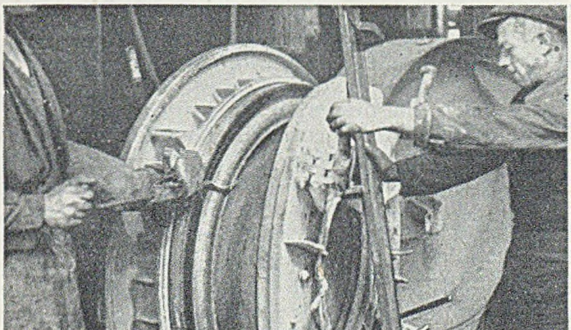

FIG. 2.—*Opening the Mould after the Casing has been removed.*

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* The Author was formerly Superintendent, Technical Application of Metals, M.O.S., now Consultant Metallurgist, London.

is lifted away and cooled out. Its section, if intended for a round bar, is of the shape shown in Fig. 7, the mould being designed to leave at the inside edge a funnel-shaped "sink head" which takes up contraction "piping" and provides a reservoir for dross or slag which is centrifuged out of the metal. This part of the cast section is therefore first trimmed to remove the sink head and to make the bar the correct shape. Using a horizontal lathe, which takes a continuous cut, the operation can be completed in about one minute (see Fig. 3).

Straightening

After this, the ring is cut through by a saw and one of the ends is opened out sufficiently to allow its insertion in a clearance die in a draw bench for the purpose of being pulled straight (see Fig. 4). The draw-bench die has a peening hammer attached which can be used when necessary to apply slight surface cold working to the inside of the bend. This prevents the possibility of cracking when the diameter of bar is greater than about 1½ in. The bar, now nearly straight, is fully straightened by hammer or press. It can then be used for cutting into billets, for forging or upsetting. When required for machining purposes, the straightened bar is "scalped" by drawing once through a sharp-edged die as shown in Fig. 5, after which it can be used direct or cold drawn to any desired size. The total discard is stated to average about 25 per cent. overall sizes. Fig. 6 illustrates a "pipeline" stock of rings and finished bars. The shapes normally produced include, besides round bars, squares, hexagons (up to 3 in.) and various widths and thicknesses of strip (up to 6 in. wide).

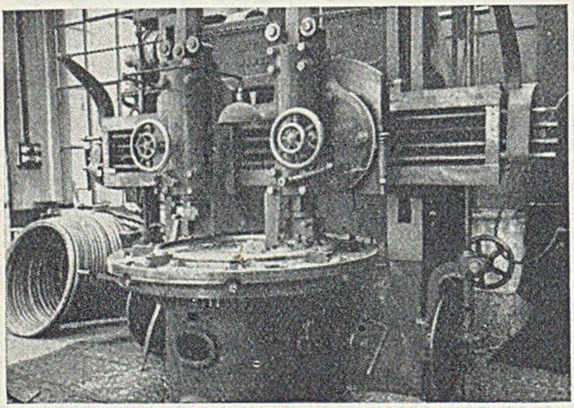


FIG. 3.—*Trimming the Casting on a Horizontal Lathe to remove the Sink Head.*

Metallurgical Features

Certain distinctive effects of casting by the process described would be expected from a consideration of the available knowledge of the factors present in the casting and solidification of metals. It could be deduced, for example, that the centrifuging action would tend to separate the lighter slag or non-metallic material from the melt and leave it in the sink head which is removed in the trimming of the ring. Fig. 8 is a photograph of a section of a ring of high-purity zinc etched to show this effect.

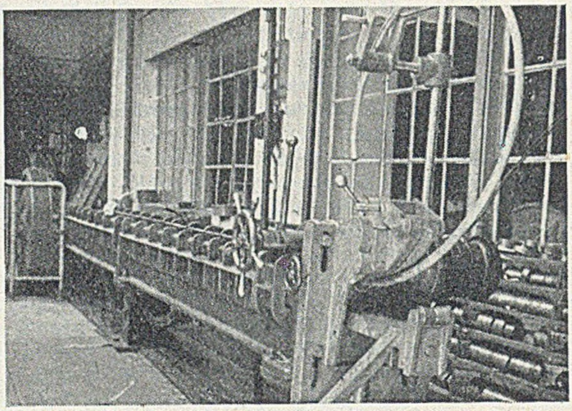


FIG. 4.—*Straightening the Ring in a Draw-bench Die.*

Soundness is, however, the most important consideration for the user of material. In the Soro process, soundness would appear to be an essential condition for the successful production of bars, as the material has to be bent straight in the cast state. It would be predicted, therefore, that the solidification of the ring section must be substantially directional. This assumption can be illustrated by considering the Soro mould as equivalent to a mould 10 ft. in length and 1 to 2 in. deep which is cast horizontally and filled by a stream moving several times along the length. A normal rate of filling an ordinary ingot mould with molten brass would be about 1 in. depth per sec., but in the Soro mould the depth of metal increases at a much slower rate, equivalent to about 1 in. over each 5 to 10 sec. It would therefore be concluded that in the section of the Soro ring, solidification would be likely to proceed layer by layer without the formation of any central contraction cavity. This feature has been confirmed by experiments.

In one example, a quantity of only 2 lb. of molten

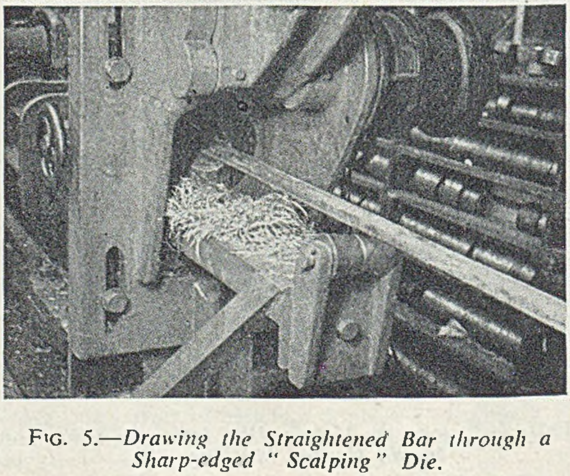


FIG. 5.—*Drawing the Straightened Bar through a Sharp-edged "Scalping" Die.*

metal was poured into a mould of 30 mm. dia. section (normally holding 48 lb.). A complete ring was produced. This was sound and of uniform thickness, showing that at the commencement of pouring the metal is distributed evenly over the whole of the 10 ft. of periphery of chilling surface, and is obviously solidified almost instantaneously. The extremely fine structure of this ring is shown in Fig. 16. Progressively larger quantities of metal produced similar rings of greater thickness. The structures of these partial rings were extremely fine but showed a gradation of crystal size and of hardness according to the amount of metal used.

Bi-metallic Rings

In a second method, two alloys of similar melting point but different colours were poured one immediately after the other without any sensible break in the continuity of the stream. The distribution of the two alloys in the section of the ring was in the order of pouring, and there was little evidence of mixing or of penetration of the stream deeply below the surface such as occurs in an ordinary static ingot mould. The example in Fig. 7 shows a 31 mm. section ring cast from 25 per cent. of white alloy followed by 75 per cent. of red alloy. Such experiments confirm that solidification in the process is directional, thus giving conditions favourable to soundness, and the results also suggest that the making of bi-metallic bars or strip might possibly be developed on the lines of the experiments just described.

