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An Age of Conferences

This seems to be the era of conferences—political, trade and technical. The first usually serve to emphasise differences of opinion rather than compromise; the second provide opportunities for "grousing" at the Government of the day, and for sightseeing. It is the third type with which we are concerned, and here a sub-division comes into the picture. There are the periodic meetings of the great technical institutions which unquestionably make worthwhile contribution to industrial and technical progress. Next there are special meetings called by some organisation to discuss one or a group of allied subjects. There being a reserve of untapped knowledge for the initial enterprise, the first conference is usually a success, and others follow which are progressively less interesting. Then there are international conferences. These vary in character, and may centre around an exhibition, a sightseeing tour, or concentrate on technological meetings and works visits. All four ingredients are invariably present, but the proportions served-up are truly diverse, and the ultimate success depends on the balance achieved.

A comment on this subject was made in a recent editorial appearing in the *American Foundryman*, which underlines one aspect and conveniently ignores a second. It reads: "At an International Foundry Congress, foundrymen engage in a peculiar form of barter at which they have become adept through long experience in discussions ranging from casual conversations to formal addresses at national meetings. Everyone participating in this barter gains—no-one loses—all come out of the exchange with everything they had at the start plus whatever has been acquired from others." What has been ignored is the ever-increasing cost of participation—a feature to which Professor Murphy drew attention in his presidential address to the Institute of Metals. Thus attendance is not wholly barter.

Finally, there is the type of "international convention," now for the moment non-existent, which operates more or less like a private tourist-agency, substituting works visits for a conducted tour to include "the Riviera, the northern cities of Italy and the Swiss Alps." Lack of support obviously quickly kills such enterprises. Happily, the foundry industry is properly and intelligently served in the matter of both national and international conferences. Ever since 1902, the Institute of British Foundrymen has held annual conferences which have given an ever-increasing service to the members. Since 1926, the International Committee of Foundry Technical Associations has inaugurated a series of International Congresses with consummate success. The 15th congress is to be held in Brussels in September, and promises to maintain in every way the high standard now established. Next year, America is to be visited, and the arrangements are already well in hand.

W. & T. Avery's New Foundry

Mr. Walford H. Turner, the chairman of the 220-yr.-old Birmingham scale-making firm of W. & T. Avery, Limited, drove a bulldozer last Thursday morning across a 122-acre site at Tame Bridge, near Walsall, to inaugurate a £1,000,000 project for a foundry which will be among the most modern in the world. The 250 foundry workers in the present foundry at Soho Works, Smithwick, which is five miles from the new site, will be transferred. Double the present foundry's output of castings is expected.

The reasons for the transfer are:—(1) The age of the buildings—parts of which were built by Boulton & Watt 150 years ago—and lack of space and headroom, which prevent the introduction of mechanical-handling equipment; (2) the buildings were badly damaged by enemy action during the war; (3) there is no room at Soho to provide baths and other facilities.

Part of the site is reserved for the Ministry of Transport, as it will be crossed by the projected trunk motor road between Bristol and the north-west. The first buildings for the new foundry will be built in the eastern quarter of the site and the centre reserved for extensions.

Bathing facilities will be a feature of the new foundry, so that men can change into working clothes on arrival, leave their street clothes in a locker, and put them on again at the end of the day, after having a shower-bath. There will also be a canteen close to the foundry.

The manager of the present foundry has visited the United States and Europe to study the latest developments in foundry buildings and practice, and modern ideas will be incorporated. The roof is to be of the "monitor" type in which parts are raised above the level of the rest and the sides of the raised portion glazed. This achieves a good distribution of heat and catches sunlight.

The present foundry at Soho was built by Matthew Boulton and James Watt to make castings for their famous engines and additions were made after W. & T. Avery took over the works in 1895. There are 2,500 employees at the works—still known as the "Soho Foundry," although only one-tenth of its personnel is employed in the foundry. All activities except for foundrywork will continue at Soho.

Forty Years Ago

The issue of the FOUNDRY TRADE JOURNAL for August, 1911, announced with no little pride that the British Foundrymen's Association with 718 members had taken the lead over the much older American Foundrymen's Association. The programme is printed of the forthcoming Glasgow convention, when Percy Longmuir was to be re-elected president, as rightly in those early days with but few leaders to choose from, each president held the office for two years. The vice-presidents nominated were Charles Jones and S. A. Gimson and they initiated the tradition of one year only. Looking back one cannot fail to notice how heavily the Editor had to resort to foreign publications for his matter for no fewer than seventeen articles came from either America or Germany, and three were home produced. Amongst "new companies" registered were the Lennox Foundry Company.

BECAUSE of the increase in the work done at the Industrial Research Laboratory, Holiday Street, Birmingham, the Public Works Committee has presented to the City Council a scheme to build an extra storey on the laboratory at a cost of £4,400.

Conference Paper Author

MR. W. B. LAWRIE

W. B. LAWRIE, M.Sc., F.R.M.S., A.I.M. is one of the joint Authors of the Paper "The Observation and Control of Dust in Foundry Dressing Operations." (Part II is printed on page 129.) Mr. Lawrie is at present H.M. Engineering Inspector of Factories and previously he was lecturer in ferrous metallurgy at the Cumberland County Technical College, Workington. Other appointments he has held are assistant to the Bessemer manager of the Workington Iron and Steel Company Limited and as assistant to the steelworks superintendent of the same concern. Mr. Lawrie is a member of the Joint Standing Committee on Conditions in Iron Foundries (the Garrett Committee) and of a large number of other committtees dealing with industrial subjects, including the Foundry Atmospheres Committee, the sub-committee of the B.S.F.A. Committee on Industrial Health in Steel Foundries, and the Dust in Steel Foundries Committee.

Correspondence

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

JOINT STANDING COMMITTE ON CONDITIONS IN IRON FOUNDRIES.—SUB-COMMITTEE

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—I have been requested by the above-mentioned sub-committee, of which Mr. Colin Gresty is chairman, to ask if you would be so good as to publish in the FOUNDRY TRADE JOURNAL a request for information on different methods of ladle drying and heating that may be in use in the trade. Obviously we are not wanting information about the use of open fires in ladles, but we are interested in other methods. The kind of information we desire is as follows:—

(1) Type of unit.
(2) Capital cost.
(3) Running costs.
(4) Kind of fuel used, and amount per ladle.
(5) Size of ladle dried or heated.
(6) Thickness of refractories dried and time of drying.
(7) Temperature to which the ladle is raised.
(8) Analysis of the products of combustion.
(9) Drawing or photograph of the installation.
(10) Experience of user.

I know the members of the committee would be grateful if your readers could assist them in this matter.—Yours, etc.,

W. B. LAWRIE.

H.M. Inspector of Factories
(Engineering and Chemical Branch),
Artillery House, Artillery Row,
London, S.W.1.
July 24, 1951.

THE TYNE IMPROVEMENT COMMISSION has approved the spending of £6,800 on the purchase of fork-lift trucks or other suitable appliances for the mechanical handling of cargo on the Tyne Commission Quay, North Shields.

Heat-treatment of Grey Cast Iron*

Report and Recommendations of Sub-Committee T.S. 31

Constitution of Sub-committee T.S. 31

T. R. Twigger, A.M.I.MECH.E. (chairman),
H. H. Beeny, M.MET., F.I.M.,
W. J. Colton, A.M.I.MECH.E., F.I.M.,
P. E. Clary,
J. W. Dews,
M. M. Hallett, F.I.M. (corresponding member),
C. A. Payne, B.SC. (corresponding member),
S. Routley (Gardom Student),
P. A. Russell, B.SC., F.I.M.,
R. C. Tucker, M.A., F.I.M.,
K. E. Walker,
G. Lambert (sub-committee secretary).

Terms of Reference

Sub-committee T.S. 31, the members of which are listed at the head of the page, was constituted by the Technical Council in March, 1949, with the following terms of reference:—

"To consider and report upon the subject of heat-treatment of grey cast iron, with particular reference to sectionalising the problems involved, and to make recommendations regarding the order in which they should be investigated."

The Sub-committee decided that the heat-treatment of accidentally-chilled iron, in order to render it grey, fell properly within its scope. The term "chilled" is used in this report to indicate the presence of an excess of carbide over the eutectoid percentage.

Scope of the Sub-committee's Activity

In accordance with the expressed wish of the Technical Council, the Sub-committee decided to explore the subject in the widest possible way. The underlying aim was to bring to light heat-treatment operations on which it was felt that there was either a lack of knowledge of the principles involved, or where industrial practice was believed to be inefficient. The Sub-committee was asked to conclude its survey as quickly as could conveniently be done, so that the Technical Council might consider the advisability of appointing one or more Sub-committees to study, in greater detail, any recommendations the Sub-committee might make. It will be obvious, from the foregoing, that this Report is necessarily a review, not necessarily complete, of available literature and the experience of members of the Sub-committee; it contains no results of new research work.

The Technical Council, having considered the Sub-committee's recommendations, decided that before any further work is undertaken, the Report should have the wider discussion that presentation at the Annual Conference affords; the Report is, therefore, presented with that object in view.

* Report presented at the Newcastle-upon-Tyne Conference of the Institute of British Foundrymen.

Heat-treatment Processes applied Commercially, or Capable of Application to Grey Cast Iron

The Sub-committee first decided to prepare a list of known heat-treatment operations, and this was drawn up as follows:—

A.—*Annealing operations*: (1) *Annealing for improved or maximum machinability, and* (2) *Annealing for the removal of chill.*

B.—*Heat-treatment to improve the hardness, wear resistance and strength of cast iron whether previously annealed or not.*

C.—*Stress relief treatment.*

D.—*Heat-treatment prior to enamelling.*

E.—*Surface or local hardening by flame and induction heating or nitriding.*

F.—*Isothermal quenching.*

G.—(1) *Heat-treatment of suitably alloyed iron to develop a martensitic structure.*

(2) *Heat-treatment of suitably alloyed iron to modify an acicular structure.*

H.—*Treatment of special irons at sub-normal temperature.*

The Sub-committee realised that processes under headings E, F, G and H were highly specialised and, where used commercially, were limited to applications which could hardly be considered as being of wide general interest. They were only briefly touched upon during the Sub-committee's deliberations, but it is thought wise to include them in this review.

SUMMARY OF THE SUB-COMMITTEE'S WORK

(A-1)—Annealing for Improved or Maximum Machinability

This is known to be a very widely-used heat-treatment operation, the object being to reduce pearlitic irons, partly or wholly, to a ferrite/graphite structure. It is assumed in this section of the Report that the original castings are free from excessive carbides. There is a considerable volume of literature available on the effect of heating at various temperatures, and for various times, irons of known composition; perhaps the most

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useful contributions being by L. W. Bolton[4], Timmins[6], and Silvester[10]. Other references[2 3 8] are also shown in the bibliography.

The very marked improvement in machinability as reflected by increased machining speed, reduced tool wear and reduced energy absorbed in machining is well known. Some quantitative results have been published by Field and Stansbury[7], who show that in machining a fully-annealed sample by milling, at 300 ft. a minute, the tool life may be increased by the ratio of 50 : 1 compared with the same operation on a pearlitic material.

It is clear from theoretical considerations and wide-spread experience that the breakdown of pearlitic carbides commences at temperatures considerably below the critical point; although the reaction takes place much more rapidly as the critical point is approached. The effect of increasing silicon content in accelerating the breakdown of the pearlitic carbides is also well known. Although R. G. McElwee[5] states that to lower the hardness re-solution of some of the combined carbon at temperatures above the critical is necessary, it is well established that there is no need for the temperature to exceed the critical, in fact, if the critical point is exceeded appreciably, the carbon commences to re-form in solid solution and may be retained as combined carbon on quick cooling. The amount of carbon re-dissolved depends upon the temperature achieved and the composition of the material, particularly with regard to silicon content. The amount retained on cooling is also affected considerably by the amount of silicon present.

It will be seen, therefore, that if a fully ferritic structure is desired, with the lowest possible Brinell hardness and greatly improved machinability, it is unnecessary to exceed the critical point; it should, however, be noted that the critical point is seldom known with any degree of accuracy, thus in practice, some temperature around the assumed critical point is used. It is clear, for the reasons mentioned above, that if the temperature appreciably exceeds the critical point and a fully ferritic structure is desired, the rate of cooling through the critical point should be sufficiently slow for no combined carbon to be retained.

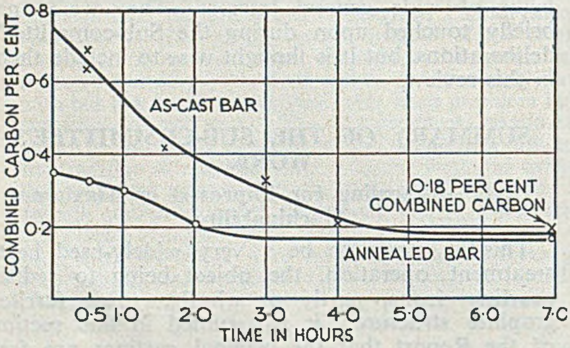

FIG. 1.—*Graph of Combined Carbon Plotted against Holding Time for Bar No.* 1 (*T.C* 3.30, *Si* 3.25, *Mn* 0.80, *S* 0.069 *and P* 1.12 *per cent*); *Heated at* 700 *deg. C.*

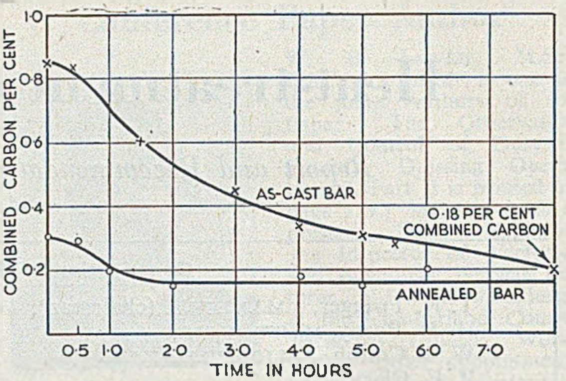

FIG. 2.—*Similar Graph to Fig.* 1 *for Bar No.* 2 (*T.C* 3.45, *Si* 2.20, *Mn* 0.71, *S* 0.054 *and P* 1.10 *per cent.*); *also Heated at* 700 *deg. C.*

The time of treatment depends, in the first place, upon the temperature, and, secondly, upon the composition of the material. The rapidity of heating is also of importance since with very slow heating-up the castings may be at temperatures only slightly below the chosen figure for some considerable time, thus reducing the need for holding at the annealing temperature. In commercial practice castings are heated to a temperature near to the critical point for periods of 1 to 3 hours, depending upon the cross-section, and cooled, either by passing through a cooler zone of the furnace or, in some cases, cooled by air. The Sub-committee consider that slow cooling to 400 deg. C. and preferably to 300 deg. C. for castings of irregular section which are liable to thermal gradients on cooling is desirable, with a view to leaving the casting in, so far as is possible, a stress-face condition.

The alternative method of heating to temperatures well above the critical, followed by slow cooling through the critical range, is quite practicable, and may even be advisable if there is any possibility of the castings having local chill.

Review of Literature and Available Experience

A review of the literature and Sub-committee members' experiences showed striking differences in the rate of breakdown of pearlitic carbides in various types of iron: for example, there was evidence of commercial engineering irons in which the combined carbon was reduced to 0.1 per cent. by heating for 4 hours at 595 deg. C. or 1 hour at 650 deg. C. On the other hand, centrifugally cast iron in regular use for piston rings containing approximately 2.1 per cent. silicon and 0.4 per cent. chromium shows little softening after heating at 640 deg. C. for 1 hour. Further evidence of high stability is furnished by the irons referred to by C. R. Tottle,[11] in which no structural breakdown was recorded even in chromium-free irons after 2,500 hours at 500 deg. C.; in this case, the temperature is low in comparison with normal annealing temperatures, but the time of heating is very long indeed.

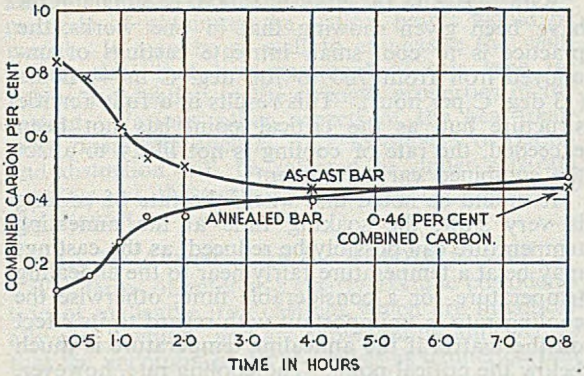

FIG. 3.—*Graph showing the Equilibrium achieved either by Annealing the As-cast Material or Reheating the Previously-annealed Bar to* 40 *deg. C. above the Critical Point* (800 *deg. C.*). *Bar Composition as in Fig.* 2.

The Sub-committee believe that there is no precise information as to the effect of composition on the breakdown of pearlitic carbides. The general effect of silicon in reducing the stability of the pearlitic carbide is well known and is illustrated, in two series of irons having widely different silicon contents, by Timmins,[6] and two compositions used by Silvester.[10]

Extensive work on the time/temperature relationship for maximum pearlite breakdown has been carried out by Timmins[6] working on sections $\frac{1}{2}$ in. thick cut from 1.2-in. bars, having silicon contents of 3.25, 2.20 and 1.30 per cent. and using temperatures at 700, 800 and 900 deg. C. Figs. 1 and 2 taken from this work show clearly the rapid initial reduction in combined carbon at temperatures below, or only slightly above the critical, followed by a much slower rate of breakdown over longer periods of heating. Timmins in fact suggests that the combined carbon reduction is proportional to the square root of the heating time. Fig. 3 relating to the 2.2 per cent. silicon iron shows the equilibrium achieved by either annealing the iron "as cast," or reheating the previously annealed bar to a temperature 40 deg. C. higher than the measured critical point for this iron. Fig. 4 illustrates the equilibrium with the same iron at 900 deg. C., the

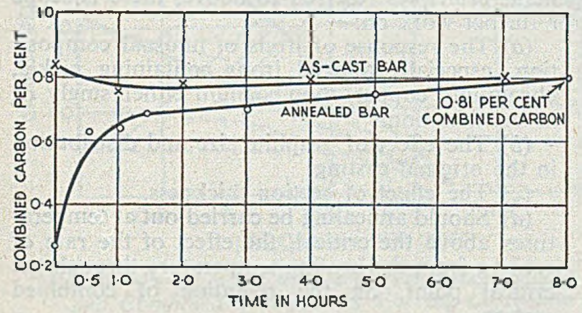

FIG. 4.—*Similar Graph to Fig.* 3 *for the Same Materials held at* 900 *deg. C. At this Temperature the Combined Carbon Stabilised at* 0.80 *per cent.* (*Bar Composition as in Fig.* 2.)

combined carbon stabilising at 0.80 per cent. at this temperature.

