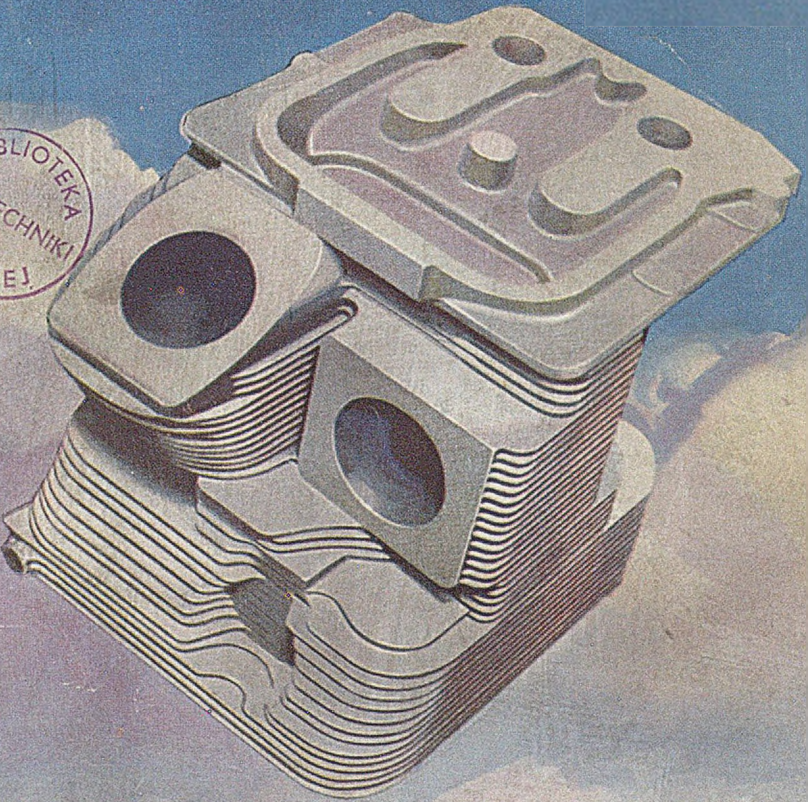
LIGHT METALS

JANUARY 1949

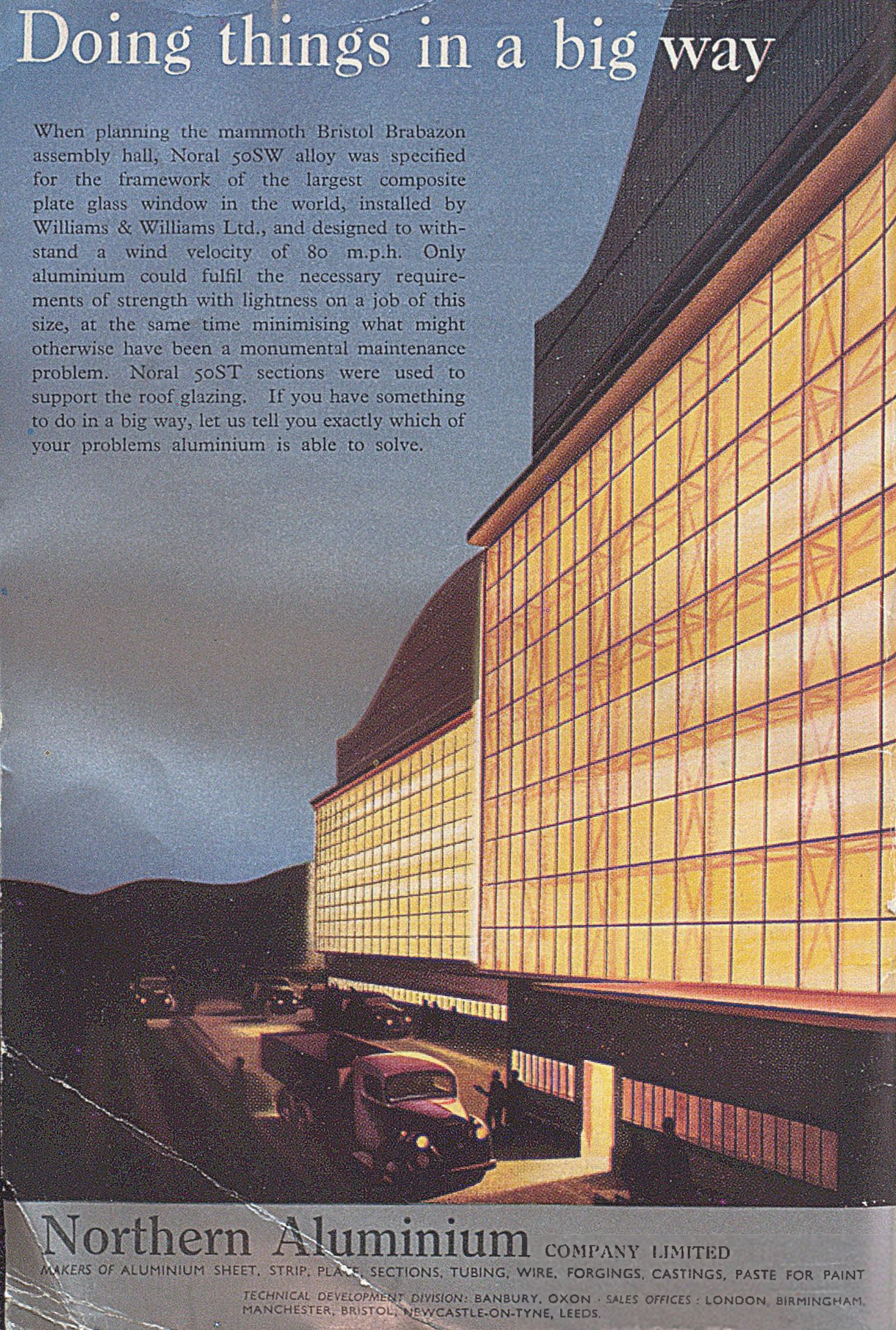
Two Shillings



ALUMINIUM DIECASTING

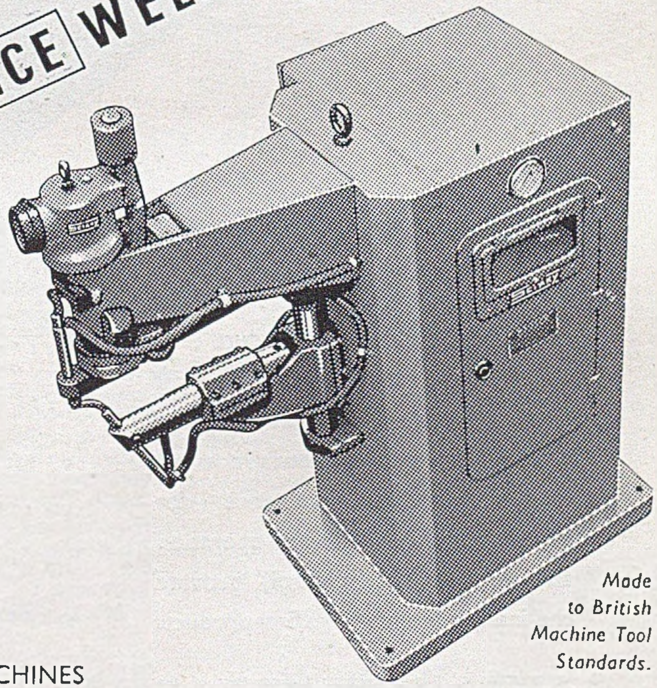
CYLINDER HEAD, PITCH OF FINS 4MMS. WEIGHT 11¼ LBS.

Illustration by courtesy of the De Havilland Engine Co. Ltd.


Doing things in a big way
When planning the mammoth Bristol Brabazon assembly hall, Noral 50SW alloy was specified for the framework of the largest composite plate glass window in the world, installed by Williams & Williams Ltd., and designed to withstand a wind velocity of 80 m.p.h. Only aluminium could fulfil the necessary requirements of strength with lightness on a job of this size, at the same time minimising what might otherwise have been a monumental maintenance problem. Noral 50ST sections were used to support the roof glazing. If you have something to do in a big way, let us tell you exactly which of your problems aluminium is able to solve.
Northern Aluminium COMPANY LIMITED
MAKERS OF ALUMINIUM SHEET, STRIP, PLATE, SECTIONS, TUBING, WIRE, FORGINGS, CASTINGS, PASTE FOR PAINT
TECHNICAL DEVELOPMENT DIVISION: BANBURY, OXON · SALES OFFICES: LONDON, BIRMINGHAM, MANCHESTER, BRISTOL, NEWCASTLE-ON-TYNE, LEEDS.

SCIAKY

RESISTANCE WELDING MACHINES



SPOT

SEAM

STITCH

FLASH-BUTT

PROJECTION

PORTABLE SPOT

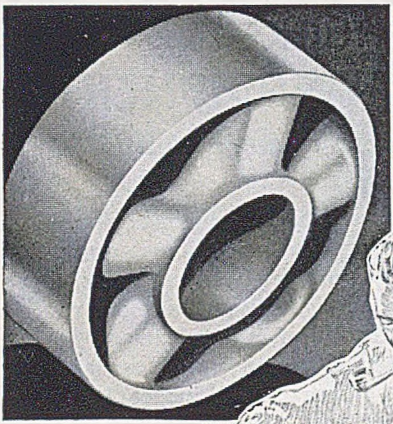
SPECIAL PURPOSE MACHINES

Made to British Machine Tool Standards.

SCIAKY SLOUGH ENGLAND

Sciaky have a machine for the job

SCIAKY ELECTRIC WELDING MACHINES LTD., FARNHAM RD., SLOUGH, BUCKS, ENGLAND
Telephone SLOUGH 22342-3
ALSO LONDON, BIRMINGHAM, MANCHESTER, PARIS, CHICAGO, SYDNEY & CALCUTTA



Pulley casting as used on double-acting Beche hammer. Weight in Elektron 850 lbs. Courtesy of the English Steel Corporation Ltd.

The pulley had to be light because in power transmission the inertia forces must be kept low; but it had to be strong also because of the very high stresses which power transmission sets up. A pulley of the prescribed dimensions in any other material would have been too heavy (steel, aluminium and bronze had already proved unsuccessful); and, apart from the time lost in acceleration, and the high stresses caused by sudden braking, it would also have required excessive power to operate. That was the problem—and only Elektron magnesium alloys could solve it. They saved power, time and wear and tear.

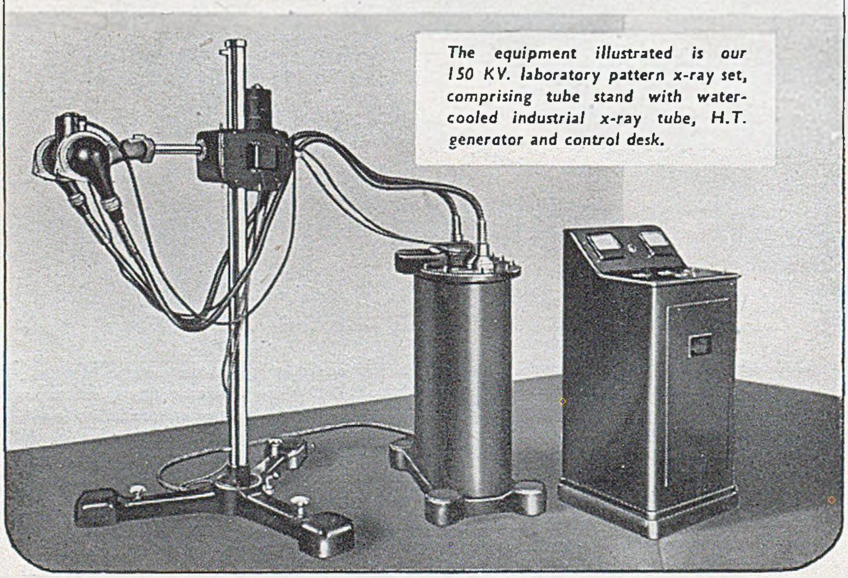
But these are economies from which all moving mechanical parts, and especially vehicles, can profit. Greater acceleration, better braking capacity, reduced stresses, improved dynamic stability, higher speed—could *your* products benefit from such advantages? In other words, would they be better for being lighter? If so, you should consider the advisability of producing them in the lightest of all constructional metals:

"ELEKTRON"
REGISTERED TRADE MARK
Magnesium Alloys

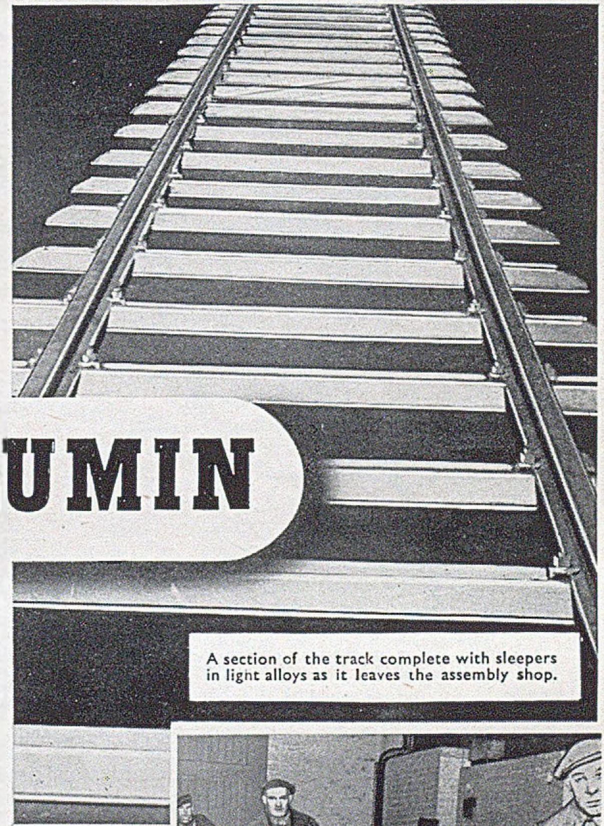
makes light of weighty problems

Write for particulars to:—

F. A. HUGHES & CO. LTD. BATH HOUSE 82 PICCADILLY LONDON W.1.


The equipment illustrated is our 150 KV. laboratory pattern x-ray set, comprising tube stand with water-cooled industrial x-ray tube, H.T. generator and control desk.

