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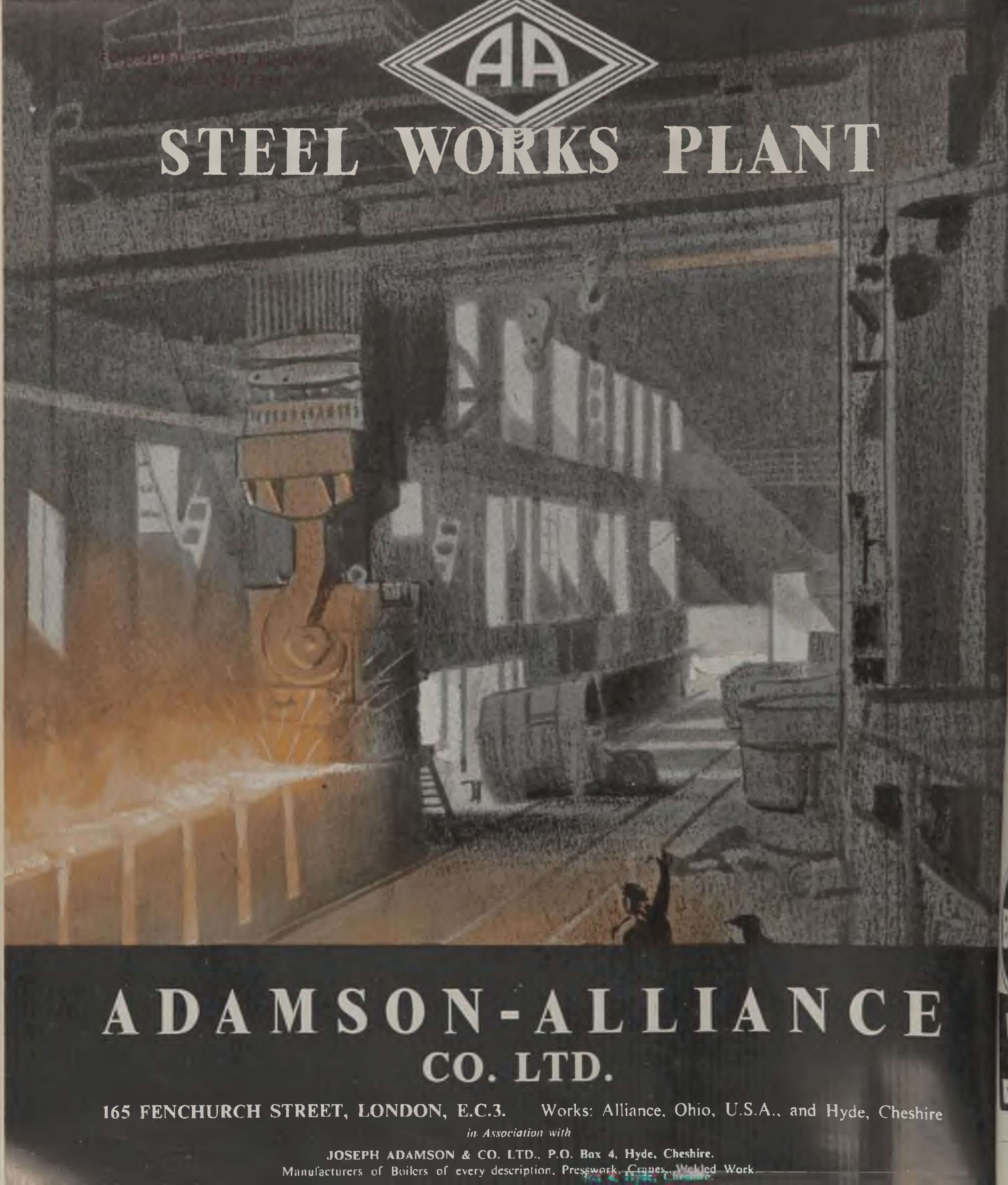
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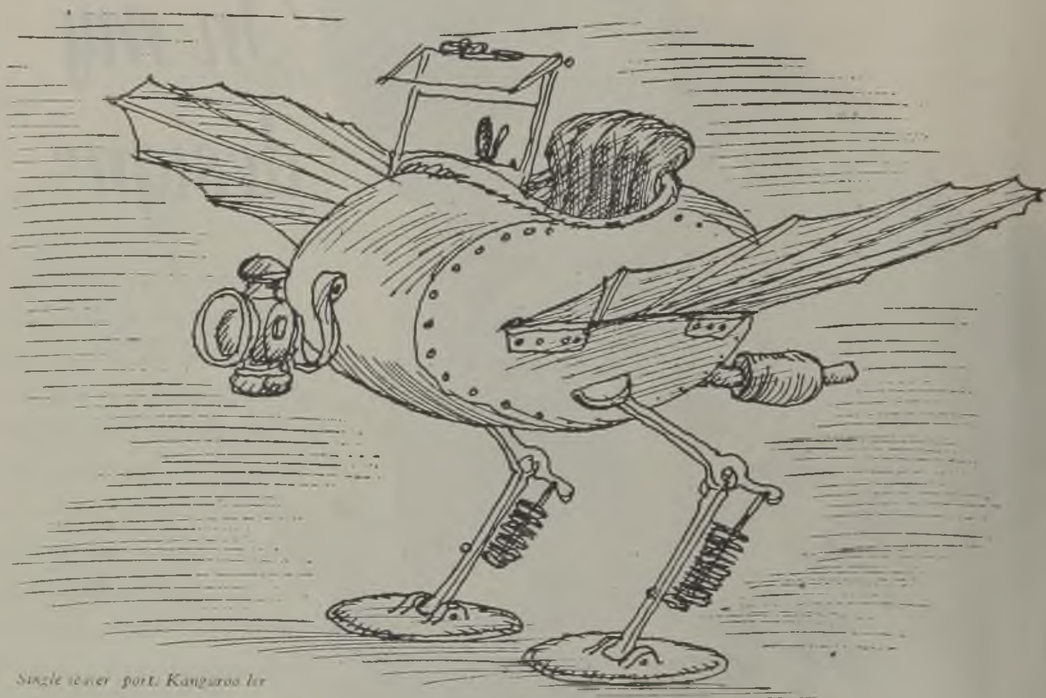

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FOUNDRY TRADE JOURNAL

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WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

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Dust in Steel Foundries

There is nothing very revolutionary in the "First Report of a Committee Appointed to Consider Methods of Preventing the Production or the Inhaling of Dust and the Possibility of Reducing the Use of Materials Containing Free Silica in Steel Foundries,"* for most of the recommendations are already standard practice in most shops. Moreover, they do not involve any serious capital expenditure. Put briefly, the suggestions which are likely to become law are: —(1) The silicosis part of what is known as "compo" should be replaced by chamotte; (2) the use of parting powder containing free silica to be prohibited; (3) free silica to be replaced as soon as possible by other materials, and (4) a number of suggested regulations to cover various aspects of shot-blasting. Dealing with these seriatim, it is germane to stress the reason for condemning "compo" of the old-fashioned type. The condemnation rests upon this premise. To quote the Report, "As with all moulding materials, a portion of the compo adheres firmly to the casting, and is difficult to remove. The methods used for removing it give rise to fine particles of dust, which the dresser is liable to inhale."

It seems to us, that health regulations apart, an effort should be made to find moulding materials which will yield castings capable of "being stripped with a tap and then exhibit a blue skin," to paraphrase a trade advertisement. The preamble to this proposed regulation is not too happily phrased, and whilst on this subject we object to the inclusion of such a ridiculous localism as "mucking off," even as minor alternative to stripping. There has recently been a deplorable tendency to depart from dignified English in Government Reports. However, to return to the implications of the Report. The second suggestion as to the prohibition of silica dust as a parting powder, no one will regret its passing. If our memory serves us correctly, this material came into vogue as an *ersatz* substance during the last war, largely replacing lycopodium. This powder used to be imported from Russia, and was very popular. However, there are now available other substances adequate, such as dolometic limestone, sillimanite and chamotte.

The majority of the recommendations in connection with shot-blasting really enter into the category of "good housekeeping." An "approved" type of helmet is to be provided; no person under eighteen years of age to be employed in or about shot-blast apparatus, and an extended use of vacuum cleaners. This final suggestion merits thought, for if it is desirable as part of the equipment of a foundry, then it is surely worth while to purchase a piece of good apparatus and extend its use to a variety of purposes.

In addition to the recommendations, there are a few suggestions as to the location of shot-blast plants—especially when planning new installations; the instruction by leaflet and poster display of the operatives as to the hazards to be associated with shot-blasting and the lapse of time between the end of shot-blasting and the opening of the doors. The final suggestion—and we quote the Report—is "Suitable respirators should be provided for and worn by fettlers and dressers of steel castings." The first part is relatively easy, but we doubt the universal popularity of the second, judging by an analogy with fettlers' goggles.

The *raison d'être* for the creation of the Committee was the deplorable increase in disablement and deaths from silicosis within the industry during the war years. It is profoundly to be hoped that the restoration of normal conditions will not merely restore the pre-war figures, but reduce them to zero.

* Published by H.M. Stationery Office. York House, Kingsway, London, W.C.2. Price 6d. net.

Contents

NOTES FROM THE BRANCHES

South Africa.—The May meeting held under the chairmanship of Mr. J. M. Stones was devoted to the discussion of members' problems. Mr. Ward raised the question as to whether if one did not light vents from large castings, the result would be an inferior job. Many reasons were given as to the desirability of the practice, but no definite answer was given. Mr. Holdsworth asked about the covering of risers to maintain pressure in the mould as South African practice was to leave them open. The view was expressed that risers had nothing to do with venting, but were to feed the casting; thus it appeared that they should be larger than the casting! Rod feeding came under review, and had both supporters and opposers. A local problem was the substitution of scrap by pig-iron. Double melting found support. The addition of ferro-silicon to the ladle or to the cupola charge found supporters of both practices, but in the latter case briquette form was preferred. The final problem was that of camber in long castings.

On May 16, a party of 60 members visited the foundries of the Dunswart Iron & Steel Works, Limited, when they saw the casting of a cast steel drum check for a 12 ft. hoist weighing about 14 tons and measuring 15 ft. diameter overall, with a gear ring cast integrally carrying 140 teeth. 4 in C.P. About 20 tons of metal was used. Mr. Stones, the Branch president, and Colonel Guy seconded a vote of thanks to Mr. Cartwright and Mr. Snow for the generous hospitality accorded the members.

Natal Section.—At the June meeting, Mr. F. H. C. Oram, the chairman, and a member of the London Branch addressed the members on "Fifty Years in Foundry Industry." This was largely an autobiography, as the Author was apprenticed in January, 1892, to the firm of Howard Farrar, of Port Elizabeth, at which time there were probably not more than 20 foundries in South Africa. Johannesburg had just been connected up by rail from the south. The progress registered was illustrated by the fact that since 1939 over 5,000 ships have been repaired in South African ports. The Boer War created a local boom, but this was followed by a four-year depression. During the last war, Mr. Oram became foundry foreman at the Standard Brass Company, of Benoni, which then only employed three journeymen, but now ranks amongst the larger industrial establishments on the Rand. Thirty-five years ago there were eleven foundries in Durban, and though to-day there are fewer, they are now sizeable concerns. In 1912, before the inception of either Iscor or Newcastle plants, pig-iron was being produced at Sweetwaters, near Pietermaritzburg. It possessed its own coke ovens and foundry, but failed to find a metallurgist capable of overcoming local difficulties.