Further work has since been carried out by Silvester[10] using irons with silicon contents of 1.93 and 2.68 per cent. (not of similar composition in other respects). The heat-treatment temperature in this work ranged between 600 and 850 deg. C. in 50-deg. steps. Charts from this Paper are reproduced in Figs. 5 and 6. These show that for the two irons considered, the lowest hardness was achieved by heat-treatment at 750 deg. C. This temperature also gave the lowest attainable hardness in the shortest possible time. These figures and also Fig. 7 show the effect of heating at temperatures higher than the critical point, followed by quick cooling (all the samples used were very small and were cooled in air). With a silicon content of 1.93 per cent. sufficient carbon was re-dissolved at 850 deg. C. for the hardness, on air cooling, to be greater than the initial hardness of the material; on the other hand, iron No. 2 with a silicon content of

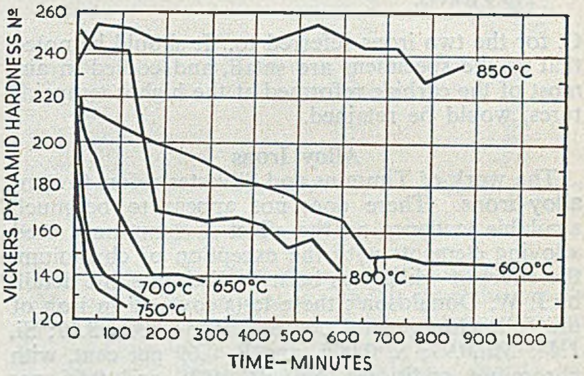

FIG. 5.—*Graph showing the Hardness Variation against Time of Treatment for Bars Annealed at a Range of Temperatures* (*Metal Composition*: *T.C* 3.38, *Si* 1.93, *Mn* 0.72 *and P* 0.10 *per cent.; Initial Hardness,* 220 *Vickers*).

2.68 per cent., when air cooled from 850 deg. C, showed a higher hardness value than as fully annealed, but the hardness was still very much lower than on the original material, because only a small amount of carbon has been re-dissolved, and retained on cooling.

For the two silicon contents mentioned, temperature and time have been equated, but it should be noted that the composition of the two irons differed in respects other than silicon, thus the time/temperature relationship Silvester established could not be taken as general. When heat-treating regularly an iron of a reasonably constant composition, the time/temperature relationship can clearly be arrived at, and the most economical time and temperature chosen.

Some reference should be made to the claim in Silvester's paper that the stability of the carbides is greater at 800 deg. C and 850 deg. C as compared with sub-critical temperatures. The Sub-committee believe that the true reason for the apparent stability is the re-solution of carbide above the critical points, which are calculated to be 766 and 791 deg.

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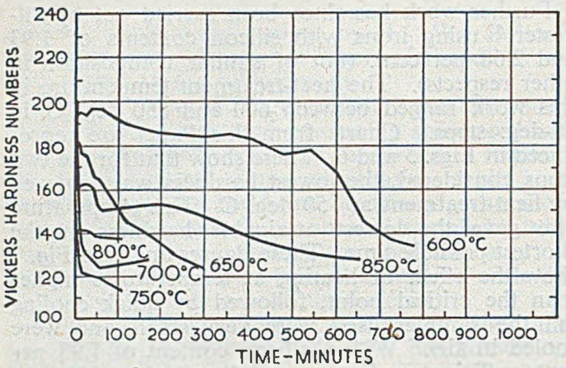

FIG. 6.—*Hardness Variation against Time of Treatment for Bars of Composition: T.C 3.63, Si 2.68, Mn 0.54 and P 0.63 per cent.; Initial Hardness, 210 Vickers.*

C. for the two irons referred to. It should be noted that as the specimens are small, and cooled in air, most of the carbide reformed at the higher temperatures, would be retained.

Alloy Irons

The work of Timmins and Silvester refers to non-alloy irons. There does not appear to be much available evidence on the effect of commonly used alloying elements with the exception of chromium, the effect of which has been studied, in some detail, by J. W. Donaldson[1]; these tests covered an iron of the following general composition:—T.C., 3.17; Si, 1.44; Mn,0.97; S, 0.005, and P, 0.69 per cent. with chromium additions: Nil, 0.2, 0.39 and 0.66 per cent. Also included in this series were two irons of the following composition:—T.C., 3.23; Si, 1.6 to 1.48; Mn, 0.95; S, 0.06 to 0.04, and P, 0.77 to 0.66 per cent. with chromium additions: 0.75 and 0.90 per cent.

The effect of prolonged heating at 550 deg. C. in an electric furnace for 5 periods of 8 hours is shown in Fig. 8, and the percentage changes in hardness, strength and combined carbon are shown in Fig. 9.

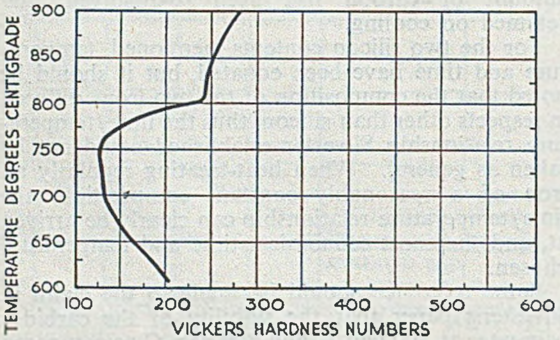

FIG. 7.—*Effect of Heating at Temperature above Critical Point followed by Rapid Cooling in Air (2 hr. Annealing Period; Bar Composition as in Fig. 5.*

With regard to the effect of rate of cooling, figures have been given showing that in one works, the practice is to cool small intricate castings of unalloyed iron from 760 to 700 deg. C in 4½ hours (13 deg. C per hour). This results in a fully ferritic structure but, as the critical point has not been exceeded, the rate of cooling is not likely to affect the combined carbon content.

It should be noted that where the rate of cooling is very slow, the soaking time at the annealing temperature can possibly be reduced, as the castings may be at a temperature fairly near to the annealing temperature for a considerable time; otherwise the cooling rate is unimportant with regard to its effect on the matrix if the annealing temperature is much below the critical point. The cooling rate, however, is of obvious interest where the castings are necessarily heated at temperatures above the critical, as in Section A-2 of this report. In one instance which was brought to the Sub-committee's notice, a cooling rate of 15 deg. C. per min. between 950 and 500 deg. C. gave some re-formation of pearlite.

After careful consideration, the Sub-committee came to the conclusion that whilst there is a large

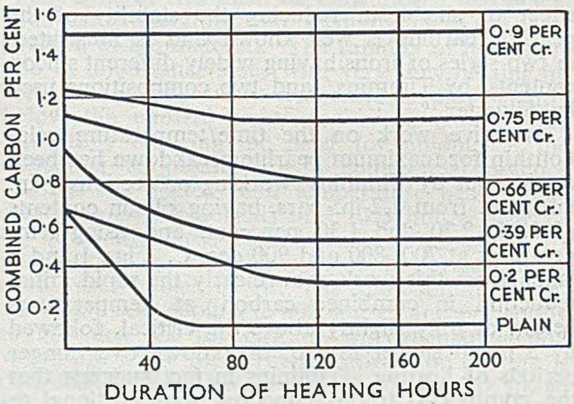

FIG. 8.—*Effect on Combined Carbon of Heat-treating Bars of Varying Chromium Content for Five 8-hr. Periods at 550 deg. C. in an Electric Furnace.*

amount of literature available, and whilst the annealing of iron castings for pearlite breakdown is generally carried out in accordance with the broad general principles referred to above, there is scope for further work on:—

(*a*) The response of irons of unusual composition, especially alloyed irons containing nickel, chromium, copper, molybdenum either singly or in combination.

(*b*) The effect of graphite size and distribution in the original casting.

(*c*) The effect of section thickness.

(*d*) Should annealing be carried out at temperatures above the critical, the effect of the rate of cooling from the heating temperature through the critical point, on the retention of combined carbon.

The Sub-committee also consider that it would facilitate heat-treatment operations if the critical point of the iron in question was known reasonably accurately, and they consider that information on methods of obtaining the critical points would be useful. It may be as well to emphasise the well-known fact that heat-treatment of this type involves a reduction in the strength properties of the casting. Various other aspects of the heat-treatment operations such as steps to prevent oxidation and distortion will be referred to under separate headings, as these also concern other sections of this Report.

(A-2)—Annealing for the Removal of Chill

The terms of reference clearly exclude consideration of malleable iron castings which are intentionally cast "white," and are subsequently annealed so that the uncombined carbon exists as temper carbon nodules.

Where iron castings, intended to be grey throughout, are partially or wholly chilled, this usually occurs in thin sections, on sharp corners, or where a "flash," occurring on a mould or core joint, has caused a chilled fin on the casting, the chill striking back for a short depth into the casting. In some cases the chill results from the use of metal densers or metal moulds. The Sub-committee was, of course, well aware of the large volume of literature relevant to the removal of chill in malleable cast iron, but the only references found on the removal of carbides in accidentally chilled cast iron were those by Beeny,[2] who states that for normal compositions massive carbides require approximately 850 deg. C. to break them down completely in a 2- to 3-hr. period, a temperature of 800 deg. C. being inadequate even with silicon over 3.0 per cent.; Austin,[3] who advocates heating to 815 to 870 deg. C., followed by slow cooling; and Bolton,[4] who recommends a temperature 50 deg. C. above the critical for periods up to 4 hrs., according to the amount of carbide present, followed by slow cooling,

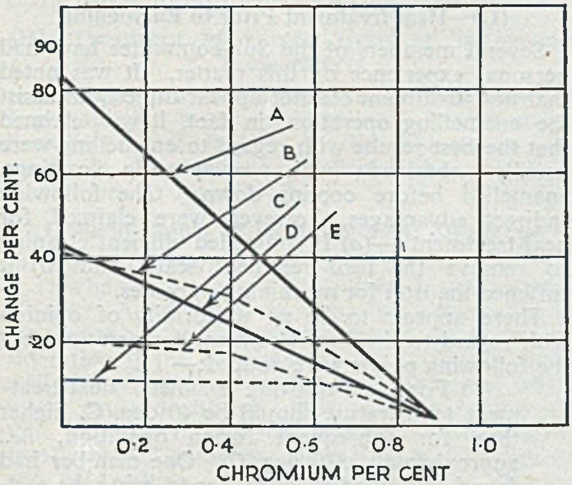

FIG. 9.—*Percentage Changes in Hardness, Strength and Combined Carbon with Varying Chromium Content (A, Combined Carbon Change; B, Hardness Change, and C, Strength Change at 550 deg. C; D, Carbide Change, and E, Hardness Change at 450 deg. C.*

e.g., from the annealing temperature to 500 deg. C. in 1 hr.

Experience of members included the following treatments:—

(*a*) Soak at 950 or 955 deg. C. for 1 hr., and cool to 440 to 455 deg. C. in 30 min. This reduces the hardness of the chilled areas from 450 to 235 Brinell and the unchilled areas from 273 to 163 Brinell.

(*b*) A 6-hr. cycle, the castings attaining 850 to 860 deg. C. in a continuous furnace having a maximum of 900 deg. C. This treatment is effective on material having ½-in. to 2-in. cross-section and a phosphorus content of 0.6 to 1.3 per cent.

(*c*) Experimental work on a 2-in. dia. test block with one face cast against a chill.

Two irons were used with a range of heat-treatment temperatures, all being air-cooled from the annealing temperature; the resulting Brinell hardness figures were as follow:—

	Iron No. 1. T.C. 3·25 Si. 1·9	*Iron No. 2.* T.C. 3·25 Si. 1·2
As cast	315 (not fully chilled)	485
3 hrs. at 725 deg. C. ..	225	490
1 hr. at 700 deg. C. ..	270	450
1 hr. at 850 deg. C. ..	300	345
1 hr. at 950 deg. C. ..	265	300

Time and Temperature

It is well known that the removal of massive carbides is considerably more difficult than the breakdown of pearlitic carbides. It is commonly found that an annealing operation where the temperature, or time, may be insufficient for the complete removal of massive carbides will give a ferrite/carbide structure. All the available evidence shows that for the removal of massive carbides, the temperature should be appreciably above the critical point; in general, this means at least 850 deg. C. for normal engineering irons. Whilst higher temperatures will result in quicker carbide breakdown, they increase considerably the risk of scaling and distortion; phosphide exudation may also take place with an annealing temperature of the order of 950 deg. C.; thus temperatures as high as this should never be used unless the phosphorus content is under 0.3 per cent.

In normal unalloyed irons, the time of treatment obviously depends upon the extent of the chilled area, the size of the carbide particles and the silicon content. The time and temperature relationship does not appear to be particularly critical, but the two can clearly be exchanged between certain limits. There is no precise information available, but it is believed that 1 hr. at 950 deg. C. might be as effective as 4 hrs. at 850 deg. C.; however, distortion and scaling become much more severe at the higher temperatures. Where irons contain carbide stabilising elements, notably chromium, added either deliberately or accidentally, the heat-treatment technique obviously needs considerable modification (Bolton[4]).

From the remarks under the preceding section, it is clear that as temperatures above the critical will

Heat-treatment of Grey Cast Iron

inevitably be used for this type of heat-treatment, re-solution of carbide will take place to an extent depending upon the temperature and composition of the material, particularly with regard to silicon content. The extent to which the re-dissolved carbon will be retained in solution on quick cooling depends upon the cooling rate.

Cooling

For maximum softness the rate of cooling through the critical point must obviously be slow, although no evidence as to the minimum rate appears to be available and the Sub-committee consider this point to be worthy of further study. Whilst from metallurgical considerations, slow cooling below the critical point is unimportant, the Sub-committee consider it advisable to cool slowly as described in the fifth paragraph of section A-1.

As in the case of annealing for pearlite breakdown (section A-1) a knowledge of the critical point would also be of value, although for the rapid removal of chill, temperatures well above the critical would normally be employed. One member of the Sub-committee quoted an example where an iron containing 1.1 per cent. silicon and 0.152 per cent. sulphur had needed 6 hours' treatment at 950 deg. C. for the removal of local chill. The increased difficulty of removing the chill in an iron with the sulphur unbalanced by manganese is also referred to by Bolton.[4]

The Sub-committee reached the conclusion that further work was desirable on the conditions governing the removal of massive free carbides in iron accidentally chilled, where the composition is unusual by reason of very low or very high silicon, unbalanced sulphur, or the presence of nickel, chromium, copper, molybdenum, either singly or in combination.

(B)—Heat-treatment to improve the hardness, wear resistance and strength of cast iron whether previously annealed or not

In the case of heat-treatment carried out in accordance with section A-1, where a sub-critical temperature is used, the retention of any desired degree of combined carbon must obviously depend upon the partial breakdown of pearlite through a selection of an appropriate annealing temperature and time. In the case of heat-treatment above the critical, as in section A-2 of this report, cooling conditions to give the desired hardness can, of course, be arranged by adjusting the temperature of the furnace, in which the annealing has taken place, to the temperature from which cooling is to take place. Where it is more convenient to allow the castings to cool down from the annealing operation, reheating is, of course, necessary. With most types of cast iron, quick cooling in air is sufficient for the retention of a considerable degree of combined carbon in pearlitic form, but the amount retained depends largely upon the silicon content.

Such heat-treatments are of course widely established—that concerning oil quenching and tempering being used on a considerable commercial scale—and there is a large volume of literature available.

The Sub-committee proceeded to consider whether any problems relating to the practice of hardening and tempering for improved strength or hardness needed investigation, but it was considered that the extent to which these processes are used is very small in relation to the foundry industry generally, and as firms using such processes appear to have solved these problems satisfactorily, there was no need to pursue this matter further; in any case, it was considered unlikely that they would be considered of sufficient importance to justify the attention of an Institute sub-committee.

It was, however, noticed that there seems to be a limited amount of evidence on the amount of carbon which returns into solution at any temperature, also on the relationship between the heating time and the amount of carbon redissolved. The Papers by Timmins[6] and Silvester[10] already referred to, give a limited amount of evidence on this matter, but it is observed that in commercial practice on surface hardening or through hardening the soaking time is invariably short and, with suitable compositions, re-solution of sufficient carbon takes place to give a very high hardness value even in irons previously annealed.

(C)—Stress-relief Heat-treatment

Stress relief heat-treatment is commonly practised at temperatures up to 600 deg. C., and is obviously a form of heat-treatment which has some connection with the work of this Sub-committee, particularly as regards annealing for improved machinability. The Sub-committee felt, however, that so much work had been carried out, and so many useful Papers had been presented on stress relief treatment that they need not give any attention to this matter, except to note that experiences had been recorded showing a noticeable reduction of combined carbon in certain irons when treated at temperatures below 600 deg. C.

(D)—Heat-treatment Prior to Enamelling

Several members of the Sub-committee have had personal experience on this matter. It was noted that heat-treatment did not appear directly to assist the enamelling operation; in fact, it was claimed that the best results with regard to enamelling were usually obtained with newly-made castings, enamelled before cooling down. The following indirect advantages, however, were claimed for heat-treatment:—(*a*) It compelled efficient cleaning to remove the heat-treatment scale; and (*b*) it softened the iron for machining purposes.

There appears to be no uniformity of opinion with regard to the heat-treatment temperature, but the following points were noticed:—

(1) For acid-resisting enamels, heat-treatment temperature should be 40 deg. C. higher than for subsequent fusion operation, *i.e.*, approximately 810 deg. C. One member had found that good practice was to bring the castings up to 810 deg. C., soaking for 15 minutes, followed by air cooling.

(2) Care was normally taken to stack castings so as to avoid distortion.

(3) Prolonged annealing or successive treatments gave bad results on enamelling.

One member of the Sub-committee confirmed that the annealing temperature should be 30 to 40 deg. C. higher than the enamelling temperature. On the other hand, it was suggested that it was not necessary and perhaps unwise to specify a maximum of 850 deg. C. It was claimed that some firms anneal at a temperature of 890 deg. C. without difficulty, and that in some cases blistering had been cured by the use of annealing temperatures over 850 deg. C. Another member of the Sub-committee stated that distortion experienced during enamelling, after annealing at 830 to 850 deg. C. was overcome by raising the annealing temperature to 915 deg. C.