ANOTHER PROBLEM SUCCESSFULLY SOLVED WITH DURALUMIN



A section of the track complete with sleepers in light alloys as it leaves the assembly shop.

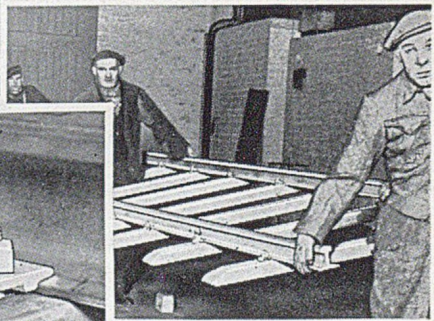
A railway track that won't sink into marshy land

Constructed entirely in

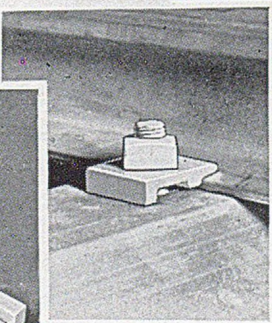
DURALUMIN

REGD. TRADE MARK

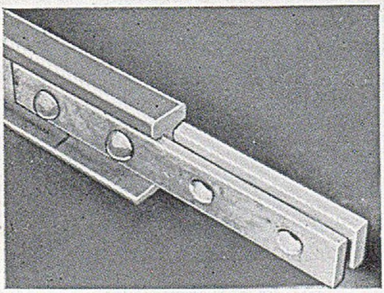
ALMOST every day brings news of fresh developments in the use of "Duralumin", the light aluminium alloy. One of the more interesting cases is the fabrication of complete sections (track and sleepers) for a railway that will carry bogies in conditions under which a normal track would sink. Designed primarily for laying over peat-marsh land its success points the way to its further use in tropics, desert and jungle.



The 30 ft. sections with sleepers attached are lifted easily by three men.



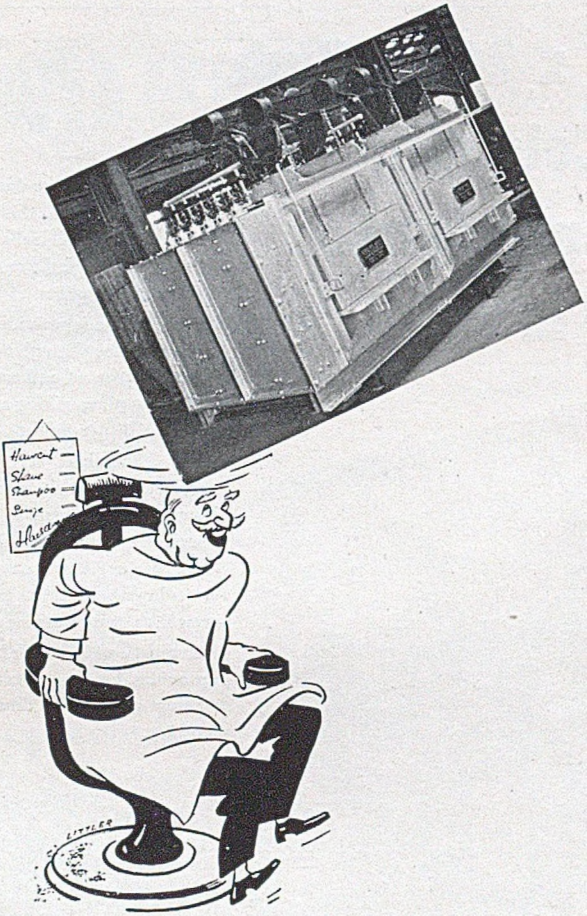
The method used for holding the track to the sleepers.

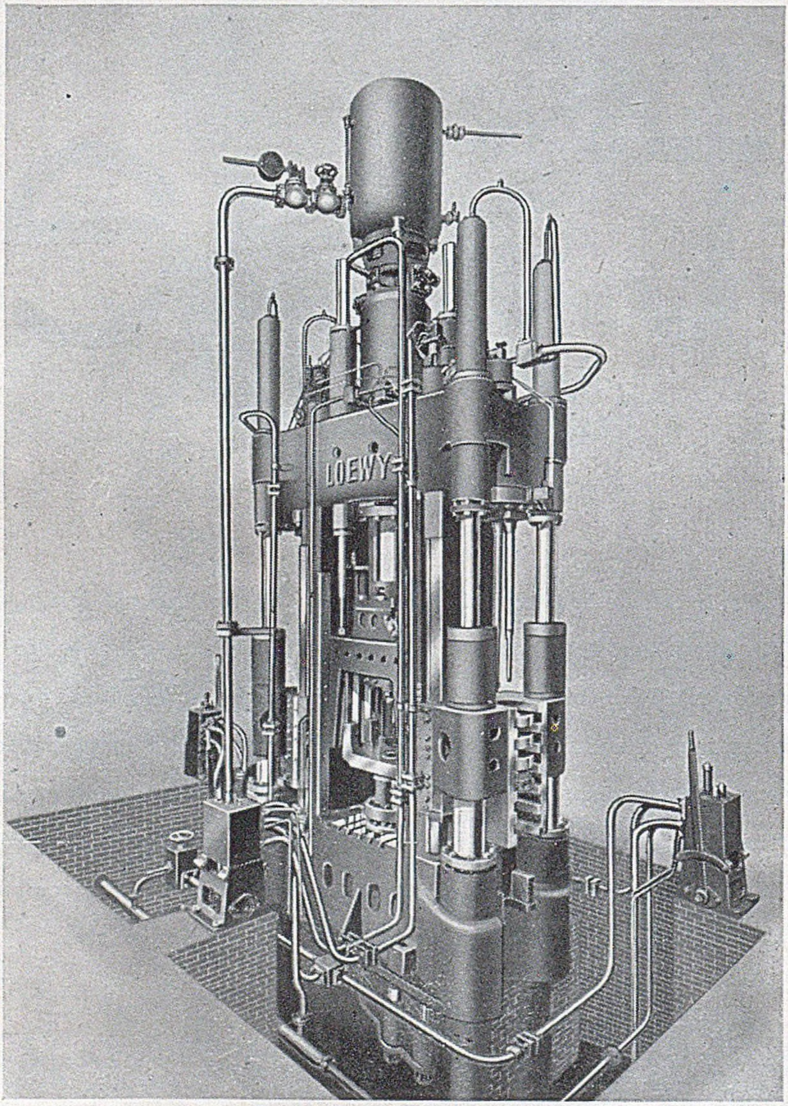


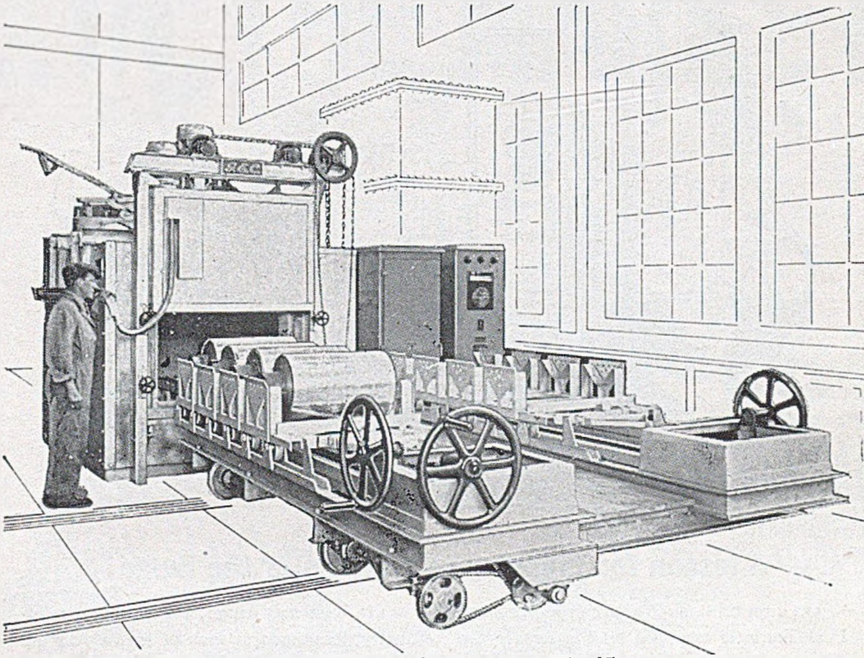
Details of the fish plate joint.

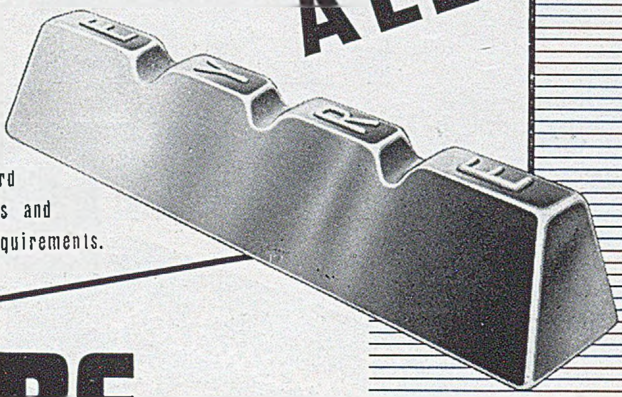
BOOTH BIRMINGHAM

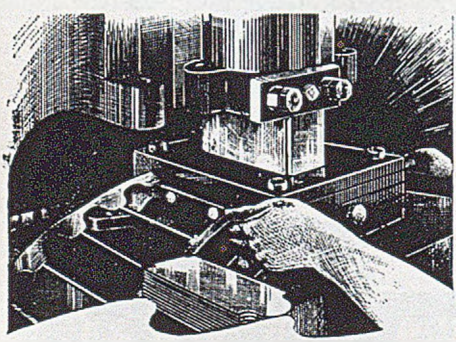
JAMES BOOTH & COMPANY LTD., ARGYLE ST. WORKS, BIRMINGHAM 7

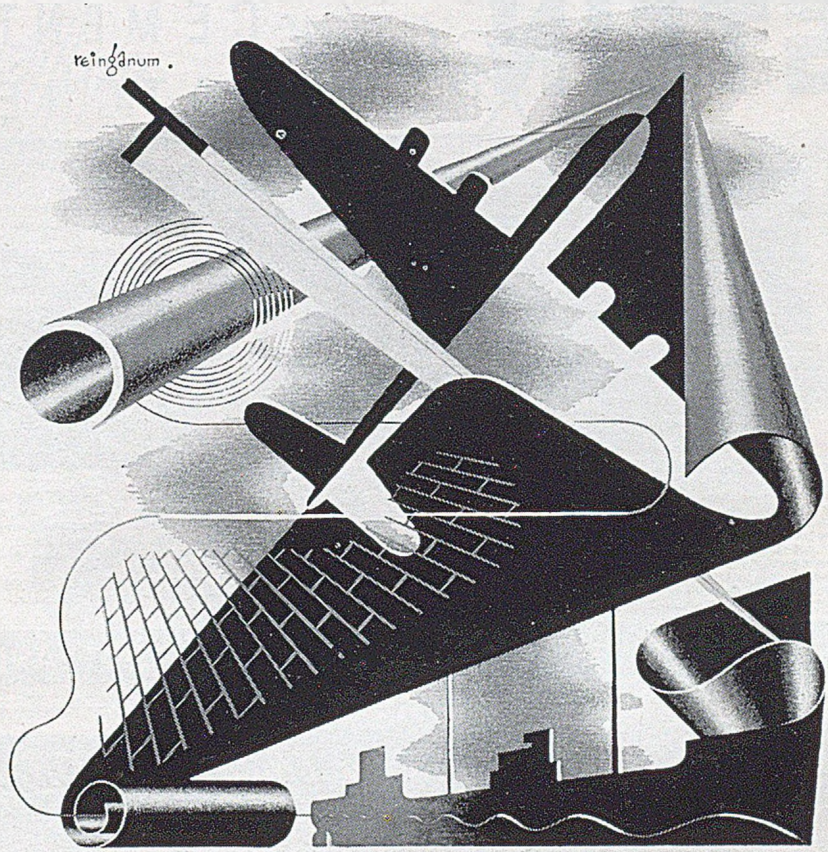



LOEWY







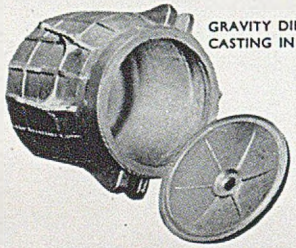

reingånum.