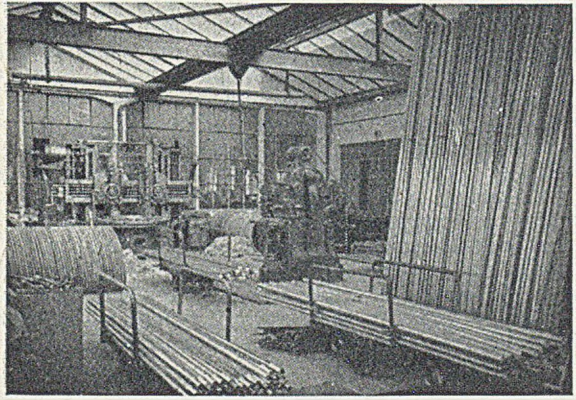


Fig. 6.—*Stock of Rings and Finished Bars.*

A further interesting feature of the process, which has been investigated, is the apparent variation in rotational speed of the metal from the periphery to the sink head. The surface of the sink head of the cast rings shows distinct evidence of circumferential flow. This " drag " effect is clearly due to the solidified outer layer quickly assuming the velocity of the mould while the molten metal in contact with it is moving more slowly owing to inertia and low friction. Thus, the molten metal in the mould, until arrested by solidification, has motion relative to the solid portion and contra to the rotational direction. The variation in speed between the molten surface and the mould surface may be considerable, judging from the effects of slight obstructions such as the edges of cracks in the mould surface which cause appreciable flow of metal along them in the opposite direction to that of the centrifugal force. The rotational-flow mechanism as a whole is probably an additional factor conducive to soundness and uniformity, not only on account of its continuous " feeding " action, but also by reason of the effect of movement in controlling crystal growth and preventing the formation of zones of columnar crystals.

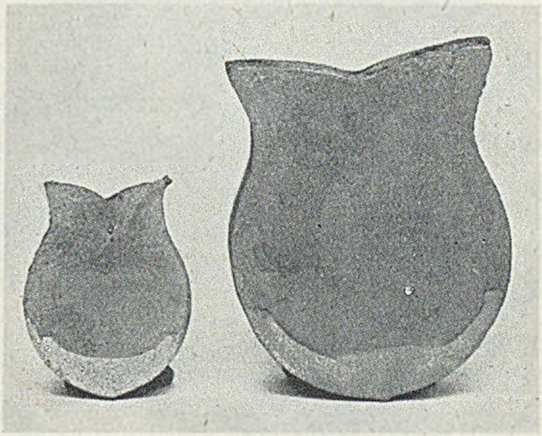


Fig. 7.—*Sections of Soro Rings* (31 *and* 51 *mm.*) *Composite Cast Bars of* 90/10 *Brass and* 50/30/20 *Nickel Brass illustrating Directional Solidification.*

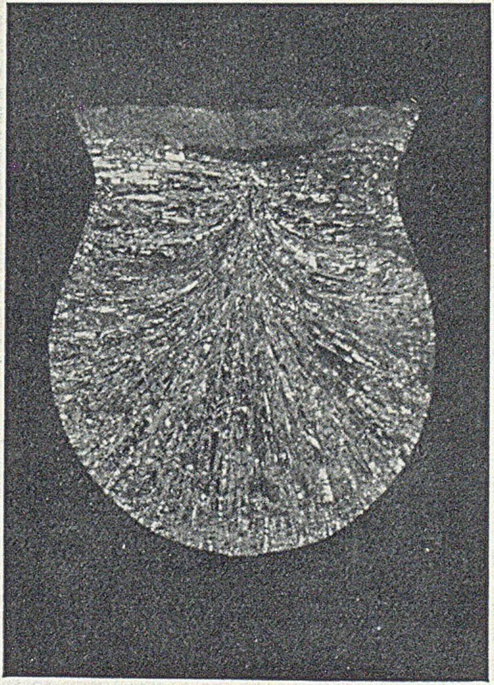


Fig. 8.—*Section of* 51 *mm. Ring showing Collection of Oxide and Slag at top of Sink Head.*

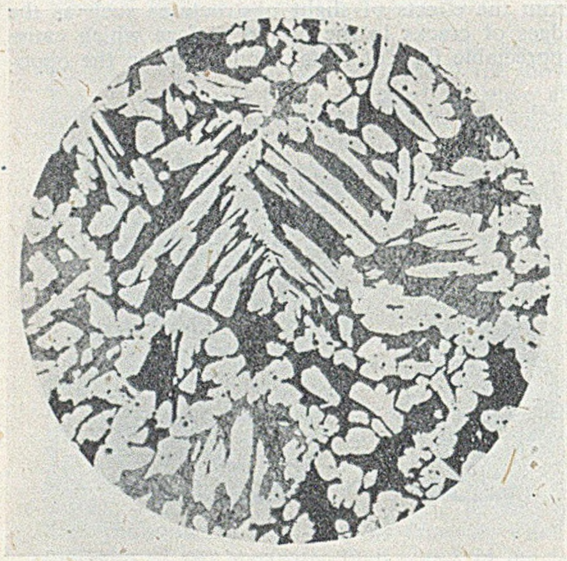


FIG. 9.—*This and the subsequent illustrations show typical Microstructures of Soro-cast Bars* (× 120). *In this case* 58/40/2 *Free-cutting Brass is illustrated.*

Non-segregation

With conventional casting methods segregation is liable to occur in many alloys when cast into large ingots for rolling or extrusion, or into small chill-cast rods or strips, and is in practice a defect of considerable importance. The occurrence of segregation is associated with the fact that the last part of an ingot to become completely solidified is at the centre of the section where it is confined by solid crystals. It can be readily understood, therefore, that these conditions are very different from those during the solidification of a Soro ring, in which the direction of growth of thickness of the solid layer is completely across a diameter of the section. This feature, in conjunction with the rotational flow of the liquid over the liquid-solid interface, serves to explain the general absence of variation in composition which is claimed to be characteristic of Soro cast bars. In this connection it is of interest to mention that in alloys containing appreciable percentages of lead, the centrifugal action does not produce any variation in lead content throughout the section as might appear possible.

Oxide Films

The formation of films of oxide on the surface of the stream of metal during pouring is an occurrence which is common to most methods of casting. In the Soro method the surface of molten metal in the mould exposed to the atmosphere is relatively very large. The resulting bar is not, however, unduly affected by this, possibly owing to the compensating effects of rotational flow and centrifugal action, which would tend to break up and remove oxide films to an extent which may vary according to the conditions present. Sections which have been examined have shown little non-metallic matter and this feature of cleanliness is also reflected in the mechanical tests.

Consideration of these factors will serve to explain the comparative ease with which Soro cast bars can be straightened out from the cast ring without fracture, in contrast to the difficulty of cold forming many alloys cast in static moulds by orthodox methods. It is general practice at the Oederlin Works, with rings up to 30 mm. dia. of all ordinary copper alloys, including such materials as 88/10/2 bronze, to straighten by simply pulling the bars through a clearance die without any peening to assist stretching of the inner surface. The properties of the Soro cast bar are thus in general somewhat distinctive in comparison with those of the ordinary chill-cast bar.