During these discussions it became quite evident that there was a very considerable variation in annealing practice throughout the industry. No standard practice seemed to exist, and the matter obviously offered scope for investigation. It was, however, reported that the B.C.I.R.A. had set up a panel to consider vitreous enamelling, and that Mr. Walker was serving on this Committee. It was felt that in view of the existence of this panel, a Sub-committee of the Institute to study this subject was probably unnecessary, but the Technical Council may wish to give consideration to this point.

Other Forms of Heat-treatment

Surface or local hardening by flame and induction heating or nitriding (E); isothermal quenching (F); the heat-treatment of suitably alloyed irons to develop a martensitic structure (G1); and the heat-treatment of suitably alloyed iron to modify an acicular structure (G2) are forms of heat-treatment which are closely allied with the more general hardening and tempering treatment mentioned under heading (B) and although included in this Report, they were considered to be of too specialised a nature to justify detailed consideration.

(H)—Treatment of Special Irons at Sub-normal Temperatures

This subject also was not considered of sufficient importance to merit investigation. It was noted, however, that a Paper[12] on the subject was presented to the Institute of British Foundrymen's Conference in June, 1950.

General Points of Heat-treatment Technique

(*a*) *Rate of Heating.*

This has been touched upon in section A-1 of this Report. Apart from the annealing effect of slow heating to the annealing temperature, the main consideration is the necessity for the casting to attain uniform temperature without undue stress which might cause distortion. It is recognised, however, that the rate of heating, even in iron-containing locally chilled areas, can vary quite widely without risk of cracking. In the case of castings of complicated design, it is advisable to raise slowly to the annealing temperature so as to ensure that the thin sections do not attain a higher temperature in advance of the thicker sections. This is obviously a matter of prudence when the castings are of massive size or complicated design.

(*b*) *Oxidation and growth during Heat-treatment.*

The oxidation of castings in heat-treatment may give rise to difficulty in machining and failure of the castings to clean up in subsequent machining. Oxidation is related to the heat-treatment temperature, furnace atmosphere, and the chemical composition and micro-structure of the material. The Sub-committee is of the opinion that high temperatures are likely to cause much more serious trouble, through oxidation, than an increase in the time of treatment; consequently, the annealing temperature should be kept to the minimum. Furnace atmosphere should be the least oxidising possible having regard to the furnace available. In many cases no special steps need to be taken to avoid oxidation, but where some form of protection is considered necessary, this may comprise one of the following methods:—(*a*) Protection of the work by surrounding with a protective cover; (*b*) as (*a*) but with carbonaceous material inside the protective cover; (*c*) packing the work in an inert material; (*d*) use of protective gas screen at the furnace entrance (and exit); (*e*) controlled atmosphere furnace; and (*f*) protective wash applied to the work. Where removal of scale is necessary, this can usually be accomplished by either shotblasting, tumbling, pickling, or salt-bath treatment.

In annealing cast iron, whether for the removal of massive or pearlitic carbides, it should be noted that any change from iron carbide to ferrite plus graphite gives rise to a small volume change. This is, of course, apart altogether from the large volume change, or growth, experienced on repeatedly heating and cooling plain and alloyed cast iron. The Sub-committee did not, however, feel it necessary to consider, in detail, the question of dimensional change.

(*c*) *Steps to Prevent Distortion.*

It was agreed that distortion is accentuated at higher furnace temperatures; thus, more precautions were called for under heading (A-2) where higher temperatures are involved. Distortion is related to furnace temperature, time of treatment, rate and uniformity of heat input, casting design, composition of the casting, and the method of loading into the furnace. Advantage can sometimes be taken of the size and shape of the castings, in packing them together to minimise distortion, so that, if possible, they support one another during the heat-treatment operation. Other methods passed in review by the Sub-committee include:—Packing the castings in an inert material, and the use of special workplates designed to support the castings.

Recommendations

The Sub-committee emphasises once again that its work has been in the nature of a broad general view of the applications of heat-treatment to grey irons, including those accidentally chilled. Many interesting technical points have emerged, but the Sub-committee has been concerned chiefly to pick out matters on which there seems to be a real lack of knowledge, or where the industrial practice varies so widely as to suggest that the heat-treatment operations could be more effectively or more economically carried out with a better understanding and application of the principles involved.

Heat-treatment of Grey Cast Iron

The points on which the Sub-committee feel that further investigation would be useful are as follow:—

(*a*) Whilst there is large volume of information on the question of pearlite breakdown in normal irons, there is little available information on the response of unusual compositions and especially modern alloyed irons containing nickel, chromium, copper, molybdenum, either singly or in combination. The effect of graphite size and distribution as cast, also of section thickness, could also usefully be studied.

(*b*) The removal of massive free carbides in iron accidentally chilled, where the composition is unusual by reason of very low or very high silicon, unbalanced sulphur, or the presence of nickel, chromium, copper, molybdenum, either singly or in combination.

(*c*) The influence of the rate of cooling through the critical point on the residual combined carbon of irons heat-treated at temperatures above the critical is not at all clear and could usefully be investigated in relation to the chemical composition.

In any work which may be undertaken, or report which may be issued, the critical point for the iron in question should be taken into consideration and methods for obtaining the critical point should be stated.

The Sub-committee now puts forward this Report for comment and criticism, so that the Technical Council may be guided in deciding what further work can usefully be undertaken.

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[3] F. B. Coyle, FOUNDRY TRADE JOURNAL, July 6, 13 and 20, 1933, pp. 7-11, 19-22, 35-37.
[4] L. W. Bolton, B.C.I.R.A. Bulletin, July, 1934. "Soft Cast Iron."
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[8] A. S. M. Handbook, 1948. "Heat Treatment of Cast Iron."
[9] W. W. Austin, Jr., *Transactions A.F.S.*, 1948, pp. 431-45.
[10] A. W. Silvester, *Transactions A.F.S.*, 1949, pp. 51-64.
[11] C. R. Tottle, *Proc. Inst. Brit. Foundrymen*, Vol XLIII, 1950, p. A162.
[12] G. N. J. Gilbert, *Proc. Inst. Brit. Foundrymen*, Vol. XLIII, 1950, p. A52.

THE RAILWAYS have ordered 1,000 four-ton steel containers of a new type for conveying ground limestone, dolomite, fluorspar, alumina, cement and similar substances. The new design is the result of experiments made with a prototype. The container is in the form of a lidded box divided into two equal compartments which can be discharged simultaneously or separately through bottom doors; these doors open by gravity on release of a catch. The lid is designed to operate with the minimum of headroom when open. Opening and closing mechanism of lid and bottom doors is simple to operate. The container is waterproof and is provided with cleats on the sides so that sheets may be fixed during unloading to keep down dust.

American Plant Maintenance Show

Sponsored by the American Society of Mechanical Engineers and the U.S. Society for the Advancement of Management, a plant maintenance show is to be held at the Convention Hall, Philadelphia from January 14 to 17, 1952. A conference on plant maintenance will be held at the same time. The show is intended to display the products, methods, and devices developed by various manufacturers in the field of industrial plant maintenance, aiming at production efficiency; cost, labour, and time saving; and the general safety and sanitation of working conditions. The exhibits will include equipment and materials for air-conditioning, heating, and ventilating; building materials and services; maintenance tools and supplies; electrical equipment; instruments, meters, gauges, etc.; lubricants and lubricating equipment; materials-handling equipment; mechanical rubber goods; paints and painting equipment; product finishes; power generating, distributing, and transmitting equipment; welding and gas-cutting equipment; and exhibits demonstrating employee relations, training, and safety.

The purpose of the show is to provide under one roof all the basic services and materials necessary for maintaining an industrial plant whether large or small. Interested firms should write to Clapp & Poliak, 341, Madison Avenue, New York, 17, N.Y.

Film Shows in Turkey

For 32 consecutive days from August 20, in a large open-air cinema which is an integral part of the British Pavilion organised by the British Chamber of Commerce of Turkey at the 1951 Izmir International Fair, will be exhibited films, made by the Big Six Film Unit, and with their explanatory commentaries spoken in Turkish, that will deal with the activities and speciality goods manufactured by twelve important engineering firms in Britain.

Turkish citizens—trade and the general public—as well as the personnel on the stands and visitors from the dozen other foreign countries with pavilions at the Fair will be able to see a film programme lasting over two hours each evening showing, *inter alia*, what British foundries produce. Amongst these are Aveling Barford, Limited, Glenfield & Kennedy, Limited, F. H. Lloyd & Company, Limited, North British Locomotive Company, Limited, Ruston-Bucyrus, Limited, Rubery, Owen & Company, Limited, Ransomes & Rapier, Limited, the Vulcan Foundry, Limited, and Harry Ferguson Limited.

Iron and Steel Productiv'ty

The Iron and Steel Productivity Team representing the British heavy steelmaking industry returned from the United States recently, after spending five and a half weeks visiting steelworks in California, Texas, and Colorado, as well as the traditional steelmaking areas in the East. The team found that high productivity in the American industry is primarily due to four factors —the size of the plant units; the purity of raw materials (resulting in a low metallurgical load); the tendency to drive units fast; and the use of high-grade fuel, including natural-gas and fuel-oil. The development of large units of production is assisted by a price and marketing system designed to avoid the interference to the flow of production arising from a high proportion of small orders, and by less-exacting standards in finishing operations. A high proportion of the smaller orders are met from stocks held by warehouses in different parts of the country.

The Timed Jolt

By H. J. Bullock

Although over the years major departures from the basic design of moulding machines have been few, it is still possible to incorporate worthwhile improvements in detail. An example is the pre-set numbering of the jolts on machines which incorporate this method of ramming. The means by which this is effected are described in the following article, the device forming an integral part of the machine. The Author also describes the way such an innovation can be used to improve the consistency of moulds and as a result the surfaces of castings. A natural implication of such a development is the determination by experiment of the correct number of jolts required to suit each particular pattern plate and the recording of this information on the plate for use throughout its working "life."

DESPITE ALL THE improvements in design and construction, and with but few exceptions, most foundry moulding machines present much the same overall appearance in 1951 as they did back in 1901. This is no reflection on the manufacturers of foundry equipment, the fact is that the principal function of the moulding machine of to-day is the same as that of its predecessors of 50 yrs. ago—ramming sand into a box—and, sand-throwing and mould-blowing apart, the fundamentals of design are conditioned by this function. Hydraulic squeezing has almost entirely given place to pneumatic and electric squeezing. The jolt- or jar-ram has arrived to supplement the squeeze and modifications and improvements to the various types of machines have been legion, but, generally speaking, the pattern is still fixed on the table, the box is still placed in position over the pattern, and the sand is still introduced from above. Then follows jolting and/or squeezing against a head that requires to be moved into position, and the mould is either pushed up or the pattern withdrawn. Machines built in 1901 went through much the same sequence of operations, and it is this similarity of function which causes most of the moulding machines of to-day to bear a distinct resemblance to those built by the pioneer designers and manufacturers.

British Advancements

Commendable progress has been made by British manufacturers, particularly during the last fifteen or twenty years, and British moulding machines are now regularly exported to all parts of the world. This accelerated progress was largely due to the 1939-45 war, which increased world demand for moulding machines, and it is interesting to note that in so far as this country is concerned, moulding machines have moved from the import to the export lists.

One outstanding development of the last few years, and one that is already being acclaimed as a great advancement in moulding-machine design, is the pre-set jolt-timer which enables a machine automatically to stop jolting at any desired number of jolts. Here again, the idea itself is not new, for as long as twenty years ago patents were taken out covering various types of sequence-controlled valves for application to moulding machines, but all of these valves had two faults in common: (1) they were electrically-operated, which is clearly undesirable in the case of hydraulic and pneumatic machines, and (2) they were all more or less complicated gadgets which tended to be an additional "something to go wrong." The new type of jolt-timer, however, is pneumatically-operated, and is built in as an integral part of the machine (see Fig. 1). It is a relatively simple and strongly-built diaphragm valve, designed to give trouble-free operation throughout the life of the machine. The valve itself is totally enclosed within the column, but the

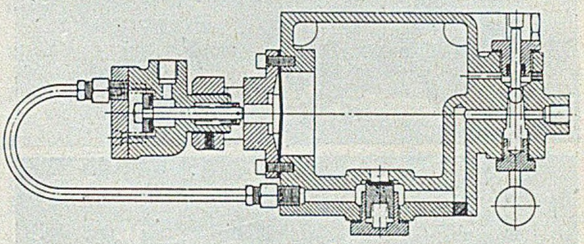
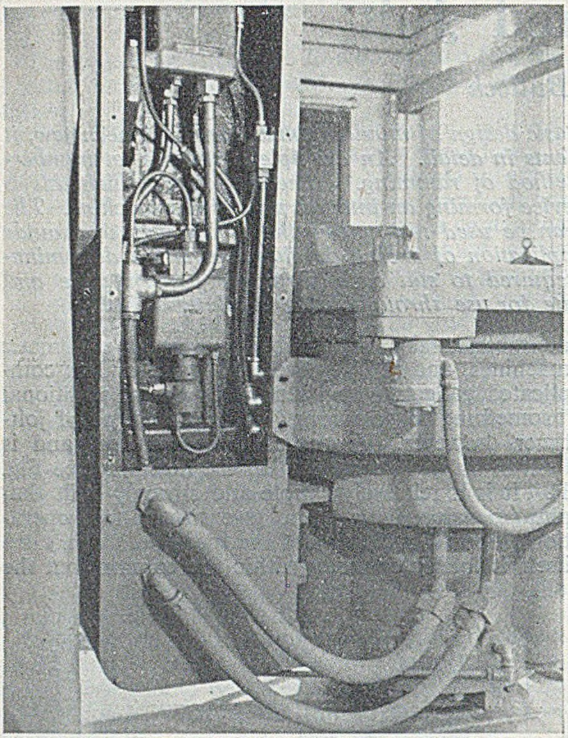


FIG. 1.—*Section through a Pneumatically-operated Jolt-timer.*

setting control, which is a single, knurled knob, has been brought through to a convenient position on the outside of the column (Figs. 2 and 3). The usefulness of this ability exactly to control the number of jolts will be immediately apparent to all who have to do with machine moulding.

In point of fact, many foundrymen do already control the number of jolts by getting the operator to count them, but there are several serious and fairly obvious drawbacks to this method. First, it is extremely difficult to count the jolts "by ear"; on some types of moulding machine the jolt stroke is so short that it is little more than a vibration, and it may be found that what the operator considers to be 10 jolts proves to be 20 when the foreman is doing the counting or (with possibly more serious consequences) *vice versa*. Even in cases where it is possible to determine the number of jolts, it is certain that individual operators will vary the number to suit their moods and personal arrangements. This variation will usually take the form of decreasing the number of jolts and is likely to result in a pile of "swollen" castings. On the other hand, the moulding-machine operator may *not* be in a hurry to keep an evening assignment, in which event it is possible that he will jolt for longer than is necessary, with consequent additions to the "scabbed" columns of the scrap sheets. The



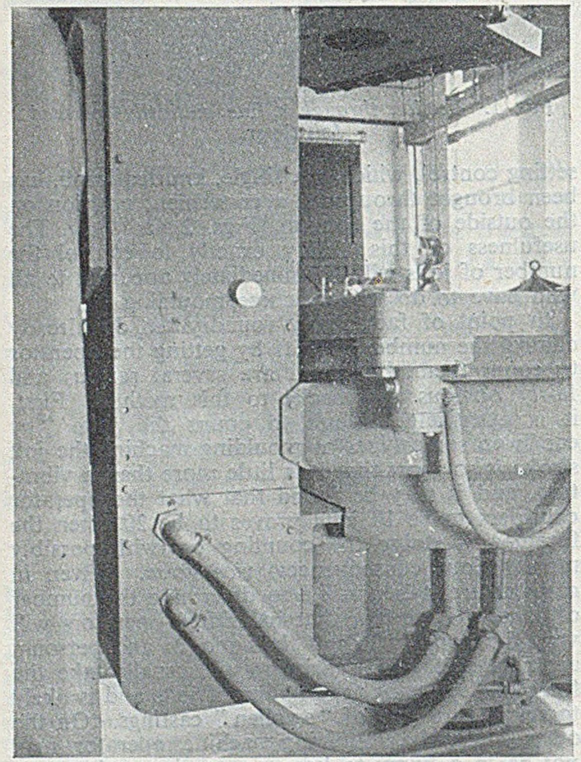


FIG. 2 AND 3.—*The Jolt Timer shown mounted in the Column of the Machine and* (FIG. 3) *Door closed with the Setting Knob ready for Operation.*

necessity to change over operators as a result of labour shortage is clearly another difficulty which arises in this matter.

Correct Number of Jolts

Most foundrymen will agree that there is an optimum number of jolts for each job and with the new system it will be possible for the foundry foreman or manager to make trial moulds before each new job goes into production and after establishing the number of jolts required, to set (and lock) the timer knob in position. The operator would then merely have to press the button for each mould and the machine would automatically stop jolting at the required number of jolts. It is thus possible, assuming that the sand properties are something-like uniform, to be assured of consistently hard moulds, even where machine-moulding personnel are frequently being changed. The trial moulds referred to earlier have to be made only once, the information as to the number of jolts being then permanently recorded on the pattern itself or on the pattern board or plate (see Fig. 4).