The "Reverbale"
MODEL 3G (3-STATION)

Some Representative Castings by

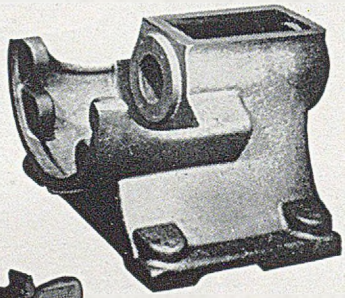
KENT ALLOYS LTD

FOUNDERS TO THE ENGINEERING INDUSTRY IN LIGHT ALLOY AND IRON CASTINGS

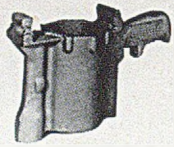


GRAVITY DIE CASTING IN L33

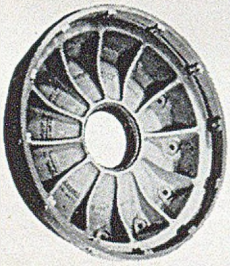
PRESSURE DIE CASTING IN L33



SAND CASTING IN IRON



SAND CASTING IN DTD 424



MAGNESIUM WHEEL SAND CASTING

THIS page illustrates the service we offer in the casting of Ferrous and non-Ferrous metals. To this service we bring a metallurgical and radiological control of the first order. May we add the production unit of KENT ALLOYS to your own facilities?

KENT ALLOYS LTD

FOUNDERS AND ENGINEERS

HEAD OFFICE · ROCHESTER KENT

TELEPHONE : STROOD 7674/8

LIGHT METALS

VOL. XII. No. 132 JANUARY, 1949

Dealing Authoritatively with the Production, Uses and Potentialities of Light Metals and their Alloys

PROPRIETORS TEMPLE PRESS LIMITED CHAIRMAN & MANAGING DIRECTOR ROLAND E. DANGERFIELD

EDITOR E. J. GROOM, M.Inst.Met.

EDITORIAL OPINION

Wood Wool

"Wann starb wohl je ein Drache am Gift einer Schlange?"

THE wood merchants are alarmed and no wonder! Our access to overseas supplies of soft timber has for some years, and for a number of reasons, been severely restricted, domestic resources are dangerously impoverished, whilst control either scares off or exasperates the prospective user to such a degree that he instinctively flies to attractive alternatives: aluminium has already established itself as equal to the occasion. So, if we may judge from a broadsheet recently wafted in on a breeze from Kent, the sawmills are impressed.

In pre-war days we were quite accustomed to receiving pamphlets, even bound volumes, written mainly in pseudo-scientific language and bearing fearsome titles, all designed to prevent our boiling the morning egg in the aluminium saucepan. This manifestation, we believe, is now almost a spent force, but another arises to take its place and, as indicated by the publication to which we have referred, attack is directed from a different direction.

"This material," the sheet tells us, "is much discussed and its use is becoming somewhat widespread. . . ." No finer tribute can be paid to the author of these words than to acknowledge our unqualified agreement. The rest of the text, in so far as it relates to light alloys for building construction, is technically unsound and no support is lent to the argument by simultaneous misrepresentation of the cases for asbestos-cement sheet and steel.

As opposed to this misguided *positive* reaction to aluminium's success, we have, within the past few days, observed an instance of negative behaviour equally unfortunate. This occurs in the Memorandum on Steel Utilization recently prepared and approved by the Parliamentary and Scientific Committee. In this statement, reference is quite rightly made to the need for economizing in the use of steel, and of the "four lines of approach" set out, the first is devoted to alternative materials. We read that "when steel for structural purposes is replaced by concrete or wood, the question of cost has to be considered in relation to the economy in steel effected." Now with respect to the use of concrete, we certainly see eye to eye with the Committee, but this attitude cannot apply in the case of wood and, indeed, does not do so.

It is well known that whereas the outer shell of a building may be quite simply constructed in freely available raw materials (of which concrete is probably the most acceptable), obtaining the wherewithal for "lids" is the architect's and contractor's biggest headache. Not only is timber doled out in halfpenny numbers, and, even so, after appalling delays, but, all too frequently, is of lamentable quality. Thus roof structure becomes a major problem. Flat roofs, needing neither steel nor timber, are a difficult proposition at the best of times, and therefore the builder is, in general, compelled to find a suitable alternative to timber and steel to support his tiles or roofing sheets. How successful aluminium has been in this regard is made quite clear in many past issues of "Light Metals." See, for example, the opening pages of our December number, wherein is described a group of buildings in which, by the use of light alloys, major economies were effected not only to the virtual exclusion of steel from the roof structure, but also in overall cost. In short, the omission of reference to aluminium and magnesium in the memorandum must, from the scientific and technological standpoints, be regarded as most regrettable.

A curious kind of hangover from war-time days has recently been brought to our notice. Issued by the British Standards Institution is War Emergency British Standards Specification BS/BOT 16 (prepared at the request of the Board of Trade) and covering hearth furniture; the opening clause reads: "non-ferrous metals shall not be used for the manufacture of the articles included in this specification, except as provided for in Clause 2." Turning to Clause 2, we find "except where otherwise stated, all articles shall be supplied either with a black japanned finish or with a copper finish." Now it is obvious that this document has not the restrictive force of an Order in Council, nor that of a recognized legal enactment, nevertheless, in spite of the fact that it is dated 1942, it still holds good, and, by reason of its wording, is frequently misinterpreted by prospective users of non-ferrous metals for the purpose it covers. Aluminium is ideally suited to the manufacture of hearth furniture, but more than one careful soul appears to have hesitated, frightened by Clause I in BS/BOT 16. The industrial air would be sweetened somewhat if this last, and its bedfellow S.R. and O., 1945, No. 1509 (parasitic on B.S.I. Spec. No. 866 (3R)—1940, Revised 1944), relating to containers and packaging, were expunged.

Contents

	Page
SPECIAL FEATURES	
Housing and Town Planning	3
Anodizing as Fine Art	6
Arc Welding of Aluminium and its Alloys	12
Light Alloys for Refrigeration Equipment	20
The Lui-Beg Footbridge	22
Advances in Magnesium Technology	24
Are They Really Necessary?	28
Aluminium Conduit and Accessories	40
Cathodic Protection	43
Art and the Container	51
Evolution of the Aluminium Industry in France	54
REGULAR FEATURES	
Editorial Opinion	1
News—General, Technical and Commercial	31
Index to Advertisers	57

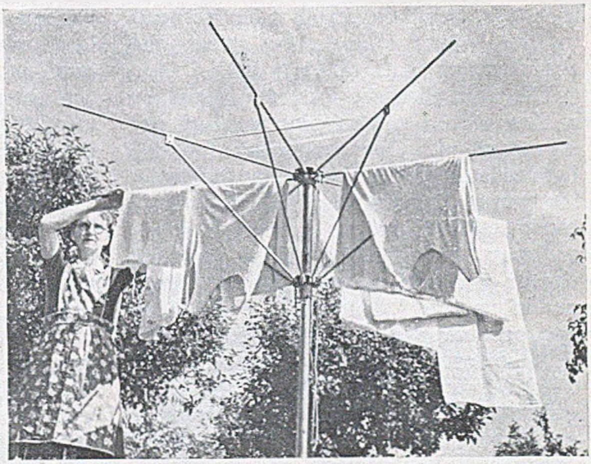
TEMPLE PRESS LIMITED

Head Offices:
Bowling Green Lane, London, E.C.1.
Telephone: Terminus 3636.
Inland Telegrams:
"Pressimus, Phone, London."

Branch Offices at:
5, Suffolk St., Birmingham, 1. *Tel.: Midland* 4117-8.
50, Hertford St., Coventry. *Tel.: Coventry* 62464.
1, Brazennose St., Manchester, 2. *Tel.: Blackfriars* 5038-9.
12, Renfield St., Glasgow. *Tel.: Glasgow Central* 9036.

"LIGHT METALS" is published in London, England, on the first Wednesday of each month.
Annual Subscription Rate: 26/- post free. Shorter periods pro rata.
SAVE PAPER.—Waste paper is still urgently required.

HOUSING and TOWN PLANNING



DOMESTIC equipment can, with some propriety, introduce our brief commentary on the International Housing and Town Planning Exhibition, which was held at Olympia in November, 1948.

The "Tolwash" expanding clothes drier by Frederick Watson and Co., 180-182, Acre Lane, Brixton, London, S.W.9, attracted by its sheer novelty very considerable attention. It is of an umbrella-type construction, built upon a substantial central tube, the whole fabricated in aluminium alloy and mounted upon a firm baseplate. Two sizes are made, one for indoors, measuring 4 ft. in diameter when open for use and equivalent to a 16-ft. clothes line, yet with a total weight of only 4½ lb. The outdoor pattern, designed to drop into a buried

SHOWN in the three illustrations on this page are (at the head), the all-aluminium "Tolwash" expanding clothes drier, outside model, in operating position, next (above, at the left), the indoor type, and (above right), the outdoor type in folded-up position.

base box, is similar in all other respects to the indoor model, but gives the equivalent of 24 ft. of line.

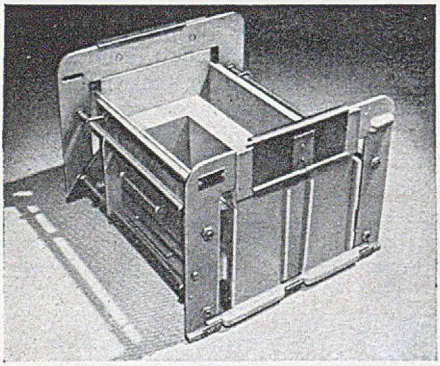
The umbrellas are instantly rigged by pulling a cord and slipping a safety peg into position. One particular attractive feature is the peg basket, which is usually hung upon the central pole. The whole construction is robust enough to carry ordinary household washing without danger of overturning or collapse. When not in use the "Tolwash" is closed up and occupies virtually no storage space.

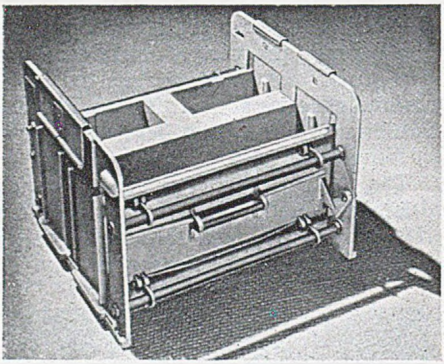
A constructive suggestion we have to offer is this, that by anodizing the arms which carry the clothes, any danger of marking delicate textiles, such as might occur if, when hung in the wet state, they were blown about for any length of time by the wind, would be entirely avoided.

On the stand of Soro Products, Ltd., 88-90, Caledonian Road, London, N.1, were shown "Supa" tiles in sizes 6 ins. by 3 ins., 6 ins. by 6 ins. and other dimensions as required. These were demonstrated as wall facings for kitchens, bathrooms and other domestic offices. The tiles are pressed from thin aluminium-alloy sheet, which is afterwards given a special surface treatment, the final appearance being similar to an enamel or anodized and dyed coating. Before fixing to plaster or concrete walling, the tiles are flush-filled to the level of their turned-up edges with a quick-setting compound. Neat internal and external tiles are available, and very thin seams between adjacent tiles are easily and neatly filled with cement or composition during the positioning.

Though this wall-finishing method is said to be less costly than the commonly used glazed tiles and doubtless has good possibilities, the examples shown gave the impression of possessing a concave surface, which, from the æsthetic standpoint, detracted from the final appearance of the finished wall. This apparent defect, which may be of a purely optical nature, could probably be avoided by slitting the flanges at the corners, i.e., by notching during the initial blanking operation. Sharper corners, of course, would result from this modification, and it is considered a somewhat neater appearance would be obtained on the wall.

The London Warming Co., Ltd., 2, Percy Street, Rathbone Place, London, W.1, exhibited the "Alimin Stove" for houses, workshops and offices. It is constructed entirely from aluminium sand castings and, although of neat appearance, could be enhanced in this respect if built up from gravity castings. At the same time, a considerable reduction in cost could probably be effected.

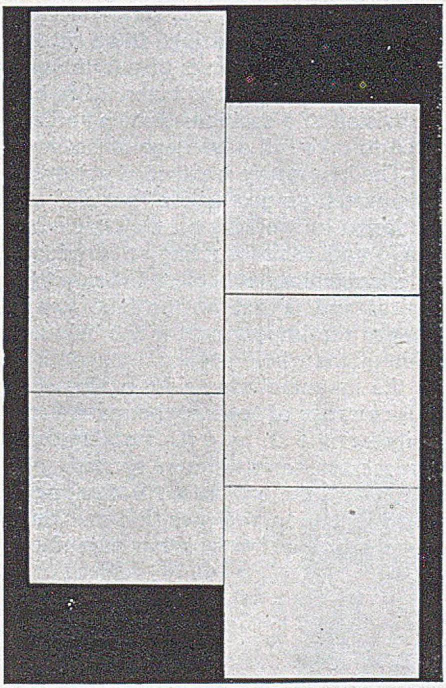




NOTABLE example of a specialized use of aluminium (in conjunction with steel bolts and ties) is the "On Site" building machine, shown here as set up for corners and "Tees" in concrete. The metal has fully demonstrated its ability to withstand the ordinary service conditions encountered here. (See "Light Metals," 1948/11/549.)

An exhibit of special interest was to be found on the stand of the Building Plant Hire (On Site), Ltd., Cray Avenue, St. Mary Cray, Kent. Here was shown the " On Site " building machine for the progressive casting of concrete footings and walls. The apparatus is made of aluminium-alloy castings with steel bolt ties and levers. Those interested in this type of equipment should refer to a comprehensive account on the uses of light alloys in the precast concrete industry, to be found in "Light Metals," 1948/11/549.

