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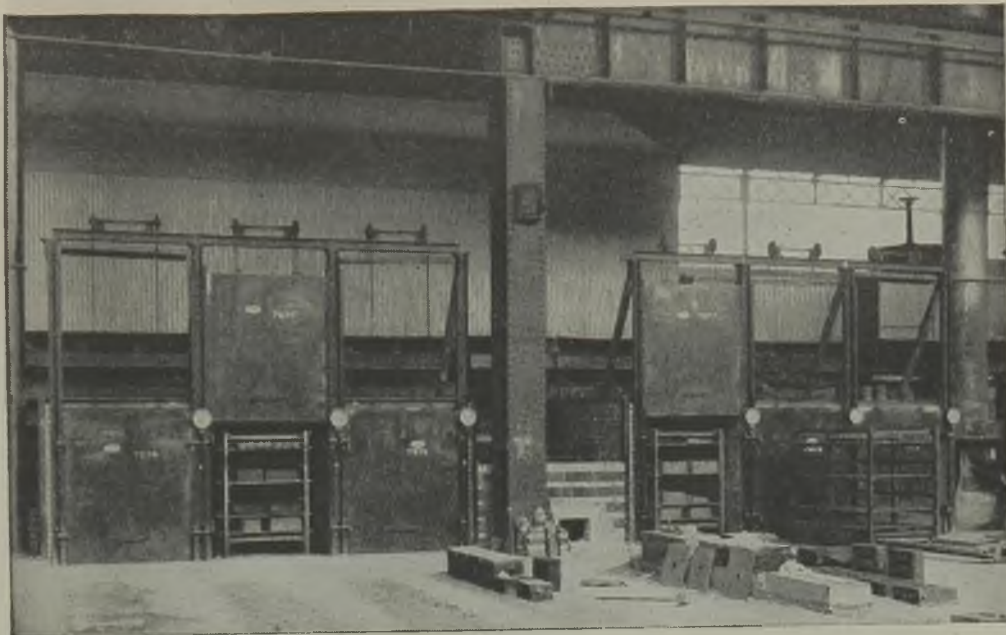

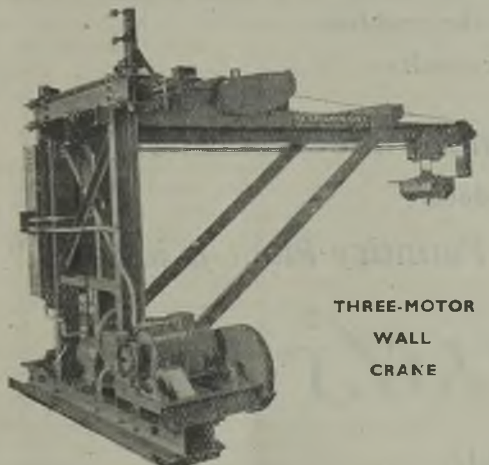

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FOUNDRY TRADE JOURNAL
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The Technical Harvest

"Metals and Alloys," the American engineering magazine of the metal industries, has devoted its April issue to the foundry industry. In order to place the industry in its proper perspective it records that the grey iron branch manufactures something of the order of thirteen million tons annually, steel and non-ferrous alloys, each two million, and malleable about one million. These figures are impressive when correlated with the general output of American industry, and it can easily be shown that the statistics for the United Kingdom bear a similar relationship.

An editorial in this magazine gives recent advances in foundry engineering as having been made in five general directions. Heading the list is the metallurgical improvement of product quality and soundness through the use of modern refining and alloying methods, and the application of scientific knowledge of the internal structure of metals. Second on the list is the development and application of specially effective casting processes and moulding practices, such as centrifugal casting, duplexing and triplexing, plaster moulding, directional solidification and blind risering. Sand control, involving the improvement of surface or internal quality of castings, through scientific formulation, treatment and testing of mould and core sands, comes next. The fourth feature is the general mechanisation of foundry operations from the conveyorised pouring of moulds through the mechanical handling of sand for conditioning treatment and reclamation. Finally, there is the use of the latest quality control tools—X-ray and radium inspection, the metallographic microscopes, pyrometric control instruments for melting and pouring temperatures, spectrographic analyses for raw materials and finished casting composition control, statistical methods, and so forth.

Apparently in America, the steel castings and the light alloy sections have "embraced modern methods and metallurgy in the greatest proportion." Against this, however, is placed the assertion that the "most notable single trend in the whole foundry field in recent years has been the steady improvement in the engineering quality of grey-iron castings made by many well-managed foundries, and the extraordinary betterment of properties achieved by a smaller number of plants using special processing techniques." These views are noteworthy as indicating the prospects of the foundry industry in the post-war world. These prospects, however, can be vitiated if an important section of the industry refuses to march with the times. The creation and maintenance of a high level of quality in castings demands from every foundry owner and executive a dynamic policy. A modicum of low quality production entering a "gossipy" market such as is the British, will undo, under conditions of normal competition, the good work recently accomplished. A good maxim for the smaller foundry owner is to work well within the capacity available to him. If a few specialised lines of production can be established, it is preferable to do everything to improve constantly the level of quality control and production, rather than have a "stab" at any job offered. It is obviously much easier to control lines which are in regular production than those which are exotic.

A small foundry now non existent thought it could make a handsome profit by tackling a job weighing two tons. It occupied the personal attention of the owner, his foreman and sundry others for the whole period of its manufacture. For its dispatch, the time of the whole staff of the foundry was occupied in the capacity of navvies for a complete afternoon. It may have shown under elementary bookkeeping conditions a paper profit, but any enlightened examination would have

(Continued overleaf, column 2.)

Contents

THE "LOST WAX" PROCESS OF PRODUCING SMALL CASTINGS *

By J. F. DRIVER

At the outset the writer would like to make it clear that he has had no practical experience of the process to be described. It is hoped that samples of castings may be available for inspection. The method is particularly suitable for intricate castings which are required to be accurate to size. Consider first an ordinary sand casting. This is moulded in a two- or three-part box; it generally has cores, whilst the patternmaker provides taper to enable the pattern to be withdrawn from the sand and allows for contraction of the metal when cooling. As the amount of rapping given to the pattern depends upon the individual taste of the moulder, the final size of the casting is doubtful, but the taper is always present except when the moulding is performed on a stripper machine.

Now it is germane to consider the way a dentist makes a casting to serve as filling for a tooth. He fills the cavity of the tooth with wax and carves away the excess wax till the outside surface resembles the original contour of the tooth. A wire is then inserted into the wax to act as a handle to withdraw it from the tooth. The wax is withdrawn and, still retaining the wire, is encased with a quick-setting substance or investment, generally a ceramic material, which is capable of withstanding the molten metal. When set, the wire is withdrawn, leaving a hole reaching to the wax. The mould is then heated to a dull heat, which volatilises the wax pattern. The heating expands the mould just the amount the metal will contract during cooling.

The mould is then placed in a suitable casting machine and the molten metal forced under pressure into the cavity left by the wax, using the hole made by the wire as the spue to carry the metal to the mould. When cooled the mould is broken away and, after the spue is removed, the casting is ready for use. The important points to observe about this method is that the pattern is not withdrawn from the mould, and therefore the most intricate shapes can be cast. The pattern, however, is destroyed, but, of course, only one casting is required.

The process to be described to a large extent follows this procedure, but differs in several important respects. A pattern of wood or other material is made true to size and shape without taper or loose pieces. Over this a quick-setting investment such as plaster of paris is moulded, having as many partings as are necessary for the various pieces of the investments to be removed without difficulty when they have set hard. After the pattern is removed, the investment is again pieced together and used to produce a number of wax patterns.

The Master Copy

Thus the plaster mould becomes the master copy and as many wax patterns as desired can be made. A number of these wax patterns are placed together with a suitable spue from each joining to a central runner. The whole group is then encased with a suitable material to form a new mould and, after setting, the wax is melted out as with the dentist's mould and, whilst hot, molten metal is run or forced into the mould so that not one but several castings are produced simultaneously. The original pattern is not lost and any number of wax castings may be made. Though a ceramic material is generally used for the mould, it seems reasonable to suppose that sand with a suitable binder such as core gum could be employed, providing the material would dry sufficiently to cause the investment to set sufficiently hard to keep its shape during the melting out of the wax pattern and the subsequent baking.

The process is used for small intricate castings weighing a few ounces and it is claimed that the castings can be of such accuracy that no subsequent machining is necessary. Castings in yellow brass and various bronzes are readily made and some degree of success has been achieved with iron and steel.

* An entry for a Short Paper Competition organised by the East Midlands Branch of the Institute of British Foundrymen.

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"BRIMULTA"—Fluxes. MULTIPLE ACTING FLUX, LIMITED, Cross House, Westgate Road, Newcastle-upon-Tyne, 1.

"HEELOY"—Alloys of common metal. HEELEY SILVER ROLLING MILLS, LIMITED, 67, Guernsey Road, Sheffield, 2.