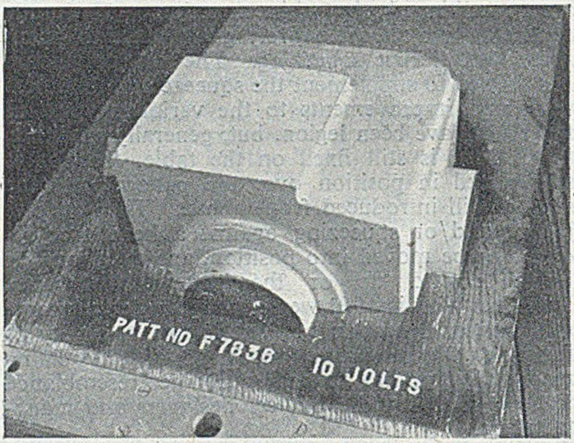
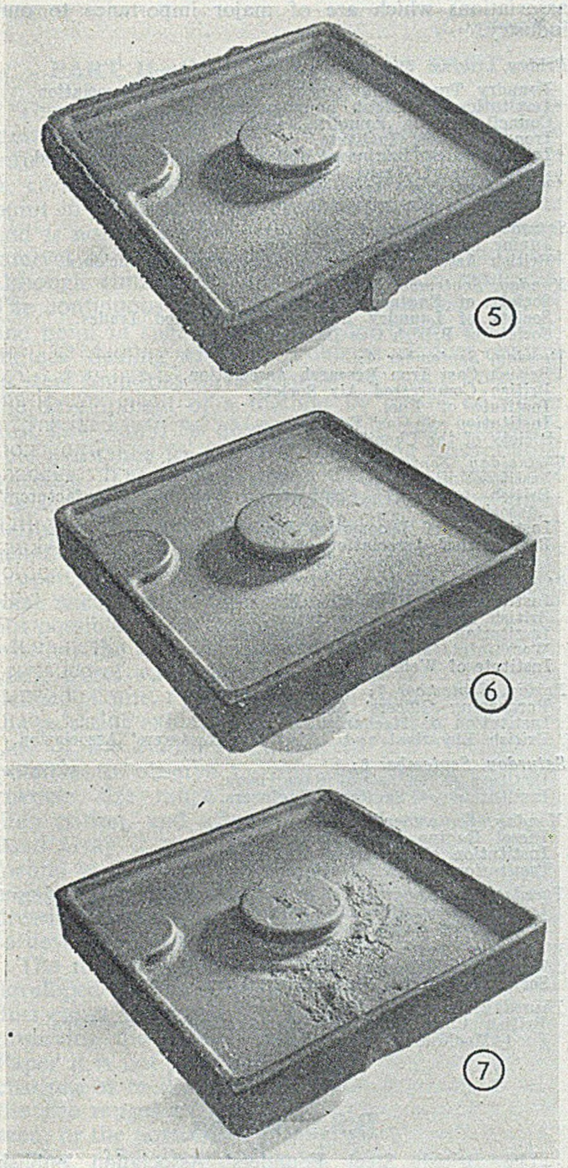


FIG. 4.—*Pattern Plate bearing a Record of the number of Jolts to be given for Satisfactory Results on a given Machine.*

Examples

Figs. 5 and 7 show examples of castings made from moulds which have been jolted too little and too much. Fig. 6 shows the same casting, made in this case from a mould which has been correctly jolted. The swelling and metal penetration which has occurred with the soft mould should be noted (Fig. 5) as well as the scabbing on the casting which was made in an over-hard mould (Fig. 7). The development of artificial bonds has resulted in the increased use of moulding sands which have much higher strength and permeability figures and the likelihood of scabbing with such sand is greatly reduced. On the other hand, the increase in strength is rarely obtained without some sacrifice of flowability and it is with this "open" type of sand that "metal-penetration" scrap is made because of under-ramming. Naturally-bonded sands have a general trend towards lower permeability figures, particularly in foundries where no provision is made for de-silting and increased scrap due to over-ramming is a greater possibility under such conditions.

It should be stated that these are broad generalisations which cannot possibly cover every size of casting and every type of sand and metal, but it is emphasised that the jolt-timer is destined to play a very important part in scrap reduction and increased productivity.



FIGS. 5, 6 AND 7.—*Castings produced from Moulds Jolted for Different Periods.*

FIG. 5.—*Swills and Metal Penetration resulting from an Under-rammed Mould caused by Insufficient Jolting.*

FIG. 6.—*Good Casting Resulting from Correct Jolting.*

FIG. 7.—*Scabbed Casting due to Over-ramming caused by Over-Jolting.*

Personal

MR. J. DOUGLAS, who has served P. & W. MacLellan, Limited, shipbreakers, of Glasgow, for 50 years, has been the recipient of a presentation from his colleagues.

A £50 cheque, a silver tankard, and a framed certificate have been presented to MR. JOHN ROSE, who has been employed for 60 years by Guest Keen & Nettlefolds (Midlands), Limited, Smethwick.

MR. E. RAYBOULD, A.I.M., has relinquished his position as chief metallurgist, foundry division, with High Duty Alloys, Limited, Slough, and will shortly take up the post of foundry manager with H. M. Hobson, Limited, Wolverhampton.

MR. N. STEWART, of Heaton, Bradford, a technician at Crofts (Engineers), Limited, Thornbury, Bradford, left last week for South Africa, where he is taking up an executive post in connection with the development and expansion of Crofts Engineers S.A. (Pty.), Limited, at Benoni, near Johannesburg.

MR. ROBERT W. JOHNSON, assistant managing director of Cammell Laird & Company, Limited, Birkenhead, has been appointed to succeed his father, SIR ROBERT JOHNSON, as managing director. Sir Robert retains the chairmanship of the company. Announcing the change on July 24, the company stated that Sir Robert had been recommended by his medical advisers to a period of rest from business duties.

MR. JOHN BOLTON has joined the staff of the Research and Development Division of the British Steel Founders' Association as editor of their technical publications. Mr. Bolton started his career as an editorial assistant in the office of the FOUNDRY TRADE JOURNAL, and for the period of the war was acting secretary of the Institute of British Foundrymen. During the last few years he has been with John Gardom, consulting engineers of Ripley, Derbyshire.

MR. V. W. PRESS has been appointed London area sales manager of Lancashire Dynamo & Crypto (Manufacturing), Limited. He joined L.D.C. in 1934 and has been senior sales engineer in the Kent/Hampshire area, having been particularly identified with variable speed drive problems and electrification in gasworks. During the last war Mr. Press served in the Royal Engineers with the rank of Major, and was engaged in the reinstatement of electricity supply in north-west Europe. Another L.D.C. appointment just announced is that of MR. A. J. C. MACLEOD, sales manager for the Willesden works products, as export manager.

TWO NEW APPOINTMENTS to the board of Babcock & Wilcox, Limited, are announced. One of them is that of SIR FREDERICK LEITH-ROSS, who recently became a director of the National Provincial Bank. Sir Frederick held the post of chief economic adviser to the Government from 1932 to 1946. From 1909 until that time he was with the Treasury, being deputy controller of finance from 1925 to 1932. He has acted for the Treasury as its representative on various commissions and at international conferences, including the Finance Board of the Reparations Commission, 1920-25. He was British representative on the Preparatory Committee and a member of the British delegation at the World Economic Conference in 1933.

Sir Frederick was chairman of the Industrial Property Conference held in May, 1934. Chairman of the Inter-Allied Post-war Requirements Committee from 1941 to 1943, he became deputy director-general of U.N.R.R.A. from 1944 to 1945, and chairman of the European Committee of the U.N.R.R.A. Council the following year.

The other appointment is that of Monsieur JEAN LOUIS, who, as president of the *Société Française des Constructions*, Babcock & Wilcox in Paris, already has connections with the firm.

Lead in the Cupola

An Unusual Occurrence

All cupola men have their worries, and are never free from unpleasant surprises. To-day it may be the coke, to-morrow the pig-iron, and the day after, the scrap. This last is often the greatest bugbear, because it may contain all kinds of extraneous substances. In this connection, a German correspondent recounts the following occurrence at a large Continental foundry.

After the furnace had been in operation for some time, the tap-hole was opened, and dense white fumes were belched forth, until the iron began to flow normally. The cupola man was naturally very alarmed, and was afraid that the cupola had been damaged in some way. On examination, the outlet where the fumes had come from was found to be covered with a fine yellowish-brown deposit. This colour characterises lead-oxide, and it was therefore assumed that lead had been introduced into the cupola.

The problem was to find out how this had happened. The scrap delivered that day had been made up very largely of heavy counter-weights. Nobody had realised that in fact these weights had been filled with lead, as this was not apparent from the outside. In this way a large quantity of lead must have been charged into the cupola. This theory was proved correct the next morning, when the rammed lining of the receiver was cleaned out. Under the refractory, between it and the base-plate of the receiver, a sheet of lead was found, which is shown in the illustration. It was 2 to 3 mm. thick, but became very distorted on being taken out of the receiver.

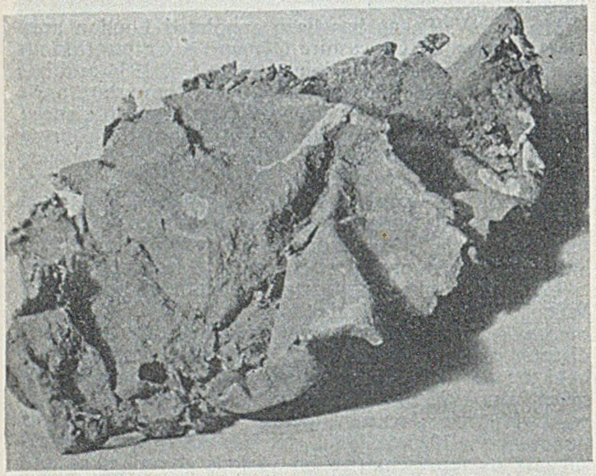


FIG. 1.—*Sheet of Lead 2 to 3 mm. thick taken from the Receiver at the end of the "Blow."*

It is believed that lead does not alloy with iron and the next problem to be solved was how the lead-sheet came to be formed. The solution is indicated by the fact that some iron ores contain a lead compound which is melted down with the iron ores in the blast furnaces. The molten lead separates from the iron owing to its higher specific gravity, and it can be removed separately from iron. This procedure is used in blast-furnace practice; the lead under the iron drips through thin slits at the base of the furnace, is collected, and cast into ingots.

Engineering and Marine Exhibition

Official Visits

As in former years, the Engineering and Marine (and Foundry) Exhibition to be held at Olympia, London, from August 30 to September 13, will receive official visits on set days from many technical institutions. In order that readers may time their attendance and stand-holders suitably arrange their staff, below is printed a programme of the various visits of associations which are of major importance to our industry.

Friday, August 31:
Foundry Trades' Equipment and Supplies' Association.
Institution of British Foundrymen.
Council of Iron Foundry Associations.
Iron and Steel Institute.
Institution of Engineers and Shipbuilders in Scotland.
Institution of Naval Architects.
North-East Coast Institution of Engineers.
Institute of Marine Engineers.

Saturday, September 1:
Junior Institution of Engineers.
British Association for the Advancement of Science.

Monday, September 3:
Society of Engineers.
Society of Laundry Engineers and Allied Trades.
Society of British Gas Industries.

Tuesday, September 4:
British Cast Iron Research Association.
British Compressed Air Society.
Institute of Fuel.
Institution of Gas Engineers.
Society of the Chemical Industry.

Wednesday, September 5:
Institute of Metals.
British Internal Combustion Engine Manufacturers' Association.
Institution of Locomotive Engineers.
Refractories' Association of Great Britain.
Institution of Heating and Ventilating Engineers.

Thursday, September 6:
Institution of Production Engineers.
British Engineers' Association.
Institution of Chemical Engineers.
Worshipful Company of Founders.
Institute of Welding

Friday, September 7:
Purchasing Officers' Association.
Institution of Mechanical Engineers.
British Electrical and Allied Manufacturers' Association.

Saturday, September 8:
Institute of Industrial Supervisors.
Institution of Sanitary Engineers.

Monday, September 10:
Diesel Engine Users' Association.
Institution of Electrical Engineers.
Institution of Civil Engineers.

Tuesday, September 11:
London Association of Engineers.
Institute of Refrigeration.

Wednesday, September 12:
Institute of Vitreous Enamellers.
Society of Motor Manufacturers and Traders.

Thursday, September 13:
British Chemical Plant Manufacturers' Association.
Food Machinery Association.

B.S.F.A. Log

The British Steel Founders' Association publish each quarter a brochure for circulation amongst their members. The contents are made up of an editorial designed to "ginger up" interest in the Association; then there is usually a letter from the chairman; a page of pictures of social events; a description of a member's foundry and short news paragraphs. They are very well written and profusely illustrated. This service is one well worth emulation in other trade associations.

Observation and Control of Dust in Foundry Dressing Operations*

Part I. Control of Dust—By R. F. Ottignon
Part II. Observation of Dust—By W. B. Lawrie, M.Sc., F.R.M.S.

(*Continued from page* 104)

PART II—OBSERVATION OF DUST

There are many methods by which atmospheric dust concentration may be determined, but the information obtained by the use of these methods in each particular case refers only to the special point in space at which the observation was made and is normally valid only for the relatively short interval of time during which the air was sampled, although continuous dust recorders are available. The continuous recorder, however, samples only at one point in space. On the other hand, the committees[3] dealing with the problems of dust control in steel foundries have thought for some time that the development of a method by means of which dust flow could be observed would offer considerable assistance to engineers designing dust-control systems. The original object was not so much the measurement of dust concentrations, as the elucidation of the direction taken by dust clouds after generation, so that collecting devices could be properly placed to intercept the dust in cases where total enclosure of the dust-producing process was not possible. The committees also wished to know whether the dust cloud from the point of a pneumatic chisel was diffuse or took the form of a well-defined plume, and the effect on the dust cloud of the pulsating exhaust from the pneumatic tool itself. One of the Authors† considered that it might be possible to observe moving dust clouds of small particle size range under correct conditions of illumination, and after some discussion with Mr. Basil Gray it was decided to commence experimental work. At the same time his co-Author was engaged on experimental work on an exhausted dressing bench, so that it was considered desirable to develop the two projects together.

The method of observation which has now been developed has been used, in general, to render the dust cloud visible so that it may form a means of observing the aerodynamics of a system. In this Paper it is not proposed to enter into detailed discussions as to the optics of the illuminating system, the size ranges of the dust particles which can be seen, or the possibility of making the method quantitative. The photographs of dust which are included in the Paper were taken from, or in conjunction with, the film which has been produced and which illustrates, qualitatively, the effects given by the use of certain fettling tools both with and without dust-controlled equipment.

Illumination

When a powerful beam of light is passed through a suspension of a finely-divided solid in a liquid or a gas, the path of the beam is clearly visible from a direction at right angles to the line of the beam itself, and in the case of very small particles in a narrow size range the light will show a blue colour. If the incident light is polarised its path will only be seen clearly from one of two opposite directions at right angles to the beam, and the polarisation will be the same as that of the incident beam. That is, if the path can be seen from each side of the beam it will not be visible from above or below or any other direction in the plane normal to the beam. If the illuminating beam is non-polarised its path can be seen from all sides, and the light emerging sideways will be polarised, but the state of polarisation of this light will vary with the angle of observation and the particle sizes. With very small particles, the light observed at right angles to the beam will be polarised, whilst at all other angles the proportion of polarised light decreases. This decrease is symmetrical as the line of observation approaches either the direction of incidence or exit of the illuminating beam. For larger particle sizes, the proportion of light polarised increases as the line of observation approaches the exit direction of the beam and more light is radiated as this direction is approached. The phenomenon is known as the Tyndall beam, and forms the basis for the ultramicroscope, when the diffracted light is viewed through a microscope system so that the light from each individual particle is visible. Because the diffracted light is weak the background must be dark. Even so, the diffracted light may be obscured by glare from larger reflecting particles—a condition which is commonly seen in dark ground microscopy.

The lower limit of resolution of the ultramicroscope depends on the adequacy of the illuminating beam, but with the normal lighting system, sizes down to 10$\mu\mu$[4] should be visible. The upper limit is determined by the fact that when the particles reach sizes of the order of the wavelength of visible light they reflect light, a reflection which is sufficiently strong to mask the weaker diffracted light from the smaller particles.

For the purposes of the work in hand it was not necessary to observe individual particles, nor in the

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* Paper presented at the Newcastle-upon-Tyne Conference of the Institute of British Foundrymen. The Authors are respectively Development and Foundry Director, K. & L. Steelfounders & Engineers, Limited, Letchworth, and H.M. Engineering Inspector of Factories, Factory Department, Ministry of Labour and National Service.

† Mr. W. B. Lawrie.

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present state of dust-control technique was it necessary to observe the smallest possible size ranges. In fact, as opposed to the observation of single particles, what was desired was the observation of large numbers of moving particles in order to ascertain the main direction of movement of a dust cloud. It was decided, therefore, to use the Tyndall beam and observe it macroscopically. It was clearly recognised that in most dressing shops the dust cloud would show a wide range of particle sizes so that in any cloud there would be many particles above the wave length of light, as well as many below this size. It was evident, therefore, that diffracted light from small particles would be masked by the stronger reflected light from the larger particles. This was not considered to be dis-

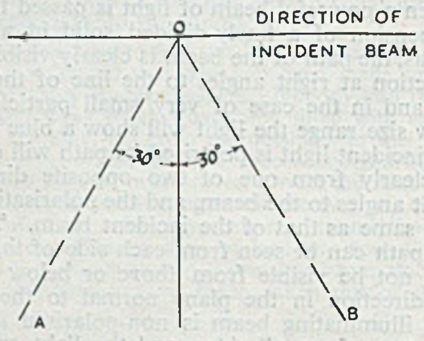

FIG. 5.—*Arrangement of Lighting Beam and Photography Angle. Most Photographs were taken within the Angle AOB.*

advantageous because information was required on the movement of all sizes within the respirable range. At the same time if larger particles were absent the diffracted light from the smaller ones would become evident.

From the outset it was obvious that the dust clouds generated were easily observable in the unpolarised beams of ordinary spot lights used by photographers in cinematograph work. This was true even though these beams showed 3 deg. of divergence, and the lamps were placed at relatively large distances from the point of observation to avoid the effects of convection currents caused by the heat of the lamps themselves. Attempts were then made to photograph the effects observed, and although many smaller eddies seen in dust clouds have not yet been photographed, sufficient work has been done to indicate certain conclusions. Because the question of dust control is of some importance in foundries it was decided to publish the work without further refinements so that engineers and foundrymen who might be interested could have access to all the available information.

Cinematography

For the purposes of record and comparison, a film was made to show the movement of dust clouds as they leave the point of origin. Many variations in photographic technique were tried because the work was of an exploratory nature. In general, the dust cloud was illuminated by a beam and photographed at right angles to the direction of the incident light. The cameras were, however, moved about to obtain the best photograph in each set of circumstances. This resulted in some exposures being made from positions which were not on a line normal to the incident beam. In these cases the angle between the line of observation and the normal to the beam did not usually exceed 30 deg., although photographs were taken both from the side of the normal nearest to the direction of incidence and also from the side nearest to the exit direction of the illuminating beam.