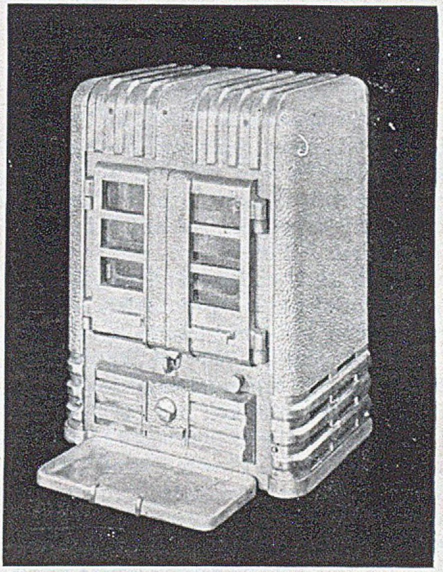
It occurred to us that the machine might with advantage be constructed of



magnesium-alloy castings in place of those in aluminium. In this way, not only would deadweight be decreased, but, furthermore, advantage could be taken of the total inertness of the ultra-light alloys to alkaline media.

Loft Ladders, Ltd., Broadway Works, Bromley, Kent, showed strong, light and neatly constructed ladders entirely in aluminium. Light metal has definitely come to stay in this connection. We await anxiously the time when the enterprise responsible for this development pushes still further ahead and we see on the market the all-magnesium-alloy ladder. These, it will be remembered, are already on sale in U.S.A., where they have gained considerable popularity among fruit farmers on the Pacific Coast.

Robert Crosse and Co., Ltd., Norman Road, S. Tottenham, London, N.15.



HERE, above, is the "Alimin" stove by the London Warming Co., Ltd. Designed for household and workshop use. it is constructed of aluminium-alloy sand castings. (See also "Light Metals" 1948/11/82.)

GROUP of "Supa" tiles (obtainable in a variety of colours) by Soro Products, Ltd. They are pressed from aluminium sheet and stove enamelled.

exhibited the "Kwikfold" tray table made in aluminium-alloy, and anodized and dyed in a range of attractive shades. Much ingenuity has been expended on the creation of this type of light-metal furniture and it is assured now of a permanent place in the home, in tea-rooms and hotels.

ANODIZING

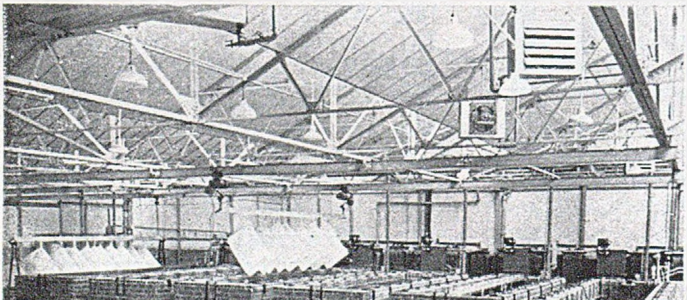
as fine art

DURING the post-war period considerable development has taken place in Scotland in all forms of light industry and in the erection of industrial estates. These estates have been built expressly to locate industries in areas where labour is more freely available. One of the factories now coming into production is that of Altones, Ltd., situated on the Newhouse Estate on the west side of Glasgow between Airdrie and Motherwell; it will produce aluminium manufactures which are particularly suited to decoration by anodizing and dyeing, and will undertake the fabrication processes, such as pressing, forging and machining and carry production through to anodizing and finishing.

Of the total 62,000 sq. ft., roughly 50,000 sq. ft. are available as factory space in one unbroken area and on one level. The remainder is devoted to administrative offices, drawing and design offices and a well-appointed canteen and laboratory. The most pleasing feature of the whole factory, apart from the well-ordered layout of plant and ample working space, is the careful attention which has been paid to lighting. In the daytime there is ample natural daylight admitted through the north-light roofing, which is supplemented and replaced by fluorescent lighting as daylight fails, thereby producing the optimum condition for the repetition of delicate shades in the dyeing process. Careful attention has also been paid to ventilation.

The primary object of the company is to place on the market goods, manufactured in aluminium by themselves, which will be finished by anodizing. In an enterprise such as this, design is of paramount importance, and here it is catered for by the provision of a spacious drawing office situated to take full advantage of natural light. The laboratory is intended not only to keep watch on production, but also to assist design by working on the choice of dyestuffs and their blending to produce any desired colour scheme. Indeed, the apparatus and layout of the laboratory emphasize the importance of the colouring side of the whole project.

On the manufacturing side, equipment includes a range of presses, the maximum capacity being 6 ft. by 4 ft. Forging can be undertaken to maximum pressure of 500 tons, and the tool room is equipped for both repetition and precision machining for the production of either manufac-



GENERAL view of one section of the factory of Altones Ltd., showing the five anodizing baths and at the extreme left the washing tank. Electrical apparatus is behind the baths along the far wall.

tures from extruded stock or for the manufacture of tools for press work. The polishing shop, situated near to the actual manufacturing section of the factory, is fully equipped to undertake all types of work which may from time to time be required.

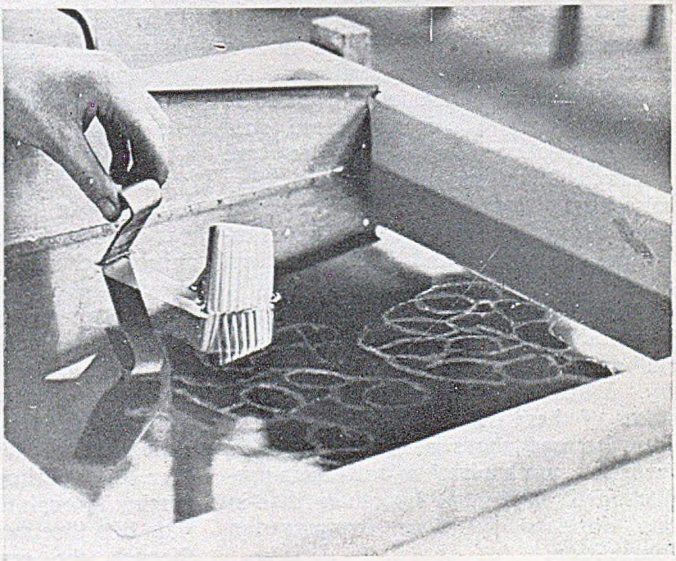
From the polishing stage the next step in production is degreasing, an essential pretreatment to anodizing. Solvent and alkali cleaning is employed, the solvent method involving the use of trichlorethylene, either in a vapour chamber or as a liquor spray.

The most striking installation of the whole factory is the anodizing plant. This comprises five large baths, 22 ft. long by 5 ft. wide and 6 ft. deep, sunk into the ground to about half their depth and arranged in a battery side by side, with a travelling crane for the introduction and removal of charges. The tanks are lined with acid-resisting glazed tiles. The electrical controls and automatic timers are arranged at the end of the tanks and are placed well back to allow plenty of working space for the operatives and to obviate any risk of damage by contact with the electrolyte, either by spray or accidental splashing. The tanks may be steam heated or water cooled, as occasion demands.

After anodizing, the articles pass on to the dyeing section of the factory, where a number of different devices are used for producing an artistic finish. The dyeing operation itself is simple and requires no explanation, but there exist a number of methods whereby multi-colour effects can be obtained. Briefly these all consist of dyeing the ground coat, stopping off certain portions of this ground coat with a resist resin, followed by a second dyeing, this process being repeated as many times as the different colours required in the final pattern.

It is in the application of the resist resin that the genius of the various designs shown in the coloured illustration lies. For instance, it may be applied with a press, as in the case of the central motif of the trays shown. Or it may be applied by hand with a sable brush, this method being employed for producing the coloured bands round the trays. On the other hand, the dye itself may be applied by hand, as in the case of the shaving-brush handle and the brooch.

The attractive scroll effects shown on the two shoe-lifts, the brush-back and the rectangular sheet are obtained by a fascinating process closely allied to water lithography. In this case the resist is first applied to a specially prepared water surface. To do this a quantity of resist is



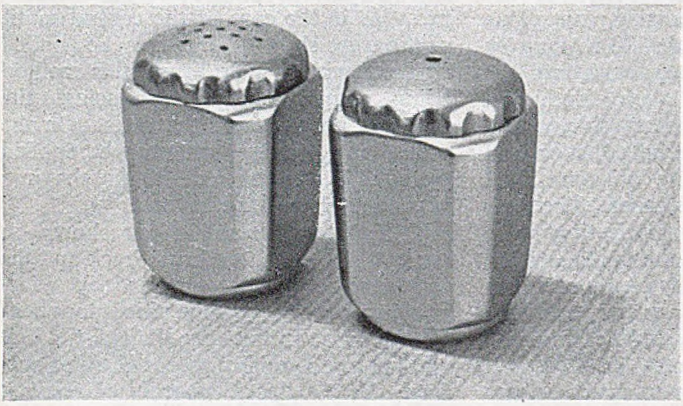
TRANSFERRING the resin resist from the surface of the water on to the workpiece. The article being processed here is a brush-back similar to that shown in the coloured illustration. Behind the operator's hand is seen the skimmer used for cleaning the water surface between each operation.

taken up on a small brush, which is then moved through the water in a regular but free-hand pattern. The resist is left on the surface of the water behind the brush. Next, the anodized piece dyed with the first colour is taken up on a holding jig and plunged under the water in a section of the bath which is free from resist. It is then carefully withdrawn from the water in such a manner that the resist becomes attached to the workpiece during the operation. The water surface is then cleaned with a skimmer ready for the next operation. The withdrawal of the workpiece is shown in an accompanying illustration.

Considerable skill is required in this process, both in the application of the resist to the water and in its transfer to the workpiece. The inexperienced hand merely produces ugly blotches and smears. Other undesirable effects may arise from over-confidence in the operator when the pattern may become too regular and stereotyped, and lose the freedom of expression offered by the process.

Many will, no doubt, welcome this re-introduction of personal manipulative skill and craftsmanship into British industry. Whilst in some quarters the future status of these islands as an exporter of manufactured goods is thought to lie in increased mechanization and mass-production, it is realized by others that in this direction we face overpowering competition.

Thus it is significant that, at the present time, one of our most valuable and most sought-after exports is English pottery. In this trade success depends less on the efficiency of the machine and more on the individual skill of the operator. It has been pointed out that the pottery industry's export target is one of the few to show a considerable increase—254 per cent. of the 1938 figure, compared with 233 per cent. for 1948—and it is expected that 1949 will show a continuing and unsatisfied demand for highest-quality pottery in the United States and Canada.



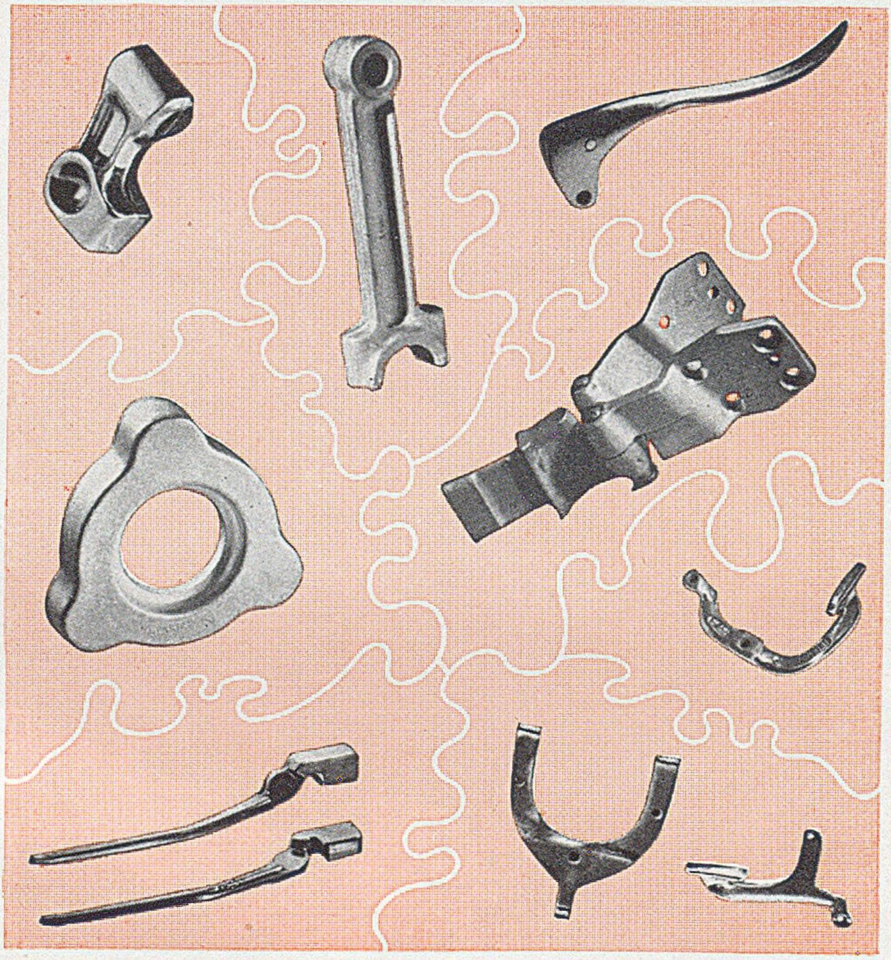
SALT and pepper pots. These are decorated in a range of colours the main body being in one shade and the cover and bottom rims contrasting with it.

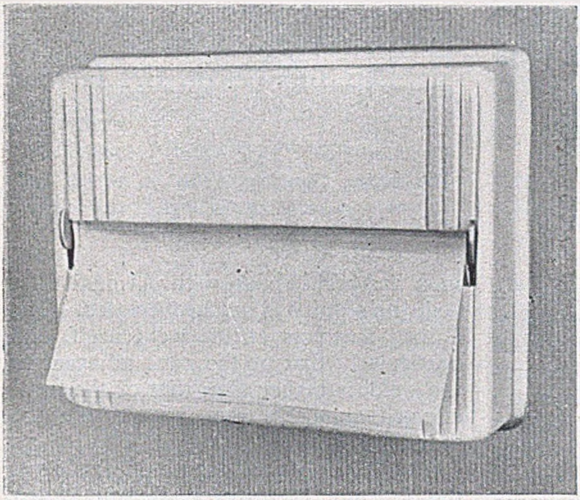
The industry—in particular, that section of it that makes high-quality wares—exemplifies the best traditions of British craftsmanship. The qualities of fine British china are recognized not only in the dollar area but throughout the world.