Structure and Properties

The crystal structures found in Soro cast alloy bars are entirely equiaxed and without directional crystal growth (high-purity zinc is the only exception), and the material should therefore be substantially uniform in properties in all directions. Forging is consequently possible in all directions to an equal extent and with equal effects. Much of the present production of Soro materials is used for forging purposes. The capacity for deformation is very high and operations which involve large increases in diameter by upsetting has been demonstrated to be possible without risk of bursting the billet. Starting with a fine "as-cast" structure, the billet is not appreciably re-crystallised on heating to forging temperature, and the structure of the forging is correspondingly fine, naturally with enhanced mechanical properties. The value of uniformity and entire absence of "fibre" in the bar is particularly reflected in the upsetting and piercing of billets to forge various types of hollow shapes suitable for subsequent cold drawing, and

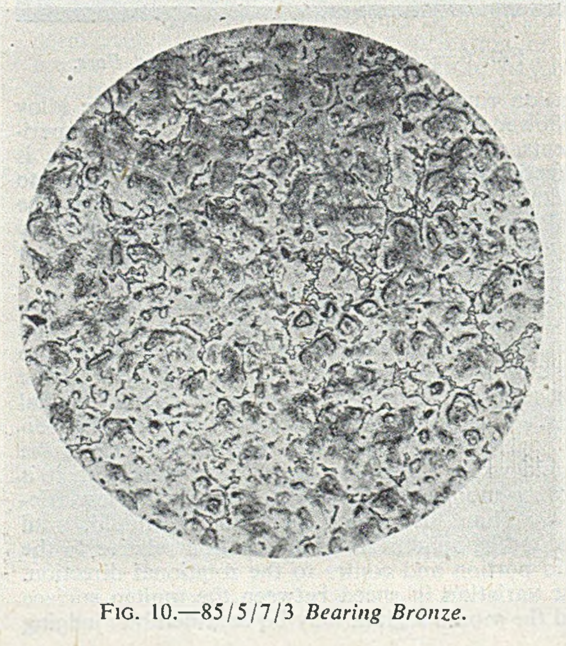


FIG. 10.—85/5/7/3 *Bearing Bronze.*

the process is understood to have been used to a considerable extent in some European countries for the manufacture of 70/30-brass cartridge cases.

The cold-drawing operations follow conventional lines, but the first stage consists in the hot-forging of a cup, the bar being pierced axially. Cups so formed do not have the same characteristic sharply-defined crystal structure as material which has been rolled, cupped from a disc and annealed, and it is found that throughout the whole series of subsequent drawings and annealings, the original tendency to fineness of structure persists. Recent development work has shown that the normal number of stages of drawing the walls of the cartridge case can be appreciably reduced by starting with a cup hot-forged from cast material.

A large part of the present output of Soro rings is, however, formed into cold-drawn bars for machining purposes. The cleanly-scalped surface is favourable to drawing, while the finely cored structure, as would be expected, has the effect of shortening the chip in machining, and this has been found favourable to the use of high speeds. It also enables the machining of fine detail, such as fine, sharp threads, and is similarly beneficial to surface finish. It is understood that with most alloys which have been tried, there has been no difficulty in producing centrifugally-cast and drawn Soro bars to meet the specification requirements for rolled bars.

Brass Bars

Some tests were recently carried out to compare in detail the properties of cast 70/30-brass Soro bars after several stages of cold drawing from 29 mm. down to 18 mm. dia., with those of 70/30 wrought-brass bars drawn to the same reductions. In each case the bars were reduced by 1 mm. dia. at each stage and no annealing was applied. The yield (proof-stress) and tensile-strength values of the two types of material were identical for all reductions. As regards longitudinal ductility, the more-highly-worked rolled bars gave slightly higher elongation values (about 10 per cent. of the Soro figure). Transverse ductility would, however, be expected to be appreciably higher in the cast material. Immersion of the bars in mercurous nitrate produced "season cracking" at the ends, due to the internal stresses resulting from cold drawing. In the case of the Soro cast bars, the cracks were extremely fine hair-cracks, in contrast to those in the ordinary wrought brass which cracked deeply and opened up over a considerable length. These tests substantially confirmed the claim which has previously been made that Soro cast material is virtually free from the risk of season cracking under ordinary circumstances. The internal stresses would be assumed to be roughly the same in the two materials or possibly higher in the cast bars. The reason for the relative immunity from cracking in the cast bars is, perhaps, to be found in the fine cored structure, which is not so vulnerable to intercrystalline penetration as the normal straight crystal boundaries.

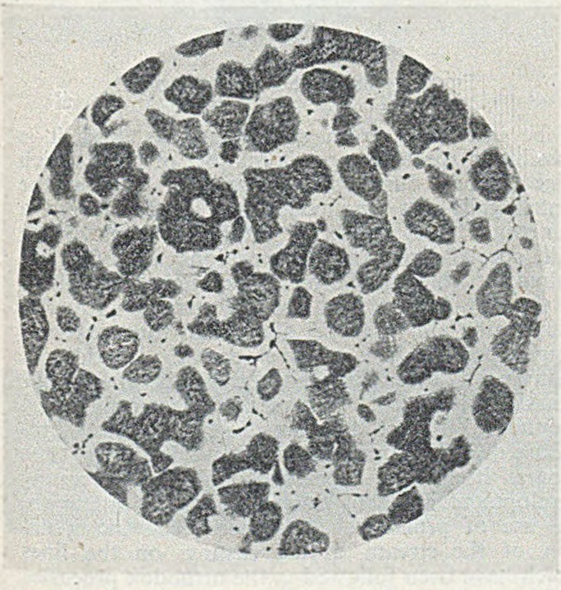


FIG. 11.—70/30 *Brass* (*heavily Etched*).

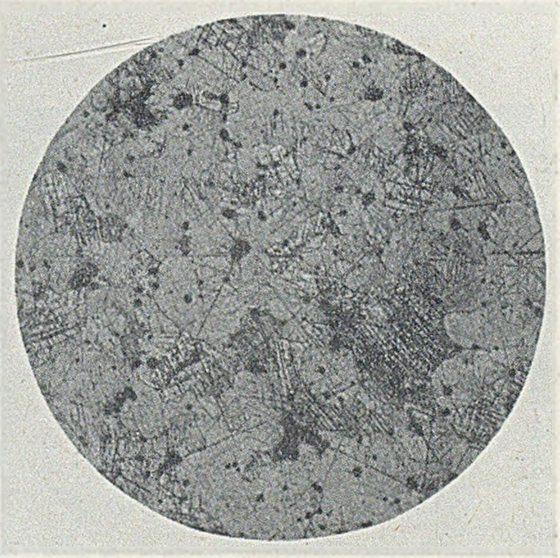


FIG. 12.—*Tin-rich Bearing Metal.*

Materials

Although the main products of the Soro process have been brasses and bronzes, substantial quantities of bars of a large variety of non-ferrous alloys covering the whole of the commercial range have been made from time to time. The microstructures of a selection of these alloys, cast as bars of 31 mm. dia., are illustrated in Figs. 9 to 15. A particular advantage which is claimed for the process is that it is capable of producing in bar form a number of alloys which are in demand by user industries, but which are difficult to roll or extrude, or, as in the case of 85/5/7/3 types of bronze, are not normally