It will be seen, therefore, that most photographs were taken from positions within the angle A O B in Fig. 5. Some difficulty was experienced in certain cases with glare in the camera, when using positions on the side of the normal remote from the direction of incidence. In every case, the cameras were placed in approximately the same horizontal plane as the point in space on which they were focused. The first photographs were taken at 48 frames per second, using two 2,000 watt lamps and one 5,000 watt lamp. It was later found possible to dispense with the 5,000 watt lamp and still photograph at 48 frames per second. This resulted in a slow-motion picture, which was made because it was thought that more information could be derived from such a picture than from a normal-speed film. At a later stage in the work the slow-motion method was discarded, because the additional information obtained was considered to be insufficient to warrant a technique which imposed certain

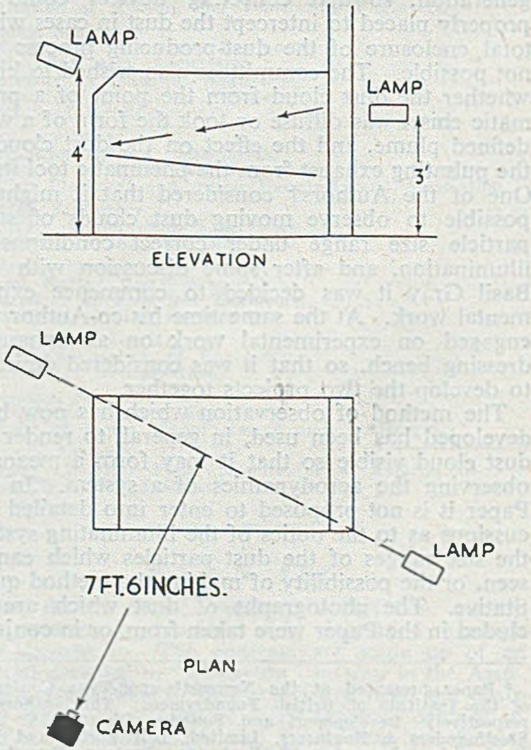

FIG. 6.—*Illuminating System Applied to the "K & L" Fettling Bench.*

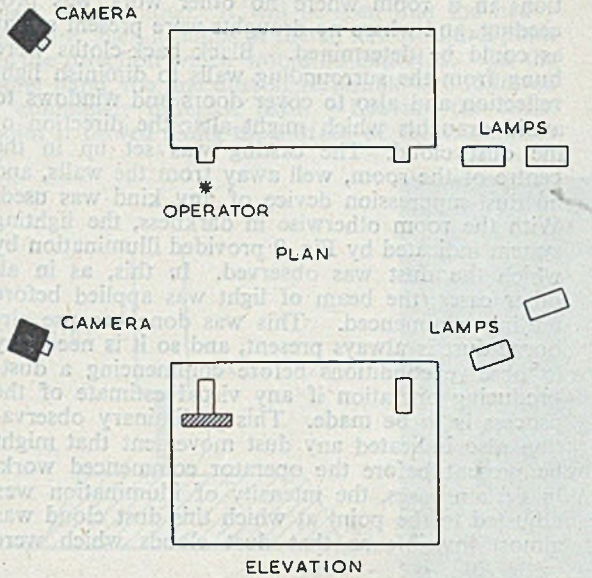

FIG. 7.—*Illuminating System Applied to Photography using the Floor-stand Grinder.*

photographic difficulties. Nevertheless, should it prove necessary at a later stage these difficulties can be surmounted.

The first photographs were taken with a Bell Howell Eyemo 71Q camera driven by a 12-v. d.c. motor. Eyemo camera was fitted with Cooke, speed-Panchro unbloomed lenses and the film was 35 mm. Kodak plus-x panchromatic stock. In the earliest experiments the camera was fitted with a 2 in. lens used at *F*.4.5, *F*.5.6, and *F*.8 at distances varying from 4 ft. to 10 ft. with lighting of 5,000 watts, 7,000 watts and 9,000 watts. A second series was run with a 3 in. lens at *F*.3.5, *F*.4.5, and *F*.5.6, at distances of 6 ft. to 8 ft. with lights of 4,000 watts and 9,000 watts.

Lighting

Work was commenced on castings lying on a flat-topped block so that there would be no vertical projections to obstruct vision or produce glare. The

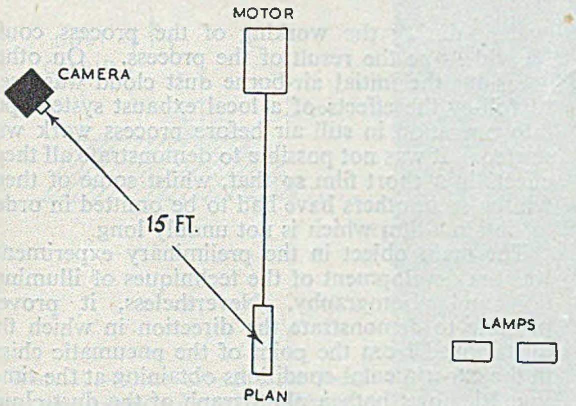

FIG. 8.—*System of Illumination used for Photographs of Swing-frame Grinder Operation.*

lighting was provided by one Mole Richardson Solar spot lamp, type 414 of 5,000 watts and two Mole Richardson 2,000-watt Junior Solar spot lamps, type 410. In order to avoid extraneous light, the work was done at night with the room lights extinguished, so that all the illumination was provided by the spot lights. Black back-cloths were used in certain cases to reduce the effects of reflection from light-coloured or glossy surfaces. The 5,000-watt lamp was placed 4 ft. from the casting at a height of 3 ft. above the floor so that the beam was horizontal across the top face of the casting which was being fettled. The first 2,000-watt lamp was placed behind this 5,000-watt lamp with its front lens 2 ft. 2 ins. behind the front lens of the larger lamp. This second lamp was 5 ft. above floor level, and the beam was directed downwards so that it crossed the beam of the first lamp just at the point where the dust cloud was generated. The third lamp was another 2,000-watt lamp which was placed behind the other two with its front lens 2 ft. 5 ins. behind the front lens of the second lamp. This third lamp was 7 ft. above floor level and its beam was again directed downwards so that it intersected the beams of the other two lights at the point of origin of the dust. Each lamp gave a beam with 3 deg. of divergence which was not altogether desirable, and a parallel or converging beam would have been better.

Further Experience

With the experience thus gained, work was commenced on dressing benches and grinding machines

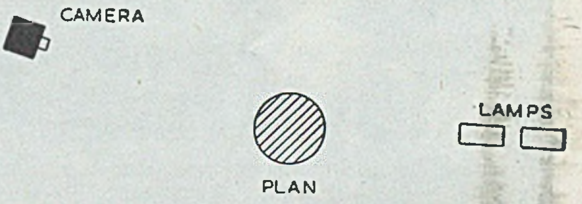

FIG. 9.—*Illuminating System Applied for the Photography of Pneumatic Chisels and Portable Abrasive Wheels—No Local Exhaust Ventilation.*

fitted with dust-suppression systems. Here the problem presented by glare became more difficult as the light was reflected from the various parts of the machines, and in the case of the benches it proved desirable to paint them with a black matt paint, before photographing.

It was decided to use the Eyemo camera with Kodak plus-x panchromatic stock as before, and illuminate with the two 2,000-watt lamps. These were placed at each end of the bench, opposed to each other with the camera either normal to the line of the beams, or within the 60 deg. shown by angle A O B in Fig. 5. In the first run the 2 in. lens was used at *F*.3.5 and *F*.4.5 at distances up to 8 ft. from the dust cloud being photographed, and the film was exposed at 48 frames per second. All subsequent work on the exhausted dressing benches was done with the Eyemo camera, using the 2 in. lens, normally stopped down to *F*.2.8 and

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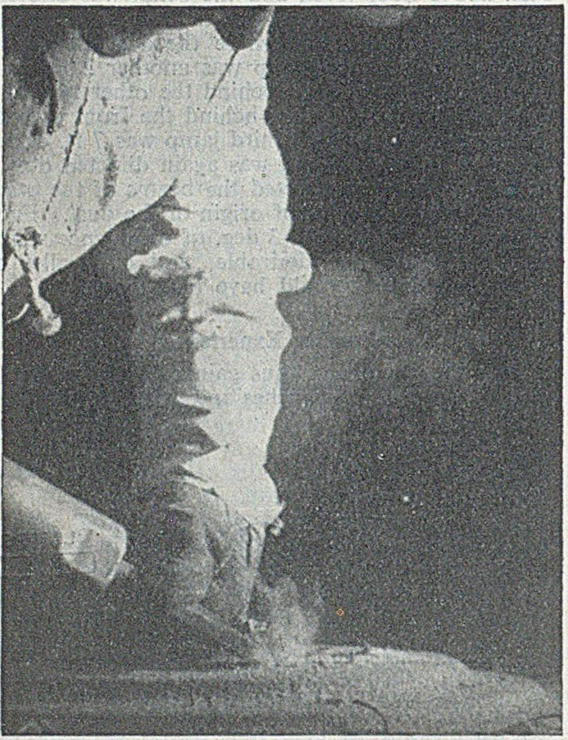
taken at 24 frames per second. A typical layout of lighting and camera is shown in Fig. 6.

For the floor-stand grinder photographs, the lights were stacked one above the other at heights of 5 ft. and 6 ft. respectively, the beam of the higher lamp being directed downwards to intersect the beam of of the lower lamp at the point where the casting is applied to the wheel. The machine was fitted with two wheels, and owing to the reflection from the machine itself the camera had to be placed on the side remote from the operator, and focused along a line at an acute angle to the line of the incident light. To avoid glare from the illuminating lamps, the camera was taken 18 ft. from the point of



origin of the dust, and placed in the shadow of a building column. This layout is shown in Fig. 7.

The swing-frame grinders ewere photographed with the lamps and camera in similar positions, a typical layout being given in Fig. 8. The exposed negatives were given normal film laboratory processing (11 minutes in D76 at 68 deg. F.), and from the resultant negatives 35 mm. positive and 16 mm. reduction prints were made. The illustrations in the Paper were taken directly from the ciné film negative.

Discussion of Results

Pneumatic Chisel

The pneumatic chisel was applied to the flat horizontal surface of a casting in order to have the simplest possible case for the early work. The experiments were conducted in laboratory conditions in a room where no other work was proceeding, and where no draughts were present so far as could be determined. Black back-cloths were hung from the surrounding walls to diminish light reflection and also to cover doors and windows to avoid draughts which might alter the direction of the dust cloud. The casting was set up in the centre of the room, well away from the walls, and no dust-suppression device of any kind was used. With the room otherwise in darkness, the lighting system indicated by Fig. 9 provided illumination by which the dust was observed. In this, as in all other cases, the beam of light was applied before fettling commenced. This was done because air-borne dust is always present, and so it is necessary to observe conditions before commencing a dust-producing operation if any visual estimate of the process is to be made. This preliminary observation also indicated any dust movement that might be present before the operator commenced work. In certain cases, the intensity of illumination was adjusted to the point at which this dust cloud was almost invisible so that dust clouds which were

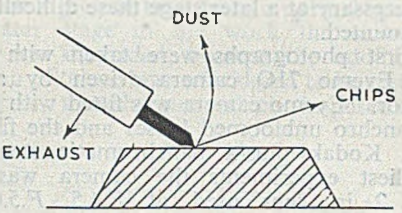
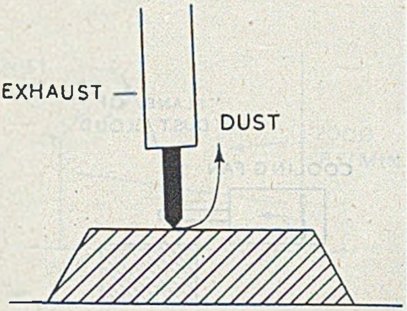


Fig. 10.—*Photograph of Dust Cloud arising from Pneumatic Chisel Operation and Diagram Illustrating the Movement Obtained; no Exhaust Ventilation in use.*

evident during the working of the process could be said to be the result of the process. On other occasions the initial air-borne dust cloud was used to follow the effects of a local exhaust system put into operation in still air before process work was started. It was not possible to demonstrate all these effects in a short film so that, whilst some of them will be seen, others have had to be omitted in order to obtain a film which is not unduly long.

The main object in the preliminary experiments was the development of the techniques of illumination and photography. Nevertheless, it proved possible to demonstrate the direction in which the dust moved from the point of the pneumatic chisel in the experimental conditions obtaining at the time. Fig. 10 shows both a photograph of the dust cloud which was taken in the circumstances described, and a line drawing indicating the direction of movement of the cloud. It will be seen that the heavy particles, such as chips of metal, left the chisel point in the direction which would be expected. On the other hand, the fine dust of respirable size followed a completely different path. Leaving the chisel point it flowed along the surface of the casting for a short distance—usually not more than 6 in.—and then turned upwards to rise and move in towards the chisel. From here it followed the line of the chisel and curled up around the arm of the operator, rising to his face.

The direction of the exhaust from the pneumatic tool is indicated in the line sketch (Fig. 10). When the chisel started cutting, the exhaust was blown down towards the floor, in such a direction that it was not impinging on the casting. As the tool reached the end of its cut it had moved across the surface of the casting, so that the exhaust was impinging, to some extent, on the edge of the casting remote from where the chisel was cutting. It was anticipated that this change would give rise to different conditions, and that in consequence the movement of the dust cloud would vary as the chisel moved over the surface of the casting. This did not prove to be the case. In view of this result the cutting chisel was replaced by a blunt-nosed



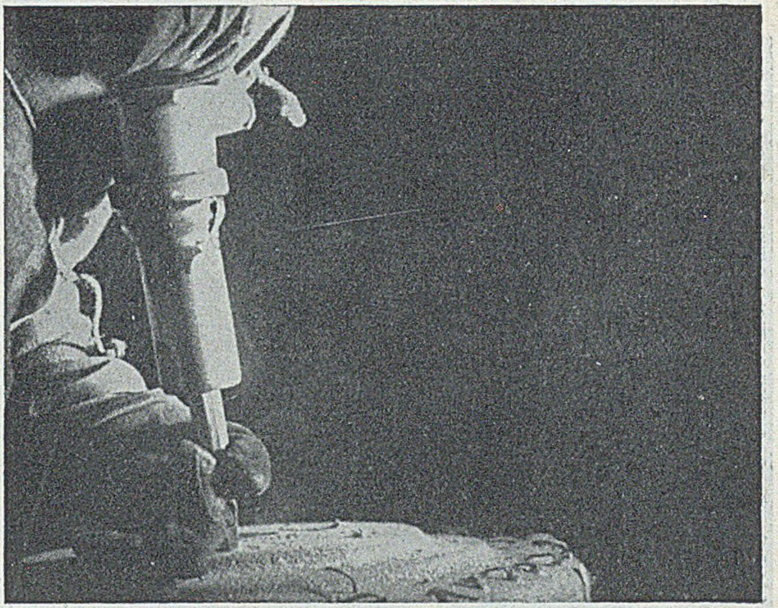
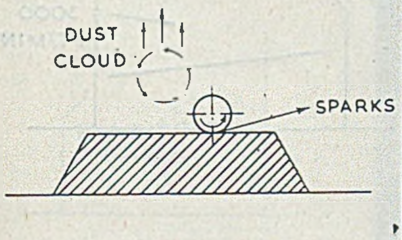


FIG. 11.—*Dust-cloud Photograph and Movement Diagram for Blunt-nosed Pneumatic Chisel; no Exhaust Ventilation.*



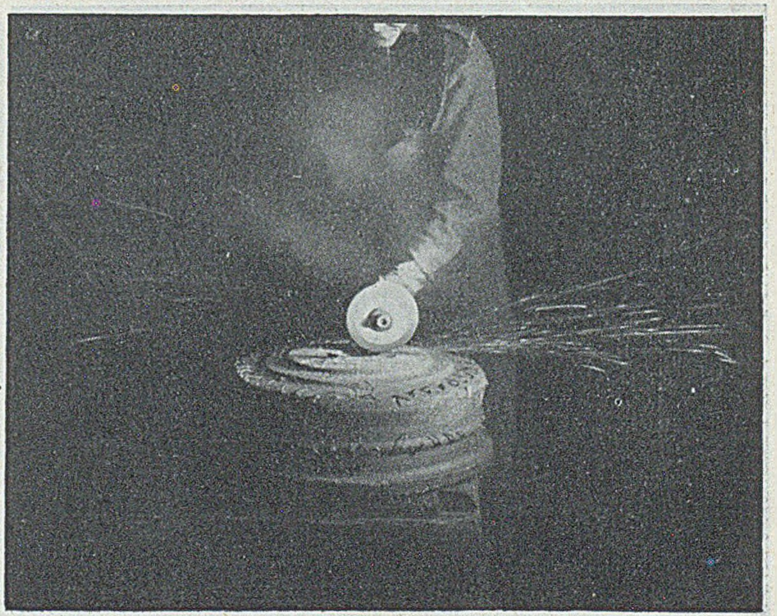


FIG. 12.—*Dust Cloud from Pneumatic-drive Portable Abrasive Wheel; no Exhaust Ventilation in use.*

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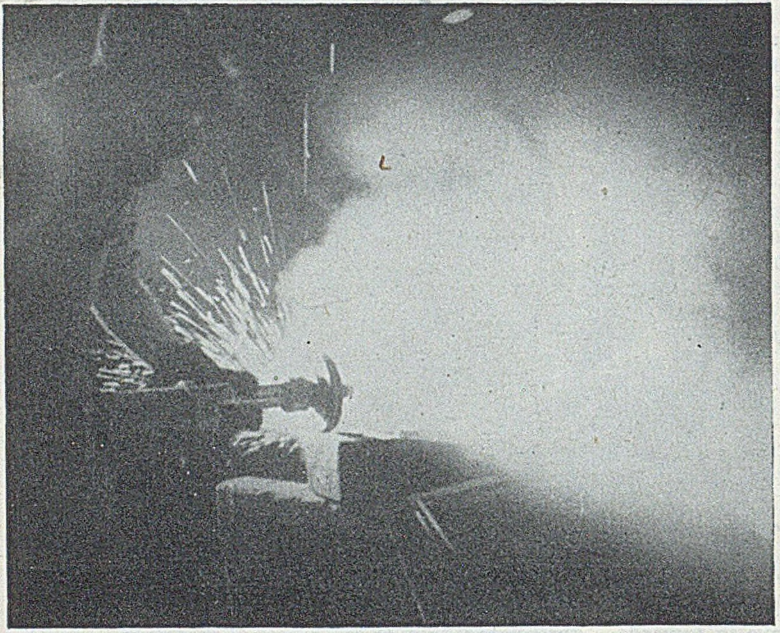
chisel which was applied vertically to the casting and worked across the surface. This resulted in the exhaust being emitted in a horizontal direction, but the path taken by the dust cloud was essentially unchanged, as will be seen from Fig. 11. Many observations were made on this point, but no alteration in the direction of working, or the line of the exhaust, produced any noticeable result on the locus of the dust cloud, which remained throughout, as shown in Figs. 10 and 11. It seems, therefore, that in the conditions under which these experiments were done, it would be wrong to place a small portable hood, as has been suggested, in front of the chisel point, unless it were sufficiently close to collect the dust before it commenced to rise. The results also suggest that, when using a pneumatic chisel on a horizontal flat surface, in the absence of extraneous air currents, the dresser may be breathing in the vicinity of a fairly-concentrated dust cloud which is rising as a definite stream from the chisel point. This may bear some relation to the medical observation that dressers appear to suffer more from silicosis than other men working in the same shop.