"RADALOY"—Corrosion-resisting common metal alloys. RADIATION, LIMITED, Thimble Mill Lane, Aston, Birmingham, 6.

"PATHFINDER"—Unwrought and partly wrought metals; machine and hand tools. THOS. FIRTH & JOHN BROWN, LIMITED, Savile Street, Sheffield.

COMPASS (device)—Aluminium and aluminium alloys. ALUMINIUM, LIMITED, c/o McKenna & Company, 14, Waterloo Place, Pall Mall, London, S.W.1.

THE TECHNICAL HARVEST

(*Continued from previous page.*)

shown it to be a dead loss. With the larger concerns, one could tell a similar story of shipbuilding firms entering the textile engineering castings market. These are factors which have in the past operated against the steady progress of the industry, both economically and technically, and must not be repeated in the post-war years. Only the correct attitude of the individuals within the industry, coupled with an enlightened lead from the employers' associations, will ensure the proper reaping of the technical harvest sown during these war years.

WARTIME CALLS ON WOMEN TO MAKE ALUMINIUM AIR-COOLED CYLINDER HEADS

Women have proved more proficient in this type of work than men

By M. J. GREGORY, Peoria, Ill., U.S.A.

(American Foundrymen's Association Exchange Paper.)

(*Continued from page* 181.)

Melting Practice

The charge consists of a liquid "heel," 35 to 40 per cent. remelt pig metal to 60 to 65 per cent. prime pig metal, plus an additional of 0.8 per cent. of a 2.5 per cent. titanium-aluminium alloy added for grain refinement just prior to pouring. A typical charge is as follows:—

	Lb.
Liquid heel (from preceding melt)	50
Remelt pig metal	380
Prime pig metal	570
2½ per cent. titanium aluminium alloy ..	8
Total charge	1,008

After melting, the charge is heated to 650 to 660 deg. C., and the temperature permitted to stabilise. A current of pure anhydrous chlorine gas is bubbled through the metal for 10 min. to remove impurities, especially hydrogen gas. Chlorine gas is piped from an outside ventilated storage room to the melting pots, where it is bubbled through the molten metal.

This chlorine system is protected against leakage near the furnaces by a safety valve operated from a pull chain running the full length of the overhead exhaust hood. A jerk on the chain instantly shuts off all chlorine flow. The chlorine and other vapour produced by the fluxing are removed through the side hood and overhead exhaust system provided.

FIG. 13.—THIS DEPARTMENT IS DEVOTED TO THE PREPARATION OF THE FURNACE CHARGES.

Aluminium Air-Cooled Cylinder Heads

The charge then is heated to 740 to 745 deg. C., and the dross is skimmed. Titanium-aluminium alloy is added and mixed into the melt. The metal then is ready to pour (see Fig. 13).

Pouring Practice

Metal is poured from the melting pot into two, 30-lb. capacity, cast-iron ladles. The metal temperature is checked with a portable potentiometer and a bare, open-end, chromel-alumel thermocouple. With this set-up, ladle temperatures of 732 to 735 deg. C. can be read with accuracy in 3 to 5 secs. The metal surface is skimmed very carefully, ladles are placed in position, and the metal is poured. The actual pouring requires $1\frac{1}{2}$ to 2 secs. In almost every instance, where pouring is done at a slower rate, some misrun fins result. Along with speed of pouring, smoothness of action is required.

Castings are poured on a continuous, moving, car-type conveyor, the speed of which is regulated to bring the next mould into pouring position by the time the pourers are ready to pour again. Conveyor shut-off switches are provided at various convenient locations for starting or stopping the conveyor when necessary.

The 50 to 60 lbs. of metal remaining after all 15 castings have been poured is held in the pouring ladles, while the furnace is scraped clean, and then returned to the melting pot to act as a " heel " for the next melt. This " heel " provides more uniform melting of the first pigs. The combined melting and pouring cycle required is $3\frac{1}{2}$ hrs. for the first heat in a furnace, and $2\frac{3}{4}$ hrs. for additional heats.

Control of Metal

A permanent record (Table I) is kept of each melt made on a convenient form, called the " Melting Work

FIG. 14.—THE SHAKE-OUT SECTION.

Sheet." This record contains various information on melting-pot performance, charge, temperatures and other pertinent data. Records of this nature have proved very useful in tracing down and eliminating sources of scrap.

At the shake-out, each casting is stamped with a number corresponding to the particular melt from which it was poured, and another number indicating in what location in the melt. Thus, 816-10 would represent the tenth casting poured from Melt No. 816. Three tensile test-bars and one spectrographic analysis disc are poured from each melt. These test-pieces are stamped with the number of the particular melt from which they were poured. The analysis discs are sent to the metallurgical laboratory for analysis and the tensile test-bars are sent to the heat-treating department to await arrival of the castings from the same melt from the cleaning department. Castings and tensile bars are heat-treated together. The composition of the melts is relatively uniform and averages:—Cu, 4.0; Ni, 2.0; Mg, 1.46; Cr, 0.20; Ti, 0.17; Si, 0.33; and Fe, 0.55 per cent.

The copper occurs as the compound $CuAl_2$ and as the ternary alloy Al-Cu-Ni. The copper provides certain of the strengthening resulting from heat-treatment. The nickel occurs as $NiAl_3$ and Al-Cu-Ni, and improves the high-temperature properties of the alloy. The magnesium provides certain hardening and strengthening effects and occurs as Mg_2Si. Titanium and chromium act to refine the grain size of the metal. Samples are taken from all heats of prime and remelt pig metal for examination for porosity, inclusions, and chemistry. One or more pilot melts are run on each new heat of both prime and remelt pigs before any additional pigs are used. In this manner it is possible to determine whether or not any special variations from standard procedure will be necessary.

Remelting Practice

The remelting of risers and scrap is done in a 20,000-lb. capacity, oil-fired, reverberatory furnace.

FIG. 15.—A BAND SAW IS USED FOR CUTTING OFF SPRUE.

TABLE I.—*Melting Work Sheet.*

Date, 11.18.43.
Furnace 1.
Shift F.
Pot No. 26.

Assistant, A.D.
Pourers, R.E.—E.S.
No. of heats, 40.

Melt No. 860.
Fire on, 7.15 a.m.
Finish, 10.45.
Total time, 3 hrs. 30 min.

FURNACE CHARGE.

Prime pig (heat No. 423)	570 lb.
Remelt pig (heat No. 16)	380 ,,
Heel melt (melt No. 856)	50 ,,
Ti–Al–Pig	8 ,,
Total charge	1,008 ,,

FURNACE OUTPUT.

No. of Castings	15
No. of test moulds	2

FLUXING.

	a.m.
Chlorinated	9.55 p.m.
Chlorinated	5 min.
Temperature	1,210 deg. F.

POURING TEMPERATURES.
Pot, 1,380 deg. F.
Ladles (deg. F.).

1—1,355	9—1,355
2—1,355	10—1,355
3—1,355	11—1,355
4—1,355	12—1,355
5—1,355	13—1,355
6—1,355	14—1,350
7—1,355	15—1,350
8—1,355	16—1,350

Remarks—
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Signed..............................

Aluminium Air-Cooled Cylinder Heads

The total time of a heat is approximately 8 hrs. from start to finish.

Charging.—Lighter material is charged into the hot furnace and is covered with heavy risers and pigs. This order of charging provides a cover for the lighter metal. Approximately 10,000 lbs. of metal are charged into the furnace in preparation for the heat of the following day. The furnace is lighted at 6 a.m. and is ready for additional material of the charge at 7.15 a.m. As the charge melts down, more additions are made and dry flux agent is added from time to time.

Furnace Practice.—When all metal has been added, the heat is turned on and the metal is completely melted. The charge is rabbled intermittently to loosen material from the furnace floor. When all metal has been melted and temperature reaches about 620 deg. C., a thermocouple is inserted and heating continued to 662 to 675 deg. C. A chromel-alumel thermocouple in a steel protection tube and a disc-type, continuous, potentiometer recorder is used for temperature measurements. Additional dry flux is added and stirred into the metal to remove oxides, gases and other impurities. This operation is continued for 15 min.

The metal is then heated to 715 to 730 deg. C. and carefully skimmed. Dross is dragged out of the large side door into a refractory lined dross buggy having drain holes at the bottom. A refractory-lined cover is placed later over the top of the buggy to aid in retention of heat and exclusion of air. This permits particles of metal entrained in the dross to remain liquid and seep down through the dross and collect in pans placed beneath the drain holes.