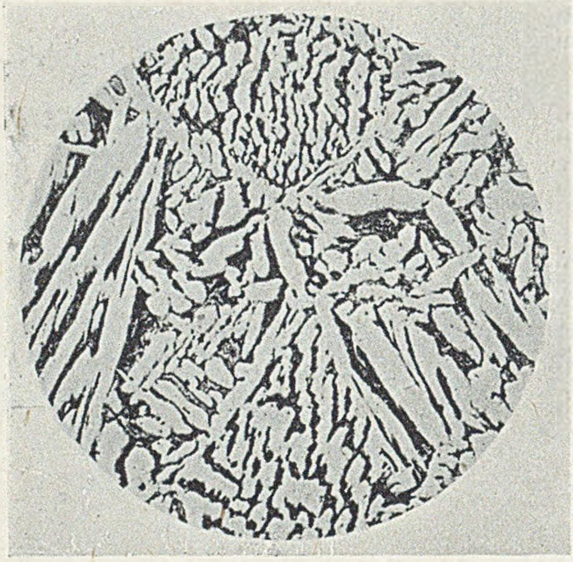


FIG. 13.—89/11 *Aluminium Bronze.*

available by any other process in the form of long bars of accurate size. Some examples of independent tests made in England on Soro bars in the "as-cast" condition are given in Table I.

Experimental trials have also been made with austenitic rust-resisting steels, including the copper-bearing types which have good machinability and casting properties and are relatively difficult to hot roll.

Possible Developments

The present achievements of a process which is still commercially an unknown quantity appear to be interesting from several aspects, and it is possible to speculate upon a number of fields which might repay further investigation. While the centrifugally-cast ring could not be considered a competitor with the large integrated steel rolling mill, special sizes and compositions are often required for which the Soro method might find a place. In the non-ferrous field, the high-strength foundry alloys, zinc alloys, nickel alloys and tool materials suggest possible lines of development. In addition, centrifugally-cast composite strips, if practicable, would provide a comparatively simple and economical method compared with the normal procedure of rolling composite edge-welded slabs. The process itself also appears capable of interesting development in detail as regards mould materials, the use of protective atmospheres and manipulation of the stream during casting, on the lines which have been followed in the orthodox processes of ingot casting.

(*Continued on page* 312.)

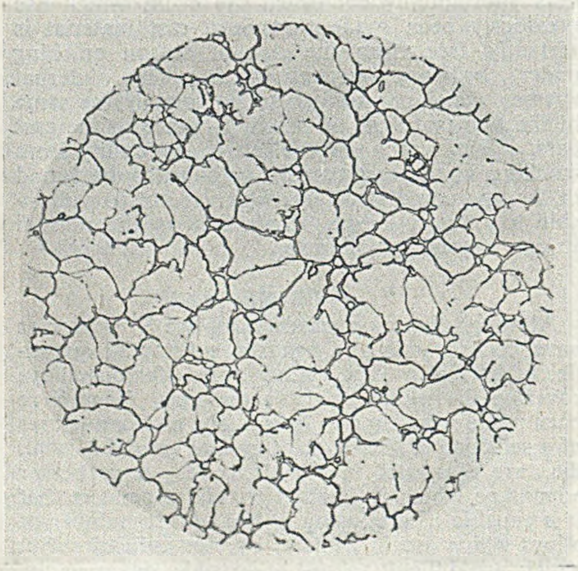


FIG. 14.—18/8 *Corrosion-resistant Steel.*

TABLE I.—*Mechanical Properties of Alloys made by the Soro Process*

	Proof stress, 0.1 tons per sq. in.	Max. load, tons per sq. in.	Elongation, per cent.	Diamond hardness.	Rockwell B hardness.
H.T. aluminium bronze (Al, 11.2, Fe, 4.5, Ni, 4.5 per cent.)	24.5	50.1	12	248	—
Tin bronze (Sn, 10 per cent.)	19.1	26.7	52	103	—
Bearing bronze (Sn, 5.7, Zn, 7.9, Pb, 3.2, P, 0·016 per cent.)	12.4	20.7	25	—	50
	(Density of bar 8.74. Calculated value 8.83)				
Bearing bronze (Sn, 9.3, Zn, 2.9, Pb, 0.10, P, 0.1 per cent.)	12.1	26.2	55	—	50
	(Density of bar 8.65. Calculated value 8.81)				

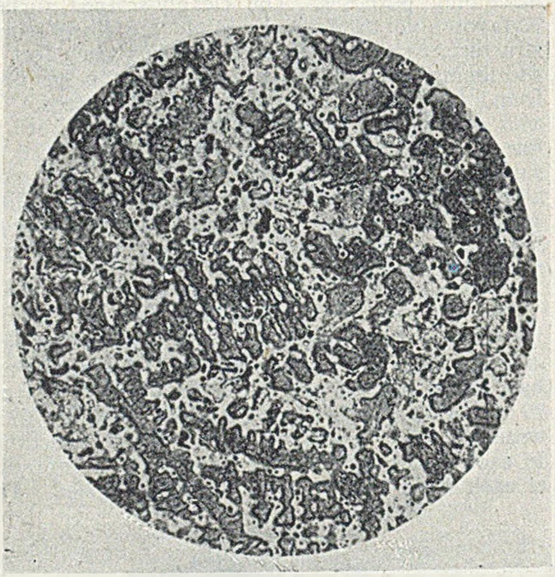
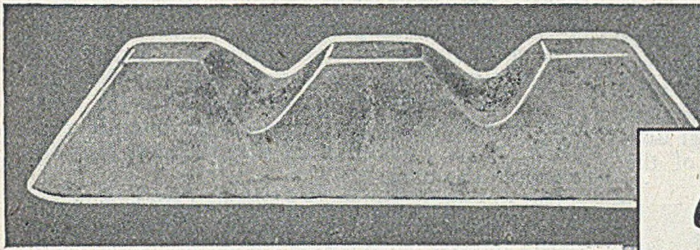
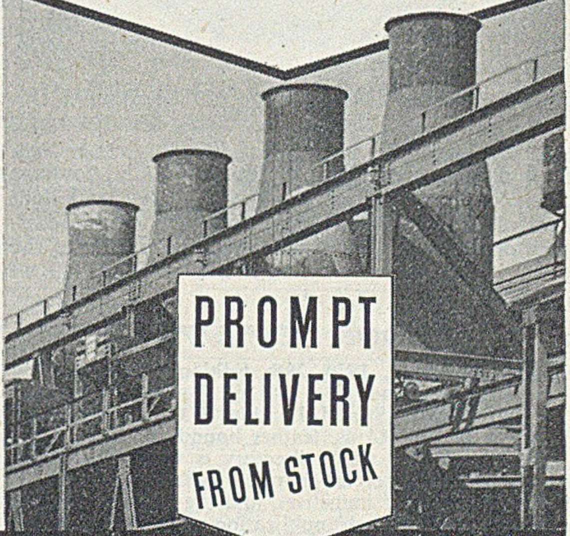
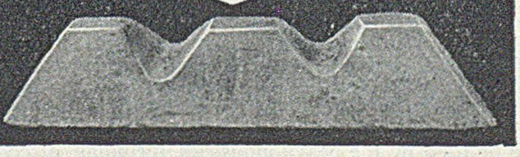


FIG. 15.—88/10/2 *Bearing Bronze.*







"*Soro*" *Process for the Casting of Bars*

(*Continued from page* 310.)