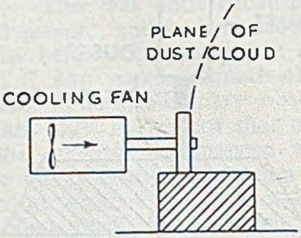
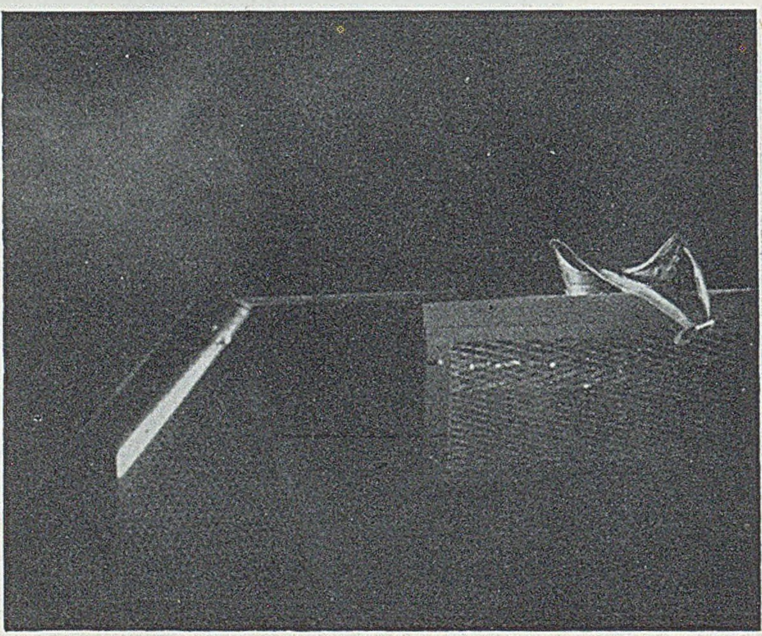


FIG. 13.—*Dust Cloud and Movement Diagram from Electric Portable Abrasive Wheel; no Exhaust Ventilation.*



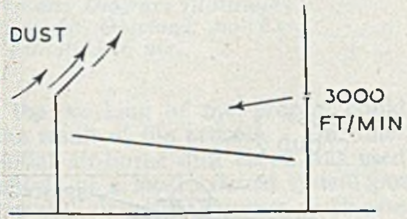


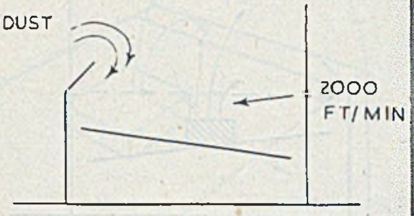
FIG. 14.—*"K & L" Fettling Bench; Turbulence from the Air Jet is ejecting Dust from the Exhaust Hood.*

Portable Abrasive Wheel

After the completion of a series of observations on the pneumatic chisel, the corresponding surface of a similar casting was ground by means of a portable abrasive wheel. All other conditions remained unchanged, and in an effort to attain the simplest possible dust movements the wheel was used without its guard. The wheel, which was driven from the compressed-air line, was a 6-in. wheel with a peripheral speed of 4,000 ft. per min. when working.

It is well known that a rotating abrasive wheel has a definite fan effect, so that it was anticipated that the movement of the dust would be different from that given by a pneumatic chisel. This proved to be the case, the only marked similarity being the fact that the heavier particles, *i.e.*, the sparks, took a well-defined path which was quite different from that taken by the smaller dust particles of respirable size. From this observation it became apparent that any collecting hood which is placed to receive the sparks cannot be expected to collect the finer dust.

The dust was seen to move round with the wheel, until it assumed a position above the horizontal axis and behind the vertical axis. Here it accumulated and in some of the films appeared to circulate in a



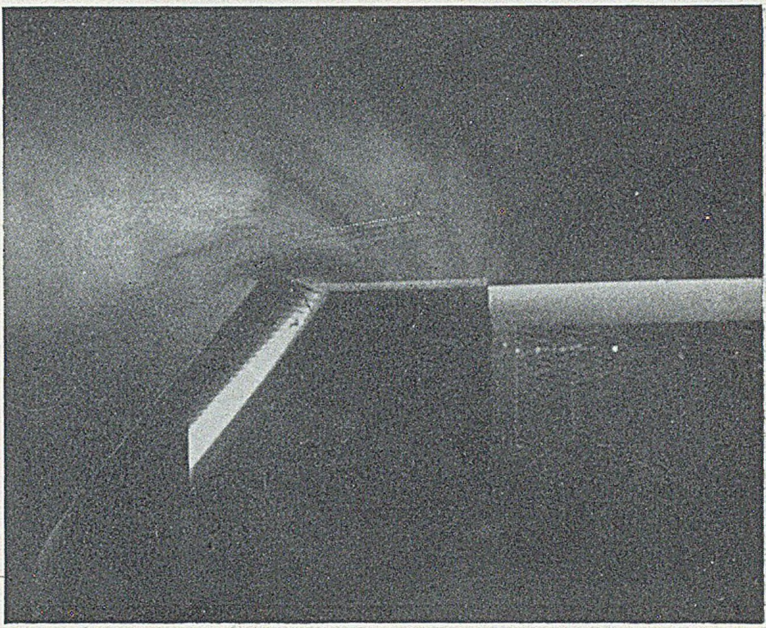
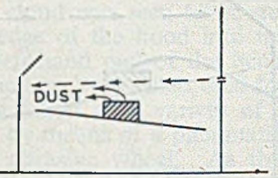


FIG. 15.—*Correct Adjustment of the Air Jet of "K & L" Fettling Bench; Dust flows into the Exhaust Hood.*



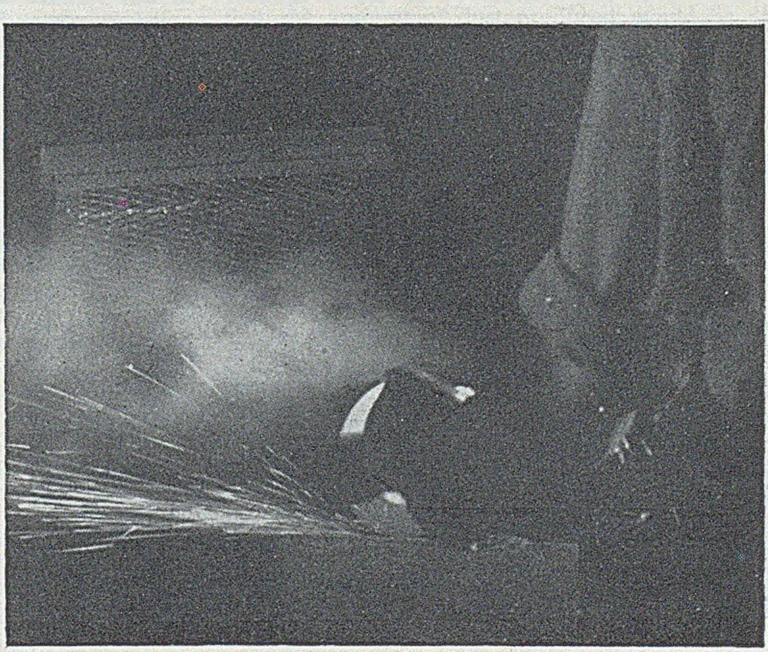


FIG. 16.—*"K & L" Fettling Bench; Heavy Dust Cloud under Control.*

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vortex from which a cloud diffused upwards past the face of the grinder. Fig. 12 shows the effects which were photographed. Once again, movement of the wheel to alter the direction of the exhaust produced no noticeable effect on the distribution of dust in the atmosphere.

In view of the interest of the committees in the possibility of erratic dust distribution due to the eddies caused by exhaust ports, the work was repeated on an electrically-driven portable abrasive wheel used without guard. The motor driving this wheel was provided with a cooling fan producing a current of air which flowed through the motor to be discharged against the side of the wheel. The wheel itself was 6 in. dia., with a peripheral speed of 4,800 ft. per min. when working.

The observed dust distribution is shown in Fig. 13. The dust cloud behaved very similarly to that given by the compressed-air wheel (Fig. 12), apart from the fact that the vertical plane of the cloud was displaced slightly, away from the operator in the direction indicated by the dotted line in Fig. 13. It is possible that this phenomenon may indicate some line of approach to the problem of dust control at abrasive wheels.

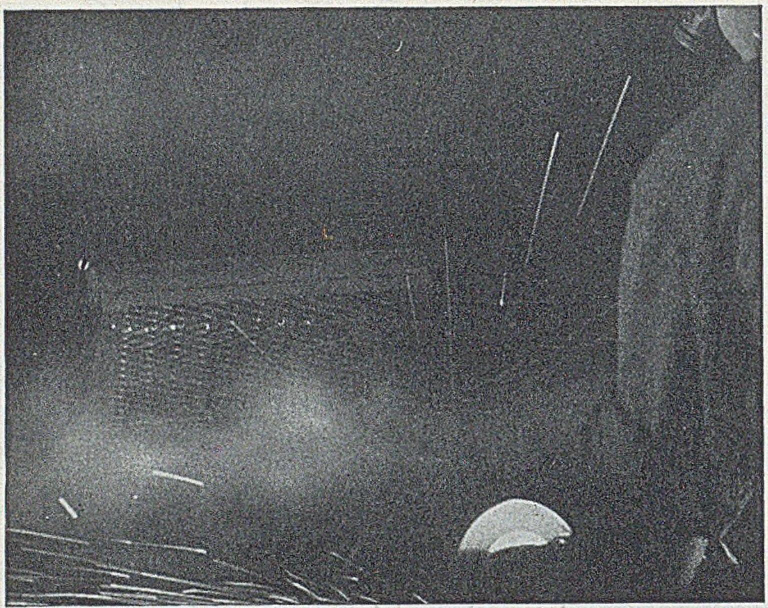
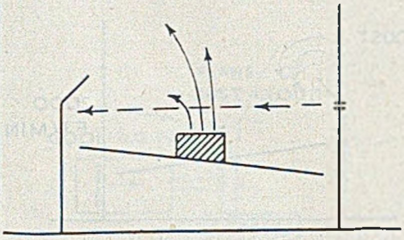



FIG. 17.—*Photograph and Diagram of "K & L" Fettling Bench showing how Part of a Heavy Dust Cloud has burst through the Horizontal Air Jet.*

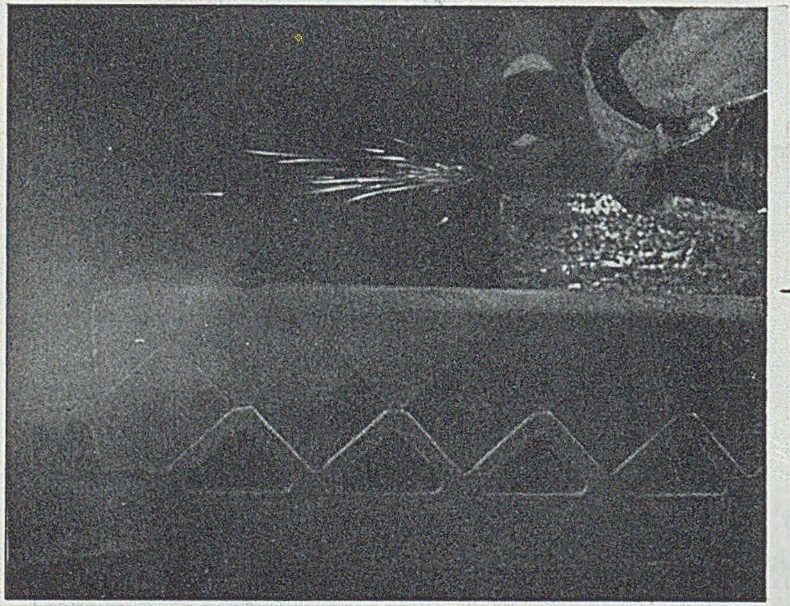
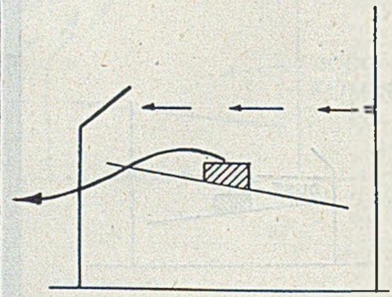



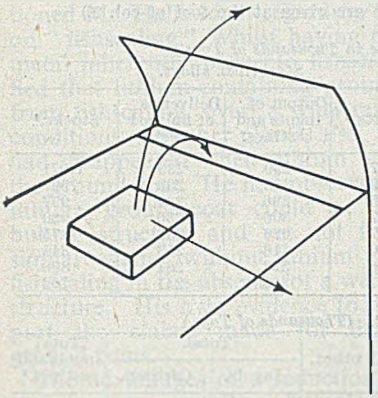
FIG. 18.—*Spillage of Dust at the Front of the "K & L" Fettling Bench.*

"K & L" Fettling Bench

The "K & L" fettling bench described in the first section of this Paper was tested in a room in which no other work was proceeding, and in a position where there was no noticeable draught which might influence the dust movement. In the first instance, the air jet and exhaust system was operated without any fettling on the bench. The resulting air streams at the bench were observed by noticing the movement of the air-borne dust normally present in any room. It was found that, when the jet left the slot in the right-hand side of the bench with a velocity of 3,000 ft. per min., appreciable turbulence developed at the exhaust end of the bench. This resulted in the dust stream being forced upwards, away from the exhaust hood and into the general atmosphere of the room (see Fig. 14). In consequence, the velocity of the jet at its point of emergence into the atmosphere was progressively reduced. The direction of the dust streams was reversed when the velocity had been reduced to 2,000 ft. per min. In these conditions the atmospheric dust cloud was seen to be quietly curving over the top edge of the hood into the exhaust provided at the left-hand end of the bench (see Fig. 15).

The bench was then used for fettling, photographs being taken of a variety of castings being dressed both by means of a pneumatic chisel and by a portable abrasive wheel. As the bench was designed for use with compressed-air tools, both chisel and wheel were driven by compressed air. Many of the observed and recorded effects can be seen in the film, and it will, therefore, suffice to indicate here certain broad features.

In general, the dust was seen to leave its point of origin and meet the horizontal air jet which immediately turned it into the exhaust hood which removed it from the room atmosphere. This condition can be seen from Fig. 16. On the other hand, with deep castings when the dresser was working with the chisel point just below the air jet, large puffs of dust, suddenly produced, burst through the jet. In some cases these were entrained by the jet and taken into the hood, but, when the amount of dust was excessive, some was dissipated into the atmosphere. Fig. 17 indicates these conditions. It was also noticed that with heavy dust clouds there was a tendency for part of the dust to spill over the front edge of the bench, at the left-hand end, where it diffused into the atmosphere as shown in Fig. 18. It should be noted that heavily-burnt-on castings were fettled on the bench to produce maximum dust clouds. In normal practice, all castings would be shotblasted before dressing, so that the amount of dust produced would be considerably less. Many of the grinding operations were performed on particularly rusty castings with the deliberate intention of obtaining dust clouds greatly in excess of anything that would appear in ordinary work. The effects were, therefore, accentuated in certain cases, and the dust extraction system was grossly overloaded.



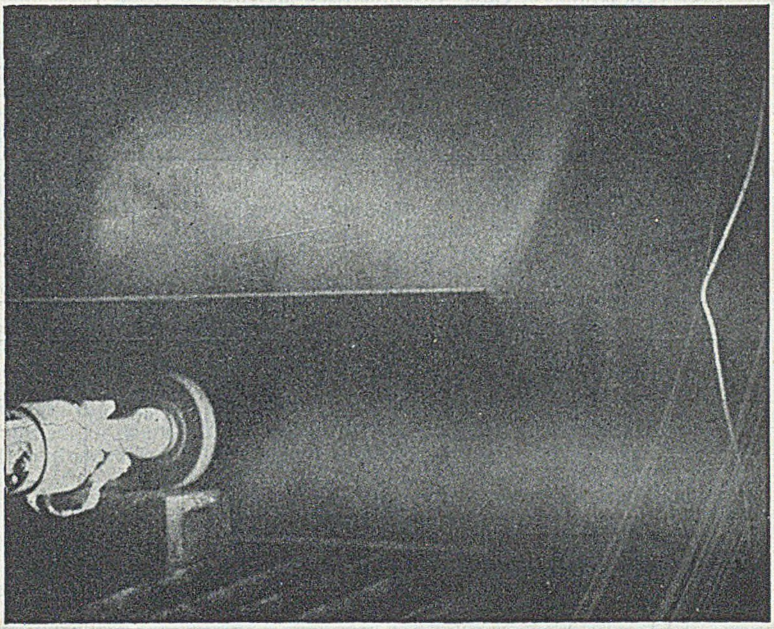


FIG. 19.—*Bench fitted with Down-draught Exhaust only; Dust escapes over the top of the Hood and at the Bench End; Local Exhaust is fitted and Operating.*

Bench Fitted with Down-draught Exhaust Only

A second bench, fitted with exhaust ventilation only, was also tested, and some of the tests were made in the presence of the excessive dust clouds described above. No attempt was made to develop this bench but the general conclusion drawn, as it stood, was that the exhaust ventilation alone was insufficient to give the dust clouds a sufficiently-marked directional tendency, and that there was in consequence more spillage of dust over the top of the hood and at each end of the bench. This is indicated in Fig. 19 and can be seen in the film.

(To be continued)

REFERENCES

[3] The Dust in Steel Foundries Committee—Factory Dept., Ministry of Labour and National Service. The Sub-Committee for Practical Work of the Industrial Health Committee—The British Steel Founders' Association.

[4] Imm = 1,000 μ = 1,000,000 $\mu\mu$.

Pig-iron and Steel Production

Statistical Summary of May Returns

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

(References applicable are given at the foot of col. 2.)