Cape Section.—A Paper by Mr. H. Steinhardt on "Practical Foundry Chemistry" was read at the April meeting. It is to be given later to a Branch meeting in Johannesburg.

CORRESPONDENCE

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

"LOST WAX" PROCESS

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest the article on the "lost wax" process of castings in your issue of July 6, 1944. I should like to correct one or two points in the procedure as defined by your correspondent. I have actually had experience with the manufacture of patterns required for this type of work and also am familiar with the actual casting.

In the first place wood patterns are not suitable, as the grain of the wood is easily lifted by the wax and metal patterns have been found to be the only type suitable. Ordinary pattern taper of approximately 6 deg. total angle and loose pieces are used where necessary. The loose piece acts in the same way as a sand core, and the mould is virtually made up in the same way. The metal pattern is mounted on a plaster odd side merely to form the parting line of the mould and to prevent the pattern, if of a fragile nature, from springing. From the above set up, we place a metal flask on the plaster odd side and into this, under pressure, a metal cast similar to printer's metal is made. If care be taken in the right selection of the metal for the pattern and the casting material to form the mould, no appreciable difference in the coefficiency occurs.

The metal pattern can then be withdrawn from the mould, and any "high spots" or blemishes which may have been on the pattern are removed with a scraper. This is a method which has been employed successfully, and castings have been in non-ferrous materials and high tensile steel. The accuracy, both dimensionally and "trueness," are very favourable with machined castings, and only grinding is necessary on steel castings.

Yours, etc.,

R. H. ROUT.

15, Old Church Street,
Aylestone,
Leicester.

NEW CATALOGUE

X-ray Dark-room Practice.—Ilford, Limited, Ilford, London, have prepared for distribution a most useful booklet covering this comparatively new adjunct to quality control in foundry practice. The booklet shows very clearly that, whilst latitude is allowed to the development of snapshots, it is essential to adhere to standardised time and temperature conditions when undertaking industrial and X-ray photography. The foundry industry at least will be grateful for the release of this pamphlet. A leaflet enclosed with this brochure covers the subject of lead screens.

Mr. W. F. Lamoreaux has resigned his appointment as director of research for the Meehanite Metal Corporation, and has accepted the post of research metallurgist to the Cooper-Bessemer Corporation, Mount Vernon, Ohio.

DEVELOPMENTS IN THE DESIGN AND USE OF SIDE-BLOWN CONVERTER PLANTS*

Advantages and disadvantages of the process outlined

By P. C. FASSOTTE (Iron and Steel Control)

Introduction

The manufacture of steel castings is one of the sections of the steel industry which has required considerable expansion during the war, and this has entailed the erection of a number of new plants. Some of them have been equipped with electric furnaces, but for reasons beyond the scope of this Paper, others have been provided with converter plants. At the time when this development was planned the supply of ores suitable for the manufacture of hematite irons suddenly became precarious, and it was therefore necessary not only to economise in the use of hematite iron, but also to explore unorthodox methods of steel production.

More than half the steel used in British foundries before the war was produced in converters. The ratio of scrap to pig-iron used in the various plants differed widely, depending on the location of the foundry and the construction of the unit; it averaged about 50 per cent. throughout the country. On account of its moderate cost, hematite iron was used liberally and in most plants was relied upon exclusively to produce the silicon content aimed at in the iron. This silicon content also varied considerably, but the average was about 1.5 per cent.

Experiments on the Relative Importance of the Silicon Reaction

Years of converter use had crystallised the opinion that molten iron had to contain 1.3 per cent. or more silicon for successful operation of the process. It was generally regarded as fundamental that the exothermic reaction of silicon and oxygen was the main determinant of the final steel temperature and that therefore this reaction, credited with a heat value of some 7,000 kg. cal., could not be dispensed with in converter operation. The carbon reaction was discounted as a heat producer owing to the belief, fostered by the text-books, that most of the carbon was burned into carbon monoxide, a reaction yielding only 2,430 kg. cal. and negative from a heat-increment point of view. Little notice was taken of the carbon-dioxide reaction, yielding 8,100 kg. cal., as this reaction was not considered to take place to an appreciable degree.

These beliefs had become deeply rooted and almost axiomatic. Yet observations made of a large number of plants operated in widely varying conditions and in different countries had thrown doubt on these accepted theories. Whereas some side-blown converters were being operated with silicon up to 2 per cent., others had been known to work with irons containing only 0.5 to 0.7 per cent. of silicon and yet produce steel sufficiently hot to make small and intricate castings. There was a strong suspicion, therefore, that too much stress had been laid on the significance of the silicon reaction. The following experiments were accordingly planned in order to ascertain its true importance:—

(1) A charge of normal cupola iron (carbon 3.2 per cent., silicon 1.3 per cent. and manganese 0.5 per cent.) was introduced into a converter and blown in the ordinary way. When the carbon flame

TABLE I.—*Analyses of Gases Escaping from the Converter.*
Samples taken 9 in. from nose end.

	First heat.			Second heat.			Third heat.		
Weight of charge. Cwt.	75			65			65		
Silicon content. Per cent.	0.18			0.32			0.6		
Duration of blow. Min.	12			12			17		
Gas analyses after min.:	1.	5.	9.	2.	7.	11.	1.	7.	11.
Carbon dioxide. Per cent.	4.0	9.8	12.8	12.0	12.2	4.2	4.2	10.0	9.8
Oxygen. Per cent.	10.4	2.6	2.8	2.4	0.9	10.2	5.6	4.4	5.0
Carbon monoxide. Per cent.	0.2	0.2	0.2	0.2	Nil	Nil	0.1	0.1	Nil
Nitrogen. Per cent.	85.4	87.4	84.2	85.4	86.9	85.6	90.1	85.5	85.2
Blast volume. Cu. ft. per min.	4,200	4,200	4,000	4,300	4,500	4,500	4,200	4,200	4,200

* A Paper prepared for presentation to the Iron and Steel Institute.

Side-blown Converter Plants

appeared the blow was stopped and the metal poured into a ladle. The temperature of the metal was then 1,535 deg. C. and the analysis 2.7 per cent. of carbon, 0.15 per cent. of silicon and 0.14 per cent. of manganese. The metal was cooled in the ladle and poured back into the converter when the temperature had dropped to 1,435 deg. C. The blast was put on again and the blow proceeded normally despite the disappearance of the silicon. The ultimate temperature of the steel was 1,650 deg. C., an increment of 195 deg. C.

(2) A charge of low-silicon iron (carbon 3.2 per cent., silicon 0.21 per cent. and manganese 0.3 per cent.), melted in an electric furnace, was introduced into a converter at a temperature of 1,385 deg. C. The blow was normal and the final steel temperature was 1,590 deg. C., an increment of 205 deg. C.

(3) A charge of low-silicon iron melted in an electric furnace (carbon 3.26 per cent., silicon 0.17 per cent. and manganese 0.18 per cent.) was introduced into a converter at 1,440 deg. C. and blown into steel with a final temperature of 1,630 deg. C., an increment of 190 deg. C.

A Carbon-dioxide Reaction

In view of the small amount of silicon contained in the irons used in these experiments, the temperature increments could only be explained by the fact that the carbon combustion was essentially a carbon-dioxide reaction. In this respect, the side-blown converter appears to work differently from the bottom-blown type, where the passage of gases through layers of metal rich in carbon favours the production of carbon monoxide. The gases escaping from the side-blown converter were analysed and Table I gives the results. The gas samples were taken some 9 in. below the exit of the converter.

Another series of samples were taken by drilling a hole in the converter body and through the lining, at a point 4 ft. above the tuyeres. Table II gives the analyses of these samples.

Attempts were also made to analyse the gases at a point a few inches above the tuyeres, but these were abortive as the aperture was quickly blocked by projections. Gas analyses were also taken in other plants. They generally confirmed that carbon dioxide is overwhelmingly prevalent. Yet under certain working conditions appreciable quantities of carbon monoxide can be present in the exit gases, and this feature has been observed particularly where the blowers are under-sized. The function of the silicon reaction now appeared in its true perspective. It is essentially a kindling agent. Its principal purpose in side-blown converter practice is to make up the difference between the temperature of the iron introduced into the converter and the temperature at which the carbon reaction starts freely.

TABLE II.—*Analyses of the Converter Gases 4 ft. above the Tuyeres.*

	First heat.			Second heat.			Third heat.			
Weight of charge. Cwt.	56			56			60			
Carbon content. Per cent.	2.92			3.14			2.98			
Silicon content. Per cent.	0.46			0.31			0.66			
Duration of blow. Min.	13			11			11			
Gas analyses after min. :	3.	6.	10.	3.	6.	11.	1.	4.	8.	10½.
Carbon dioxide. Per cent.	4.0	6.2	14.2	8.0	6.6	10.8	6.4	12.0	12.8	12.4
Oxygen. Per cent.	10.6	3.0	1.6	0.8	4.2	0.4	0.3	0.1	Nil	0.6
Carbon monoxide. Per cent.	1.0	0.4	2.6	0.8	0.4	1.4	0.9	0.7	0.2	0.1
Nitrogen. Per cent.	84.4	90.4	81.6	90.4	88.8	87.4	92.4	87.2	87.0	86.9
Blast volume. Cu. ft. per min.	3,500	3,000	3,000	3,580	3,050	3,050	3,200	2,900	2,900	2,900

Conclusions from Experimental Data

The experimental work warranted the following conclusions:—(1) In the side-blown converter the bulk of the carbon is transformed into carbon-dioxide, provided that there is adequate blast volume; (2) irons containing from 2.7 per cent. of carbon upwards, with only a negligible silicon content, can produce a temperature increment of over 200 deg. C.; (3) the carbon-dioxide reaction is capable of making up the difference between an iron temperature of, say, 1,450 deg. C. and the steel temperature required by the steel foundry, and (4) silicon in the iron can be dispensed with, provided that the metal is sufficiently hot at the commencement of the blow.

It is a well-known fact that the affinity of carbon for oxygen increases with temperature, and becomes particularly pronounced at temperatures exceeding 1,450 deg. C. If, therefore, iron were supplied to the converter sufficiently hot for the carbon reaction to start immediately, then silicon could be dispensed with, with the concomitant elimination of the hematite and ferro-silicon from the cupola charges. It became a matter of substituting for heat chemically produced in the converter by the silicon combustion, heat physically imparted to the iron prior to the conversion process. To achieve this end a furnace had to be introduced between the cupola and converter in which the iron could be brought up to the temperature at which the carbon reaction starts. If large enough, such a furnace would also act as a mixer and reservoir for hot metal, which would make it possible to operate the cupola independently of fluctuations in the demand for steel and to secure greater uniformity in the iron and efficiency in the converter operation.