General

While the metallurgical factors of such a process are of considerable technical interest, the commercial aspect is of paramount importance. It is difficult, owing to changes in costs and exchange values, to compile any detailed figures and it also has to be kept in mind that the economy of the Soro process must largely depend on the tonnage produced per machine per day. Heavy and light bars require on the average the same manufacturing time, so that costs will change according to the weight of the bars. It is stated that the price for bars of about 1 in. dia. can be considered as average and this is in the range of extrusion prices. Where an engineering plant involves a large volume of circulating scrap, the Soro method offers a means of quick scrap absorption and a degree of self-sufficiency. In connection with the economic aspect, it is interesting to note that while the Swiss plant is producing bars entirely for internal consumption, the Swedish plant manufactures bars for external sales only.

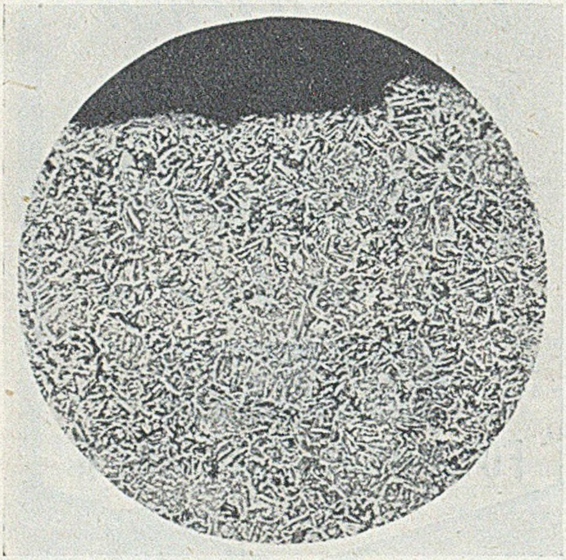


FIG. 16.—*Chilled Fine Structure of Thin Ring* (2 *lb.*).

The purely commercial advantages which are claimed include rapid availability of material in a variety of sizes, economy in stocks, the convenience of scrap absorption, and the small space and inexpensive plant required for a comparatively large production of bars. For special alloys requiring a large plant and considerable labour and time in working down ingots by conventional methods, the Soro process may be specially interesting. From the metallurgical point of view, the Soro method is of particular interest regarding the factors which include cleanliness, soundness and fine structure, with the absence of fibre, conditions desirable in all materials used for forging. The automatic uniformity of structure and of the properties from end-to-end of each bar is a further feature which cannot always be relied upon in more orthodox commercial materials. The structural characteristics which confer on the material good machinability, resistance to stress-corrosion, cracking and freedom from segregation should also be of general value in a number of applications.

Besides being a comparative newcomer on the industrial scene, the Soro process is of an unusual type which naturally attracts the attention of those who are technically interested in the casting of metals, and from the information now available there appear to be indications that it will find a useful field of application and possibly an extension of its scope among the several present-day trends of metallurgical advancement.

Book Reviews

Rylands Directory, 1950, 29th Edition. Published by "The Iron and Coal Trades Review," 49, Wellington Street, Strand, London, W.C.2. Price £3 3s. cloth bound; £4 4s. leather bound.

The object of a trade directory is to furnish information of a commercial character pertaining to an industry or group of industries, and the success which is attained by any such publication is a measure of intelligent anticipation as to what is useful "commercial information" and of its presentation. The Editors of Rylands, with sixty years of experience upon which to draw, have decided that the two main features must be aids to buying and selling—the latter in both the home and export markets. In its 2,300-odd pages appear lists of manufacturers of almost any commodity likely to be used by the heavy industries, including, of course, that of founding. There are lists of iron, steel and non-ferrous foundries arranged on a regional basis by county and town. The lists of dominion and foreign foundries have been based on the sales potential for British equipment.

The sole additional feature in this edition is the inclusion of the telephone numbers for the firms in the main alphabetical list. Of course, as industry modifies its manufactures, new headings are introduced. To the reviewer, Rylands is indispensable and this applies also to any concern in our industry possessing a modern outlook on the conduct of business.

V. C. F.

Book-keeping and Accountancy for Private Companies, by Owen J. West, F.C.A. Published by Jordan & Sons, Limited, 116, Chancery Lane, London, W.C.2. Price 10s. 6d. net.

Since this book was published in 1937, three fresh editions have been printed. This new one, the fourth, has been carefully revised to take care of the provisions of the Companies Act, 1948. In its sixteen chapters every phase of book-keeping and accountancy are thoroughly and competently covered. The book is written in easily assimilated language and can be regarded as a standard textbook on the subject.

"IT'S QUICKER WITH THE HOLMAN -AND BETTER"

Prove it? Experience has proved it time and again in foundries everywhere. HOLMAN PNEUMATIC RAMMERS consolidate loose material much more swiftly, smoothly and solidly than the old hand-rammer. They take all the labour out of the job. That's the operator's point of view. But managements also praise these robust, hard-hitting tools for their time-saving value and their sheer efficiency day after day. All who have ever used a rammer will appreciate their effectiveness even on varying levels of material, when the piston stroke automatically adjusts itself. The four machines in the range cover almost all requirements in "bench" and "floor" work. Round or hexagon piston rod. Butts and peins in various sizes and shapes are available. **DELIVERY EX STOCK.**

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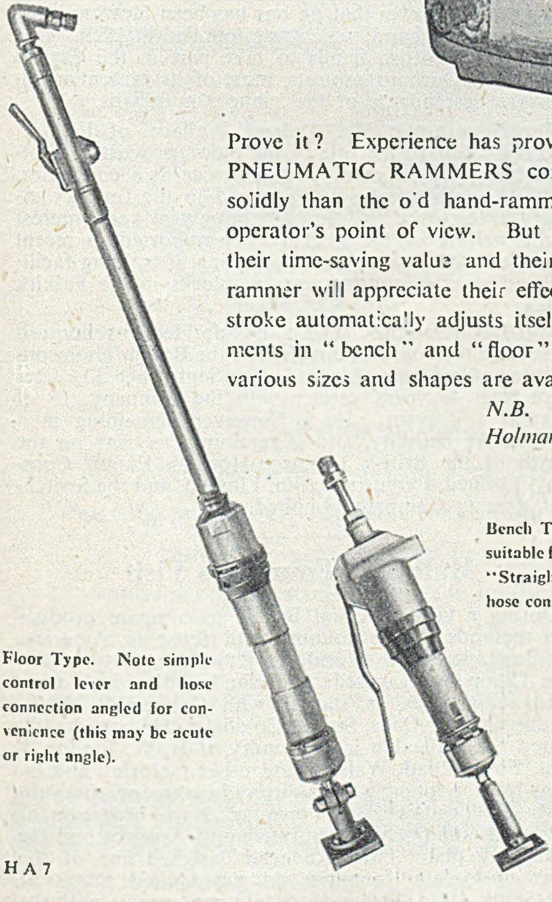

Bench Type. Especially suitable for foundry work. "Straight" or "angled" hose connection.