In the hand decoration of anodized aluminium we see a parallel case, for here, as in pottery, it is possible to achieve that personal appeal which is an inherent characteristic of the hand-made article and a most difficult feature for competitors to imitate.

After the application of the resist the workpiece is dyed a second time, and if a two-colour pattern only is required, as in the case of the brush-back, it is then sealed off. Another pattern can, however, be superimposed upon the first by passing through the cycle again. The two shoe lifts illustrated have actually passed through the resist-dyeing cycle twice

SHOWN here are typical examples of anodized work by Altones Ltd., Newhouse Industrial Estate, Lanarkshire. The illustration includes five small trays in heavy-gauge aluminium grouped around two shoe lifts. Below these from left to right are a shaving brush handle, a sample showing the effect obtained with the special process described an hand-coloured brooch, and a brush back.





TOILET fixture forming part of a range of bathroom fittings. A neat method for reloading is incorporated in this design.

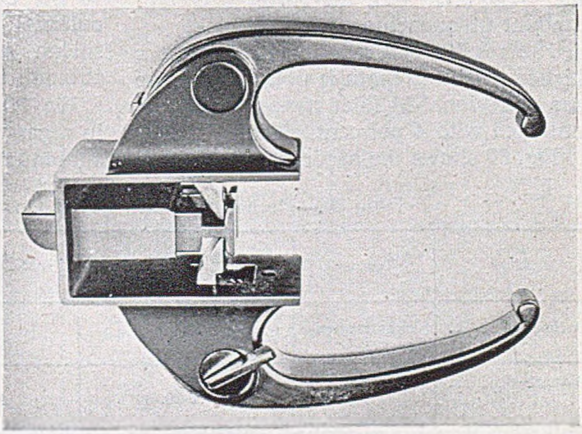
although the effect obtained is not clearly shown in the illustration.

If straightforward dyeing is to be employed, the first dye applied is of the lightest shade, subsequent dyeings being progressively darker. In other words, the background colour, the red in the case of the brush-back, is applied last. The process would. therefore, normally only permit a light-coloured design on a dark background were it not for a further degree of possible variation arising from the fact that certain dyes undergo a complete change in colour when treated with the appropriate chemical reagent. A dark colour may thereby be selectively transformed to a totally different and lighter colour or vice versa.

Finally, a word about some of the products at present envisaged. Besides those already mentioned, a complete coal-fire surround has been designed which incorporates elements for electric heating with hinged screens, which cover either the fireplace or the electric elements. Other electric fires and fittings are contemplated which take advantage of the heat- and light-reflecting properties of anodized aluminium.

Another development is a novel idea in latch design. The body of this latch is produced by forging extruded stock. It is of robust but neat design, and in fitting requires only a small amount of wood to be removed from the door. The locking device operates on an eccentric bush, which moves one handle into such a position that it locks against the frame of the latch. Two types will be available; one with a removable key, the other with a lever.

Toilet and bathroom fittings have also been designed, and examples of these and other manufactures are illustrated.



DOOR latch in anodized aluminium. In operation the mechanism is actuated by a forward pull instead of the customary up-and-down movement.

ARC WELDING of Aluminium and its Alloys

by A. Schärer,
Dip.-Ing.-Chem. E.T.H.

Continued from "Light Metals" 1948, 11, 671.
The Author Considers Welds in Avional and Chilled Castings.

THE following investigations refer to arc-welded and gas-welded joints in heat-treatable copper-bearing alloys of Avional-M (Al-Cu-Mg type). The properties of the unwelded base alloys are set out in Table 30, the corresponding figures for the welded material being summarized in Table 31.

As averages of 10 tensile specimens made from 4-mm. Avional-M sheet, the data set out in Table 30 were obtained.

Subsequently tensile figures for unheat-treated and heat-treated gas and arc welds were determined as averages from 20 specimens (Table 31).

The tensile strength of specimens welded with Avional-M or 4 per cent. silicon filler wire is 4-9 kg./mm.^{2} higher than that of the annealed Avional-M. This seems to be due to the quenching action at high welding speed, which was already observed when arc-welding Anticorodal-B. If a gas weld is made by a skilled welder, who uses a strong flame and welds at high speed, rapid cooling of the weld area and, therefore, a certain amount of quenching, takes place.

The results, furthermore, prove that a higher tensile strength is obtained by the use of Avional-M filler rods than can be obtained with 4 per cent. silicon wire.

Fig. 89 shows the hardness distribution in a gas weld made with Avional filler rod; the seam was not heat-treated. The Brinell hardness of the weld itself, and particularly that of the zone adjacent to the weld, is higher than that of the heat-affected zone 3-4 mm. away from the seam.

The lower Brinell figure in this zone (84 kg./mm.^{2}), however, is still higher than the tensile strength of the annealed sheet (70-73 kg./mm.^{2}). The total width of the softened zone in the neighbourhood of the seam is 8-9 cm.

A further investigation was made to determine the tensile strength of heat-treated gas welds; 4-mm. sheets were welded and subsequently annealed for two hours at 490 degrees C. then quenched in water at 18-20 degrees C. and kept at 45 degrees C. for 24 hours. Subsequently, tensile specimens were cut from the sheet and tested.

As expected, the heat treatment increases the tensile strength of a seam weld from 30 to 35 kg./mm.^{2}, i.e., up to 78 per cent. of that of the heat-treated material; the heat-treated 4 per cent. silicon weld, however, shows a tensile strength of 21.2 kg./mm.^{2} only.

Fig. 90 shows the hardness distribution in a gas-welded Avional seam which was subsequently heat-treated, and it will be

Table 30.—Mechanical Properties of Unwelded Avional-M

Alloy	Temper	Ultimate tensile strength, kg./mm.^{2}	Yield point kg. mm^2	% elongation (Gauge length = diam. × 10)
Avional-M	Heat treated	45.4 (45.2–45.6)	30.2 (30.1–30.5)	19.8 (18.8–21.8)
Avional-M	Annealed	20.2 (19.9–20.4)	8.8 (8.6–9.1)	20.0 (17.3–21.8)

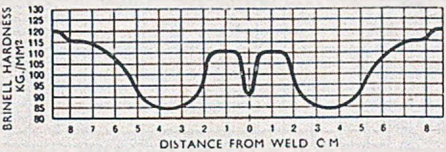


Fig. 89.—Curve for Brinell hardness values across gas-welded seam in unheat-treated Avional-M, with Avional filler.

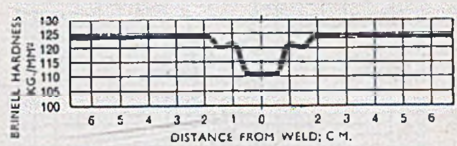


Fig. 90.—Curve for Brinell hardness values across heat-treated gas weld in Avional-M, with Avional filler.

seen that the softening of the zone adjacent to the weld has been cancelled out by the heat treatment. The hardness of the seam increases from 91 to 110 kg./mm.² Fracture under tensile stress occurs in the weld area because the heat-treated (cast) structure of the seam has a lower tensile strength than the wrought structure of the sheet.

Further tests were carried out to investigate the physical properties of Avional arc welds unheat-treated. Table 31 shows average values on each of 20 untreated weld specimens.

The arc-welded specimens show an increase in yield point and tensile strength in comparison to annealed Avional. Yield point and tensile strength of arc-

Table 31.—Mechanical Properties of Gas and Arc Welds in Avional-M

Material—Avional-M	Filler rod or electrode	Ultimate tensile strength kg./mm.²	Elastic limit kg./mm.²	% elongation (gauge length = diam. × 10)	U.T.S. as % of that of annealed sheet	Fracture occurred
Annealed sheet; gas welded weld not H.T.	Av	29.9 (27.6–31.1)	17.0 (16.3–18.2)	6.2 (5.5–7.8)	100	In and near the seam
Annealed sheet; gas welded weld not H.T.	4Si	24.1 (22.7–26.2)	15.9 (14.6–17.1)	3.1 (2.5–3.6)	100	In the seam
Annealed sheet; gas welded weld not H.T.	12Si	21.4 (20.8–23.0)	12.8 (12.7–13.0)	2.4 (0.5–2.5)	100	In the seam
Heat-treated sheet; gas welded weld H.T.	Av	35.5 (33.5–41.4)	26.5 24.5–27.5)	4.4 (2.4–7.5)	78	In the seam
Heat-treated sheet; gas welded weld H.T.	4Si	21.2 (19.0–23.5)	19.8 (18.5–20.3)	1.8 (1.5–2.2)	46	In the seam
Heat-treated sheet; arc welded weld not H.T.	Av	23.4 (23.6–30.0)	22.6 (21.4–23.4)	1.2 (1.1–1.5)	142	Adjacent to seam
Heat-treated sheet; arc welded weld not H.T.	4Si	26.0 (24.8–27.7)	—	0.8 (0.6–1.0)	130	Adjacent to seam
Heat-treated sheet; arc welded weld not H.T.	12Si	30.9 (28.1–32.6)	25.8 (23.7–26.4)	1.6 (1.1–2.4)	154	Adjacent to seam
Heat-treated sheet; arc welded weld H.T.	Av	34.0 (33.2–35.3)	26.2 (25.5–26.7)	2.6 (1.8–3.7)	74	Adjacent to seam
Heat-treated sheet; arc welded weld H.T.	4Si	31.7 (29.2–34.1)	25.1 (23.7–26.1)	2.2 (1.4–3.1)	70	Adjacent to seam

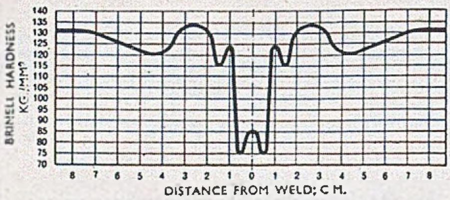


Fig. 91.—Curve for Brinell hardness values across an unheat-treated arc weld in Avional-M, using Avional electrode.

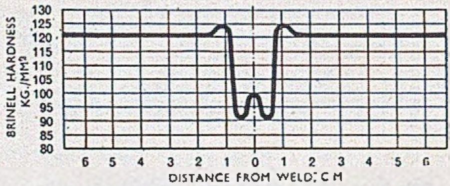


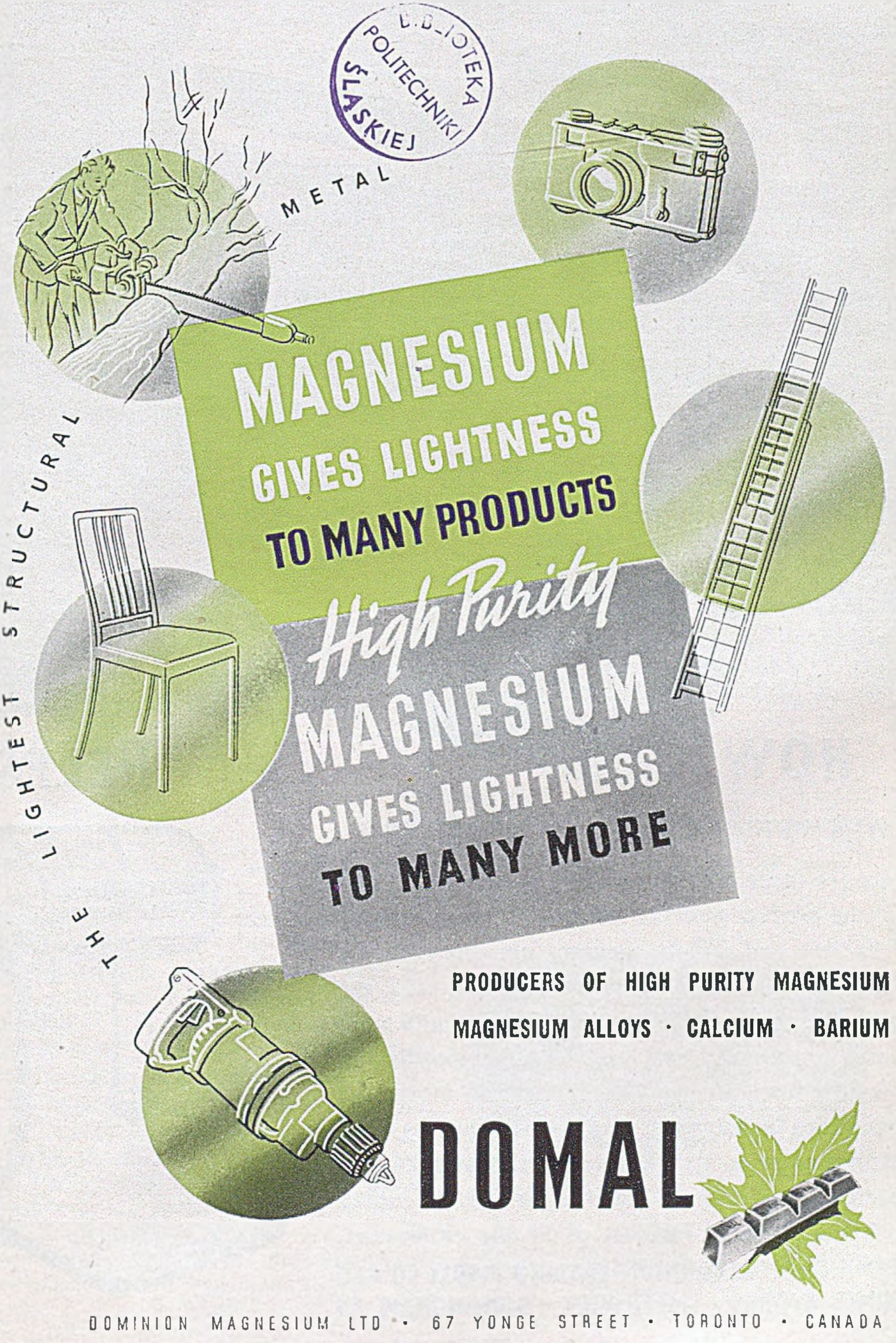
Fig. 92.—Curve for Brinell hardness values across an heat-treated arc weld in Avional-M, using Avional electrode.