Description and Operation of the Side-blown Converter Plant

In designing the cupolas care was taken to provide them with deep wells in order to favour carbon pick-up, as the charges were to be composed of steel scrap only. The metal produced by the cupolas has approximately the following composition:—C, 2.7 to 3.2; Si, 0.05 to 0.2; M, 0.3 to 0.7; S, 0.11 to 0.18, and P, 0.03 to 0.07 per cent. After it has been desulphurised the iron is transferred to the mixer, the temperature being 1,280 to 1,380 deg. C.

The rotary mixers have a nominal capacity of 12 tons, but may reach 25 tons, depending on the degree of wear of the linings. They are fired by anthracite, and the calorific input is such that the iron can be raised to the required temperature at the rate of 17 to 18 tons per hr. The fuel consumption is 80 lbs. per ton of metal. After it has been superheated the iron is transferred to the converters in batches of 56 to 70 cwts. The mixer is continually being refilled by desulphurised cupola metal, usually in lots of 5 tons.

The silicon content in the metal charged into the converter approximates to 0.05 to 0.2 per cent. Iron containing as little as 0.05 per cent. of silicon has been blown successfully and yielded steel sufficiently hot for foundry requirements. As the castings produced in this plant have a wall thickness of 0.3 in., it will be realised that quite hot metal is required. Although in principle the converters work with silicon-free iron, in practice small amounts of ferro-silicon are used for minor temperature adjustments. If, for instance, the temperature of the iron is judged to be on the low side, if the converter has been standing for some time before the new charge is introduced or if a particularly high temperature is required in the steel, ferro-silicon additions are made in the converter. For a week's operation entailing the use of 1,085 tons 10 cwts. of liquid iron, the ferro-silicon consumption (75 per cent. silicon) is 4 ton 10 cwts. 3 qrs. 18 lbs., representing an average addition of 0.28 per cent. of silicon to the converter charges.

Desulphurisation

As no pig-iron is charged into the cupolas, a high coke ratio is required (6:1), which involves a relatively high sulphur content in the iron (from 0.11 to 0.18 per cent.). When desulphurising with sodium carbonate in the normal manner the steel frequently showed a sulphur content upwards of 0.06 per cent. Selection of a more suitable lining material for the ladle improved matters. It was then found that by using two ladles and pouring slag and metal from the first to the second ladle the efficiency of the process was increased. In Table III the complete analyses of a shift's operation of the plant are recorded. Heats Nos. 9,139 to 9,160 were desulphurised in ladles lined

TABLE III.—*Analyses of the Steels Obtained on One Shift.*

Heats Nos.	T.C. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.
9139	0.23	0.35	1.72	0.052	0.075
9140	0.22	0.27	1.64	0.046	0.076
9141	0.22	0.31	1.68	0.044	0.075
9142	0.24	0.27	1.64	0.038	0.072
9143	0.22	0.32	1.64	0.042	0.068
9144	0.23	0.26	1.50	0.036	0.067
9145	0.22	0.27	1.58	0.038	0.069
9146	0.22	0.24	1.60	0.036	0.068
9147	0.23	0.29	1.52	0.038	0.066
9148	0.21	0.27	1.60	0.032	0.067
9149	0.23	0.28	1.60	0.032	0.066
9150	0.21	0.29	1.62	0.036	0.063
9151	0.22	0.28	1.70	0.030	0.064
9152	0.22	0.23	1.46	0.038	0.064
9153	0.21	0.25	1.46	0.040	0.062
9154	0.21	0.25	1.42	0.036	0.059
9155	0.21	0.32	1.54	0.034	0.057
9156	0.21	0.24	1.54	0.032	0.058
9157	0.21	0.23	1.42	0.018	0.058
9158	0.21	0.30	1.46	0.038	0.057
9159	0.22	0.29	1.60	0.036	0.059
9160	0.21	0.24	1.38	0.036	0.057
9161	0.22	0.28	1.50	0.028	0.057
9162	0.21	0.28	1.46	0.030	0.058
9163	0.21	0.33	1.50	0.028	0.058
9164	0.23	0.27	1.52	0.028	0.060
9165	0.21	0.32	1.48	0.026	0.061
9166	0.21	0.29	1.44	0.026	0.059
9167	0.22	0.30	1.44	0.028	0.061
9168	0.22	0.29	1.44	0.026	0.069
9169	0.21	0.31	1.42	0.028	0.058
9170	0.23	0.25	1.46	0.028	0.059
9171	0.21	0.34	1.64	0.026	0.059
9172	0.23	0.27	1.50	0.026	0.061
9173	0.22	0.37	1.48	0.028	0.060
9174	0.24	0.27	1.44	0.024	0.060
9175	0.23	0.35	1.44	0.030	0.059

with firebrick, and gave an average sulphur content of 0.0367 per cent. The subsequent heats were desulphurised in ladles lined with basic material, and gave an average sulphur content of 0.0272 per cent. Assuming that the iron used in the latter heats had an original sulphur content of 0.13 per cent., there was a sulphur elimination of 79 per cent. The high sulphur content of the iron produced by the process is therefore not necessarily detrimental; in fact, steel

Side-blown Converter Plants

has been produced with a sulphur content below 0.02 per cent.

Duration of the Blow

The rotary mixers were not ready to operate when the plant was started up, and for a time steel was made in the normal Tropenas manner, using a proportion of pig-iron and ferro-silicon in the cupola to give iron with upwards of 1 per cent. of silicon. With these charges, the converter blows lasted an average of 18 min. When the rotary mixers were brought into use with irons low in silicon, the average duration of the blow was reduced to 11 min. The immediate result was that two converters instead of three were able to feed the foundry with the requisite amount of steel, and this added flexibility was accompanied by a reduction in the labour cost.

Slagging

A favoured deoxidation procedure in converter foundries is to remove the bulk of the slag from the converter before any deoxidising agent is introduced into the bath. When high-silicon irons are used, converter slags are heavy and the removal of the slag is a slow and difficult operation. With low-silicon iron there is less slag, it is less viscous and its removal is both easier and faster.

Converter Linings

It was realised that with low-silicon irons there would be almost no SiO_2 produced, and that the converter linings were likely to be attacked severely by metallic oxides. The first few blows after the mixers were put into operation provided confirmation. Silica sand was then introduced in the empty converter before the liquid iron, so as to provide the SiO_2 required to balance the oxides. Not only did this addition of sand stop undue corrosion, but it improved the life of the linings remarkably. When operating the plant in the normal Tropenas manner, the inner linings of the converter gave an average life of 60 heats without patching. When using low-silicon irons together with a sand addition, the inner linings made up of bricks from the same source and also without patching gave an average life of over 200 heats. This increased life of the linings, however, is partly attributable to the reduced blowing time.

To ascertain the effect of sand additions on the composition of the slags, samples were taken during the converter operation in another foundry where high-silicon irons are used and the plant is such that the converter operation is of long duration. These metal and slag analyses are recorded in Table IV.

TABLE IV.—*Metal and Slag Analyses during the Blow (Tropenas Plant).*

Converter charge: C 2.54, Si 1.46, S 0.079, P 0.047, Mn 0.27 per cent.; 75 cwt. Temperature of iron: 1,280 deg. C. Total blowing time, 48 min.

	Time from commencement of blow—				
	11 min.	18 min.	28 min.	37 min.	Finish of blow.
Analysis of metal:					
C, per cent.	2.66	2.44	2.18	1.38	0.05
Si, per cent.	1.26	1.08	0.50	0.34	0.06
Mn, per cent.	0.19	0.15	0.08	0.06	0.03
S, per cent.	0.078	0.070	0.067	0.059	0.054
P, per cent.	0.047	0.050	0.052	0.049	0.045
Analysis of slag:					
Silica, per cent.	38.1	40.95	46.15	55.35	66.65
Ferrous oxide, per cent.	54.5	52.28	47.61	37.67	27.09
Alumina, per cent.	3.9	3.20	2.80	3.70	3.60
Manganous oxide, per cent.	3.29	3.36	3.36	3.07	3.39
Lime, per cent.	0.50	0.40	0.30	0.30	0.30
Magnesia, per cent.	Trace	Trace	Trace	Trace	Trace
Temperature (immersion thermocouple), deg. C.	1,310	1,370	1,560	1,685	1,690

It is interesting to compare these results with samples of slag taken from one of the converters of the plant operating the new system (see Table V). It will be noted that in the case of the normal Tropenas plant there is a constant deficiency of SiO_2 to balance the oxides until the operation is well advanced, which is not the case with low-silicon irons when a sand addition has been made to the converter. It is also noteworthy in Table IV that the formation of FeO and MnO is practically instantaneous; therefore the timely presence of a sufficiency of SiO_2 in the slag, namely, at the beginning of the blow, is all important.

Metallic Loss

It was expected that irons low in silicon and manganese and blown in shorter time would not be subject to the same amount of metallic loss as is encountered in normal side-blown converters. This anticipation was verified in practice. When worked in the Tropenas manner, the blowing loss in the converter was about 9 per cent., which compared favourably with the average metallic loss throughout the country. With low-silicon irons and reduced blowing time the metallic loss in the converter, checked as carefully as possible over a number of heats, averages between 5 and 6 per cent. No metallic loss is experienced in the rotary mixers.

Phosphorus

It is a well-known fact in converter foundries that, despite the care which is taken, wrought or cast iron occasionally finds its way into the cupola charges. Moreover, the phosphorus content of steel scrap can vary considerably, particularly in a plant like the one under review which has to work with unselected scrap. In such conditions, the phosphorus content of the final steel can sometimes be very high, and when this plant was worked in the Tropenas manner the final steel occasionally showed a phosphorus content well above 0.1 per cent. These fluctuations in the phosphorus content have been levelled out by the mixers and, as will be seen from Table III, the phosphorus variation in the steel produced is extremely small after the first few heats.

Every day the first few heats tapped from the cupola show a higher phosphorus content than during the remainder of the day. The phenomenon is explained by the phosphorus pick-up from the ash of the initial coke charge (the phosphorus content of the coke being 0.3 per cent.). There is, however, a more important aspect to the question of phosphorus content. Attempts to dephosphorise iron in the cupola in the presence of silicon and manganese have failed, as selective oxidation of these elements takes place before any impression is made on the phosphorus. When using all-steel charges in the cupola, however, the silicon and manganese contents of the iron are negligible and conditions are fulfilled wherein dephosphorisation in the cupola becomes theoretically possible, provided that a basic lining is used. Experimental work in this direction is in hand.

TABLE V.—*Slag Analysis during the Blow (Low-Silicon Iron).*

Converter charge: C 2.7, Si 0.2, Mn 0.35 per cent.; 70 cwt. Sand (70 lb.) put into the converter prior to the introduction of the iron. Total blowing time: 14 min.