Floor Type. Note simple control lever and hose connection angled for convenience (this may be acute or right angle).

TYPE	SIZE	L'TH ins.	WT. lb.
BENCH	0	17	9
BENCH	10	23	18
FLOOR	20	48	22
FLOOR	30	47	27

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Forthcoming Events

OCTOBER 2.

Institute of British Foundrymen.

Sheffield Branch :—Presidential address, "Human Relationships in Industry," followed by film, "In Step with the Times," at the Royal Victoria Hotel, Sheffield, at 7.30 p.m.

OCTOBER 3.

Institution of Works Managers.

Sheffield Branch :—"The Psychology of Works Management," by W. Higgs, at the Grand Hotel, Sheffield, at 7.30 p.m.

Leicester Branch :—"Factory Discipline," by J. Ayres, at the Bell Hotel, Leicester, at 7 p.m.

Sheffield Society of Engineers and Metallurgists.

"Metallurgy," by Professor Hay, Ph.D., F.R.I.C., at the Royal Victoria Hotel, Sheffield, at 6.15 p.m.

Institute of Production Engineers.

Reading Sub-section :—"Electronics in Industry," by Dr. E. J. B. Willey, F.R.I.C., at the Great Western Hotel, Reading, at 7.15 p.m.

OCTOBER 4.

Institute of Vitreous Enamellers.

Southern Section :—"Use of Colouring Oxides in Vitreous Enamels," by J. Goodwin, at the Haward Hotel, Norfolk Street, London, W.C.2, at 7 p.m.

Institution of Industrial Supervisors.

Birmingham Section :—"The Foreman and Cost Control," by F. B. Anscombe, at the Birmingham Central Technical College, at 7 p.m.

OCTOBER 5.

Institution of Works Managers.

Bristol Branch :—"Managing a Small Factory," by A. H. Huckle, at the Royal Hotel, Bristol, at 7.15 p.m.

British Institution of Radio Engineers.

North-Western Section :—"Education in Industry," by Dr. P. F. R. Venables, at the College of Technology, Manchester, at 6.45 p.m.

OCTOBER 6.

Institute of British Foundrymen.

National Works Visits to Foundries in the Birmingham Area (8 parties have been arranged).

Manchester Association of Engineers.

Presidential Address by J. Adamson, M.I.Mech.E., at the Engineers' Club, Albert Square, Manchester, at 6.45 p.m.

OCTOBER 7.

Institute of British Foundrymen.

Lincolnshire Branch :—Presidential address and visit to the Gainsborough Works of Marshall, Sons & Company, Limited.

West Riding of Yorkshire Branch :—Discussion on the Ironfounders' Productivity Team Report, at the Technical College, Bradford, at 6.30 p.m.

Wales and Monmouth Branch :—"The Production of Castings for Internal-combustion Engines," by C. R. van der Ben and H. Haynes, at the Engineers' Institute, Cardiff, at 6 p.m.

Institution of Production Engineers.

Yorkshire Graduate Section :—Visit to Fairbairn Lawson, Combe Barbour, Limited, Wellington Bridge, Leeds, 1.

North-Eastern Graduate Section :—Visit to Consett Iron Company, Limited, at 10 a.m.

Foundry Foremen's Training Course, 1951

Preliminary arrangements are now being made for the third Foundry Foremen's Training Course conducted by the Institute of British Foundrymen from funds furnished by the Joint Iron Council. The course will be held at Ashorne Hill, near Leamington Spa, from March 8 to 10, 1951. Particulars will be announced at a later date.

Plant and machinery, including compressor units, furnaces, moulding machines, core-oven and other foundry equipment, will be sold by auction from October 24 to 27 at James Shaffer, Limited (in liquidation), Riverside, South Shields. Catalogues may be obtained from Peat Marwick Mitchell & Company, 13, Mosley Street, Newcastle-upon-Tyne.

Personal

Mr. William T. Wylie, deputy manager since 1944 of Harland & Wolff, Limited, at Southampton, and formerly manager, has retired.

Colonel Sir Henry Barraclough, the eminent Australian engineer, has been elected an honorary member of the Institution of Mechanical Engineers.

Mr. J. I. Thomson has been appointed secretary of Radiation, Limited, Aston, Birmingham, in succession to Mr. T. N. Jennings, who has retired after 25 years' service, but will continue as a director.

Mr. W. Wicks, secretary of Peglers, Limited, brassfounders, of Doncaster, has been appointed a director of the company. He joined the company as cashier in 1923 and was appointed assistant secretary in 1938 and secretary in 1947.

Mr. W. F. Chubb, B.SC., F.R.I.C., a member of the London branch of the Institute of British Foundrymen, has been appointed to the Foundation Chair of Metallurgy at King Fouad 1st University, Cairo, and as consulting metallurgist to the Egyptian Government.

Newman Industries, Limited, announce that Mr. E. B. Piggott has resigned for health reasons from the position of secretary. Mr. Charles Bush has been appointed to succeed him; he previously held an executive position for a number of years with Wimpey, Limited.

Mr. Jimmy Stevenson, president of Shotts Foundry Brass Band, believes that no one has been blowing brass longer than his band, which was founded in 1829. One of the first Scottish bands to take part in the Crystal Palace and Durham contests, most of its present members are descendants of the pioneer musicians.