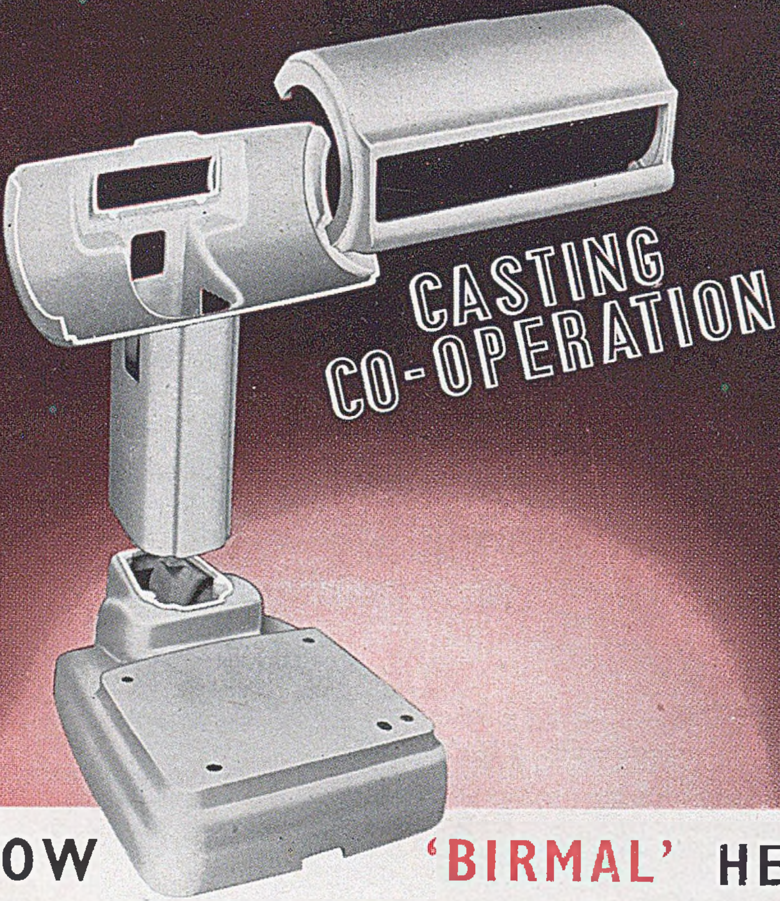
welded Avional-M and 4 per cent. silicon seams are practically the same as those of gas-welded joints. The elongation of the arc-welded specimens, however, is lower than that of the gas-welded specimens owing to the narrow softened zone. It is interesting to note that a tensile strength of 30.9 kg./mm.² was obtained with 12 per cent. silicon electrodes, although the tensile strength of a chilled casting in 12 per cent. silicon is only 15-16 kg./mm.² The high tensile strength of 12 per cent. silicon welds is probably due to the good stirring action in the molten pool, which is a characteristic of arc welding. In the above case the addition of 12 per cent. silicon metal to the Avional pool results in the formation of mixed crystals in the transition zone with good mechanical properties. However, such 12 per cent. silicon electrodes are used only to a limited extent for the welding of Avional-M owing to the greyish colour of the deposit, which, although constituting no disadvantage for purely structural purposes, very obviously mitigates against its satisfactory employment where considerations of an aesthetic or artistic nature arise, and where, in such instances, no effective means exist for "disguising" or covering the disfigurement by paint, etc.

Fig. 91 shows the hardness distribution in an untreated Avional-M weld. The irregular increase in hardness from the centre of the seam to the heat-treated parent material should be noted.

Table 31 shows the tensile figures obtained for heat-treated arc-welded specimens. Joints welded with Avional electrodes, which were afterwards heat treated show the same tensile strength as gas welds in this material, but it should be noted that the elongation is slightly lower. The results obtained are much more uniform than in the case of gas welding. After heat treatment arc-welded 4 per cent. silicon welds show a tensile strength which is approximately 10 kg./mm.² higher than that of a gas weld in this material. The hardness distribution in Fig. 92 indicates that the softening effect in the heat-affected zone adjacent to the weld cancels out the effect of heat treatment. Fracture occurs in

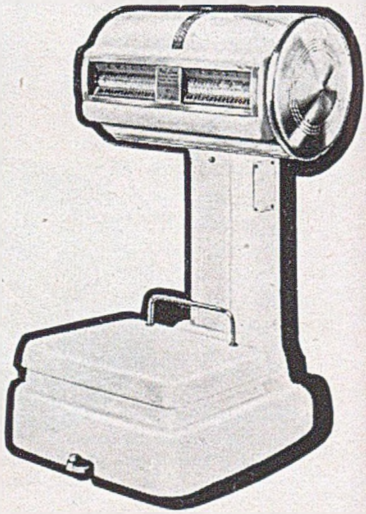
Fig. 93.—Transition zone in unheat-treated arc-welded seam in Avional-M, using Avional electrode. (Equivalent magnification in reproduction = x72.)


THE LIGHTEST STRUCTURAL METAL
MAGNESIUM
GIVES LIGHTNESS
TO MANY PRODUCTS
High Purity
MAGNESIUM
GIVES LIGHTNESS
TO MANY MORE
PRODUCERS OF HIGH PURITY MAGNESIUM
MAGNESIUM ALLOYS · CALCIUM · BARIUM
DOMAL
DOMINION MAGNESIUM LTD · 67 YONGE STREET · TORONTO · CANADA



HOW 'BIRMAL' HELPS

IN THE PRODUCTION OF THE "*Swift*" 20LB. CYLINDER SCALE.



Here are three castings of which our customer says "*In the production of an instrument where delicacy of balance and infinite accuracy are essential, the highest quality aluminium castings must be used. We appreciate the way your staff has taken infinite pains in studying the problems involved and in meeting our specialised requirements.*" More and more our friends are realising the advantages of buying their castings *en suite*, thus ensuring uniform quality in specification alloys and matched deliveries coupled with the personal interest of all our employees.

BIRMINGHAM ALUMINIUM CASTING (1903) CO LTD
BIRMID WORKS · SMETHWICK · BIRMINGHAM 40

Table 32.—Mechanical Properties of Wrought Aluminium Alloys

Metal	Forms available: Rolled	Forms available: Extruded	Forms available: Drawn	0.2 per cent. proof stress kg./mm.²	U.T.S. kg./mm.²	% Elongation: Gauge length = diam. × 5	% Elongation: Gauge length = diam. × 10	Brinell hardness kg./mm.²	Minimum Bend Radius mm.	Erichsen Value mm.	Impact in mkg./cm.²
Al. 99.5 per cent											
Soft	X	—	X	2-4.5	7-9	40-55	30-40	18-25	0	10.5	10
Half-hard	X	—	X	8-13	9-15	10-20	5-10	30-40	1	8	—
Hard	X	—	X	12-16	13-18	4-10	2-8	35-45	2	—	—
As Extruded	—	X	—	2.5-5	7-10	25-45	20-35	18-28	—	—	10
Aluman											
Soft	X	—	X	4-7	10-12	30-45	25-40	25-35	0	10	10
Half-hard	X	—	X	10-17	13-18	10-30	5-20	35-50	1.5	7.5	—
Hard	X	—	—	17-23	19-25	2-10	2-6	45-60	3	—	—
As Extruded	—	X	—	5-9	10-15	25-40	20-30	30-45	—	—	10
Peraluman—1											
Soft	X	—	X	5-10	16-20	20-25	15-20	40-55	0.5	8	3.5-4.5
Hard	X	—	X	18-26	22-26	10-20	6-10	60-80	1.5	—	—
Half-hard	X	—	—	24-30	27-32	5-10	4-7	70-80	3	—	—
As Extruded	—	X	—	7-12	16-20	16-25	12-20	40-55	—	—	3.5-4.5
Peraluman—3											
Soft	X	—	X	9-14	21-26	22-30	18-26	50-65	0.5	7	3.5-4.5
Hard	X	—	—	25-32	29-35	6-10	4-7	80-95	3	—	—
As Extruded	—	X	—	10-16	22-26	20-30	15-25	50-65	—	—	3.5-4.5
Peraluman—5											
Soft	X	—	X	12-18	26-32	22-30	18-26	60-80	1	7	4-5
Hard	X	—	—	29-35	34-40	8-15	6-12	90-110	3	—	—
As Extruded	—	X	—	14-22	27-32	22-30	18-25	65-85	—	—	4-5
Anticorodal											
Soft	X	X	X	4-8	10-14	30-40	20-30	30-40	1	9	—
Half-hard heat-treated	X	X	X	14-21	24-30	22-30	18-22	60-90	2	6	2.5-3.5
Hard heat-treated	X	X	X	27-38	32-42	12-20	10-14	90-120	3	—	1-2
Spring hard	X	—	—	33-38	35-42	2-10	2-6	110-120	—	—	—
Avional—M											
Soft	X	X	X	8-12	19-25	20-30	16-22	50-65	1	8	—
Rolled heat-treated	X	—	—	28-34	43-50	20-25	16-20	105-125	3	6	1.5-3
Drawn heat-treated	—	—	X	26-34	40-50	16-25	12-20	105-125	3	—	1.5-3
Extrusion heat-treated.. ..	—	X	—	26-36	40-48	16-26	12-20	100-125	—	—	1.5-3

the transition zone between weld deposit and parent material. Fig. 93 shows the micro-structure of the transition zone of an arc-welded Avional deposit (non-heat treated). The segregations appear in bands in the parent material, whilst in the cast structure of the deposit and in the transition zone these segregations appear at the grain boundaries.

Fig. 94 shows the micro-structure of the same weld, and it should be noted that the cast structure shows a finer grain than that of a weld in unalloyed aluminium, furthermore, the orientation of the crystals is less pronounced.

Fig. 94.—Macro-structure of cross-section of unheat-treated arc weld in Avional M. (See also Fig. 93.)

Table 33.—Chemical Composition of Wrought Aluminium Alloys (of Swiss Origin)

Metal	Composition per cent.						
	Cu	Si	Mu	Mg	Fe	Other elements	Al
Al 99.995 per cent.	(Fe+Si+Cu) <0.005 per cent.						
Al 99.5 per cent.	(Fe+Si+Cu+Zn) <0.5 per cent. . . . (Cu+Zn) 0.05 per cent.						
Aluman	—	—	1–2	—	—	—	Remainder
Peraluman–1	—	—	0.5–1.5	0.5–1.5	—	—	Remainder
Peraluman–3	—	—	0–0.4	2–3	—	—	Remainder
Peraluman–5	—	—	0–0.4	4–6	—	—	Remainder
Peraluman–7	—	—	0–0.4	6–8	—	—	Remainder
Anticorodal	—	0.5–1.5	0.5–1.0	0.5–1.0	—	—	Remainder
Avional–D, –M, –S	3.5–5	0–1.0	0.2–1.5	0.2–1.5	—	—	Remainder

Conclusions

Arc welds in Avional-M compare favourably with gas welds.

The tensile strength of Avional-M arc welds is higher than that of the soft parent material.

Arc Welding of Aluminium Castings

The advantages of arc welding of aluminium and its alloys are specially pronounced in the case of repair welding of castings. It was in this particular field that arc welding of aluminium was at first tried out because the intense, but locally concentrated heat of the electric arc offers decided advantages over gas welding. Repair of castings of heavy wall thickness is, sometimes, impossible by means of the gas-welding process. Preheating of a heavy casting is a very lengthy job and requires a fair amount of gas and, in many cases, a special oven. Preheating of the entire casting has certainly the advantage of uniform heat distribution, which minimizes the danger of locked-up stresses and cracks on cooling. A casting which is not sufficiently preheated or which is only being locally preheated undergoes non-uniform expansion, as a result of which deformations or locked-up stresses can be observed.

Preheating is also required in the case of arc welding in order to obtain proper penetration and a deposit which is free from porosity. In the case of arc welding, however, preheating to 200 degrees C. is quite sufficient, whilst in the case of gas welding at least 400 degrees C. are required. Arc-welded castings are less prone to cracking than gas-welded ones.

Mechanical Properties of Arc Welds on Gravity Castings

For these experiments special chilled castings, measuring 5 by 200 by 100 mm.,

Table 34.—Mechanical Properties of Gas and Electric Welded Unalloyed Aluminium Sheet

Unalloyed aluminium sheet 99.5%, 4 m.m. thick	Filler or electrode	Method of welding	Subsequent treatment of weld	Elastic limit, kg./mm.²	UTS, kg./mm.²	Elongation per cent. gauge length = diam. X10	Tensile strength of weld expressed as percentage of tensile strength of fully annealed sheet
Soft	—	Unwelded sheet	—	4.4	9.5	34.9	100
Hard	—	Unwelded sheet	—	7.3	16.5	7.1	—
Hard	Al 99.5	Electric	—	6.9	10.4	6.0	100
Soft	Al 99.5	Electric	—	4.1	9.2	33.0	100
Hard	4 Si	Electric	—	6.8	9.5	7.4	100
Hard	4 Si	Electric	Seam hammered cold	9.1	10.5	5.3	100
Hard	Al 99.5	Gas	—	4.1	9.5	21.8	100
Soft	Al 99.5	Gas	—	3.1	8.9	26.2	100
Hard	4 Si	Gas	—	4.2	9.9	24.1	100

Table 35.—Mechanical Properties of Gas and Electrically Welded Aluminium Alloys.