	Time from commencement of blow—				
	2 min.	4 min.	6 min.	8 min.	14 min.
SiO_2 ..	55.4	54.2	54.0	56.0	60.0
Al_2O_3	3.6	3.5	3.7	3.6	3.1
FeO ..	23.2	25.7	25.1	25.2	22.5
Fe_2O_3	7.5	4.1	4.7	4.0	3.3
MnO ..	10.1	12.2	12.0	10.9	10.7

TABLE VI.—*Physical Properties of Three of the Heats Obtained.*
Clover-leaf test-blocks treated at 940 deg. C. for ½ hour and air-cooled.

Heats Nos.	Analyses. C. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	Physical properties. Yield point. Tons per sq. in.	Maximum stress. Tons per sq. in.	Elastic ratio. Per cent.	Elongation. Per cent.	Reduction of area. Per cent.	Izod value. Ft.-lb.	Brinell hardness No.
8131	0.20	0.27	1.26	0.032	0.064	27.2 27.2 27.2	39.6 40.0 40.0	68 68 68	22 27 26	26.31 43.41 36.56	25, 26, 30—27 41, 42, 43—42 33, 33, 33—33	163
8129	0.19	0.27	1.08	0.034	0.063	24.8 25.8 25.6	36.0 36.0 36.0	69 72 71	30 31 30	43.41 40.72 43.41	46, 46, 46—46 44, 51, 46—47 46, 44, 45—45	156
8119	0.19	0.33	1.23	0.040	0.064	26.8 26.0 26.4	37.2 37.2 39.6	72 71 66	28 29 27	42.07 43.41 36.56	40, 40, 43—41 46, 48, 47—47 37, 37, 37—37	156

Physical Properties of the Steels Obtained

The typical test results given in Table VI will enable the physical properties of the steels made by this process to be compared with similar steels made by other methods.

(Continued overleaf, column 1.)

DEVELOPMENTS IN THE DESIGN AND USE OF SIDE-BLOWN CONVERTER PLANTS

(*Continued from previous page.*)

Credits and Debits

The advantages of the process may be summarised as follow:—(1) Elimination of hematite and ferro-silicon from the cupola charges; (2) reduced consumption of ferro-silicon in the converters; (3) appreciable reduction of blowing loss in converter; (4) increased flexibility and production through reduction in blowing and slagging time; (5) longer life of converter linings; (6) less variation in phosphorus contents and in final steel analyses; (7) more continuity in cupola operation; and (8) reduced quantity of converter slag and easier removal.

The process has the following disadvantages which must not be overlooked:—(1) Considerable increase in capital expenditure due to the cost of the mixers and the provision of a heavy crane to change the mixer bodies; (2) heavier structure needed to support this crane and larger area required by the melting plant; (3) higher coke ratios needed in the cupola for melting all-steel charges; (4) greater wear on cupola refractories; (5) extra labour and upkeep entailed by the operation of the mixers; and (6) fuel and lining costs of the mixers.

In the particular plant under review, the items of increased cost are more than offset by the savings due to cheaper charges, reduced metallic loss and improved performance of converter refractories. The main purpose of the unconventional design, namely, the conservation of hematite iron, has been fully achieved.

Acknowledgments

This record represents work carried out over several years and has led to the formation of a Sub-Committee on Side-Blown Converter Practice (reporting to the Steel Castings Research Committee) which is continuing the investigations. Acknowledgment is made to this Sub-Committee for information contained in Tables II and VI.

Technical developments are frequently the result of combined efforts and in the case of the process outlined this is particularly true. Among the contributors, special reference must be made to Dr. T. P. Colclough and Mr. S. L. Bengtson, without whom the process would never have been established. A great deal has been due to the energy of Mr. P. H. Wilson and the enthusiasm of his staff, Mr. W. Routledge, Mr. H. Smith, Mr. S. Spray and, last but not least, Mr. J. Townsend. Dr. T. Swinden and the staff of the United Steel Companies' Research Laboratory, in particular, Mr. W. W. Stevenson, have given valuable help and guidance. Other notable contributions have been made by Mr. W. K. Bird, Mr. C. W. D. Townsend, Mr. F. Cousans, Dr. A. Cross, Dr. J. Rait, the late Mr. S. J. Hewitt, Mr. T. H. Skelton, Mr. J. Gibb, the staffs of the British Cast Iron Research Association and H. A. Brassert & Company, Limited, and many others too numerous to mention.

IRONFOUNDRY FUEL NEWS—XVII

Numbers of foundries visited on behalf of the Regional Panels of the Ironfounding Industry Fuel Committee have been found to be operating mould and core-drying stoves with doors of ordinary sheet steel—not insulated in any way. Such doors allow, of course, a considerable amount of heat to be lost by conduction through them. To one foundryman who doubted the importance of this loss, it was quite a simple matter to prove that the amount of coke he had to burn to supply the heat lost through one of his mould drying stove doors, size 10 ft. by 8 ft., amounted to at least 5 cwts. per week.

Where doors are constructed of single steel sheets braced with angle iron on the outside it is a simple matter to face the door with more sheets and to fill the intervening space with slag wool. Alternatively, doors can readily be lagged with proprietary insulating boards. At one foundry on the North-East Coast the stove doors were insulated with blocks made from a mixture of coke breeze and cement. While the use of coke breeze for this purpose may, perhaps, be open to question, there is no doubt that the amount of fuel used in the blocks was recovered in increased efficiency in a matter of weeks, or even of days.

FUEL SAVING BY ECONOMY IN WATER CONSUMPTION

Fuel can be saved by reducing the power required to pump water at the waterworks and in the factory. This can be accomplished:—(1) By finding out how much and where the water is used; (2) by reducing the consumption to a minimum: and (3) by reducing the head at which the water is pumped to a minimum, and by maintaining all pumps in good order.

To do this:—(1) Keep drinking water clean and cool; (2) use the cheapest source of water in lavatories if more than one source is available; (3) use the same water as many times as possible; (4) insert orifices in cooling mains to allow only the required quantity to pass; (5) fit booster pumps to supply small users of high pressure water; (6) maintain pipes and plant in a clean condition.

CASTINGS *v.* WELDINGS

An article by Mr. L. F. Williams, assistant secretary, Cooper Bessemer Corporation, Mount Vernon, Ohio, printed in the "Iron Age," carries the following introductory paragraph:—"In the manufacture of Diesel engine components from welded steel fabricated both within and without its own shops, this company has been able to compare factory costs with those of comparable parts machined from Meehanite castings, and has found them very much in favour of castings, when production runs are moderate." The author's figure is that weldings are 330 per cent. more costly.

MOULDING A MORTAR MILL ROLLER IN GREEN SAND

By W. G.

Making a mould in green sand from a pattern such as is shown in Fig. 1 demands careful attention to detail. These would not be strictly adhered to if the mould is constructed in dry sand. The reason for this is that it is a block of iron, which when cast weighs 25 cwts., and is without cores except for one in the boss. The writer favours dried moulds for this type of casting, as there is considerably less danger of the top face of the mould being drawn down by the extreme heat of the molten iron. Nevertheless, solid rollers weighing up to 38 cwts. are successfully poured in moulds made in green sand.

As this pattern is moulded in the floor a coke bed

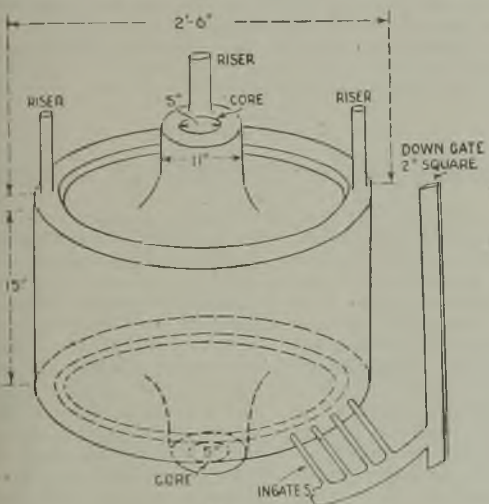


FIG. 1.

is necessary with enough sand riddled on it to leave 12 in. from the face of the mould to the coke.

The riddled sand is then levelled, and facing sand to the depth of $1\frac{1}{2}$ in. is spread over it. This is well vented down to the coke bed with a $\frac{1}{2}$-in. rod, care being taken to make sure that the tops of the vent holes are tightly stopped up to prevent the air from lifting the face of the mould in the process of pouring.

The pattern is then bedded solidly down with the aid of a heavy hammer, after which it is removed and the floor of the mould finished. Before replacing the pattern, four ingates, 2 in. deep by $1\frac{1}{4}$ in. wide, are cut, as the metal makes its entry from the underside of the mould. The size of these gates ensures a very rapid flow of iron fed by a downgate 2 in. square.

Hard ramming is necessary at the bottom of the mould to prevent strain, as the pressure is very great, and the possibility of "swells" on the mould face is lessened if the flat rammer is used to finish off each course of ramming. Hard ramming can be safely performed if care is taken to make sure that the rammer strikes the sand 2 in. away from the pattern. This is most important if rammer "scabs" are to be avoided. Before making the parting, a row of vents all round the pattern is pushed down to the coke bed, which will save bringing the air off by way of the joint afterwards.

In ramming up the top part a tough facing sand is used. Carelessly mixed facing sand for a mould of this description is courting trouble, especially with the top part. This is closely gaggered, afterwards covering the gaggers with 3 or 4 in. of facing sand. When finishing the top part, the space between the gaggers is well sprigged, the heads of the sprigs showing level with the mould face. A good quality plumbago is used, rubbing well on the mould if the casting is to strip cleanly.

The roof of the mould in the absence of cores to shield it is exposed to a punishing heat. Therefore pouring is done at an unusually high speed, as a slow or medium flow of metal would give the face of the top part of the mould time to peel off in the swiftly drying process which takes place. To cope with quick pouring, a large casting basin is used, one that will contain a few hundred weights of iron so that when the stopper is lifted the molten iron will flush rapidly into the mould. Care must be taken that the pouring basin is kept full until the metal appears in the risers. The least drawing of air either from runner or riser will result in the pulling down of portions of the top part. The strain of casting is relieved by three risers approximately $2\frac{1}{4}$ in. dia., the one on the boss being used to feed the casting with a $\frac{3}{4}$-in. rod.

30-in. GRAPHITE ELECTRODES

Research by the National Carbon Company, Inc., has resulted in the development of two new and larger sizes of graphite electrodes. The new electrodes are 24 and 30 in. in diameter—the first graphite electrodes of these sizes to be produced commercially. The major problem to be met in increasing the size of graphite electrodes without sacrificing other desirable physical properties was that of strength. This problem was met and the 30-in. electrodes are proportionately as strong as the widely used 18-in. electrodes. Although at the present time there are no electric steel furnaces which require the 24- and 30-in. electrodes, the availability of the electrodes will make possible new developments in furnace design and have an important influence on future electric furnace production.

In an article, "Some Notes and Considerations of Practical Value to Foundrymen," published in our issue of March 23 last, we printed the author's initials as "F. H." instead of F. Andrew. We sincerely regret any inconvenience this has caused Mr. Andrew.