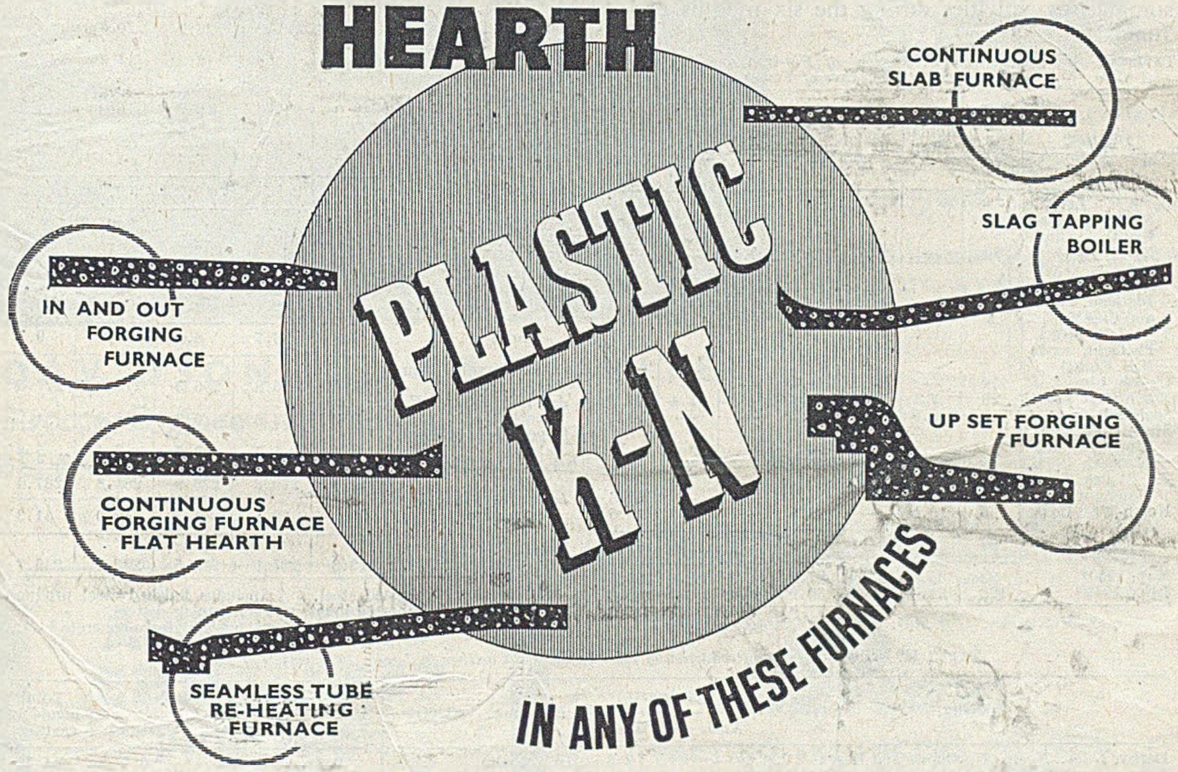
Eighty-year-old Mr. Andrew Wallace, of Falkirk, who lays claim to the title of the oldest provost in Scotland, has given 30 years' public service as a councillor. Until 10 years ago he was engaged in the foundry industry in the town, and he still takes a very keen interest in the welfare of the workers. As reported in recent issues, he has officiated at the opening of training facilities and several foundry amenity blocks in the Falkirk area.

Mr. J. S. Ramsden, M.I.E.E., has decided to relinquish his seat on the board of directors of the British Thomson-Houston Company, Limited, on September 30, after more than 40 years' service with the company, 15 of them as a director. He is, however, remaining in a consultative capacity, and is retaining his seat on the boards of the British Thomson-Houston Export Company, Limited, Ferguson Pailin, Limited, and the Switchgear Testing Company, Limited.

Malleable Founder's Visit

During a visit to Great Britain to compare production methods in this country with those in America, Mr. J. H. Redhead, president of the Lake City Malleable Company, Limited, Cleveland, Ohio, and associated companies, is staying with Colonel C. A. B. Lindop at Four Oaks, Sutton Coldfield. He has already visited the malleable iron foundry of H. W. Lindop & Sons, Fleck Road, Walsall, and other factories, and he plans further foundry tours during his three-weeks' stay.

Mr. Redhead is in this country at the invitation of Colonel Lindop, who recently went to America and the Lake City plant. Mr. Redhead designed one of the most up-to-date foundries in the United States at Ashtabula, Ohio. It has an output comparable with the largest foundries of its type in Britain.


CONTINUOUS SLAB FURNACE
SLAG TAPPING BOILER
IN AND OUT FORGING FURNACE
PLASTIC K-N
UP SET FORGING FURNACE
CONTINUOUS FORGING FURNACE FLAT HEARTH
SEAMLESS TUBE RE-HEATING FURNACE
IN ANY OF THESE FURNACES

Pig-iron and Steel Production

Summary of June Statistics

The following particulars of pig-iron and steel produced in Great Britain have been extracted from the Statistical Bulletin for July, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in June, with the number of furnaces in blast; Table II, production of steel ingots and castings in June, and Table III, deliveries of finished steel. Table IV summarises activities during the six months ended June.

TABLE I.—*Weekly Average Production of Pig-iron and Ferro-alloy§ during June. (Thousands of Tons.)*

District.	Furnaces in blast, 1.7.50.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, and Essex	24	—	17.5	21.9	1.1	—	40.6
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire .. Yorkshire (incl. Sheffield, excl. N.E. Coast) ..	6	—	7.0	—	—	1.4	8.4
Lincolnshire ..	14	—	23.7	0.3	—	—	24.0
North-East Coast	23	7.1	37.5	0.2	—	1.4	46.2
Scotland	8	0.9	10.0	2.2	—	—	13.1
Staffs., Shrops., Worcs., and Warwick ..	9	—	8.9	1.6	—	—	10.5
S. Wales and Monmouthshire	8	4.3	19.5	—	—	—	23.8
North-West Coast	6	15.5	—	0.1	—	—	15.6
Total ..	98	27.8	124.1	26.3	1.1	2.8	182.2†
May, 1950* ..	98	28.0	125.9	27.6	1.3	2.6	185.5†
June, 1949* ..	102	28.0	122.4	30.9	1.5	3.0	185.8

* Five weeks. † Incl. 100 tons of direct castings.

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel. (Thousands of Tons.)*

Product.	1948.	1949.	1949.	1950.	
			June.*	May.*	June.
Non-alloy Steel :—					
Heavy rails and sleepers	8.9	9.8	10.1	11.6	12.5
Heavy and medium plates	36.1	39.2	41.7	41.5	40.1
Other heavy prod...	34.7	36.1	37.3	39.2	38.5
Light rolled prod.§ ..	59.7	46.4	45.4	47.2	45.8
Hot-rolled strip ..		17.1	17.2	20.9	19.2
Cold-rolled strip ..	4.8	4.9	4.7	5.5	5.6
Bright steel bars ..	6.1	5.8	5.5	5.9	6.7
Sheets, coated and uncoated ..	26.3	27.6	26.9	29.6	33.6
Tin-, terne- and blackplate	13.5	13.7	12.9	14.3	14.9
Tubes, pipes and fittings	15.1	18.5	17.8	19.5	20.6
Wire	12.8	15.0	15.2	15.2	16.2
Tyres, wheels, axles	3.9	4.1	4.1	3.4	3.8
Forgings	6.0	6.3	6.5	6.5	6.6
Castings	3.5	3.6	3.4	3.4	3.7
Total	231.4	248.1	248.7	263.7	267.8
Alloy Steel† :—					
Tubes and pipes ..	0.4	0.6	0.5	1.1	1.0
Bars, plates, sheets, strip and wire ..	4.7	4.7	4.5	5.1	4.9
Forgings	2.5	2.7	2.6	3.1	3.0
Castings	0.7	0.7	0.6	0.8	0.8
Total	8.3	8.7	8.2	10.1	9.7
Total deliveries from U.K. prod.‡ ..	239.7	256.8	256.9	273.8	277.5
Add from other U.K. sources	5.7	5.8	6.3	5.6	4.2
Imported finished steel	3.4	7.7	13.7	2.4	5.3
	248.8	270.3	276.9	281.8	287.0
Less intra-industry conversion ..	35.0	39.1	41.4	42.0	41.3
Total deliveries of finished steel ..	213.8	231.2	235.5	239.8	245.7

† Excludes high-speed steel. ‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

§ Excl. wire rods and alloy-steel bars, but incl. ferro-concrete bars.