After skimming is completed, about 50 lbs. of pure

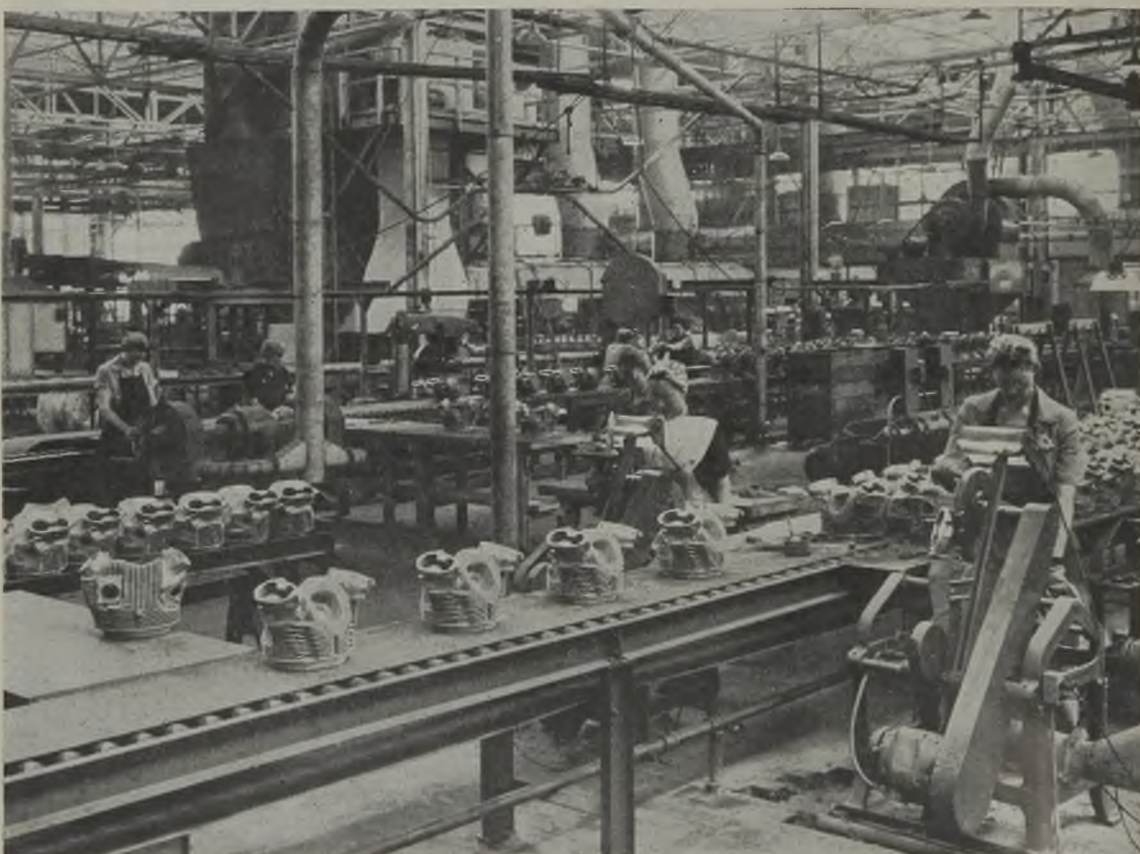

FIG. 16.—SPECIAL MACHINES ARE USED FOR GRINDING OUT THE METAL FINS.

magnesium metal is added to the remelt. This addition raises the magnesium content of the melt to about 1.55 per cent., which is within the required specification.

Magnesium Additions.—The magnesium pig is put into a 6-in. square box made of ¼-in. steel plate perforated with ½-in. holes. It is closed at one end and welded to a handle. The other end is open to permit insertion of the magnesium pig. The tool is then placed in the bath and held under the metal surface and swung in an arc to mix into the metal. After all the magnesium has been added, the bath is rabbled for an additional 5 min. to ensure more uniform distribution of the magnesium.

Tapping.—Next, the tapered cast-iron tap-hole is knocked loose and the metal is run into a pouring basin. Pigs are poured on a moving conveyor, three pigs being poured at one time. Pigging is automatic, the pouring basin being tilted to a standard position and remaining in that position until completion of pouring. Pouring holes are provided with spouts that pivot, permitting the spouts to rise and fall in passing from one set of pigs to the following.

The Mould Conveyor.—Most of the pig mould conveyor runs in a ventilated pit and the aluminium pigs are cooled by a suction fan. At the discharge end, the pig moulds fall forward and strike an obstruction which loosens the pigs, causing them to drop down into a shute, whence they are loaded on to flats. The conveyor moulds pass down through a controlled

TABLE II.—*Remelt Working Sheet.*

Date, 11.22.43. Shift, First. Remelt No. RA18.

Start	6 a.m.				
FLUXING (Fluorides): Dry flux	50 lb.				
Temperature	1,230 deg. F.				
	a.m.				
Start rabble	10.40 p.m.				
Finish rabble	10.55				
MAGNESIUM ADDITION	50 lb.				
Temperature	1,330 deg. F.				
	a.m.				
Start rabble	12.03 p.m.				
Finish rabble	12.08				
TAPPED	12.10 p.m.				
FINISH PIGGING	2.00 p.m.				

CHARGE LOG.

Type.	Wt.	Time.	Flux.
1. Heads	1,258	—	—
2. Heads	1,076	—	—
3. Risers	1,180	—	—
4. Pigs	782	—	—
5. Risers	1,068	—	—
6. Risers	1,061	—	—
7. Risers	1,204	—	—
8. Risers	1,604	—	—
9. Pigs	1,126	—	—
10. Pigs	1,630	7.30	—
11. Drippings	1,186	—	—
12. Risers	1,036	—	—
13. Risers	1,192	—	—
14. Risers	1,083	—	—
15. Risers	925	8.10	9
16. Risers	1,160	—	—
17. Risers	1,858	8.45	4
18. Risers	1.329	—	—
19. Risers	945	9.35	12
20. —	—	—	—
Totals	22,703	—	25

FURNACE CHARGE	22,703 lb.
MAGNESIUM ADDED	50 „
TOTAL CHARGE	22,753 „
METAL PIGGED	21,504 „
MELTING LOSS	1,249 „
MELTING LOSS	5.5 per cent.

TEST SAMPLES

	Temp. Deg. F.	Time.
1.	1,330	12.15
2.	1,310	12.35
3.	1,310	12.55
4.	1,310	1.15
5.	1,300	1.35
	1,290	1.55

Remarks :—
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Signed ....

Aluminium Air-Cooled Cylinder Heads

water spray for further cooling and then up past the pouring basin to begin another round. After cooling to room temperature, pigs are taken to scales for weighing and are then divided into loads for charging into the melting pots, after their chemical analysis has been approved.

A permanent record of each remelt heat is made (see Table II). This work sheet indicates all additions, temperatures and other pertinent data.

Spectrographic analysis discs are poured in permanent moulds every 20 min. to check uniformity of analysis. Samples are cut from pigs for examination for porosity, inclusions and similar defects.

Cleaning

Poured moulds on the conveyor move around to the shake-out after approximately 2 hrs. of cooling. They are picked up by an electric hoist, rolled over, and placed on the vibrating shake-out. This shake-out action instantly breaks away the major portions of sand, but leaves the sand between the fins.

Shake-out Fin Sand.—An additional shake-out unit, therefore, had to be developed to remove this fin sand. The machine was so designed that four chipping hammers are forced up under the head by air cylinders until the blunt chisels contact the combination riser and pouring basin. The air is turned on and the hammers completely loosen the fin sand in 30 to 45 secs. The head is removed from the vibrator, stamped for identification and hung on the overhead conveyor for cooling (see Fig. 14).

Riser Removal.—A 36-in. metal-cutting band saw, equipped with a clamp fixture and pull cylinder, is used to cut off risers. The operator removes a head from the conveyor, places it in the fixture, starts the saw and air cylinder, and steers the head while the cut is made. A very slight amount of cooling fluid is dripped on the blade (see Fig. 15). The blade life, originally 20 to 30 heads, has been increased by careful saw setting and sharpening to more than 100 heads. The saw speed, originally 3,000 ft. per min., had to be reduced to approximately 1,800 ft. per min. to eliminate saw failure. After the riser has been removed, the head is unclamped and placed on the belt conveyor for delivery to the stand grinder.