HARDENABILITY OF CAST STEEL

Mr. C. W. Briggs, technical and research director, Steel Founders' Society of America, Cleveland, has introduced a symposium on this subject, printed in the June issue of "Metal and Alloys."

Numerous articles have appeared in the technical Press of the country on the subject of hardenability and the use of the end-quench test for wrought steels, he writes. Hardenability data are available for practically every type of wrought steel produced. However, the following articles are the first to appear in the technical Press regarding end-quench studies on cast steels. This does not mean that these studies are the first investigations made on this subject in the steel-casting industry. All the manufacturers of armour castings have been studying the hardenability of their steels during the past few years. Such information as they obtain is on the restricted list.

The publication of this series of Caine, Wellauer and Kiper is made to advise the engineer and purchaser of steel parts that the steel casting industry is actively engaged in hardenability considerations, and that sufficient information is available so that broad conclusions can be drawn. It will be evident from a review of the following articles that:—

(1) Cast steel and wrought steel of the same composition have similar hardenability as illustrated by the end-quench test.

(2) Commercial cast steel will in general show slightly higher values than commercial wrought steel of the same carbon content, due to the higher silicon, aluminium, and sometimes manganese, contents of cast steel, since all cast steels are dead-killed steels.

(3) Hardenability of cast steel is dependent upon composition and grain size in exactly the same manner as wrought steel.

(4) Information available on wrought steels can be used for cast steels of similar composition, by the application of a multiplying factor.

(5) End-quench tests on cast steel can be used for calculating the hardness gradients of cast steel sections in the quenched and tempered conditions.

(6) The substitution of one cast steel for another to obtain similar hardenability is possible with cast steels as with wrought steels.

(7) An understanding of the properties developed in castings of varying sections can be obtained by the use of the end-quench test as a routine control in steel foundry operations.

"**Something new has been added** to a well-known method of testing castings or forgings by hitting them with a hammer," reports "Metals and Alloys." When the piece to be tested is struck, the sound is picked up by a microphone and amplified. The harmonic frequencies are then suppressed by a filter, and the remaining base frequency determines whether the casting or forging is defective or not since there is a variation in base frequency between a defective and a perfect specimen.

ABRASIVE WHEELS

The "Industrial Accident Prevention Bulletin" lists the following operating rules as being a useful guide to sound practice:—

(1) Do not operate any wheel at a speed higher than that scheduled by the manufacturer and reduce this speed if conditions are necessarily such as to impose any unusual strain on the wheel.

(2) Enclose the wheel, face, sides and arbors, to the greatest extent consistent with operation, and be sure that the enclosure is of ample strength.

(3) Test the wheel by tapping lightly before mounting. The sound should be clear and ringing. If the wheel sounds cracked, do not mount it.

(4) Use pairs of flanges of the same diameter, which should be as great as possible and never less than one-half of the diameter of the wheel. Do not clamp the wheel tighter than is necessary to drive it.

(5) Adjust the rest close to the wheel and slightly above the centre.

(6) Use eye protection!

PRESENTATION TO MRS. D. SHARPE

A pleasing little ceremony was held recently in the office of Mr. John Bell, hon. secretary of the Scottish Branch of the Institute of British Foundrymen. It took the form of a presentation of a crystal vase and a silver sugar dish to Mrs. Daniel Sharpe, the wife of the immediate past-president of the Institute. In making the presentation on behalf of the past-president, Mr. John Cameron, J.P., made reference to the recent return of Mrs. Sharpe to this country after spending most of the war period in South Africa, and to the particularly strenuous time Mr. Sharpe had in travelling on Institute business during his year of office. Amongst those present were Mr. and Mrs. Winterton, Mr. Tyrie (branch-president) and Mr. Young (past branch-president).

ZINC ALLOY DIECASTERS' ASSOCIATION

Formed in February, 1942, this Association has just issued its first publication. It contains a list of members, the aims of the Association, and a well-written article on "How to Make the Best Use of Die Castings." This booklet, which is available to our readers on application to the director of the Association at Lincoln House, 15, Turl Street, Oxford, is to be followed by others dealing with such subjects as "Plastics and Die Castings Compared," "The Designing of Die Castings" "The Plating of Die Castings" and "The Organic Finishing of Die Castings." Congratulations are due on the enterprise shown by this new Association.

STEEL MIXES AND INOCULANTS IN GREY CAST IRON

Assumption that melting of steel in cupolas is a difficult practice is entirely false

By W. BARNES and C. W. HICKS

(*Continued from page* 319.)

Low-Temperature Treatment

Considerable interest has been taken recently in the "acicular" irons which respond to heat-treatment at less than 600 deg. C., and in one otherwise excellent presentation of the subject, there was a casual two-line reference to the fact that the best results appeared to be obtained with a high steel content. It was felt that this should be examined, and a series of test-bars were used containing 0, 30 and 60 per cent. steel respectively. To avoid any danger of obscuring the results, no alloying elements were used, and each grade of metal was simply a "straight" cast iron. Fig. 72 shows the effect of low-temperature treatment on the iron cast with a mixture containing 0 per cent. steel. It will be seen that there is no change in hardness, but whilst there is an increase in deflection, there is a slight fall in both tensile and transverse values.

With 30 per cent. steel, Fig. 73 shows an improvement in all physical properties up to a maximum increase in tensile of 0.65 tons per sq. in. at 400 deg. C., and then a gradual fall in tensile and transverse, although the gradual increase of deflection continues up to 600 deg. C. With 60 per cent. steel the reaction to treatment is much greater, and Fig. 74 shows that the tensile strength increases by 1.4 tons per sq. in. at 425 deg. C., with a proportionate increase in transverse strength. It is also seen that with these increasing values there is no increase in hardness, but actually a slight fall. Once again the gradual increase of deflection is sustained throughout the range of temperatures employed.

The groups of photomicrographs reveal that the pearlitic matrix of the 0 per cent. steel iron (Figs. 75 to 78) is coarser and more lamellar than in the other groups: the 30 per cent. steel (Figs. 79 to 82)

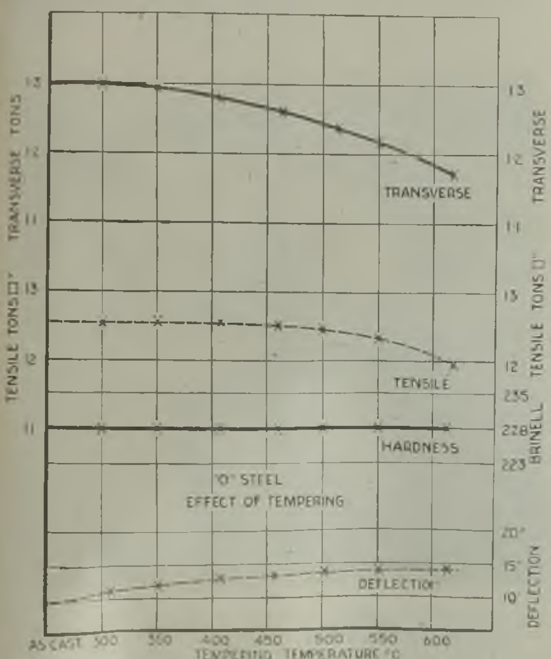


FIG. 72.—INFLUENCE OF TEMPERING ON THE PROPERTIES OF CAST IRON.

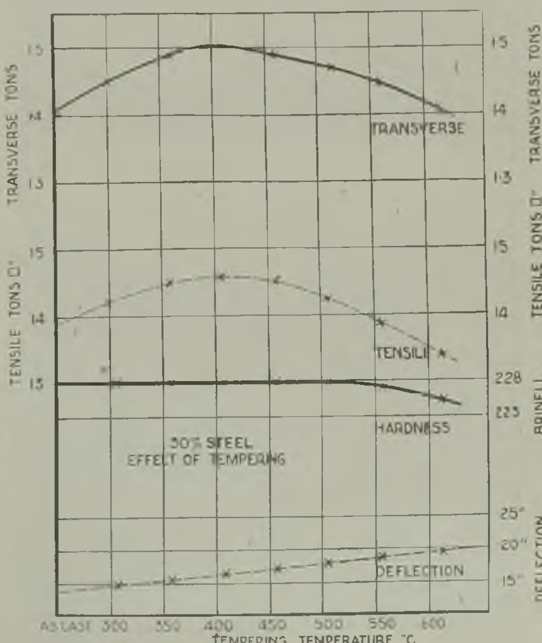


FIG. 73.—INFLUENCE OF TEMPERING ON THE PROPERTIES OF 30 PER CENT. STEEL MIX.

Steel Mixes and Inoculants

shows finer laminations of the pearlite, not so continuous; the 60 per cent. steel shows that the continuity of the laminæ is broken up, and in some areas a semi-sorbitic structure can be seen (Figs. 83 to 86). There does not, however, appear to be any difference in the structure of the "as cast" and "treated" specimens in any of the groups, and we confine ourselves to the plain statement of facts given in the graphs without offering any theories in explanation. There is no doubt that some change occurs, but whatever this change may be, it is sub-microscopic.

Jominy Hardenability Tests

To compare the depth of hardness penetration and increase in hardness value, the Jominy or end-quench test was adopted, in accordance with S.A.E. standard procedure recommended for testing the hardenability of steel.

Test Procedure.—The test consisted of water-quenching one end of a 1 in. dia. machined bar, 4 in. long, and measuring how far from the end the metal hardened, by means of Vickers Brinell readings along the length of the bar. Fig. 87 clearly illustrates the results of this test, and it will be seen that as the steel content of the metal mixture is increased, both