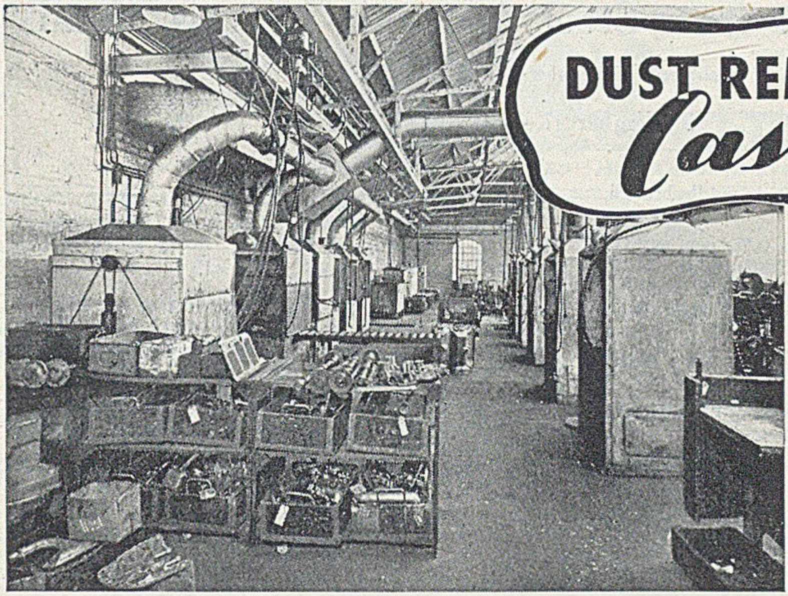
TABLE II.—*Weekly Average Production of Steel Ingots and Castings in June. (Thousands of Tons.)*

District.	Open-hearth.		Bessemer.	Electric	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants and Essex ..	—	2.8	10.4 (basic)	1.3	0.2	14.0	0.7	14.7
Lancs. (excl. N.W. Coast), Denbigh, Flints., and Cheshire .. .. Yorkshire (excl. N.E. Coast and Sheffield) ..	0.8	23.3	—	1.3	0.4	24.9	0.9	25.8
Lincolnshire	—	29.5	—	—	0.1	29.4	0.2	29.6
North-East Coast	1.5	58.1	—	0.8	0.5	59.3	1.6	60.9
Scotland	4.2	42.1	—	1.4	0.8	47.0	1.5	48.5
Staffs., Shrops., Worcs. and Warwick	—	15.9	—	0.8	0.7	15.9	1.5	17.4
S. Wales and Monmouthshire	11.8	49.7	5.4 (basic)	0.8	0.1	67.4	0.4	67.8
Sheffield (incl. small quantity in Manchester) ..	8.5	22.4	—	8.0	0.6	37.8	1.7	39.5
North-West Coast	0.2	2.8	5.2 (acid)	—	0.1	8.2	0.1	8.3
Total	27.0	246.6	21.0	14.4	3.5	303.9	8.6	312.5
May, 1950*	25.5	255.0	21.3	14.1	3.3	310.7	8.5	319.2
June, 1949*	25.5	237.0	21.0	14.3	3.1	293.0	7.9	300.9

TABLE IV.—*General Summary of Pig-iron and Steel Production. (Weekly Average in Thousands of Tons.)*

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy).			
						Imports.†	Output of ingots and castings.	Deliveries of finished steel.	Stocks.‡
1938	228	89	—	130	118	16	200	—	—
1948	252	172	200	178	174	8	286	214	1,028
949	258	169	199	183	188	17	299	231	1,275
1950—January	260	175	198	187	189	11	305	234	1,263
February	250	170	194	184	206	8	325	244	1,257
March*	255	174	197	186	212	12	330	252	1,279
April *	242	171	196	183	207	11	324	236	1,320
May*	248	172	199	186	204	10	319	240	1,326
June	243	170	194	182	199	12	313	246	1,352

* Five weeks. † Weekly average of calendar month. ‡ Stocks at end of years and months shown.



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

(Delivered, unless otherwise stated)

September 27, 1950

PIG-IRON

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

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

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

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

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

Cold Blast.—South Staffs, £16 3s. 3d.

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

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

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

FERRO-ALLOYS

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

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

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

Ferro-molybdenum.—70/75 per cent., carbon-free, 8s. 6d. per lb. of Mo.

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

Ferro-tungsten.—80/85 per cent., 14s. 4d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 15s. 10d. per lb. of W.

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

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

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

Ferro-manganese (blast-furnace). — 78 per cent., £28 3s. 3d.

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

SEMI-FINISHED STEEL

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

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

Sheet and Tinplate Bars.—£16 16s. 6d.

FINISHED STEEL

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

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

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

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

NON-FERROUS METALS

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

Tin.—Cash, £803 to £804 ; three months, £794 to £795 ; settlement, £803.

Zinc.—G.O.B. (foreign) (duty paid), £147 10s. ; ditto (domestic), £147 10s. ; "Primo Western," £147 10s. ; electrolytic, £152 ; not less than 99.99 per cent., £158.

Lead.—Good soft pig-lead (foreign) (duty paid), £128 ; ditto (Empire and domestic), £128 ; "English," £129 10s.

Zinc Sheets, etc.—Sheets, 10g. and thicker, all English destinations, £167 2s. 6d. ; rolled zinc (boiler plates), all English destinations, £165 2s. 6d. ; zinc oxide (Red Seal), d/d buyers' premises, £136 10s.

Other Metals.—Aluminium, ingots, £112 ; antimony, English, 99 per cent., £205 ; quicksilver, ex warehouse, £23 10s. to £24 10s. ; nickel, £386.

Brass.—Solid-drawn tubes, 21⅝d. per lb. ; rods, drawn, 28¼d. ; sheets to 10 w.g., 26d. ; wire, 26⅝d. ; rolled metal, 24¾d.

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

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £150 to £163 ; BS. 1400—LG3—1 (86/7/5/2), £160 to £170 ; BS. 1400—G1—1 (88/10/2), £230 to £238 ; Admiralty GM (88/10/2), virgin quality, £255 to £274, per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £250 to £260 ; L.P.Bl £164 to £175 per ton.

Phosphor Bronze.—Strip, 34d. per lb. ; sheets to 10 w.g., 35⅝d. ; wire, 36d. ; rods, 33½d. ; tubes, 38¾d. ; chill cast bars : solids, 34½d., cored, 35½d. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 2s. 3¾d. per lb. (7%) to 3s. 2¾d. (30%) ; rolled metal, 3 in. to 9 in. wide × .056, 2s. 9¾d. (7%) to 3s. 8¾d. (30%) ; to 12 in. wide × .056, 2s. 10d. to 3s. 9d. ; to 25 in. wide × .056, 3s. to 3s. 11d. Spoon and fork metal, unsheared, 2s. 6¾d. to 3s. 5¾d. Wire, 10g., in coils, 3s. 3¼d. (10%) to 4s. 2¼d. ; (30%). Special quality turning rod, 10%, 3s. 2¼d. 15%, 3s. 6¾d. ; 18%, 3s. 11¼d.