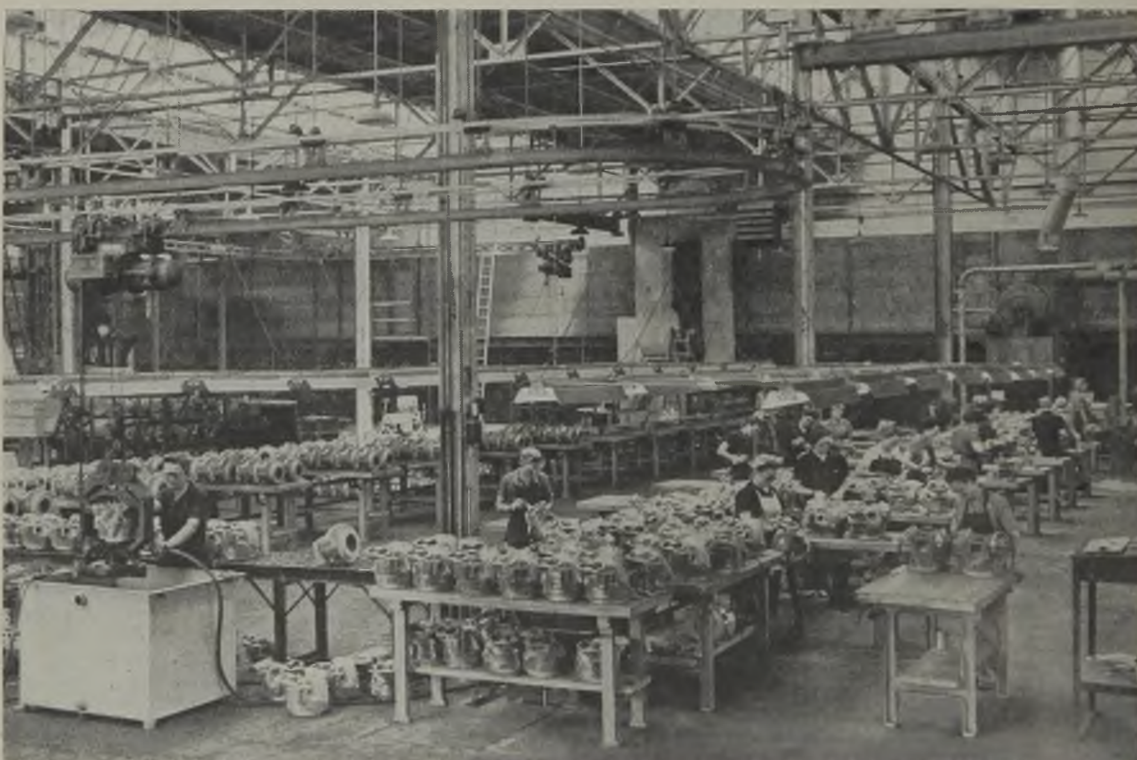

FIG. 17.—THE CYLINDERS ARE AIR-PRESSURE TESTED AT 70 LBS. PER SQ. IN.

Grinding Operations.—The heads are fed from the band and circular saws on an 18-in. belt conveyor to the stand grinders, where rough grinding is done. The stand grinding machines are equipped with a 15-h.p., 1,800-r.p.m. motor, two 2-in. thick, 20-in. dia. resinoid-bonded wheels, and special work rests. The operator grinds off excess metal at the parting, rocker boxes and exhaust ports. Following this operation, the head is placed on a bench where the intake port is finish ground with a portable tool.

Blast Cleaning.—All of the heads next undergo a thorough blasting in a table-type blasting machine. This machine is equipped with twelve 18-in. diameter revolving tables to spin the heads and two blasting units, using No. 60 grit. The heads are blasted in three different positions, and one then is removed and placed on a section of roller conveyor which runs to the preliminary cleaning line. All of the work on the preliminary casting cleaning line is done by women. Although the casting weighs approximately 38 lbs., the operations are lightened by the use of special tools, vices and fixtures.

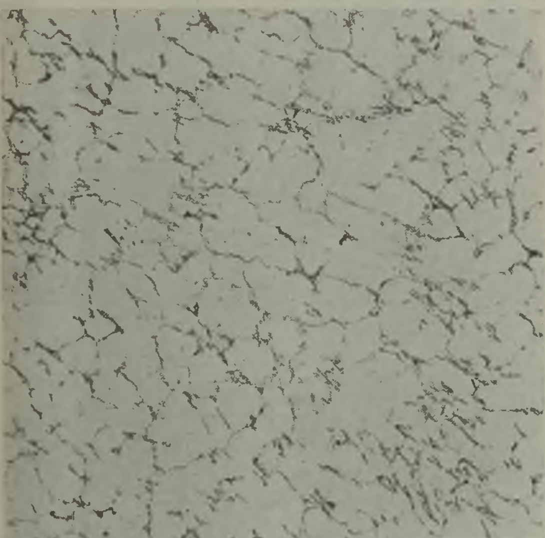

FIG. 18.—THE "AS CAST" STRUCTURE. × 100.

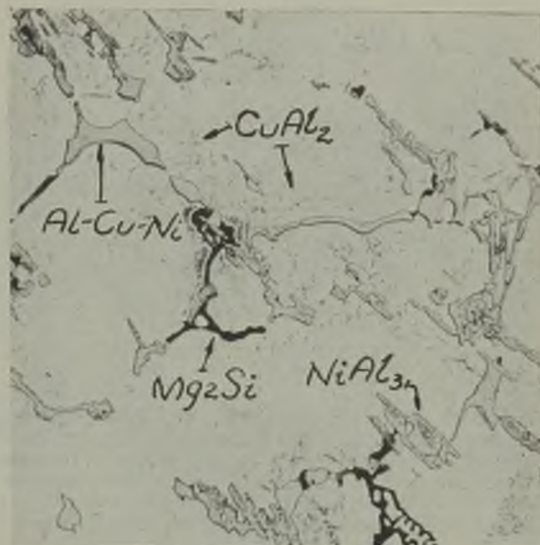

FIG. 19.—THE "AS CAST" STRUCTURE. × 500.

Chipping and Fin Grinding.—The head first is chipped with pneumatic chisels to remove excess metal not touched by the stand grinder. Then it is placed on a belt conveyor and moved to the fin grinding operators. This operation is done on three special machines designed to grind out metal fins left at the mould parting. The machines are indexed manually (see operation to right in Fig. 16). Other operations on this line are performed with small, high-speed, pneumatic grinders. These tools are used, with suitable bits, reamers and routers, to clean all sections of the rocker box, ports, etc. This work is inspected and, if approved, the head is placed ready for water testing.

Water Test.—The water test operation is located at the end of the preliminary cleaning line so that scrap heads may be rejected before the final cleaning is started. The casting is removed from the conveyor and placed in a special fixture, where it is clamped and sealed with steel-backed rubber pads. Seventy lbs. per sq. in. air pressure is applied and maintained inside the head, and the whole fixture is lowered into a tank of water for testing. Any leaks are instantly disclosed by a stream of air bubbles (see operation at left in Fig. 17).

Final Cleaning.—Final cleaning also is handled entirely by women. As in the preliminary line, the heads are mounted in vices to simplify handling and decrease fatigue. The castings are cleaned thoroughly inside the valve ports, between the fins and over the entire exterior, with files, burrs, and reamers. Any imperfections are cut out and carefully blended to remove sharp corners or tool marks which would present a focal point for fatigue failure.

The company with which the Author is associated has been able materially to decrease cleaning time by using a very fine close-grained facing sand. This sand makes a smooth casting, which cleans up remarkably well with only brief blasting. Coarser sands would have forced the cleaning room to ream the surfaces of all fins and greatly increase costs. All castings are inspected and then are loaded into racks for heat-treatment.

Aluminium Air-Cooled Cylinder Heads

Heat-treating Department

The heat-treating department consists of recirculating, electrically-heated, batch-type furnaces. Each furnace is provided with an individual roll-type recorder control. A special instrument automatically shuts off the electric power on the particular furnace, if the temperature goes above a certain maximum. This prevents overheating and possible melting of the castings in the furnace, should the recorder control fail to function properly and allow temperatures to rise too high.

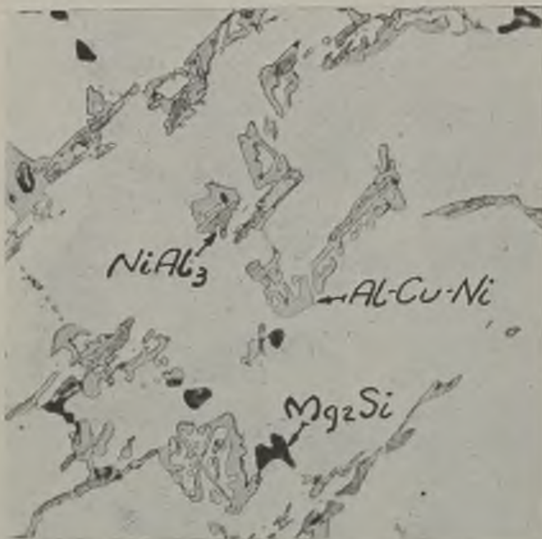

FIG. 20.—STRUCTURE AFTER SOLUTION TREATMENT QUENCHING. × 500.

A timer is connected in each furnace circuit to measure the elapsed time after the load reaches temperature. The moment a furnace is started, a red coloured lamp flashes on above the particular recorder panel and remains on during the heat-treatment. At the end of the period set on the timer, the red coloured lamp flashes off, and a white coloured lamp lights, indicating completion of the treatment. Another control instrument indicates the per cent. of power capacity being used, thus providing a check on the heating equipment. The furnaces are built on foundations below floor level so that the top of the furnace protrudes about $2\frac{1}{2}$ ft. above the floor level. This greatly facilitates handling and inspection.

Heat-treating Practice

Castings are loaded on racks with proper spacing to permit free and uniform circulation of the heating atmosphere. Sixty castings, together with the tensile test-bars of the same melts, are loaded on a rack. The loaded rack is lifted and carried by an overhead mono-rail crane and lowered into a solution treatment furnace. The power is turned on and the automatic timer is set.