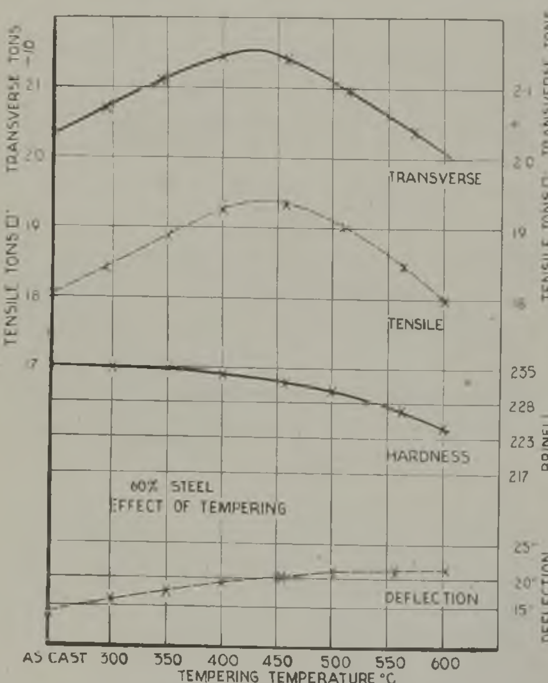
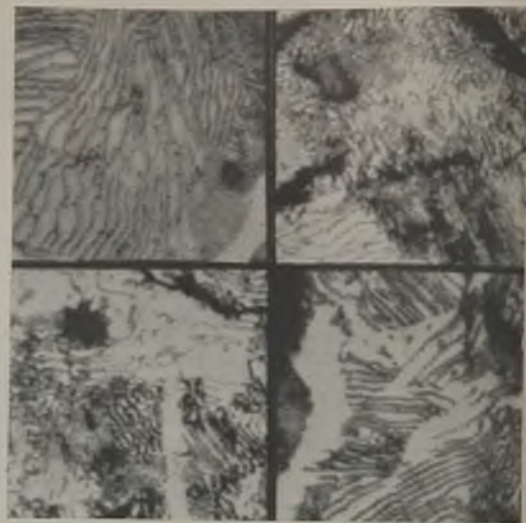
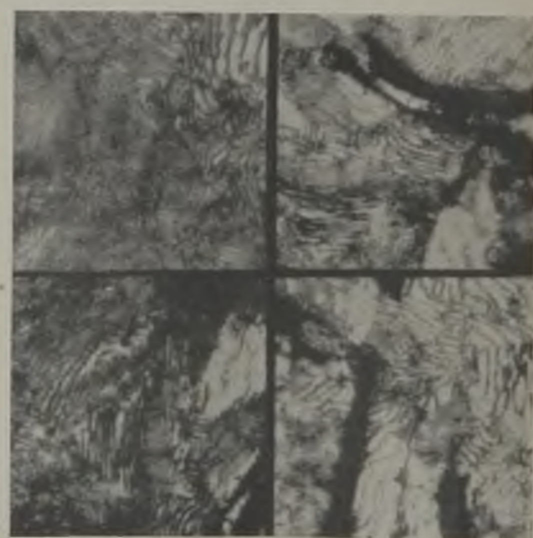


FIG. 74.—INFLUENCE OF TEMPERING 60% STEEL MIX IRON.

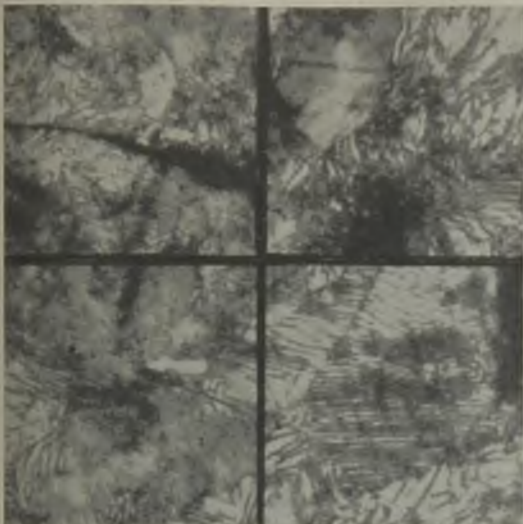


FIGS. 75-78.—EFFECT OF LOW TEMPERATURE TEMPERING 0% STEEL. FIG. 75, TOP LEFT: AS CAST. FIG. 76, TOP RIGHT: TEMPERED AT 350 DEG. C. FIG. 77, BOTTOM LEFT: TEMPERED AT 450 DEG. C. FIG. 78, BOTTOM RIGHT: TEMPERED AT 550 DEG. C. ALL × 1,000.



FIGS. 79-82.—EFFECT OF LOW TEMPERATURE TEMPERING 30% STEEL. FIG. 79, TOP LEFT: AS CAST. FIG. 80, TOP RIGHT: TEMPERED AT 350 DEG. C. FIG. 81, BOTTOM LEFT: TEMPERED AT 450 DEG. C. FIG. 82, BOTTOM RIGHT. TEMPERED AT 550 DEG. C. ALL × 1,000.

the hardening depth and the proportionate increase in hardness value against the initial hardness, are more marked with each increase of steel.



FIGS. 83-86.—EFFECT OF LOW TEMPERATURE TEMPERING 60% STEEL. FIG. 83, TOP LEFT. AS CAST. FIG. 84, TOP RIGHT: TEMPERED AT 350 DEG. C. FIG. 85, BOTTOM LEFT: TEMPERED AT 450 DEG. C. FIG. 86, BOTTOM RIGHT: TEMPERED AT 550 DEG. C.

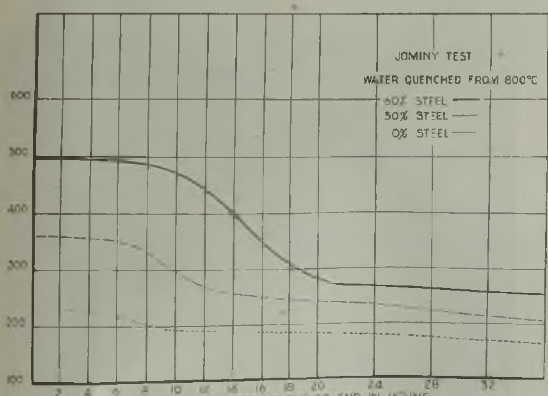


FIG. 87.—JOMINY TEST ON STEEL MIX IRON. THE VERTICAL NUMBERS ARE VICKERS BRINELL NUMBERS. THE SOLID LINE REPRESENTS 60% STEEL, THE BROKEN LINE 30%, AND THE DOTTED LINE 0% STEEL.

Internal Soundness

When one standard iron is used for the production of different castings, varying considerably in section, it is often found that the quality of metal finish after machining is much coarser in the castings of heavy section than in those of lighter section. For example, when deep grooves are machined in a pulley casting which has been cast with a solid rim, and the metal is general cast iron or, in other words, a mixture of pig-iron and scrap, the metal becomes more open as the groove gets deeper, although the first cuts near the face reveal a close finish.

This is the result of the precipitation of primary graphite, which on its formation must occupy space,

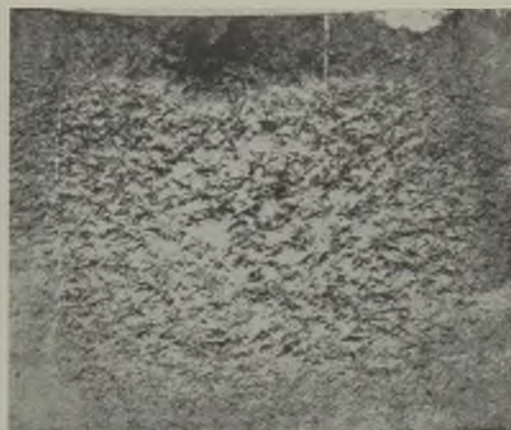


FIG. 88.—0% STEEL.

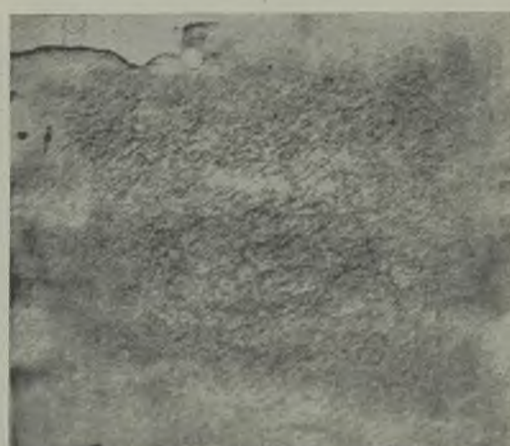


FIG. 89.—10% STEEL.

Steel Mixes and Inoculants

so that there is an expansion by which the metal is forced against the mould face. The heat abstraction from the mould rapidly solidifies this first "skin," while the main bulk of the metal remains pasty. The next layer again expands at its freezing point, and so on, although it is realised that, apart from the outer face, the casting does not actually freeze in layers, but solidifies progressively until the interior finally freezes, with its final graphite precipitation. At the same time, the liquid shrinkage of the matrix iron in heavy sections is sufficient to be not quite equalised by the above expansions, and the result is a very open centre structure.

A series of iron blocks, 6 in. in dia. and 5 in. thick, were cast with increasing steel contents in the metal mixtures used. The ingate was 1 in. by $\frac{1}{4}$ in., attached to the pattern to standardise running speeds, and in each case the casting temperature was as consistent as possible. As it was necessary to observe just where the effects of shrinkage were revealed, no feeding riser was used, and as the steel increased the external shrinkage increased, but the internal shrinkage diminished.

The main purpose of these tests, however, was to demonstrate the effect of increasing steel percentages

FIG. 90.—20% STEEL.

FIG. 92.—40% STEEL.

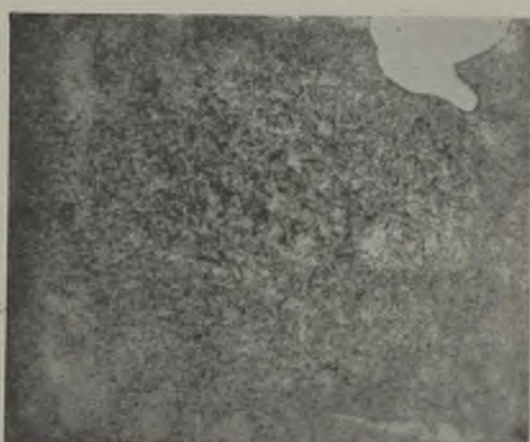


FIG. 91.—30% STEEL.

FIG. 93.—50% STEEL.

on internal soundness, sometimes described as solidity penetration, which is of the utmost importance in pressure castings and in any other high-quality machined castings. Figs. 88 to 95 were obtained by cutting the blocks through the centre, and taking a contact print from each (reduced by 50 per cent. linear on reproduction).

The effect of increasing steel is so marked that the decrease of porosity with each 10 per cent. steel can be clearly followed through the full range of prints. An important fact is that on all these blocks except the 0 and 10 per cent. steel mixes, the wedge value was 4 in each instance, which means that the increasing internal soundness was not obtained by an iron of increasing chill value, but was truly related to the steel content of the mix. It is evident that the formation of primary graphite, because of the reduction in total carbon, and even more, the increase in combined carbon, is controlled by the amount of steel in the mix.

Table V.—*Percentage T.C. and Si Contents of Mixtures Used for Internal Soundness Tests.*

Steel content.	T.C.	Si	C.C.	T.C. Equivalent.
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
0	3.46	1.42	0.52	3.93
10	3.33	1.41	0.54	3.80
20	3.21	1.57	0.59	3.73
30	3.10	1.77	0.54	3.69
40	3.29	1.66	0.54	3.84
50	3.15	1.64	0.54	3.70
60	3.04	1.43	0.65	3.52
70	3.01	1.44	0.66	3.49

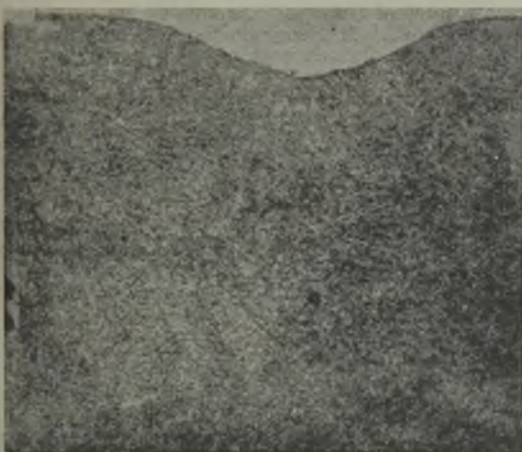


Fig. 94.—60% Steel.