Material (4 m.m. sheet)	Filler Rod or Electrode	Method of Welding	Subsequent treatment of weld	Elastic Limit kg./mm.²	U.T.S. kg./mm.²	% Elongation. Gauge length = diam. × 10	U.T.S. of weld as percentage of U.T.S. of fully annealed basis metal	Position of fracture relative to seam
Peraluman-3 sheet soft ..	(Sheet material itself in unwelded state)		—	10.2	22.3	23.7	100	—
Peraluman-3 sheet hard ..	(Sheet material itself in unwelded state)		—	30.1	33.8	6.7	—	—
Peraluman-3 sheet hard ..	pe-3	electric	—	13.0	14.3	1.6	64	Adjacent
Peraluman-3 sheet hard ..	4SI	electric	—	14.4	17.2	1.5	77	Adjacent
Peraluman-3 sheet hard ..	pe-5	electric	—	13.3	14.7	1.7	66	Adjacent
Peraluman-3 sheet hard ..	pe-7	electric	—	14.0	17.3	2.0	77	Adjacent
Peraluman-3 sheet hard ..	pe-9	electric	—	14.8	18.4	2.2	83	Adjacent
Peraluman-3 sheet hard ..	pe-3	gas	—	10.0	21.1	15.2	100	5/10 mm. off
Peraluman-3 sheet hard ..	pe-5	gas	—	10.0	21.0	11.4	100	5/10 mm. off
Peraluman-3 sheet hard ..	pe-7	gas	—	10.2	21.4	11.9	100	5/10 mm. off
Peraluman-3 sheet hard ..	pe-9	gas	—	10.0	21.3	14.4	100	5/10 mm. off
Peraluman-5 sheet soft ..	(Sheet material itself in unwelded state)		—	12.0	27.6	23.2	100	—
Peraluman-5 sheet hard ..	(Sheet material itself in unwelded state)		—	30.3	35.1	7.2	—	—
Peraluman-5 sheet hard ..	pe-3	electric	—	12.3	14.7	1.9	53	Adjacent
Peraluman-5 sheet hard ..	pe-5	electric	—	12.0	13.7	1.2	49	Adjacent
Peraluman-5 sheet hard ..	pe-7	electric	—	15.0	15.5	1.3	41	Adjacent
Peraluman-5 sheet hard ..	pe-9	electric	—	17.2	19.2	2.3	69	Adjacent
Peraluman-5 sheet hard ..	pe-3	gas	—	14.7	21.3	5.4	77	In seam
Peraluman-5 sheet hard ..	pe-5	gas	—	12.9	26.0	10.6	94	In seam
Peraluman-5 sheet hard ..	pe-7	gas	—	13.1	27.1	12 7	100	In seam
Peraluman-5 sheet hard ..	pe-9	gas	—	12.8	21.3	8.1	77	In seam
Peraluman-7 sheet half-hard	(Sheet material itself in unwelded state)		—	23.5	38.5	14.0	—	—
Peraluman-7 sheet soft ..	(Sheet material itself in unwelded state)		—	15.5	34.1	24.4	100	—
Peraluman-7 sheet half-hard	pe-5	electric	—	14.5	15.9	1.0	42	Adjacent
Peraluman-7 sheet half-hard	pe-9	electric	—	17.0	19.7	1.3	58	Adjacent
Peraluman-7 sheet half-hard	pe-5	gas	—	15.3	25.3	6.9	74	In seam
Peraluman-7 sheet half-hard	pe-7	gas	—	15.4	30.3	14.7	89	Adjacent
Anticorodal sheet soft ..	(Sheet material itself in unwelded state)		—	4.9	11.1	31.3	100	—
Anticorodal B sheet heat-treated	(Sheet material itself in unwelded state)		—	31.1	34.6	12.4	—	—
Anticorodal B sheet heat-treated	Anticorodal	electric	—	13.9	14.9	1.5	100	Adjacent
Anticorodal B sheet heat-treated	4SI	electric	—	17.2	19.1	1.7	100	Adjacent
Anticorodal B sheet heat-treated	12SI	electric	—	15.5	21.3	1.3	100	Adjacent
Anticorodal B sheet heat-treated	Anticorodal	electric	heat-treated	23.6	28.1	2.2	81	Adjacent
Anticorodal B sheet heat-treated	4SI	electric	heat-treated	23.5	28.2	3.4	81	Adjacent
Anticorodal B sheet heat-treated	Anticorodal	gas	—	7.1	13.7	10.3	100	50/66 mm. off
Anticorodal B sheet heat-treated	4SI	gas	—	8.7	16.3	8.4	100	50/66 mm. off
Anticorodal B sheet heat-treated	12SI	gas	—	6.0	12.2	6.8	100	In seam
Anticorodal B sheet heat-treated	Anticorodal	gas	heat-treated	25.4	30.3	1.2	87	In seam
Anticorodal B sheet heat-treated	4SI	gas	heat-treated	—	18.0	1.3	52	In seam

were obtained. Two of each were then butt-welded after preheating, using a backing plate. Half of the heat-treatable alloys were again heat treated after welding, whilst the remainder were tested without subsequent heat treatment. All welds were made with 6 mm. Alcord electrodes. The average results from five tensile specimens each are shown in Table 36.

Further experiments were carried out to clarify the question whether it is essential to preheat a casting in order to obtain a deposit free from porosity. The special step type of casting shown in Fig. 95 was prepared from unalloyed alu-

Table 36.—Mechanical Properties of Arc Welds in Gravity Die Cast Aluminium Alloys

Alloy	Electrode	Subsequent treatment of weld	Elastic limit kg./mm.^{2}	U.T.S. kg./mm.^{2}	% Elongation Gauge length = diam. x 5	Position of fracture relative to seam
Anticorodal-5 Si not heat-treated	Initial strength in unwelded, unheat-treated state		13.3	15.0	3.2	—
Anticorodal-5 Si heat-treated	Initial strength in unwelded, unheat-treated state		21.8	28.7	4.4	—
Anticorodal-5 Si heat-treated	4 Si	—	13.5	16.8	1.9	Adjacent to and in
Anticorodal-5 Si heat-treated	4 Si	Weld heat-treated	13.9	19.9	2.4	In seam and 20 mm. off
Anticorodal-5 Si heat-treated	Anticorodal	—	12.7	14.5	1.9	In and adjacent
Anticorodal-5 Si heat-treated	Anticorodal	Weld heat-treated	14.4	18.9	2.3	Immediately adjacent
Alufont-3 not heat-treated	Initial strength in unwelded, unheat-treated state		8.0	16.9	9.8	—
Alufont-3 heat-treated	Initial strength in unwelded, unheat-treated state		23.0	33.9	10.2	—
Alufont-3 heat-treated	4 Si	—	12.3	15.7	2.8	In seam
Alufont-3 heat-treated	Avional	—	11.1	18.4	4.1	In seam
Alufont-3 heat-treated	Avional	Weld heat-treated	17.2	27.0	3.9	Next to and in
Silumin modified with Na	Initial strength in unwelded state		11.2	14.3	2.4	—
Silumin modified with Na	4 Si	—	10.8	12.3	1.1	25 mm. off
Silumin modified with Na	13 Si	—	10.9	14.0	1.2	Next to
Silumin-Gamma heat-treated	Initial strength in unwelded state		22.7	25.7	1.9	—
Silumin-Gamma heat-treated	4 Si	—	8.3	12.2	2.1	20-35 mm. off
Silumin-Gamma heat-treated	13 Si	—	10.0	14.1	2.4	20-30 mm, off
Silumin-Gamma heat-treated	13 Si	Weld heat-treated	19.6	21.8	1.5	In seam

minium and from aluminium alloys; two specimens each were used, one of which was preheated to 200 degrees C., whilst the other one remained in its original condition. In both cases one deposit was laid down on each step; the length of the deposit was approximately 80 mm. and its depth on the individual steps 5, 15 and 30 mm. respectively.

After welding, all flux residues were removed and the castings milled parallel to the direction of the weld. Subsequently they were etched in the direction indicated in Fig. 95. The starting points for each weld are marked with arrows (1, 2, 3). This procedure enabled the observer to judge depth of penetration, porosity and structure of the deposit. The point marked 1 was subsequently polished to a high degree and re-etched to determine the porosity.

Furthermore, cross-sectional macro specimens were prepared for further assessment of penetration and porosity. All these welds were carried out with 5 mm. electrodes, having a core wire similar in composition to that of the parent material. Speed of welding and amperage (140 amps.) were the same for all specimens. The tensile figures obtained indicate that even untreated weld specimens reached the tensile strength of the untreated parent material.

It was established that, for the welding of Anticorodal-5 Si, 4 per cent. silicon electrodes yield better results than Anticorodal electrodes. The tensile strength

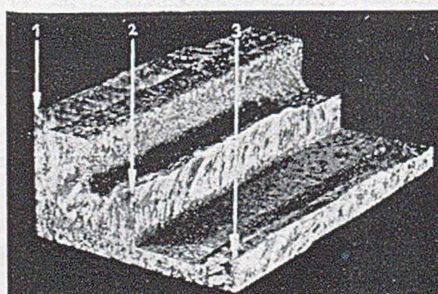


Fig. 95.—Special step-form casting in unalloyed aluminium, after laying on by arc welding, of three deposits of metal.

Table 37.—Arc Welds in Aluminium Castings. Effect of Preheating on Porosity of weld.

Alloy	Electrode	Pre-heat temperature 200 degrees C	Degree of Porosity. Thickness of Basis Metal in Millimetres		
			5	15	30
99.5 Al	99.5 Al	No pre-heating	Porous	Porous	Porous
99.5 Al	99.5 Al	Pre-heated	Pore-free	Pore-free	Pore-free
Anticorodal-5 Si heat-treated ..	Anticorodal	No pre-heating	Some porosity	Porous	Porous
Anticorodal-5 Si heat-treated ..	Anticorodal	Pre-heated	Pore-free	Pore-free	Pore-free
Alufont-3 heat-treated	Avional	No pre-heating	Some porosity	Some porosity	Some porosity
Alufont-3 heat-treated	Avional	Pre-heated	Pore-free	Pore-free	Pore-free
Peraluman-3	Pe-3	No pre-heating	Some porosity	Porous	Porous
Peraluman-3	Pe-3	Pre-heated	Pore-free	Pore-free	Pore-free
Silumin unmodified	13 Si	No pre-heating	Some porosity	Porous	Some porosity
Silumin unmodified	13 Si	Pre-heated	Pore-free	Pore-free	Pore-free
Silumin modified	13 Si	No pre-heating	Some porosity	Porous	Porous
Silumin modified	13 Si	Pre-heated	Pore-free	Pore-free	Pore-free
Silumin-Gamma heat-treated ..	13 Si	No pre-heating	Pore-free	Some porosity	Some porosity
Silumin-Gamma heat-treated ..	13 Si	Pre-heated	Pore-free	Pore-free	Pore-free

of a weld made with a 4 per cent. silicon electrode reaches (after heat treatment) 70 per cent. of that of the heat-treated parent material, whilst in the case of welds with Anticorodal electrodes not more than 65 per cent. of the original strength was obtained.

For the arc welding of Alufont-3, the use of Avional electrodes is recommended as they seem to give higher strength than 4 per cent. silicon electrodes. The tensile strength of the untreated weld is slightly higher than the strength of the untreated parent material, whilst heat-treated welds show up to 80 per cent. of the tensile strength of the heat-treated parent material. For the welding of Silumin Alpha-Beta-and-Gamma, 12 per cent. silicon electrodes gave most favourable results. The structure of the weld made with 12 per cent. silicon electrodes is very similar to that of Silumin Beta, due to the effect of sodium from the sodium chloride in the coating.

Heat-treated welds in Silumin Gamma have a tensile strength equalling 85 per cent. of that of heat-treated Silumin Gamma.

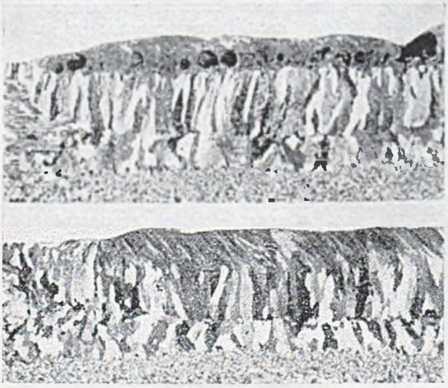


Fig. 96.—Unalloyed aluminium deposited by arc welding on to the surface of castings also in unalloyed aluminium. Cross sections etched. Upper illustration: Without preheating. Lower illustration: With preheating. (Equivalent magnification in reproduction = x $\frac{2}{3}$).