TABLE I.—*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.[2]	Output of ingots and castings.	Deliveries of finished steel.	Stocks.[3]
1949	258	169	199	183	188	17	299	233	1,071
1950	249	174	197	185	197	9	313	239	997
1950—December	249	171	198	188	175	5	296	234	997
1951—January[1]	258	163	200	183	183	7	306	236	920
February	262	164	202	186	193	7	326	252	875
March	267	167	204	184	187	6	318	253	848
April	279	149	201	179	195	6	323	261	800
May[1]	287	159	204	182	180	7	305	241	762

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

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.[1]
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants and Essex	—	3.1	11.6 (basic)	1.5	0.2	15.7	0.7	16.4
Lancashire (excl. N.W. Coast), Denbigh, Flints., and Cheshire; Yorkshire (excl. N.E. Coast and Sheffield)	1.3	18.6	—	1.7	0.5	21.1	1.0	22.1
Lincolnshire	—	27.9	—	—	0.1	27.9	0.1	28.0
North-East Coast	1.6	60.4	—	1.0	0.4	61.8	1.6	63.4
Scotland	4.6	37.2	—	1.2	0.8	41.9	1.9	43.8
Staffs., Shrops., Worcs. and Warwick	—	15.7	—	0.8	0.7	15.8	1.4	17.2
S. Wales and Monmouthshire	6.8	53.9	5.4 (basic)	0.8	0.1	66.6	0.4	67.0
Sheffield (incl. small quantity in Manchester)	7.2	23.7	—	8.0	0.6	37.6	1.9	39.5
North-West Coast	0.3	2.5	4.4 (acid)	0.4	0.1	7.5	0.2	7.7
Total	21.8	243.0	21.4	15.4	3.5	295.9	9.2	305.1
April, 1951	27.8	252.6	21.4	17.0	3.7	312.7	9.8	322.5
May, 1950[2]	25.5	255.0	21.3	14.1	3.3	310.7	8.5	319.2

TABLE III.—*Weekly Average Deliveries of Finished Steel. (Thousands of Tons.)*

Product.	1949.	1950.	1950.	1951.	
			May.[1]	April.	May.[1]
Non-alloy steel:					
Ingots, blooms, billets and slabs[4]	4.5	3.6	3.4	4.4	4.0
Heavy rails, sleepers, etc.	9.8	11.3	11.6	10.4	11.1
Plates ⅛ in. thick and over	39.2	40.0	41.5	43.8	41.5
Other heavy prod.	37.5	40.2	40.9	43.4	41.6
Light rolled prod.	46.4	47.6	47.2	52.2	47.2
Hot rolled strip	17.1	19.4	20.8	20.5	18.6
Wire rods	15.4	16.3	15.9	19.0	16.6
Cold-rolled strip	4.9	5.5	5.5	6.0	5.6
Bright steel bars	5.6	6.2	5.7	7.7	6.6
Sheets, coated and uncoated	27.6	30.5	29.6	35.3	32.3
Tin, terne and blackplate	13.7	14.3	14.2	14.4	13.7
Tubes, pipes and fittings	18.5	20.0	19.5	24.1	20.5
Mild wire	12.0	12.6	12.0	12.8	11.8
Hard wire	3.2	3.5	3.4	4.2	3.4
Tyres, wheels and axles	4.1	3.5	3.3	4.1	3.1
Steel forgings (excl. drop forgings)	2.4	2.2	2.2	2.6	2.2
Steel castings	3.6	3.5	3.4	3.6	3.6
Total	265.5	280.2	280.1	308.5	283.4
Alloy steel	10.4	10.6	10.8	12.8	11.3
Total deliveries from U.K. prod.[5]	275.9	290.8	290.9	321.3	294.7
Add imported finished steel	9.5	3.8	2.4	4.2	3.0
	285.4	294.6	293.3	325.5	297.7
Deduct intra-industry conversion[6]	52.8	55.6	55.7	64.4	57.0
Total net deliveries	232.6	239.0	237.6	261.1	240.7

TABLE IV.—*Weekly Average Production of Pig-iron and Ferro-alloys. (Thousands of Tons.)*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total
Derby, Leics., Notts., Northants and Essex	24	0.1	16.3	21.8	1.7	—	40.0
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (incl. Sheffield, excl. N.E. Coast)	6	—	7.6	—	—	0.8	8.4
Lincolnshire	14	—	24.6	—	—	—	24.6
North-East Coast	23	7.4	34.4	0.2	—	1.4	43.4
Scotland	9	0.7	11.7	3.1	—	—	15.5
Staffs., Shrops., Worcs. and Warwick	9		9.3	1.5	—	—	10.8
S. Wales and Monmouthshire	7	3.3	21.9	—	—	—	25.2
North-West Coast	7	12.8	—	0.1	—	1.5	14.4
Total	99	24.3	125.8	26.7	1.7	3.7	182.3[7]
April, 1951	99	25.9	122.7	24.6	1.9	3.4	178.5
May, 1950[2]	98	28.0	125.9	27.6	1.3	2.6	185.5

[1] Five weeks.
[2] Weekly average of calendar month.
[3] Stocks at the end of the years and months shown.
[4] Other than for conversion into any form of finished steel listed above.
[5] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
[6] Material for conversion into other products also listed in this table
[7] Including 100 tons direct castings.

Lithium in Vitreous Enamels*

Discussion of Mr. S. Hallsworth's Paper

DR. G. T. O. MARTIN (Radiation, Limited) questioned Mr. Hallsworth regarding the effect of lithium on "fishscaling." Whilst having no experience with metal inherently prone to fishscaling, he was satisfied that lithium-containing ground-coats were free from fishscaling over a wide range of processing conditions. In other plants, also, fishscaling troubles had disappeared when lithium was introduced into the ground-coat. He had observed instances where a lithium ground-coat could be almost free from bubble structure and yet not fishscale, whereas a similar enamel without lithium was very subject to fishscaling in the absence of a well-developed bubble structure. His own evidence to date tended to support the claims made for lithium in sheet-iron ground-coats.

The advantages of a reduction in firing temperature were universally acknowledged, but the relatively small decreases mentioned in the Paper were somewhat disappointing. It was often possible to obtain such decreases without the use of such an expensive material as lithium.

Effect on Colour

It appeared to be general experience that lithium in cover-coat enamels gave a creamy shade of white, but the claim for increased gloss was new; his own experience suggested a slight decrease in gloss. An increase of gloss, if secured, would be useful in obtaining cast-iron enamels of gloss equal to the modern titanium enamels for sheet-iron. He wondered whether Mr. Hallsworth had collected subsequently any information on the effect of lithium on coloured enamels. It had been found that lithium reduced the stability of many of the present colouring oxides, for example, the widely used greys for cast iron.

MR. HALLSWORTH said he referred in his Paper to experiments on steel which was definitely prone to fishscaling. He had never found lithium enamels to fishscale on non-fishscaling steel, and experience was that it had little or no effect on fishscaling tendencies inherent in the steel. If fishscaling could not be prevented with normal ground coats, he thought that lithium-bearing enamels would also show fishscaling.

Replying to the effect of lithium additions on the colour, he suggested that a colour expert might wish to make a contribution to this. Regarding gloss, it was found that, where the lithium had been smelted into the frit, an improvement in the gloss was generally observed and, where the lithium was added as a mill addition, there was generally reduction in gloss. He had no experience of decrease in gloss in any enamel when the lithium had been used as a smelter addition.

* Paper presented at the Annual Conference of the Institute of Vitreous Enamellers and printed in the JOURNAL, April 5, 1951.

MR. W. G. BALL said a stable colour was produced when the colouring oxide retained a completely separate identity, being only in suspension in the frit, whether it was an "ordinary" enamel or contained titanium or lithium. The higher the firing temperature the more fluid the enamel became, and the greater the possibility of combination between the frit and the colouring oxide, particularly if the frit was not in perfect balance. The addition of lithium to titanium frits increased the fluidity, and so increased the tendency to variations of colour, so that in the case of lithium/titanium frits the possibility of error was considerably extended and quite a number of colours, so far as he knew, still could not be produced in this type of enamel in a sufficiently stable form for practical use. In the case of enamels containing lithium but not titanium as an opacifying agent, he considered it possible to produce oxides which would be reasonably stable in most colours. Generally, he did not think that lithium enamels, apart from lithium/titanium enamels, were used commercially on a large scale at present.

Possible Temperature Reduction

MR. HALLSWORTH, on this subject, said the variation in coloured titanium enamels depended mainly on the colour of the frit itself during subsequent fusing. If a lithium addition resulted in a change of colour in a white enamel, then variations would be experienced in a coloured enamel produced from the same frit. He did not think it was the oxide which changed colour, but rather the enamel itself. The advantages of lithium were two-fold, the reduction of fusing temperature and the increase in fluidity. Some enamellers were using lithium enamels to obtain the benefit of increased fluidity and were fusing at the same temperature as non-lithium enamels. This really meant that they were over-firing the enamel and with titanium enamels, where over-firing tended to show slight yellowing of the white, variations would be shown in the coloured enamels. Where the correct fusing temperature was used, little or no difference should be experienced with coloured enamels due to the use of lithium.

MR. W. A. MURDOCH (Ferro Enamels, Limited) supported Mr. Hallsworth on this matter.

With regard to the amount of lithium carbonate, Mr. Hallsworth put this at a maximum of $1\frac{1}{2}$ per cent.; this was probably true, but not the complete story. There were some enamels where there was no appreciable difference between the effect of adding $\frac{1}{2}$, 1, or $1\frac{1}{2}$ per cent. of lithium carbonate, while in other cases (and this must depend upon the actual formula of the enamel) there was a marked difference between a 1 and a $1\frac{1}{2}$ per cent. addition. Probably it was true to say that, generally speaking, the addition of 1 per cent. of lithium carbonate would give the maximum advantage.

Lithium in Vitreous Enamels

With regard to adherence, it was his opinion that if this was good in the first instance, it would not be increased by the use of lithium, but if the adherence of the enamel was only fair, then the addition of lithium did seem to assist. In the other extreme, if the adherence was poor before the addition of lithium, there was little or no improvement. He could not say he had noticed any real effect upon the gloss by the addition of lithium within the economical working limits. This, again, he thought, would depend more upon the primary formula of the enamel before the addition of the lithium compounds.

MR. HALLSWORTH replied that the figure of 1½ per cent. of lithium carbonate was an arbitrary figure in several types of enamel to show the general effect of lithium additions on various frits and he accepted Mr. Murdoch's statement that 1 per cent. and in some cases less would be as good as 1½ per cent. in certain mixtures. The study of enamels was very complicated and maximum decrease in temperature with minimum additions of lithium were no doubt affected by the composition of the enamel itself. He agreed that the addition of lithium appeared to have a beneficial effect on adherence, although this could not be proved by mechanical means and was, therefore, not included in the Paper.

Wetting

MR. A. J. BIDDULPH (Ferro Enamels Limited) said there did not appear to be any effect of lithium as far as low heat-resistance was concerned, or variation of colour. The possibility of thinner coatings was mentioned; it had been experienced with lithium cover-coat enamels that thinner coats were more easily obtained in production. With the normal titanium cover-coats, one could get sufficient reflectance at an application of 20 gm. per sq. ft., but, in practice, this thickness was not easy to attain on continuous coatings because of the possibility of very fine tearing. On the lithium/titanium type of cover-coats the enamel wetted the surface more readily and there was less tendency to fine tearing. Thus thin coats could be applied successfully.

It had been said that lithium enamel did not cover rough welding as well as ordinary enamels. This was admitted, but the true reason was that because lithium enamels could be used so thinly, and flowed more readily, the normal build-up of enamel around a rough weld did not occur. When working at six thousandths of an inch total thickness one could not expect to cover abrupt irregularities of surface.

MR. HALLSWORTH agreed with Mr. Biddulph that thinner coatings could be obtained with lithium cover-coat enamels. He thought, however, lithium enamels gave better results over welds by reason of the increased fluidity, but accepted Mr. Biddulph's findings that exceptionally-thin coatings would off-set this advantage.

MR. H. LAITHWAITE (Radiation Limited) felt that by adding lithium to an existing enamel the balance of composition was disturbed. Some of the results obtained might have been achieved by materials other than lithium and it would have been better to replace soda by lithia. Regarding fishscaling, he agreed with Dr. Martin that lithium appeared to have an inhibiting effect on fishscale formation.

Other Advantages

Speaking as one who was enthusiastic about lithium, he felt that neither the Paper nor the discussion had made a very convincing case for its use. No-one had mentioned that the limitations of ordinary self-opacifying titanium enamels—high viscosity and low expansion coefficient—could be overcome by the use of lithium to a degree possible with no other material. Lithium was a new material for the enameller and had come to stay; the amounts necessary were quite small and commercially practicable.

In addition to Mr. Hallsworth's suggestions, he had found it possible, with lithium, to make more durable versions of enamels of existing types, which should be helpful in the general trend towards higher durability. Also, lithium enabled ground- and cover-coat enamels on sheet-iron to be fired at the same temperature; this, in his opinion, would ultimately become universal practice, and at temperatures lower than at present.

MR. HALLSWORTH agreed generally with these comments. It was possible that the use of lithium would minimise the fish-scaling tendency but, with steel which would fish-scale when processed correctly and in conjunction with several different commercial enamels, his experience had been that the use of lithium would not prevent it. Lithium tended to increase the workability of the enamel and thus increased the safety margin.

In pursuing a certain study it was difficult to decide what factors to take into consideration. To replace alkalies with lithium would have incurred more complications than the present study and, therefore it had seemed wise to adopt a procedure to show the effect of lithium additions to existing formulae, using a variety of frits rather than the development of one particular formula. He thought Mr. Laithwaite missed one important point, that although the fusing temperature could be reduced by increasing the alkalies, this would mean a reduction in the value of certain other properties, whereas by the use of lithium the benefit of reduced fusing temperature and increased fluidity could be obtained, without reducing the properties and durability of the finished article.

Consolidation and Future Development

MR. J. H. GRAY (Stewart and Gray Limited) thought the development of lithium-bearing sheet-iron ground-coats to enable fusing temperatures to be reduced by 20 to 30 per cent. was quite an achievement, and at this stage the industry should be content to run these ground-coats to enable the results in production to be studied over a number of years. To endeavour to get thinner coatings at this stage before consolidating experience was wrong, as it may cause confusion regarding the benefits of softer ground-coats. In continuous plants and plants with a single static furnace, to be able to fire ground-coats and cover-coats together was something the industry had been wanting for many years.

In connection with fish-scaling, it was his experience that the low-firing temperature of sheet-iron ground-coats had eliminated this trouble, particularly on heavy-gauge metals, where fish-scaling had been experienced with the harder type of ground coats.

Mr. Hallsworth said one could not be content with present results and improvements must continually take place. The aim of the enamelling industry must be to improve continually the products, thus enabling them to keep their market against competitive finishes.

House Organs

Nickel Bulletin, Vol. 24, No. 5. Published by The Mond Nickel Company, Limited, Sunderland House, Curzon Street, London, W.1.

This issue contains a useful tabulation showing current standard specifications for corrosion and heat-resisting steels containing nickel, as well as abstracts of numerous papers dealing with methods of rapid identification of metals and the sigma phase. Other abstracts of interest describe work on nickel-tungstate catalysts, arc welding of clad steels, the periodic reverse plating of nickel, electrodeposition of nickel-tin alloys and the influence of austenitising temperature on the properties of nickel-alloy steels.

Albion Works Bulletin, Vol. 5, No. 5. Issued by John Harper & Company, Limited, Albion Works, Willenhall, Staffs.

After reading the daily Press, this bulletin comes like a breath of fresh air, as it reports:—The Meehanite figure (for broken castings) is the best since records were taken; absenteeism is running at a record low figure (4.9 per cent.), with one department at 3.9 per cent.; the grey-iron and Meehanite foundries both produced record outputs during the quarter ended on July 1; exports are running at a record figure. Such a record of records may have caused us to write English of low standard, but general emulation throughout industry would kill inflation and put this country back on the map.

The Iron Worker, Summer Issue, 1951. Published by the Lynchburg Foundry Company, Lynchburg, Virginia, U.S.A.

The reviewer has for long been fascinated by the Colonial type of architecture and never remembers seeing a more pleasing example than Thomas Jefferson's home in Virginia. The coloured reproduction on the cover of this issue is part and parcel of the article on "Thomas Jefferson, Homebuilder." There is a long illustrated description of casting machine-tool beds and where an operative is shown to be engaged on a particular job, his name is included in the caption. One, for instance, reads "Garvin Gravely touching up sides of bottom core before setting." It is a nice idea well worth emulation by other house organs. Mr. Max Kuniansky is in the news, as he has been promoted to the position of executive vice-president (managing director) of the company. Finally, there is an interesting article on cast ductile-iron pipes which undoubtedly records remarkable properties.

VOWLES ALUMINIUM FOUNDRY COMPANY are planning extensions to their foundry at Bank Street, West Bromwich.

Obituary

THE DEATH is announced from Sweden of Mr. Gustav Meyersburg, the well-known German foundry metallurgist. He was at one time with the A.E.G. and later was the director of the *Edelguss Verband* (High-duty Iron Association). He left Germany during the Hitler régime.

THE CARDIFF FIRM of Best & Blake, engineers and agents, have lost their senior partner by the death of MR. OSWALD FAIRBROTHER BEST, who established the firm in 1908. Best & Blake act as agents for Allen West & Company, Limited, Simon-Carves, Limited, the Wellman Smith Owen Engineering Corporation Limited, and other companies.

MR. A. W. HEATH, of Moor Hall Park, Sutton Coldfield, died last Friday at the age of 83. He was the third generation to enter the family business of Samuel Heath & Sons, Limited, general brassfounders of which he became chairman and managing director. He was a city magistrate for 25 years.

MR. ANDREW M. HUNTER, who died last week at his home, Ayr, was a grandson of the founder of R. Hunter & Son, Wallacetown Foundry. He and his brother took over the Ayr Foundry in Green Street in 1906, and the firm of A. & J. Hunter, Limited, have continued to carry on business there since. Mr. Hunter was 77 and had been a member of Ayr Town Council from 1920 to 1932.

A PIONEER in the production of shells by means of hydraulically operated lathes, MR. W. LITTLEJOHN PHILIP died on July 20 at the age of 88. He served his apprenticeship with Wm. McKinnon & Company Limited, engineers and ironfounders, etc., of Aberdeen, later becoming managing director of the Mirrlees Watson, Company Limited, and afterwards of Spencer & Company of Melksham, Wilts.

THE DEATH is announced of DR. JOHN THOMAS BATEY at the age of 88. After serving his apprenticeship with R. & W. Hawthorn, Leslie & Company, Limited, Hebburn, he gained further experience at another shipyard before returning to Hawthorn, Leslie & Company in 1901. Six years later he joined the board of that company and in 1921 he became its managing director. Dr. Batey, who was prominent in industrial and technical shipbuilding spheres, was president of the Shipbuilding Employers' Federation in 1927-28. He was also a past-president of the North East Coast Institution of Engineers and Shipbuilders and a vice-president of the Institution of Naval Architects. Dr. Batey retired from R. & W. Hawthorn, Leslie & Company in 1936.