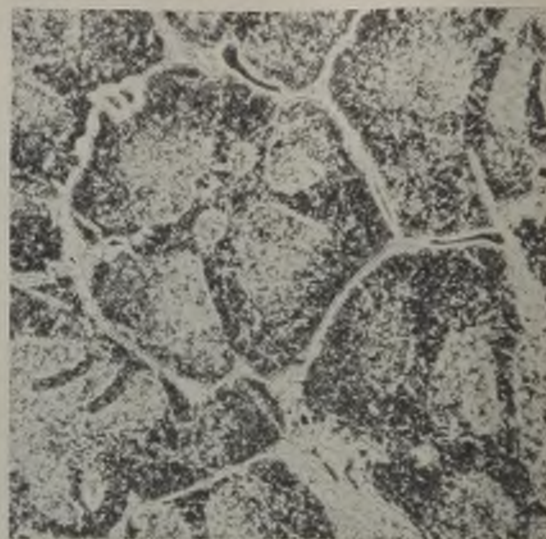

FIG. 21.—STRUCTURE OF THE PRECIPITATION HEAT-TREATED ALLOY. × 500.

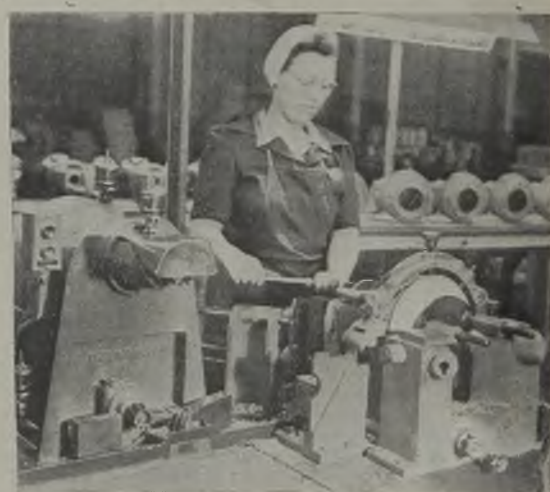

FIG. 22.—THE MILLING OPERATION.

Quenching.—The white coloured lamp flashes on at the end of 6 hrs. at 515 deg. C., indicating that the load is ready for the quench. The loaded rack then is removed from the furnace and lowered into an enclosed quenching fixture. A turntable revolves the load in the quenching medium, thus providing for more uniform cooling. An exhaust fan removes the circulating air. The enclosed quench fixture, open only at the top, causes air to be drawn down over the revolving rack and then out through the exhaust fan.

Precipitation Treatment.—The castings are cooled to room temperature in about 1½ hrs., and then are placed in a precipitation treatment furnace for 4 hrs. at 250 deg. C. After the precipitation treatment is complete, the rack is removed from the furnace and placed aside to cool in still air. After treatment, the castings are stamped with identification numbers to identify both heat and heat-treatment, and are again blasted in a table-type machine using No. 90 grit to give the desired finish. This second blasting operation is required to remove discolorations caused by heat-treatment.

Microstructures.—Fig. 18 shows the microstructure of the alloy in the as-cast state at × 100, while Fig. 19 shows the structure at × 500. Fig. 20 shows the microstructure of the alloy in the solution treated and quenched condition at × 500, and Fig. 21 the microstructure of the precipitation heat-treated alloy at × 500.

All samples were etched with 0.5 per cent. hydrofluoric acid. Comparison of the as-cast structures (Figs. 18 and 19) and the as-solution treated and air-quenched structure (Fig. 20) reveals the disappearance of the feathery constituent ($CuAl_2$) in the grain boundaries and the disappearance of certain of the dark (Mg_2Si) particles. The larger Mg_2Si particles are rounded at the edges, but not entirely dissolved. The $NiAl_3$ and Al-Cu-Ni microconstituents are apparently unaffected. Fig. 21 shows the darkened

(*Continued overleaf, column* 1.)

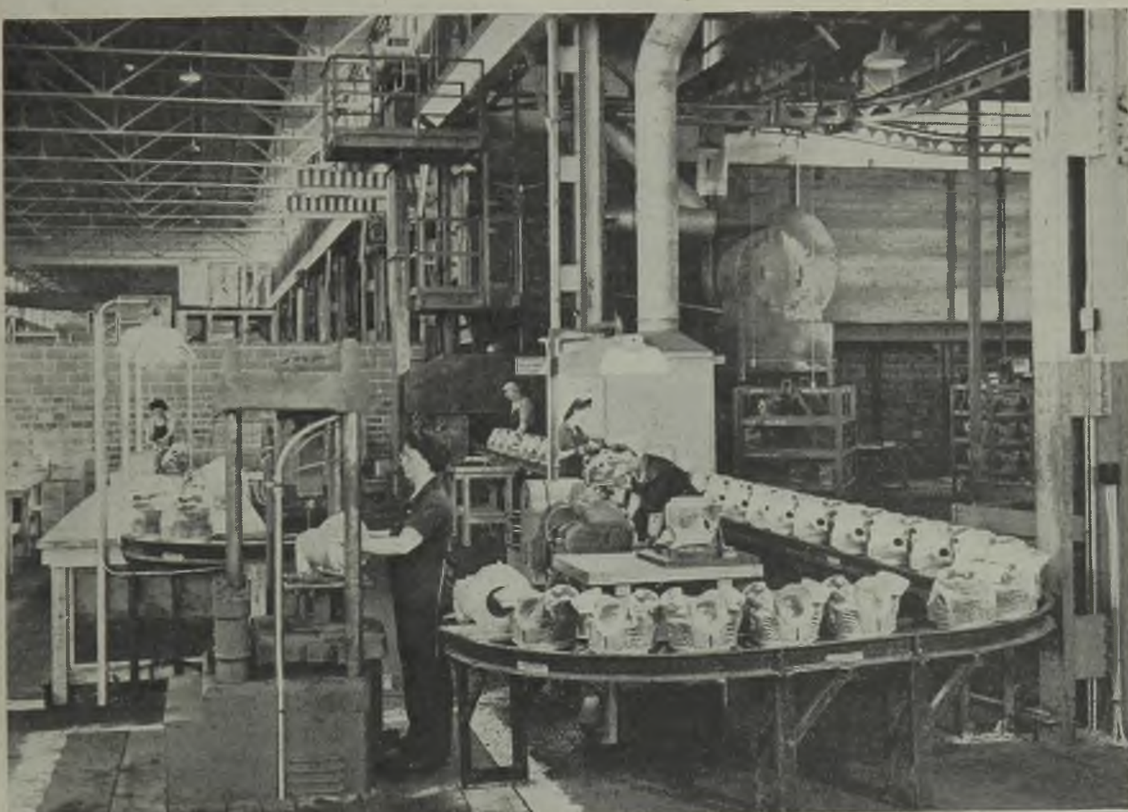

Fig. 23.—Brinell Testing Section.

WARTIME CALLS ON WOMEN TO MAKE ALUMINIUM AIR-COOLED CYLINDER HEADS

(*Continued from previous page.*)

appearance of the structure after the precipitation treatment. The darkened appearance is attributed variously to the method of polishing and precipitation of $CuAl_2$.

Heat-treated Properties.—The heat-treatment results in average physical properties as follow:—

	Tensile strength, tons per sq. in.	Elongation in 2 in., per cent.	Brinell hardness (1,000 kg. load).
Separately cast test bars ..	15.0	1.0	85
Test-bars machined from castings	9.7	1.0	82

Final Operations

Milling Locating Points.—Following final heat-treatment, the castings are cleaned by an air blast and are rolled down a conveyor to a layout fixture. Due to the rigid inspection requirements, each head is laid out and scribed to check casting accuracy. The layout fixture is mounted on a milling machine so that machine locating points can be milled after the casting is checked. This milling operation provides a definite set of locating points which are used in the first machining operations to great advantage (see Fig. 22). Castings and tensile test-bars, when cool, are stamped with a number representing the particular load in which they were heat-treated. One tensile test-bar is broken by the metallurgical laboratory and the remaining two bars are available to the purchaser.

Brinell Hardness Test.—After milling, the heads are again placed on a roller conveyor and moved down to the hardness-checking machine. The Brinell testing machine is a three-column, automatic, direct-reading machine equipped with a special stand to hold the head. The operator inserts the head, steps on the pedal, and the machine automatically raises the head, exerts the pressure and gives the reading on a dial indicator (see operation at left in Fig. 23). The cylinder head must be within a hardness range of 3.7 to 4.0 mm. dia. impression with 1,000-kg. load.

Final Inspection.—All of the castings are thoroughly inspected after the hardness check and, when approved, are stamped and packed into individual shipping cartons ready for shipment.

Mr. Andrew M. Bryan, of the Shotts Iron Company, Limited, has been appointed to the Board of Governors of the Royal Technical College, Glasgow, in succession to Sir George A. Mitchell, retired. Mr. Bryan formerly held a professorial appointment jointly at the College and the University.