Fig. 95.—70% Steel.

Summary

(1) Increasing steel in the metal mixture for grey-iron castings produces the following effects:—(*a*) Increased tensile and transverse strengths; (*b*) greater stability of the iron-silicon carbides at high temperatures, so that physical properties can be improved by oil quenching and tempering; (*c*) reaction to low-temperature tempering; and (*d*) internal soundness in heavy sections, with resultant improvements in machined finish.

(2) The use of refined irons, which could be aptly described as synthetic pig-irons, is an expensive method of obtaining similar results.

(3) Although the addition of 1.0 per cent. nickel appears to refine the graphite in the lower steel mixtures, the effect on the graphite in the higher steel mixtures is negligible. The increase in tensile strength does not justify the sharp increase in cost.

(4) With iron grey at the spout, the normal silicon base inoculants appear to act as deoxidising agents, and the metal is improved by a low optimum addition. Increasing amounts above the optimum effect no improvement, but a deterioration of physical properties. The addition of aluminium alone has a greater scavenging action than silicon addition.

(5) Correct melting practice makes the melting of steel mixtures simple and straightforward. Special cupolas are no more essential than they are for ordinary iron mixtures, although a well-designed cupola provides many advantages in the efficient melting of any cast iron.

The authors wish to record their thanks to Mr. A. Botwood, deputy managing director of Humber, Limited, for his interest in this work, and for permission to publish this Paper.

NEWS IN BRIEF

Argentina recently signed a new trade treaty with Spain under which the latter is to supply Argentina with 30,000 tons of iron and steel per annum, in addition to the 30,000 tons stipulated in the 1942 agreement.

Mr. Charles E. Wilson, vice-chairman of the U.S. War Production Board, anticipates that 35 per cent. of the productive capacity now tied up with work will be available for peacetime production when Germany is defeated.

Certain French metal combines have founded the "Groupement d'Achats des Producteurs de Minerais et Métaux Bruts," a central buying organisation to facilitate purchases of raw materials and to prevent competition between members.

That the sudden death from heart failure at a Bloxwich foundry of Lawrence A. Homer, aged 31, of 24, Haskell Street, Walsall, was partly due to the fact that he wore too many clothes while working in excessive heat, was stated in evidence at the inquest on him recently. A verdict in accordance with the medical evidence was returned.

To meet the wishes of many members, the Council of the Institute of Metals is sponsoring a testimonial fund to Mr. G. Shaw Scott, who has recently retired from the position of secretary. Cheques should be sent to the president, Mr. D. W. T. Griffiths, 4, Grosvenor Gardens, London, S.W.1, made payable to the honorary treasurer, marking the envelope "S. S. presentation."

The National Union of Manufacturers, in a memorandum on the Government White Paper on Employment, remarks that it seems to contemplate a set of benevolent and skilled experts who will plan for industry and labour and tell them what to do. "We cannot help remembering," comments the National Union of Manufacturers, "that British industry has been built up by the management and labour very largely without the assistance of the Government, and these two elements will have a far greater share in the work of making any employment scheme a success than the White Paper, as it stands, would seem to indicate."

Speaking at an official inspection of the laboratory of the British Cast Iron Research Association at Falkirk on Wednesday of last week, Mr. Arthur Woodburn, M.P., said that ironfounding was one of the fundamental arts of the engineering trades. Much of the work in engineering, he said, became automatic, but in the foundry the worker was an artist; it was hard work, but satisfying in its creativeness. Yet, other products were being discovered and we were entering upon a plastic age. The ironfoundry industry had not to rest on its past achievements, and here research played an important part. Without co-operation within the industry and the conviction that all were partners in it, there was little hope of full success. Mr. Woodburn said that industry must attract the young; it must give them satisfaction as well as reward, and it must inspire the spirit of service.

STOCKS OF ALUMINIUM HOLLOW-WARE

The Board of Trade are now issuing licences to manufacturers and wholesalers to enable them to dispose of their small stocks of aluminium hollow-ware. In the case of manufacturers, these licences will only permit supplies—direct or through wholesalers—to hospitals and certain other institutions.

After consultation with the Central Price Regulation Committee, the Board have issued the General Hardware and Ironmongery (Maximum Prices) Order, 1944, amending the General Hardware and Ironmongery (Maximum Prices) Order, 1943, by fixing maximum prices for these stocks. The maximum price prescribed for manufacturers is their October 1, 1940, price, plus $16\frac{2}{3}$ per cent. Wholesalers who maintain a regular selling organisation and carry substantial stocks of hardware and ironmongery are permitted to add, in respect of aluminium hollow-ware which they can establish formed part of their stock on July 1, 1944, a sum equal to $16\frac{2}{3}$ per cent. on price paid to the maximum price prescribed in Article 3 (1) of the 1943 Order. All other wholesale sales of aluminium hollow-ware remain subject to the ordinary margins for hollow-ware fixed by the 1943 Order. The maximum retail margin remains at 50 per cent. on price paid, exclusive of purchase tax.

This Order does not in itself authorise manufacturers and wholesalers to supply aluminium hollow-ware; before doing so, they must obtain licences from the Industries and Manufactures Department 4, Board of Trade, Neville House, Page Street, London, S.W.1.

EMPLOYMENT OF DISABLED PERSONS

By an Order in Council, certain sections of the Disabled Persons (Employment) Act passed last March were brought into operation on August 15.

The Sections brought into operation at the present stage are those dealing with the definition of "disabled person"; the provision of vocational training and rehabilitation courses; special facilities for the employment of the severely disabled; preference for men who have served in H.M. Forces or the Merchant Navy, and for women who have served in certain of the Women's Services; the establishment of a National Advisory Council; the appointment of officers, issue of regulations and application to Northern Ireland; and the application of the Act to non-British subjects.

The remaining Sections, which will come into operation at a later date, are those dealing with the registration of disabled persons; the obligation on certain employers to employ a quota of disabled persons; and the appropriation of vacancies in designated classes of employment to persons registered as disabled.

SAVE PAPER WHEN YOU CAN

COMPANY RESULTS

(Figures for previous year in brackets)

James Howden & Company—Dividend of 15% (same).

W. G. Frith & Company—No dividend for year to February 28, 1944.

Head Wrightson & Company—Final ordinary dividend of 3½%, making 6% (same).

Waste Heat & Gas Electrical Generating Stations—Interim dividend on the ordinary shares of 2½% (same).

Gaskell & Chambers—Net profit for 1943, after providing for depreciation, war damage contributions and taxation, £45,161 (£40,372); dividend of 10% and a bonus of 10%, making 20%; forward, £26,074 (£22,992).

Richardsons, Westgarth—Profit for the year ended March 31, after providing for taxation, deferred repairs, and the sum of £46,586 for depreciation, £63,396 (£44,411); dividend of 8% (same); forward, £58,933 (£34,463).

Wellman Smith Owen Engineering Corporation—Profit for the year ended March 31, £93,357 (£137,054); tax, £51,000 (£101,000); net profit, £42,357 (£36,054); final dividend of 5% (same) and a bonus of 2½% (same), making 12½% (same).

Darlington Railway Plant & Foundry—Trading profit for the year to April 30, £13,930; income from investments, £132; depreciation, £1,559; E.P.T. and income-tax, £8,500; to general reserve, £1,000; dividend of 10% on the ordinary shares; forward, £2,991 (£2,413).

Matthew Wells & Company—Profit to May 31 last, after provision for depreciation, taxation and war damage contribution, directors' fees £669, and including income from investments, etc., £1,254, and a gain of £2,860, arising out of a sale of a capital asset, £14,044; dividend of 20% (same), plus a capital distribution of 2½%.

OBITUARY

MR. JOHN MORRISON, of John Morrison & Sons, brassfounders, Paisley, died suddenly on August 9.

MR. ERNEST DAVISON, late of the School of Metalliferous Mining, Camborne, Cornwall, died at Derby on August 9, as the result of an accident.

MR. EDMOND WILLIAM PAYNE, late joint managing director of Matthew T. Shaw & Company, Limited, structural engineers, Millwall, died on August 3, aged 75.

MR. CHARLES HENRY JOHNSON, managing director of Dent & Company & Johnson, Limited, scientific, electrical, and mechanical engineers, Linwood, Paisley, died recently.

MR. WILLIAM HARRIES, J.P., died at Morriston on August 10, following a motoring accident. He was Mayor of Swansea, and in business had been associated for many years with Mr. David Matthews in the firm of David Matthews, Limited, iron and steel merchants, Morriston.

PERSONAL

DR. ANDREW M'CANCE, F.R.S., deputy chairman and joint managing director of Colvilles, Limited, has been appointed a Justice of the Peace for Lanarkshire.

MR. WILLIAM GOMERSALL, secretary of Joshua Hindle & Sons, Limited, brassfounders and engineers, Leeds, 11, has been appointed a director of the company.

MR. E. G. KING has resigned his appointment with the Ministry of Aircraft Production to return to industry, and has been appointed a director of D. H. Diecasting Company, Limited, and D. H. (Engineers), Limited, of Slough.

MR. ARTHUR SMITH, who has been selected to become the next mayor of West Bromwich, is chairman of Izons & Company, Limited, ironfounders and hollow-ware manufacturers. He has now completed 55 years' service in the firm.

WE OFFER OUR CONGRATULATIONS to Mr. and Mrs. F. J. Cook, of 31, Poplar Avenue, Edgbaston, Birmingham, 17, who to-morrow will celebrate their golden wedding. Mr. Cook is a founder member of the Institute of British Foundrymen, its oldest living past-president, and an honorary member. His contributions to the technical literature of the industry have received international approbation.