THE DEATH OCCURRED suddenly in London on July 19, following an operation, of MR. SAMUEL ERIC OSBORN, chairman of Samuel Osborn & Company, Limited, steel and tool manufacturers, of Sheffield, and Master Cutler in 1945. He was 59. Educated at Rugby, he became managing director of the family business in 1919 following service in the first world war, and last year succeeded his uncle, the late Mr. Fred M. Osborn, as chairman. He was a son of the late Mr. W. F. Osborn, a former chairman. Mr. S. E. Osborn's election as Master Cutler in 1945 created a family record in the 300-year-old history of the Cutlers' Company of Hallamshire. His father was Master Cutler in 1906, his maternal grandfather, Mr. R. G. Holland, held the office in 1900, and his paternal grandfather, founder of Samuel Osborn & Company, was Master Cutler in 1873. Mr. Osborn, who was a member of the council of the Sheffield Chamber of Commerce, had served as a director of Brayshaw Furnaces & Tools, Limited, Burys & Company, Limited, Osborn Foundry & Engineering Company, Limited, Osborn-Mushet Tools, Limited, and the Titanic Steel Company, Limited.

News in Brief

JOHN ROBSON (SHIPLEY) LIMITED have prepared plans to extend their foundry at Ives Street, Shipley.

STEWART AND LLOYDS LIMITED propose extensions to their Bilston iron and steel works, Staffordshire.

THE REPUBLIC OF IRELAND imported 140 tons of pig-iron, valued at £981, in May, against 2,184 tons (£9,628) in May, 1950.

THE INDUSTRIAL PYROMETER COMPANY, LIMITED, will shortly be moving to a new 5,000 sq. ft. factory in Gooch Street, Birmingham, 5.

AFTER BEING CLOSED since March for repairs, the 60-ft. lock entrance at Tyne Dock, South Shields, has been reopened for traffic.

MATTERSON, LIMITED, Rochdale, have transferred their Midland representation to the Barnol Engineering Company, Limited, of 83, Newhall Street, Birmingham, 3 (telephone, CEN. 2760).

BRITISH INSULATED CALENDER'S CABLES LIMITED last week kept " open house " at their various factories for the reception of the employee's families—a facility which was much appreciated.

SOME DAMAGE WAS DONE to the offices and laboratories of the Low Moor Alloy Steel Works, Limited, Bradford, last Friday, when a 7-lb. tin of magnesium caught fire from a bunsen burner.

THE FINAL DIVIDEND of George Cohen Sons & Company, Limited, is being increased from 12 per cent. to 15 per cent., making 23 per cent., less tax, on the £600,000 ordinary stock for the year to March 31 last, compared with 20 per cent. for the previous year.

THE DIRECTORS of Johnson, Matthey & Company, Limited, precious metal refiners and smelters, etc., of London, E.C.1, announce that they intend to offer the 737,776 ordinary £1 shares to the company's ordinary shareholders and loan stockholders at 58s. a share.

DARWINS, LIMITED, Sheffield steel and tool makers, is returning to the dividend list with a payment of 3 per cent., less tax, on the £514,150 ordinary capital for the year ended March 31 last. The previous payment on the ordinary was the 6 per cent. for 1947-48.

THE COZY STOVE COMPANY, who introduced the first of this type of heating stove in this country, have joined the selling organisation of Radiation Group Sales, Limited, solid fuel division. The Cozy stoves are being produced at the Radiation production centre, Belper, near Derby.

TEAMS covering such industries as machine tools, constructional steelwork, various branches of the food industries, and certain specialised subjects such as inspection methods and production control are to visit the United States under the auspices of the Anglo-American Productivity Council.

A TOTAL of 134 motions on wages, prices, and profits has been submitted for consideration by the Labour Party's annual conference to be held at Scarborough in October, the preliminary agenda for which was published on July 24. Last year's agenda carried only 44 resolutions on these subjects.

The MINISTER OF EDUCATION, said there was no need to worry about the alleged cut in technical college building. There were going to be no cuts in technical college building. There were going to be no cuts except in the sense that the size of the programme would not increase quite so rapidly as they would have liked.

ORDERS FOR African native cooking pots are pouring into a Bonnybridge foundry—the only one in Scotland making them. Pots of cast iron are shipped in big consignments to ports all over Africa. A range of the pots is on view—side by side with the most modern wares—at Bonnybridge industrial exhibition, which opened on July 24.

FOREMEN ACTED AS GUIDES round their departments when 3,000 people, most of them relatives of the 2,000 workers at the 15-acre works of J. & H. McLaren, Limited, agricultural engineers and Diesel engine builders, of Hunslet, Leeds, visited the works on July 21. The first visiting day at the factory was held last year, and it is planned to make it an annual event.

A FLOATING DOCK which John I. Thornycroft & Company, Limited, has built for the Peruvian Navy was launched from the Woolston yard of the company on July 19. The dock, the first to be built at Southampton, is 194 ft. in length and 61 ft. 3 in. in breadth, and has a lifting capacity of 600 tons. It will be towed to Iquitos, the Peruvian naval base on the river Amazon, in two or three weeks.

FROM JULY 30, the inland parcel postage rates were increased by 1d. at each of the first three steps of the weight scale and by 2d. at each subsequent step, while the rates for parels sent by post from the United Kingdom to the Irish Republic were increased by 3d. at each step of the scale. The G.P.O. states that the increases are necessary to reduce the loss falling on the parcel post service and in order to preserve a reasonable degree of parity with railway parcel rates.

A. A. JONES & SHIPMAN, LIMITED, toolmakers, of Braunstone (Leics), have called an extraordinary meeting for August 15 to consider a proposal to adopt new articles of association, which have been prepared to comply with present-day practice and the requirements of the Stock Exchange. The directors are also taking the opportunity of sub-dividing the share capital of the company, which, it is stated, is purely a matter of convenience. All shares in future will be of 5s. denomination.

G. & J. WEIR, LIMITED, of Cathcart, Glasgow, being desirous that their employees should take full advantage of technical educational facilities, propose to pay the entrance fee and annual subscriptions of all who are accepted in technical institutions. As a further inducement, the firm have offered an award of £20 to any member, of not less than three years' continuous service, who qualifies and is accepted as an associate member of one of the professional bodies associated with their industry.

THE FESTIVAL CELEBRATIONS at Thorncliffe had been notable for the underlying spirit of co-operation by all concerned, said Sir Harold West, managing director of Newton, Chambers & Company, Limited, speaking at a luncheon on July 21 which marked the final day of the company's Festival of Britain week. " If we could only get the same thought and understanding in business life, I think we could see an increase of at least 25 per cent. in production, without an increase in working hours," he said. It was the problem of management to discover how co-operation with the worker could be achieved.

A SPECIAL RESOLUTION to change the name of the Brush Electrical Engineering Company, Limited, to " Brush Aboe, Limited," is to be considered at an extraordinary meeting of the company next month. The reason given for the special resolution is that it is felt that the present name of the company is not sufficiently descriptive of the wide range of activities and manfactures of the group. It is now proposed that " Brush Aboe, Limited," shall become a holding company and that, simultaneously, a new company under the name of Brush Electrical Engineering Company, Limited, should be formed as one of the subsidiary companies of " Brush Aboe, Limited," to take over the manufacturing activities at Loughborough.

Raw Material Markets

Iron and Steel

Many foundries are in the midst of their annual holidays, during which repairs to plant, relining of cupolas, and reconstruction of stocking and production departments will be carried out. In some cases, foundries are arranging for the receipt of raw materials during the holidays, as, their stocks of pig-iron, scrap, and coke being so low, they are anxious to replenish them before operations are resumed.

The raw material supply position is the chief problem among foundrymen, who have full order-books in most instances. Unfortunately, prospects of an improvement in the position in the early future cannot be viewed with any large degree of optimism. The general engineering, motor, and textile foundries are in need of much larger tonnages of low- and medium-phosphorus iron and hematite. Production of hematite has shown some improvement, due to a better supply of ore, but, apart from the needs of the foundries, the furnaces have to meet insistent demands from the steelworks. Refined iron is taken up as available, and the foundries readily accept any parcels of Scotch foundry iron which can be obtained. Supplies of high-phosphorus pig-iron to the jobbing and light foundries are also very stringent, makers being heavily committed and in arrears with their orders.

Scrap is in heavy request; foundries are short of cupola scrap in both cast iron and steel, particularly the former. Foundry coke is coming forward in sufficient quantities for current use, and ganister, limestone, and firebricks are received to requirements.

Steel semis remain in very short supply, and most re-rollers are compelled to work short time. Home steelworks are unable to supply sufficient tonnages of billets, blooms, and slabs to keep the mills in full production, and deliveries from the Continent are only on a small scale. The sheet re-rollers have a large amount of work on hand, which calls for increased quantities of sheet bars. The re-rollers readily accept all arisings of defective material and crops, but these are not now available in any large quantities.

Non-ferrous Metals

There was probably a fair amount of bear covering on the London tin market last week when it came out that the United States is proposing to pay Bolivia for tin-bearing concentrates on the basis of 112 cents per lb., 6 cents above the level at which the R.F.C. is at present prepared to sell to American consumers. The market had been looking rather sorry for itself and values were drooping almost daily, but this news from the States put a stop to that and there was a swift, albeit temporary, recovery. It is understood that the figure of 112 cents for Bolivian tin is temporary for 30 days, until the report of a commission, recently in Bolivia, can be determined. This report, it is stated, will be used to decide a new price, which will encourage output of tin concentrates used in the Texas smelter. Apparently there is no intention of increasing the level of the offers made to other foreign countries.

As to the immediate future, it rather looks as though last week's recovery is likely to prove a short-lived affair, for with America virtually out of the market, and production going ahead briskly, the statistical position from the bulls' point of view would seem to be deteriorating.

While it is true that tin is the only metal so far to suffer a major reaction from its highest level, there has been of late a rather easier trend on the Continental "grey" market for metals. Attention has been drawn to a "buyers' strike" in what have come to be known as the free markets in metals. It seems to be a fact that Continental sellers are finding buyers rather reluctant and, in fact, reports last week suggested that they were holding off. This development is perhaps the result of the report that the U.K. is unlikely in the future to purchase any marginal high-priced copper, although it would appear that we have been obliged to make some concessions to our main suppliers of lead and zinc, from whom we have previously bought on the basis of the U.S. quotations. These American prices are largely artificial, as they are held down by Government decree, and our price structure in the U.K. has hitherto been built on them.

Official tin quotations on the London Metal Exchange were as follow:—

Cash—Thursday, £890 to £900; Friday, £870 to £875; Monday, £825 to £832 10s.; Tuesday, £823 to £823 10s.; Wednesday, £818 to £819.

Three Months—Thursday, £855 to £860; Friday, £835 to £840; Monday, £807 10s. to £810; Tuesday, £811 to £812 10s.; Wednesday, £808 to £810.

Returns for Iron and Steel Allocation Scheme

The Minister of Supply has made an Order calling for returns of iron and steel consumed during the first half of 1951, corresponding stocks, and estimated requirements for the following nine months. The object is to collect information on which the allocation of steel can be based. Allocation schemes will be introduced as soon as possible for alloy steel and for all other steel—including sheet steel and tinplate, which are already allocated.

The Order (the Iron and Steel Utilisation (Information) Order, 1951) calls for two returns. Return "A" is required if an undertaking consumed 25 tons or more of non-alloy iron and steel in the half-year. A separate return is needed of all the iron and steel, including alloy iron and steel, consumed and held in stock in each of the undertaking's works and stockyards. Return "B" is required if an undertaking consumed either 5 tons of alloy iron and steel or 1,000 lb. of high-speed steel in the half-year. A separate return is needed of all the alloy iron and steel, including high-speed steel, consumed and held in stock at each of the undertaking's works and stockyards.

Returns are not required from works using iron and steel only for the main processes of iron and steel manufacture; for iron castings other than alloy iron castings; or from scrap merchants, stockholding or distributing merchants; or from warehousemen.

All returns must be made in duplicate, not later than August 22 next, on official copies of the Forms "A" and "B" set out in the second schedule to the Order. Copies of these forms are being sent direct to all steel-using firms whose names and addresses are known.

Firms which have not received copies by August 8 must write immediately to the appropriate Regional Controller, Ministry of Supply, who will send forms at once. Making the returns is a statutory obligation.

TRADE ASSOCIATIONS AND FIRMS who have evidence of special circumstances in their industries which they would like the Government to consider before introducing the proposed legislation on resale price maintenance are invited to write to the Board of Trade. Evidence should be sent in writing (in duplicate) to the Assistant Secretary, Board of Trade, I.M.1.A Division, Thames House (N), Millbank, London, S.W.1.

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

(Delivered, unless otherwise stated)

August 1, 1951

PIG-IRON

Foundry Iron.—No. 3 Iron, Class 2:—Middlesbrough, £10 17s. 9d.; Birmingham, £10 13s.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £12 9s., 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 16s. 6d.; South Zone, £12 19s.

Scotch Iron.—No. 3 foundry, £12 7s. 9d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £13 7s. 6d.; South Zone, £13 10s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £13 17s. 6d.; South Zone, £14.

Cold Blast.—South Staffs, £16 10s. 6d.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £12 7s. 6d.; Scotland, £12 14s.; Sheffield, £13 2s. 6d.; Birmingham, £13 9s.; Wales (Welsh iron), £12 7s. 6d.

Spiegeleisen.—20 per cent. Mn, £18 3s.

Basic Pig-iron.—£10 19s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £37 15s., basis 45% Si, scale 14s. per unit; 70/84 per cent., £52, basis 75% Si, scale 14s. 6d. per unit.

Silicon Briquettes (5-ton lots and over).—2lb. Si, £44 2s.; 1lb. Si, £45 2s.

Ferro-vanadium.—50/60 per cent., 15s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 9s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £175; ditto, copper-free, £190.

Ferro-tungsten.—80/85 per cent., 32s. 9d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 34s. 9d, per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent C, £66, basis 60% Cr, scale 22s. per unit; 6/8 per cent. C, £61, basis 60% Cr, scale 21s. per unit; max. 2 per cent. C, 1s. 6¾d. per lb. Cr; max. 1 per cent. C, 1s. 7¼d. per lb. Cr; max. 0.15 per cent. C 1s. 8d. per lb. Cr.; max. 0.10 per cent. C, 1s. 8¼d. per lb. Cr.

Chromium Briquettes (5-ton lots and over).—1lb. Cr, £69 4s.

Cobalt.—98/99 per cent., 17s. 6d. per lb.

Metallic Chromium.—98/99 per cent., 5s. 11d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £37 19s. 10d.

Manganese Briquettes (5-ton lots and over).—2lb. Mn, £46 18s.

Metallic Manganese.—96/98 per cent., carbon-free, £215 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—Basic: Soft, u.t., £17 4s.; tested, up to 0.25 per cent. C (100-ton lots), £17 9s.; hard (0.42 to 0.60 per cent. C), £19 4s.; silico-manganese, £24 6s. 6d.; free-cutting, £20 9s. Siemens Martin Acid: Up to 0.25 per cent. C, £22 11s. 6d.; case-hardening, £23 9s.; silico-manganese, £26 14s.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £20 4s.; basic, hard, over 0.41 up to 0.60 per cent. C, £21 9s.; acid, up to 0.25 per cent. C, £23 9s.

Sheet and Tinplate Bars.—£17 6s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £21 3s.; boiler plates (N.-E. Coast), £22 10s. 6d.; chequer plates (N.-E. Coast), £23 8s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £20 1s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £22 15s.; flats, 5 in. wide and under, £22 15s.; hoop and strip, £23 10s.; black sheets, 17/20 g., £29 13s.; galvanised corrugated sheets, 17/20 g., £43 6s.

Alloy Steel Bars.—1-in. dia. and up: Nickel, £37 19s. 3d.; nickel-chrome, £56 6s.; nickel-chrome-molybdenum, £63 1s.

Tinplates.—48s. 3½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £234; high-grade fire-refined, £233 10s.; fire-refined of not less than 99.7 per cent., £233; ditto, 99.2 per cent., £232 10s.; black hot-rolled wire rods, £243 12s. 6d.

Tin.—Cash, £818 to £819; three months, £808 to £810; settlement, £819.

Zinc.—G.O.B. (foreign) (duty paid), £190; ditto (domestic), £190; "Prime Western," £190; electrolytic, £194; not less than 99.99 per cent., £196.

Lead.—Good soft pig-lead (foreign) (duty paid), £180; ditto (Empire and domestic), £180; "English," £181 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £210 10s.; rolled zinc (boiler plates), all English destinations, £208 10s.; zinc oxide (Red Seal), d/d buyers' premises, £205.

Other Metals.—Aluminium, ingots, £124; antimony, English, 99 per cent., £390; quicksilver, ex warehouse, £73 5s. to £74; nickel, £454.

Brass.—Solid-drawn tubes, 25½d. per lb.; rods, drawn, 28¼d.; sheets to 10 w.g., 30⅝d.; wire, 31¾d. rolled metal, 28⅞d.

Copper Tubes, etc.—Solid-drawn tubes, 26⅞d. per lb.; wire, 261s. 9d. per cwt. basis; 20 s.w.g., 288s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5). £277 to £281; BS. 1400—LG3—1 (86/7/5/2), £282 to £300; BS. 1400—G1—1 (88/10/2), £346 to £360; Admiralty GM (88/10/2), virgin quality, £346 to £350 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £354 to £390; L.P.Bl, £309 to £322 per ton.

Phosphor Bronze.—Strip, 38½d. per lb.; sheets to 10 w.g., 40⅝d.; wire, 42⅝d.; rods, 38½d.; tubes, 43½d.; chill cast bars: solids 3s. 11d., cored, 4s. (C. Clifford & Son, Limited.)

Nickel Silver, etc.—Ingots for raising, 2s. 7½d. per lb. (7%) to 3s. 7¼d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 1½d. (7%) to 4s. 1¼d. (30%); to 12 in. wide × .056, 3s. 1¾d. to 4s. 1½d.; to 25 in. wide × .056, 3s. 3¾d. to 4s. 3½d. Spoon and fork metal, unsheared, 2s. 10¼d. to 3s. 10¼d. Wire, 10g., in coils, 3s. 7¼d. (10%) to 4s. 7d. (30%). Special quality turning rod, 10%, 3s. 6¼d.: 15%, 3s. 11d.; 18%, 4s. 3¼d. All prices are net.