CORRESPONDENCE

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

HALIFAX UNDERCARRIAGE LEG

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—My attention has been drawn to a paragraph on page 99 of your issue of June 1 relative to a display of light alloy products by High Duty Alloys, Limited. In this paragraph, a statement is made that the Halifax undercarriage leg, one of the exhibits, is the largest magnesium casting in the world.

As I am sure that those responsible for the statement quoted would wish to be correct in their facts, I would like to state that the company with which I am connected produce highly stressed elektron magnesium castings as commercial productions weighing up to 830 lbs. each, requiring a very high degree of strength and soundness. Bulk production of highly stressed aircraft castings weighing 3 cwts. each is in progress at the present time, and there are various other production castings ranging from the figure just mentioned up to the maximum weight so far reached of 830 lbs. for the finished casting.

Full credit must be given to High Duty Alloys for an excellent foundry production in the Halifax undercarriage leg. If, however, weight is the standard by which the size of a casting is judged, then obviously the claim that the Halifax casting is the largest magnesium casting in the world can hardly be substantiated. Indeed, we should have thought that such a claim on any standard was very difficult to make confidently for lack of universal knowledge.

Yours, etc.,

E. PLAYER, Managing Director.

Sterling Metals, Limited. Coventry.
June 21, 1944.

NOTES FROM THE BRANCHES

London Branch, East Anglian Section.—The opening meeting of the session was held in the Lecture Hall of the Central Library, Ipswich, when Mr. C. H. Kain, the newly-elected president, addressed the meeting on two subjects. The first was, "Can the Metallurgist Manage a Foundry?" and the second, "Centrifugal Casting in Sand Moulds." It was announced that at the next meeting the President of the Institute is personally to present the Mechanical Handling Report.

INSTITUTE OF WELDING

The twenty-first annual meeting was held on June 20 at the Institution of Civil Engineers, Westminster. The annual report showed that the membership had increased by 897 during the year, and now was 3,252. The target membership for the new session is set as high as 5,000. Commendable progress is shown in its various fields of activities.


The High-Quality Iron for High-Duty Castings.
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Made in seven standard grades or to individual requirements, this iron has a close grain structure and fine graphitic carbon content. It replaces Hematite, and tones up high phosphorus irons.
We also make Dale Refined Malleable Iron to any required specification.
STANTON
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THE STANTON IRONWORKS COMPANY LIMITED
NEAR NOTTINGHAM

THE DETERMINATION OF SULPHUR IN CAST IRON BY THE COMBUSTION METHOD

By W. J. ROSKROW

For the determination of sulphur in cast iron the volumetric method has been largely superseded by the combustion method which, although initially expensive, rapidly justifies itself where a large number of sulphur estimations have to be made. It also presents an extremely rapid method in comparison with the older process. Coke can be quickly estimated for its sulphur content by this method.

The original combustion furnace used for the determination was equipped with Silit rod heating elements, owing to the high temperature necessary for the determination of alloy irons. Where Silit rods are not obtainable, the American globars can be used. These bars age rapidly, and after six or seven weeks the necessary temperature cannot be maintained, but for quantity rapid determinations, the combustion method is extremely accurate.

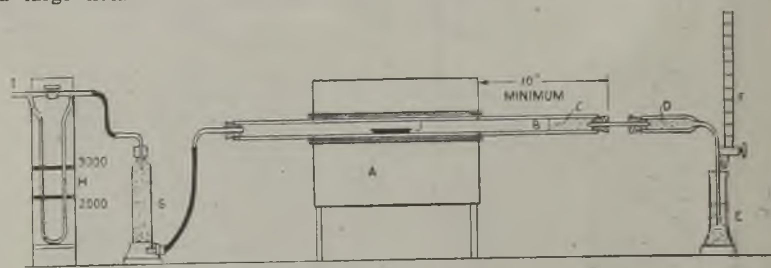

Fig. 1.—A: Furnace Heated by Silit Rods. B: Fused Alumina Tube. C: Burnt Asbestos Wool to Retain Iron Oxide. D: Glass Prolong Filled with Dry Cotton Wool. E: Vessel Containing $AgNO_3$ Solution. F: Burette Containing N/200 Sodium Hydroxide. G: Tower Containing Silica Gel. H.: Meter Keeping Rate of Oxygen 2,000-3.000 Ml. Per Min. I: Oxygen Supply. J: Combustion Boat.

Reagents

N/50 $AgNO_3$ Solution.—For the preparation of this, 3.4 gms. of silver nitrate is dissolved in distilled water, then 5 ml. of a 0.1 per cent. solution of methyl, red indicator in alcohol is added, and the solution is made up to 1 litre. This solution should be neutral to the indicator.

N/200 Sodium Hydroxide Solution.—Dilute exactly 10 times an N/20 solution of sodium hydroxide which has been previously standardised against oxalic acid.

Method

The combustion tube shown in Fig. 1 is raised to a temperature of 1,300 to 1,350 deg. C. for high-duty alloyed cast irons. The author uses combustion tubes and boats made by the Morgan Crucible Company, 1 gm. sample is used, the boat being inserted into the heated portion of the tube by means of a nickel rod. A constant stream of oxygen, approximately 3,000 ml. per min., is passed over the sample. At once the silver nitrate absorbent assumes a red tinge. A short period is allowed for the CO_2 to pass out of the solution, and the absorbent is titrated with N/200 sodium hydrate just sufficient to discharge the pink coloration. After passing oxygen for a few seconds without the reappearance of the pink tinge, the supply is turned off. The amount of sodium hydrate used is a direct measure of the sulphur content of the sample.

The N/200 sodium hydrate is standardised by running a B.C.S. standard along with the other estimations. Hydrogen peroxide solution can be used in place of silver nitrate, 30 ml. of 30 vols. hydrogen peroxide, plus 0.4 gms. potassium sulphate, is diluted to 1 litre with water for this purpose.

IRONFOUNDRY FUEL NEWS—X

One of the matters which should now be engaging the attention of many ironfounders is the provision of suitable equipment for shop heating next winter. The normal means of heating in the majority of ironfoundries is by means of fire-baskets burning either coal or coke. The use of such fire-baskets is, in most cases, to be deprecated (*a*) because the use of coal means the production of smoke which is unpleasant for workers in the vicinity, while the use of coke may be frowned upon by the factory inspector; and (*b*) because there is no doubt that fire-baskets are much less efficient than properly designed heating stoves.

As, however, coal and coke are not likely to be in better supply next winter than last winter, and the position may well be worse, founders might like to be reminded of another fuel which can be used for space-heating purposes, namely, sawdust. Some foundries may have a supply of sawdust available from their own patternshops, while others could obtain supplies from local firms.

Sawdust cannot readily be burnt on normal grates, but the attention of the Ironfounding Industry Fuel Committee has recently been brought to a pamphlet describing a sawdust-burning stove which can readily be constructed from two empty oil drums, a few pieces of sheet steel and a stove pipe. If you would like to consider constructing any of these stoves in readiness for next winter, please write for a copy of the pamphlet to the Fuel Officer, Ironfounding Industry Fuel Committee, Alvechurch, Birmingham. Meanwhile, if you have storage space available, you may be well advised to start accumulating a stock of sawdust.

FUTURE OF THE TIN-MINING INDUSTRY

CONTROL DEFENDED

The more careful consideration that is given to the future prosperity and stability of the tin-mining industry, the more convincing becomes the necessity of a continued and carefully planned international organisation, to maintain the vital interests of consumers and producers.

Opening a discussion of the prospects of the industry with this sentence, the Tin Producers' Association, in their bulletin, "Tin," claim that tin-mining and the important consuming industries were saved from disaster after 1918 by the fact that the Governments of Malaya and the Netherlands East Indies combined in forming a reservoir of tin known as the Bandoeng Pool. These stocks stood between the consuming industry and any physical shortage, and played a more important part than was realised at that post-war period. So long as supplies were in sight a stampede to buy tin was avoided.

From 1922 to 1925, 22,500 tons more tin was consumed than produced, and if consumption had not fallen in 1926 by 11,300 tons below the previous year, owing to industrial troubles in England, the position would have been far worse. As it was, prices reached a peak of £321 a ton. It can be seen, therefore, what would have happened without the controlled reserve of stocks at the end of the war.

Among the many unknown factors in the future are, how quickly the post-war increase of consumption will start, and whether the Japanese have been unable to remove stocks from Malaya, the Netherlands East Indies and Indo-China. The speed with which production can get going in these countries will depend on what the damage has been to plant and machinery and what preparation has been possible in advance to get mining started with new equipment. The volume of production will doubtless be influenced by the extent of the recovery of tin from the vast amount of scrap metal that will be available when the breaking up of war materials can be undertaken. After the last war, the recovery of tin in America for a number of years was from 250 to 300 per cent. of the pre-war figure. The amount of valuable scrap at the end of this war is likely to be incomparably greater.