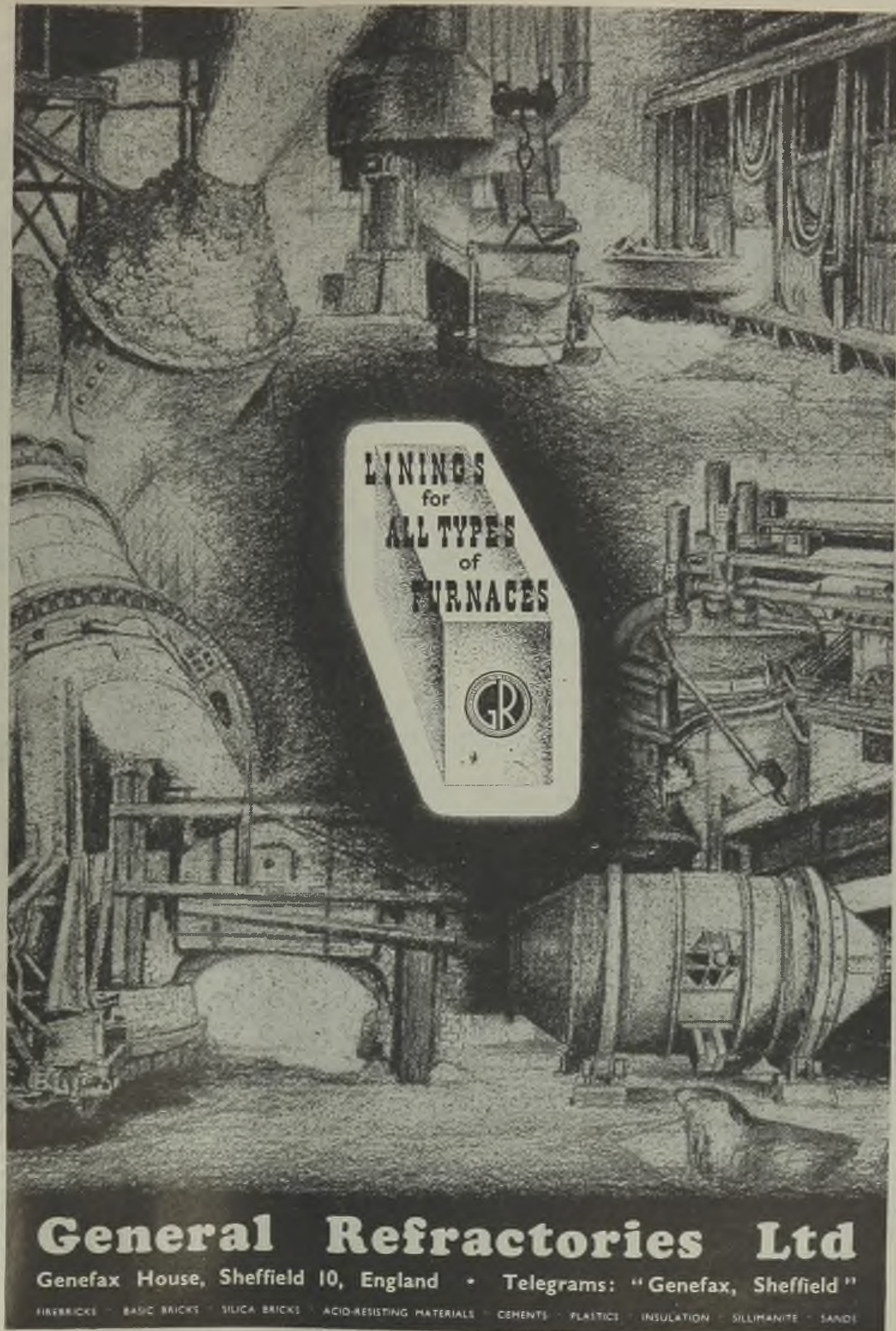
MR. F. W. G. HOBBS, works director of the Standard Brass Iron and Steel Foundries, Limited, of Benoni, Transvaal, has retired from business. He was amongst the first South African foundrymen to join the Institute of British Foundrymen. He and his co-director, Mr. Moore, were regular visitors to this country before the war. His last visit was in 1938, when he participated in the Warsaw Convention.

COL. WILLIAM E. GIBBONS has been selected by the Executive Committee of the Bilston Conservative and Unionist Association as prospective candidate for the coming by-election at Bilston. Col. Gibbons, who is 46 years of age, is a director of Gibbons (Dudley), Limited, general constructional engineers. He served in the last war, and in this was one of the last to leave Dunkirk. He is now the commandant of a battle and weapons training school.

MR. FRANK ANDREW, a well-known figure in the foundry world, is retiring from his position as foundry manager to Ferranti, Limited. His services will continue to be available to the company in the capacity of technical adviser and consultant on foundry matters. Mr. Andrew will retain his connection with the North-West Regional Fuel Efficiency Committee. The management of the foundry is being taken over by MR. R. LAROUX HANDLEY, B.Sc. (Tech.), A.M.I.E.E., who has for some time been assistant to the general works manager.

Wills

ROGERS, E. L., of Wrexham, iron merchant	£22,779
HARLOW, B. S., principal of Robert Harlow & Son, Limited, brassfounders and engineers, of Stockport	£49,352
MEREDITH, H. W., of Howard W. Meredith & Son, vice-chairman and a founder of the former London Iron and Steel Exchange	£28,765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Raw Material Markets

IRON AND STEEL

By the careful regulation of production and distribution, conservation of materials and man-power has been achieved without detriment to the interests of pig-iron consumers. Good stores of iron having been accumulated, the output has been curtailed, and, although consumers have not always been able to obtain the particular quality of iron they desire, a sufficiency has always been available for essential work. If only meagre tonnages of hematite are being released, users have learnt to "make do" with refined or low-phosphorus iron, and production of both basic and common foundry iron keeps well abreast of current needs. The position in regard to scrap is slightly better than it was. Heavy steel and cast-iron scrap is arriving in fairly satisfactory quantities, but many foundries are still on the look-out for larger tonnages. There is a strong demand for heavy machinery metal.

Coke supplies are generally satisfactory, and consumers can obtain their full requirements without much delay. Many users are taking in as much as possible for reserve stocks to safeguard winter needs.

The intense activity of the re-rolling industry—contrasting with the quieter conditions in other branches of the steel trade—is conditioned by a steady flow of semi-finished products from the steelworks. In response to this heavy demand, an adequate supply of material is maintained, but in order to avoid encroachments on reserve stocks of imported material, it is still necessary for the re-rollers to make full use of all the defective billets, crops, shell discard steel, etc., which they are able to acquire. Works still have big tonnages of small bars, light sections, etc., to deliver before the end of September, and the further outlook in these departments is particularly bright.

The disposition of the more important trades—engineering, shipbuilding, etc.—to work upon existing stocks and to limit further buying is still a noticeable feature in the finished steel trade, accentuated, no doubt, by the knowledge that further orders can be placed and executed at short notice. Specifications for joists and heavy channels are particularly scarce, and rollers of flats are also securing orders to keep the mills going. Even the call for sheets has lost some of its urgency, although fairly steady employment for the sheet mills is assured for a month or two ahead. Rail mills, too, are very busy, and collieries have not reduced their demands for arches, props, bars, etc.

NON-FERROUS METALS

All war requirements of copper continue to be satisfied without any difficulty whatsoever. At the same time, there are no indications of any forthcoming civilian releases, although large stocks are known to be held. Demand for copper scrap has recently declined, and the tendency of the market is easy. In America the official view is that there is a very serious shortage of copper in the country. Although the position actually is very tight, it is believed that in some directions the demand has passed its peak.

Essential needs of the tin consuming industries are being steadily supplied. Armament factories are obtaining all the metal they require, and on the basis of current consumption, there is certainly no indication of any impending shortage. Shipments to this country are being regularly maintained, and it seems likely that by this time extensive stocks have been accumulated. On the other hand, there is no disposition by the Control to allow a larger scale of ordinary commercial manufacture, and in America also the use of tin is rigidly limited, although in some directions, notably in the tin content of solder, the regulations are somewhat easier than they are in this country.

There is no material change in the market for lead. Supplies are adequate for war needs, and deliveries are made without delay. Quite a large amount of lead is still being used, although the pressure for supplies is far below that of the peak period.

In the case of zinc, also, conditions are comparatively steady. Priority users are obtaining all the metal they need. Demand has lessened somewhat recently, but supplies to other consumers are still allocated very sparingly, although on a more generous scale than in the case of the other non-ferrous metals.

NEW COMPANIES

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

Priory Engineering Company (Christchurch), 2, High Street, Christchurch, Hants—£1,000. A. B. and E. J. Isaac.

Farvalube, 90, Gresham House, London, E.C.2—Engineers, etc. £1,000. A. Walters, L. D. Colam, and C. L. W. Rees.

Moir & Company (Hardware)—£1.000. A. Moir, F. Lambourn, and C. E. Snape, 56, Repton Avenue, Gidea Park, Essex.

Tym's Engineering Productions, 13, Commercial Road, London, E.—£1,600. J. H. Tym, J. H. G. Hillier, and R. G. C. Scutt.

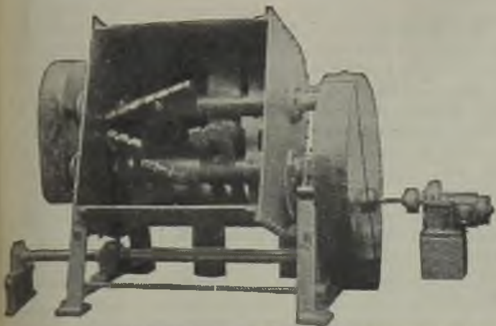
H. J. Briggs, 65, College Gardens, Chingford, London, E.4—Engineers, etc. £2,000. H. J. Briggs and E. C. Hardcastle.

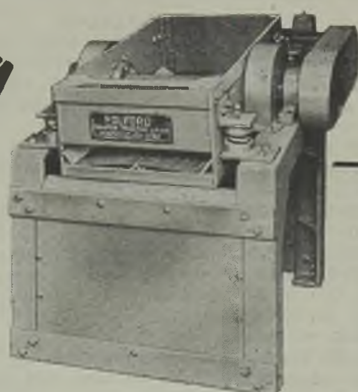
Sprayed Surfaces, 1. St. Nicholas Buildings, Newcastle-upon-Tyne, 1—Metal sprayers, etc. £1,000. F. Dunden and C. Hope.

C. A. Hughes Blattman, Midland Bank Chambers, 1, York Street, Twickenham—Engineers, etc. £5,000. C. A. Hughes Blattman and A. Gee.

Newbould & Conway, 68, Carter Knowle Road, Sheffield, 7—Engineers, etc. £2,000. G. N. Newbould, W. A. Conway, and L. K. Conway.

Weldax (Newcastle-upon-Tyne), 210, West Road, Newcastle-upon-Tyne—Engineers and welders. £1,000. E. W. S. Parmley, B. D. Duffy, and T. C. Green.





CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, August 23, 1944

PIG-IRON

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

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

Hematite.—Si up to 3.00 per cent., S & P 0.03 to 0.05 per cent.; Scotland, N.-E.Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

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

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

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

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

Cold Blast.—South Staffs, 227s. 6d.

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

FERRO-ALLOYS

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

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

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

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

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

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

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

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

Cobalt.—98/99 per cent., 8s. 9d. lb.

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

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

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

SEMI-FINISHED STEEL

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

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

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

FINISHED STEEL

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

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

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

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

NON-FERROUS METALS

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

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

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

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

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

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

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16s.; rods, drawn, 11⅜d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 11⅛d.; wire, 10⅞d.; rolled metal, 10½d.; yellow metal rods, 9d.

Copper Tubes, etc.—Solid-drawn tubes, 15½d. per lb.; brazed tubes, 15½d.; wire, 10d.

Phosphor Bronze.—Strip, 14½d. per lb.; sheets to 10 w.g., 15½d.; wire, 16½d.; rods, 16½d.; tubes, 21½d.; castings, 20d., delivery 3 cwt. free. 10 per cent. phos. cop. £3[illegible] above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

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

NON-FERROUS SCRAP

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

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended Aug. 19, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

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

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

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

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

IRON AND STEEL SCRAP

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

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

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

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