With regard to consumption one can only speculate, but in view of essential requirements due to years of war and the demands due to loss, damage, normal requirements and obsolescent replacements, the Association thinks the figures are very large.

Post-War Problems

The history of tin after the last war suggests (the article continues) that important problems have to be solved in satisfying the demand for tin after the present war. The first duties of producers to the consumers are to prevent violent fluctuations in price and obtain for them a sufficiency of tin at all times at a reasonable price. The situation which can arise from lack of control was demonstrated in 1928, when declining market prices coincided with the greatest advance in consumption within memory. Nearly 20,000 tons more tin were consumed in 1928 than in 1927, and stocks averaged only 20,000 tons. Yet, an increase of production to meet this demand resulted in a greatly reduced sale value compared with the previous year. A net loss to the tin miners of £3,500,000 resulted. This happened on a rising demand. If supplies had been normal, and demand reduced, the fall in price could be expected. But what happened with tin knocked all economic theories on the head. It came because a concerted attack of speculators on the market by a group who had no interest in the welfare of the tin industry, and cared less for what happened to its consumers, says "Tin." During 1928, the year of active demand and moderate stocks, there was no reason why the price of tin should not have remained at the 1927 level—except this artificial influence. In plain words, tin producers under such conditions were incapable of protecting their own interests.

PERSONAL

Mr. F. Cox has taken over the duties of chief engineer of the Tees Side Bridge & Engineering Works, Limited, Middlesbrough.

Mr. Marmont Warren has been appointed a director of Wm. Gray & Company, Limited, of West Hartlepool. Mr. Warren served his apprenticeship at the Central Marine Engine Works.

Mr. G. Shaw Scott, secretary of the Institute of Metals since its formation, retired on June 30. He will become secretary emeritus of the Institute. Mr. Shaw Scott was only 24 when he was appointed, and had seen the growth in membership from 250 to 2,500. From a single room at Caxton House, London, the Institute has progressed by stages to the present premises in Grosvenor Gardens that are shared with the Iron and Steel Institute. During the retiring secretary's term of office the growth of the Institute's financial resources has been at the average rate of £1,000 a year. Mr. Shaw Scott received his metallurgical training under Prof. Thomas Turner, and was the first Birmingham University student to receive the B.Sc. degree in metallurgy. He has many interests outside metallurgy, particularly motoring and aviation, being a pioneer motorist and a member of the Executive Committee of the Automobile Association. He is a member of council of the Chartered Institute of Secretaries.

Wills

Russell, S., of Leicester, brassfounder	£44,197
Mathieson, W., of Horsforth, ironfounder	£95,620
M'Hattie, Joseph, of Ardrossan, retired steel-founder	£46,931
Douglas, Herbert, of Rotherham, cogging-mill manager, Steel, Peech & Tozer, Limited ...	£3,762
Napier, J. H., of Airdrie, Lanarkshire, managing director of Napier, Son & Company, Limited, ironfounders	£15,533
Dalgliesh, R. S., of Newcastle-upon-Tyne, chairman of R. S. Dalgliesh, Limited, and the Blyth Dry Docks & Shipbuilding Company, Limited	£769,122

COMPANY RESULTS

(Figures for previous year in brackets)

International Diatomite Company—No dividend on the ordinary shares for the year to March 31 last (3%).

W. & T. Avery—Final dividend on the ordinary shares of 10% (same), less tax at 9s. 9½d. (9s. 7d.), making 15%, less tax (same).

Mellowes & Company—Final dividend of 10% (same), plus a bonus of 7½% (2½%) on the ordinary shares, making 27½% for 1943 (22½%).

A.C.E. Machinery—Profit to September 30 last, £8,246 (£13,976); income-tax, £4,235 (£7,571); N.D.C., £410 (£813); dividend of 15% (same), £4,500; forward, £6,750 (£7,649).

Textile Machinery Makers—Balance of revenue for 1943, £82,735; over-provision for tax, £47,893; preference dividends, £39,079; ordinary dividend of 6%, £76,185; forward, £42,843 (£27,479).

Petrie & McNaught—Profit to August 30 last, £10,342; preference dividend for two years to April 30, 1942, £6,856; further year's preference dividend now recommended; forward, £16,748 (£16,689).

Francis Morton—Net profit to March 31 last, £24,136 (£19,121, after £2,000 to contingencies reserve); preference dividend, £1,000 (same); ordinary dividend of 10% (same) and a bonus of 5% on both preference and ordinary shares; forward, £48,508 (£37,122).

Drakes—Trading profit, including dividends and interest, etc., for 1943, £30,568; net profit, £6,804 (£8,271); special depreciation, £2,000; to reserve, £392; dividend on the 6% cumulative preference shares, £2,400; dividend of 7½% on the ordinary shares (same); forward, £15,890 (£15,754).

Park Gate Iron & Steel Company—Gross trading profit for the year to March 31, £225,445 (£198,638); depreciation, £60,000 (same); reserved for taxation, £68,000 (£105,000); debenture interest and sinking fund, £28,000 (same); war damage insurance, £8,495 (nil); net profit, £60,950 (£59,252); dividend of 4%, less tax, £40,000 (same); to reserve, £20,000 (same); forward, £47,958 (£47,008).

Whessoe Foundry & Engineering—Trading profit, etc., to March 31 last, £273,630 (£278,304); depreciation, £9,108 (£8,847); provident funds, £2,994 (£2,739); staff and workmen's bonus, £9,437 (£10,000); directors' commission on profits, £3,589 (£3,422); tax, £195,104 (£206,599); net profit, £51,325 (£44,233); to reserve, £15,000 (nil); interim dividend of 10%, £10,000 (same); final dividend of 30%, £30,000 (same); forward, £37,259 (£40,934).

OBITUARY

Mr. Alexander M. B. Cousins, partner in the firm of J. B. Cousins & Sons, consulting engineers, of Glasgow, died on June 24, aged 58.

Prof. Charles Thomas Archer, of Norbury, has been killed by enemy action. He was professor of science at the Imperial College of Science and Technology.

NEWS IN BRIEF

Rodney Foundry Company, Limited, is being wound up voluntarily. Mr. M. W. H. Lancaster, Oakmead, South Hill Avenue, Harrow, Middlesex, is the liquidator.

Tylerybont Lime & Limestone Company, Limited, is being wound up voluntarily. Mr. W. J. James, of Stephenson, Smart & Company, 4, The Bulwark, Brecon, is the liquidator.

The Cast Iron Pipe Research Association of America, in co-operation with a number of interested bodies in Texas, is conducting a survey of corrosion experience with a view to reducing corrosion of pipelines.

The Commissioners of Inland Revenue have authorised relief from United Kingdom income-tax in respect of Dominion income-tax for the four years ended April 5, 1942, on dividends declared by the International Nickel Company of Canada, Limited.

The British Cast Iron Research Association opened on July 1 a building uses department, to deal with technical problems concerning the use of cast iron in various branches of building. Mr. Derek Bridgwater has been appointed to act as the consulting architect to this new department.

The T.U.C. has sent a circular to all affiliated unions suggesting that it should be empowered to ask the Government for a Bill giving the Minister of Labour authority to legalise agreements concluded by the employers and workers in all industries for the establishment of a 40-hour week without reduction in earnings.

The Companies Registration Office gives notice that the names of the undermentioned companies have been struck off the register, and such companies are dissolved:—Fosse Lime & Limestone, Limited; Hartley Engineering Company, Limited; Mosborough Moor Coal Company, Limited; Simfield Tool Company, Limited.

At the annual meeting last week of the Royal Society of Arts, Dr. F. E. Armstrong, F.R.S., was re-elected president for the next year. He informally presented the Albert Gold Medal for the year to Sir Henry Tizard, F.R.S., for his work on aeronautical research and his general services to science and technology.

The Control of Machine Tools (Cutting Tools) (No. 3) Order, 1944, made by the Minister of Supply, revokes the Control of Machine Tools (Cutting Tools) (No. 2) Order, 1942, under which cutting tools of certain types and dimensions had to be made by welding or brazing the cutting portion to a shank not containing any tungsten or vanadium or cobalt.

According to the U.S. Bureau of Mines, production of iron ore in February totalled 2,646,717 gross tons. This is the lowest figure recorded for any month since the Bureau started the monthly iron-ore survey in October, 1942. About 85 per cent. of the United States total is produced in the Lake Superior district. Nine shipments in February totalled 1,263,734 tons. Iron-ore stocks at mines continued to increase during the month, having accumulated to 8,265,159 tons at the end of February.

Raw Material Markets

IRON AND STEEL

Business in foundry pig-iron continues to be on a restricted scale, but substantial tonnages of all other grades of iron are moving steadily into consumption. Though conditions vary at different establishments, most of the engineering foundries have a lot of work in hand and maintain a steady demand for low- and medium-phosphorus irons. Makers of refined iron are disposing of fairly large quantities for delivery in the third quarter of the year, and the big output of basic iron is reserved for the steelworks. Blast-furnace supplies of coke, ironstone and limestone are all coming to hand in adequate tonnages and generally the transport position is showing a marked improvement. Foundries, however, would welcome the opportunity of putting down stocks of coke. They also would wish that there were less stringency in scrap supplies.

It is still necessary from time to time to release imported steel semis to ensure the regular operation of the re-rolling mills, but the great bulk of the material used is now supplied from home sources. This takes various forms, defectives as well as prime billets, double-sawn crops, occasional tonnages of shell discard steel, etc., all being grist to the re-rolling mills. The sheet mills are just as busy as those engaged on light sections, etc., but adequate tonnages of sheet bars are still readily obtainable.

Just as the demand for sections is focussed almost wholly on the light and medium sizes, so also is the call for plates drifting more and more towards the lighter sizes. The pressure on the plate mills is not so intense as it was, but the demand is still very extensive, and the high activity of the shipbuilding, boilermaking and rolling-stock trades ensures full-scale employment for the plate mills for long periods ahead. The collieries are taking up considerable tonnages of steel in the form of arches, props, bars, rails, etc., and in many cases would be glad to accept more if their allocations could be increased.

NON-FERROUS METALS

The non-ferrous metal situation has of late undergone little marked change from week to week. Many of the war factories are operating considerably less actively than they were, and output as a whole is well below the levels of the peak period of a year or so ago. It is not yet known how this state of affairs will be modified by the progress of military operations and whether there will be any strengthening in the demand during the next few months.

In America during the last month or two it has been understood that there has been a scarcity of copper, but the latest reports have hinted that the position is less tight than was suggested. Although the Government stockpiles are not as large as might be desired, it seems that the actual situation is much more comfortable than was at first indicated.

Supplies of copper are available to this country on a large scale. The Allies now command vast resources of this metal from the various sources of supply open to them. It is probable that there may be some reduction in imports, owing to the heavy calls being made on shipping space. The reserve stocks now held ensure satisfactory supplies to war plants, but any likelihood of civilian releases has been even further reduced. At the present time the scrap position is very dull, and this may be said to reflect the general trend of the copper market.

The tin market remains rather featureless. There is no metal to spare for non-priority purposes, but for essential work the required amounts are forthcoming. It is becoming increasingly obvious that the liberation of the Far Eastern producing areas is drawing steadily nearer. Even after this, however, it will in all probability be three or four years before rehabilitation and restoration to production is completed. In the meantime consumers will have to depend on the alternative sources of supply that they are now relying on. The recognition of the Bolivian Government by Great Britain and the United States should assist trading relations and ensure that the supply of tin from that country is full maintained. It may also result in Bolivia's obtaining assistance in the way of equipment, etc.

AT A MEETING at Newcastle-upon-Tyne attended by trade union representatives, local councillors and several industrialists, to consider the post-war industrial future of Tyneside, it was decided to appoint a committee of ten to draw up rules for the formation of an association. The meeting was called by Lord Ridley, chairman of Northumberland County Council. The new committee includes Mr. Clive Cookson and Colonel H. B. Leeson, and representatives of local councils and various trade unions.

CURRENT PRICES OF IRON, STEEL AND NON-FERROUS METALS

(Delivered, unless otherwise stated)

Wednesday, July 5, 1944

PIG-IRON

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

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

Hematite.—Si up to 2.25 per cent., S & P 0.03 to 0.05 per cent: Scotland, N.-E. Coast and West Coast of England, 138s. 6d.; Sheffield, 144s.; Birmingham, 150s.; Wales (Welsh iron), 134s. East Coast No. 3 at Birmingham, 149s.

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

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

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

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

Cold Blast.—South Staffs, 227s. 6d.

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

FERRO-ALLOYS

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

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

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

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

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

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

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

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

Cobalt.—98/99 per cent., 8s. 9d. lb.

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

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

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

SEMI-FINISHED STEEL

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

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

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

FINISHED STEEL

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

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

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

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

NON-FERROUS METALS

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

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

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

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

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

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

Brass.—Solid-drawn tubes, 14d. per lb.; brazed tubes, 16d.; rods, drawn, 11⅝d.; rods, extruded or rolled, 9d.; sheets to 10 w.g., 11¼d.; wire, 10⅞d.; rolled metal, 10½d.; yellow metal rods, 9d.

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

Phosphor Bronze.—Strip, 14¼d. per lb.; sheets to 10 w.g., 15¼d.; wire, 16½d.; rods, 16½d.; tubes, 21½d.; castings, 20d., delivery 3 cwt. free. 10 per cent. phos. cop. £35 above B.S.; 15 per cent. phos. cop. £43 above B.S.; phosphor tin (5 per cent.) £40 above price of English ingots. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 10d. to 1s. 4d. per lb.; rolled to 9 in. wide, 1s. 4d. to 1s. 10d.; to 12 in wide, 1s. 4½d. to 1s. 10½d.; to 15 in. wide, 1s. 4½d. to 1s. 10½d.; to 18 in. wide, 1s. 5d. to 1s. 11d.; to 21 in. wide, 1s. 5½d. to 1s. 11½d.; to 25 in. wide, 1s. 6d. to 2s. Ingots for spoons and forks, 10d. to 1s. 6½d. Ingots rolled to spoon size, 1s. 1d. to 1s. 9½d. Wire round, to 10g., 1s. 7½d. to 2s. 2¼d., with extras according to gauge. Special 5ths quality turning rods in straight lengths, 1s. 6½d. upwards.

NON-FERROUS SCRAP

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

Returned Process Scrap.—(Issued by the N.F.M.C. as the basis of settlement for returned process scrap, week ended July 1, where buyer and seller have not mutually agreed a price; net, per ton, ex-sellers' works, suitably packed):—

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

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

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

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

IRON AND STEEL SCRAP

(*Delivered free to consumers' works. Plus 3½ per cent. dealers' remuneration.* 50 *tons and upwards over three months,* 2s. 6d. *extra.*)

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

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

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

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

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

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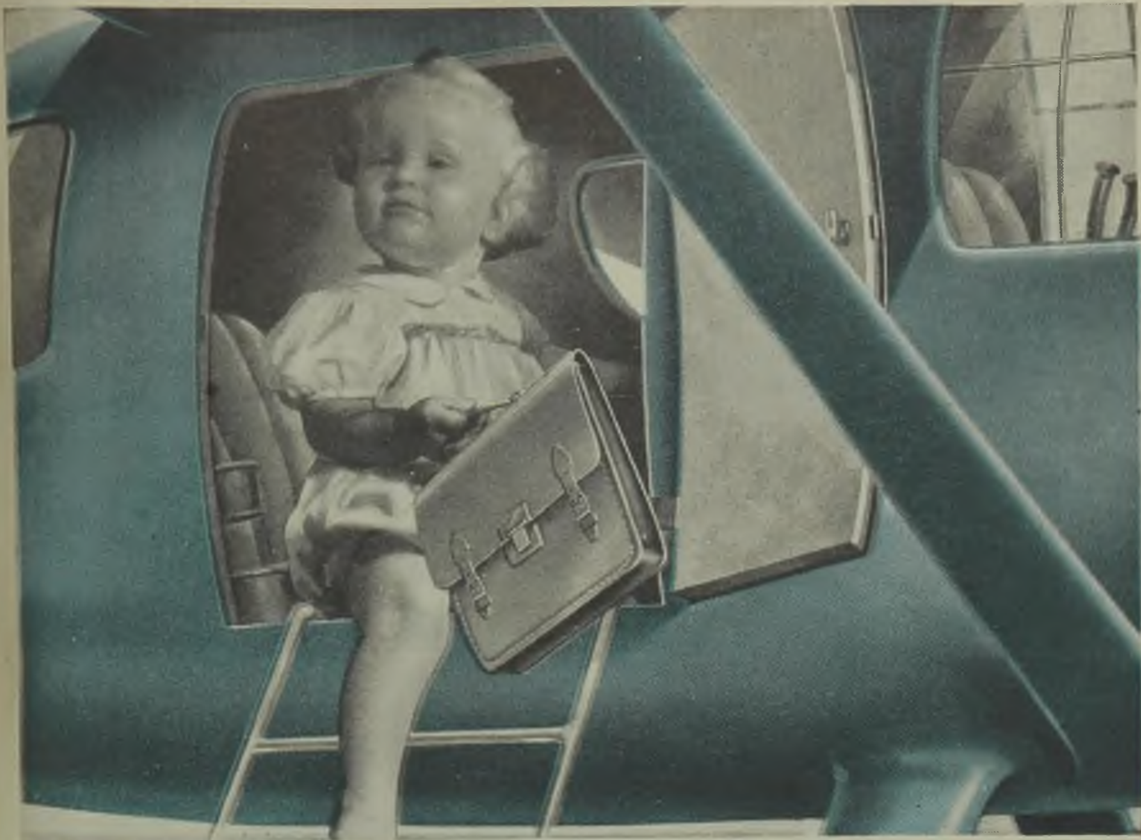

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