Preheating of Aluminium Castings Before Welding (Table 37)

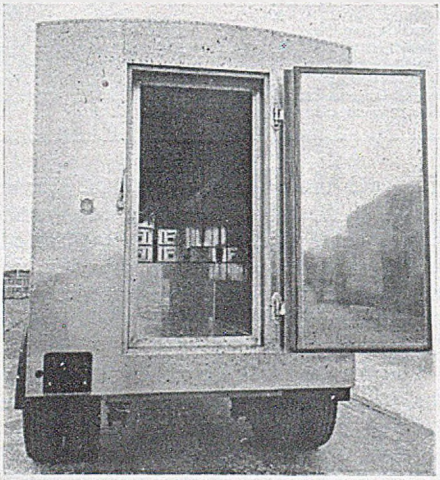
Butts welds are only rarely used for the repair of aluminium castings. Generally speaking, castings are repaired by over-welding the pores or any other defects which develop during the casting process. It is also possible to make satisfactory fillet and lap welds with castings. If one examines the micro-structure of welds on castings made with and without preheating, one can observe a striking difference in the porosity of the deposit. Fig. 96 (top) shows an etched microsection of a weld which was not preheated; Fig. 96 (bottom) that of a weld preheated to 200 degrees C. The casting as well as the electrode core wire were of unalloyed aluminium.

(To be concluded)

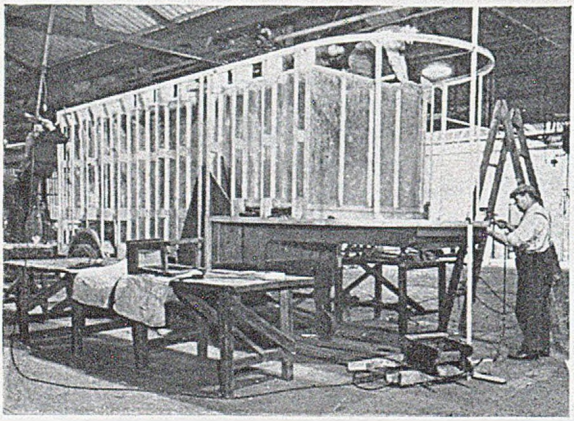
Light Alloys for Refrigeration Equipment

INTERESTING light-metal developments are in progress at the Rochester Airport works of Morrisons Engineering, Ltd. This company was engaged in aircraft work throughout the war, but has, since then, specialized in refrigerating equipment, for the construction of which light alloys are employed. As in other instances, this change-over from military aircraft work to some special branch of civilian industry has enabled the company to retain most of its skilled metal workers.

The particular branch selected by Morrisons Engineering, Ltd., has been refrigeration, and the Morrisons "Frigmobile" container for the transport of deep-frozen or perishable goods by road, rail or water, has already made a name for itself. These containers, equipped



ABOVE, a view of the rear of a refrigerator van. The highly reflective surface of the aluminium sheet, both inside and out contributes materially to efficient insulation.



AT the left an articulated semi - trailer refrigerator van under construction in the works of Morrisons Engineering, Ltd. The framework is of light-alloy extruded angle.

with an independent refrigerating system, powered by a small petrol motor, are constructed entirely from light alloy extrusions and sheet. The compressor, driven by the small power unit, circulates methyl chloride through the cooling plates or coils fixed to the roof and sides of the cold chamber.

Morrisons Engineering, Ltd., have now turned their attention to road transport vehicles, and the first of an order for articulated semi-trailer refrigerator vans has been delivered recently to Uruguay. This outfit also carries an independent refrigeration unit, and the form of construction employed for its doubleskinned body has points of unusual interest. Framework for the inner and outer shells is made in light alloy angle extrusions. A minimum insulating space of 6 ins. is maintained everywhere between the two skins, and this space is filled with Isoflex.

Hydrolignum impregnated plywood distance pieces are fitted to prevent heat leakages and there are no through metal-to-metal contacts. A special feature is the double floor construction, floors often presenting a source of heat leakage in refrigerator vans. The upper floor, which takes the load, is of ¼-in. light-alloy plate, whilst the lower one, mounted directly on the chassis, is of 16-gauge sheet. Bearers running between the two consist of impregnated plywood strips, set on edge and fixed to robust light-alloy angle extrusions.

Framing of the inner and outer bodies is arranged in such a manner that expansion and contraction arising from the great difference between temperatures obtaining outside and within the body are compensated. Birmabright sheet is used, with every joint made watertight by means of non-hardening plastic cement and close-riveted throughout with light-alloy hollow rivets. The sheet is left with a polished surface so that the interior can be quickly and easily cleaned by pressure hose or steam jet. There are no capillary crevices to harbour dirt and the body is proof against termites.

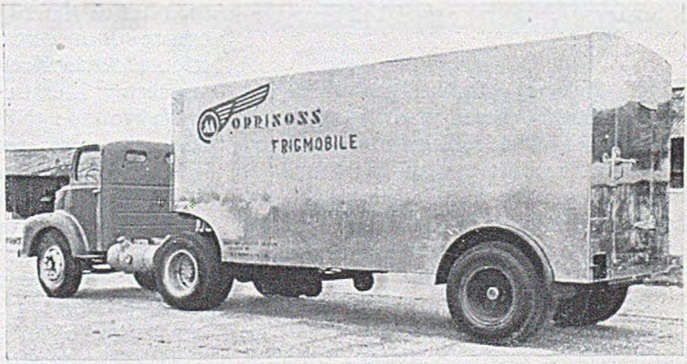
The independent refrigerating unit is housed forward in a separate compartment, completely sealed off from the rest of the body. It includes a compressor, driven by a small Petter petrol engine, the two arranged on a common bedplate, mounted on rubber blocks.

The refrigerant is driven through expansion valves to a series of vacuum plates in the cold chamber. In the event of engine failure on the road, a warning pilot lamps lights up in the driving cab of the tractor. This "Frigmobile" body is mounted on a Dyson drop-frame semi-trailer chassis coupled to a Leyland Comet oil-engined tractor. It has been designed to carry a 6-ton load of fresh fish. This will be maintained at a constant temperature of about 35 degrees F. in the various atmospheric temperatures experienced in Uruguay. A notable point about this outfit is that the light-alloy body, complete with refrigerating plant and all other equipment, weighs less than 30 cwt.

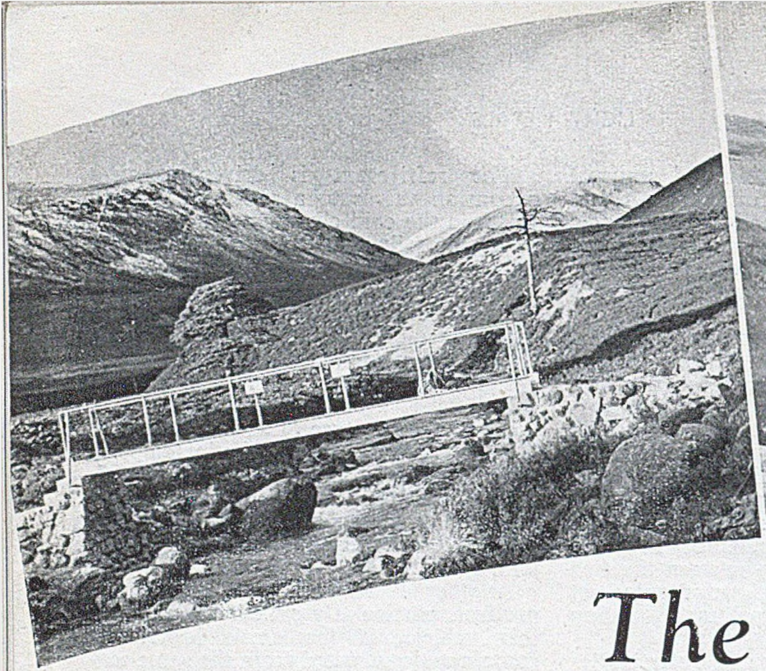
Another Morrisons Engineering product, particularly suited for use with this vehicle, is the small Morricrate container, constructed from the same sea-water resisting alloy as the trailer body and the road, rail or sea container already mentioned. These Morricrate boxes are convenient to handle, easily sterilized and can be stacked to utilize every inch of floor space within the body. Should an independent refrigerating plant not be required, the "Frigmobile" semi-trailer can be delivered with bunkers for solid CO_2, or with cold hold-over plates.

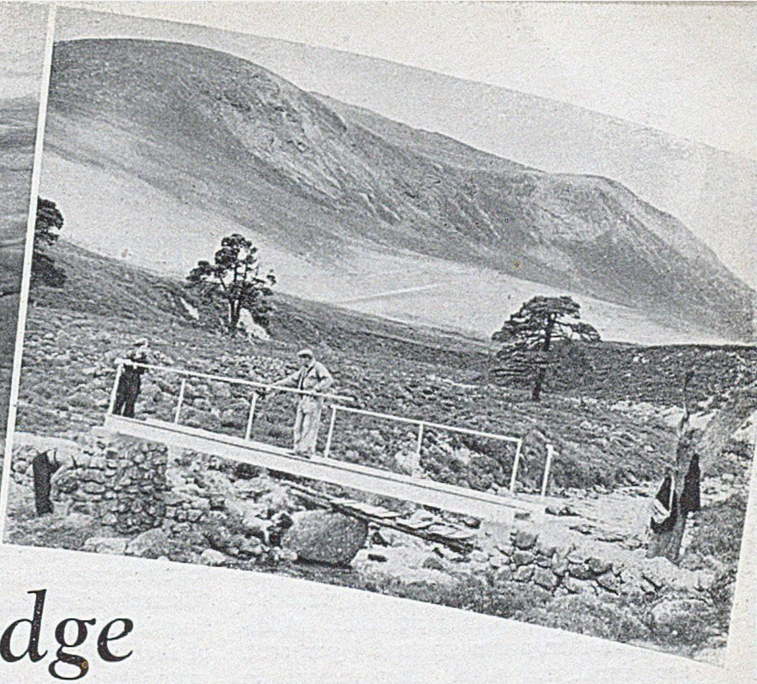
Refrigerating private lockers for the preservation of game, etc., form another Morrisons Engineering, Ltd., speciality.

It should be observed that the use of light alloy for the interior "working" surface of constructions such as those described here, entirely eliminates the difficult problem of providing a permanent, non-stain, easily cleaned finish. Paints and enamels are not required.



GENERAL view of the articulated semi-trailer refrigerator van which is mounted on a Dyson drop-frame chassis and drawn by a Leyland Comet tractor.





The Lui-beg Footbridge

PICTURED above is the Lui-beg footbridge after the opening ceremony on November 7, 1948. Carn à Mhaim is seen on the left.

CENTRE is the view from Carn à Mhaim, looking down Glen Lui-beg. At the right, the handrails being fitted to the footbridge.

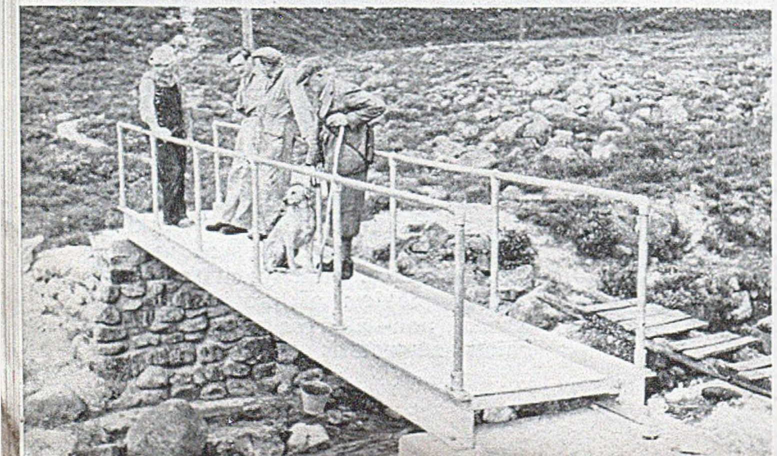
THE Lui-beg footbridge which is illustrated here was erected in August, 1948, to replace a dilapidated timber bridge over the Lui-beg Burn. It is situated about two miles beyond Derry Lodge at the south or Deeside end of the Lairig Ghru, the best known of the passes through the Cairngorms.

The bridge was built by the Cairngorm Club as a tribute to the late James A. Parker, B.Sc., M.I.C.E., Hon. President of the Club, Past President of the Scottish Mountaineering Club and member of the Alpine Club, who, in the course of a lifetime of climbing, contributed extensively to Scottish Mountaineering literature, edited the S.M.C. guide to the North West Highlands, designed and erected many mountain indicators and erected the Cairngorm Club's footbridge over the Allt na Beinnie at the North of the Lairig Ghru.

The abutments are built of local boulders set in concrete with a concrete bearing course. The superstructure is constructed of an aluminium alloy, Noral 51ST. The two main beams are 10 ins. by 3 ins. by 7.86 lb., channels 3 ft. apart and have a clear span of 23 ft. 6 ins. and overall length of 26 ft.; 4-in. by 3-in. by 3/8-in. tee-section cross beams are provided at 3-ft. 1-in. centres, and diagonal bracing consists of 1½ in. by 1½ in. by 3/16 in. cadmium plated A single handrail is provided on each side, these and the standards being 1 1/16 in. o.d. Noral 57ST tube secured by galvanized Kee Klamps. The footway consists of 3-ft. by 1-ft. 4-in. by 2-in. reinforced concrete slabs laid in pairs on the flanges of the tee beams, building felt being placed between aluminium and concrete.

All cement, slabs and other materials were hauled on an improvised handcart up the rough mountain track from Lui-beg, a distance of 1½ miles to the site, by climbers who volunteered to do the work. The ordinary load for four men was slightly over 500 lb. The main beams were carried up, one at a time, by six men using three poles. Building and erection were done by Wm. Tawse, Ltd., Aberdeen, and all work was completed in 12 days.

The bridge carries two cast aluminium tablets bearing inscriptions as below.



LUI-BEG BRIDGE

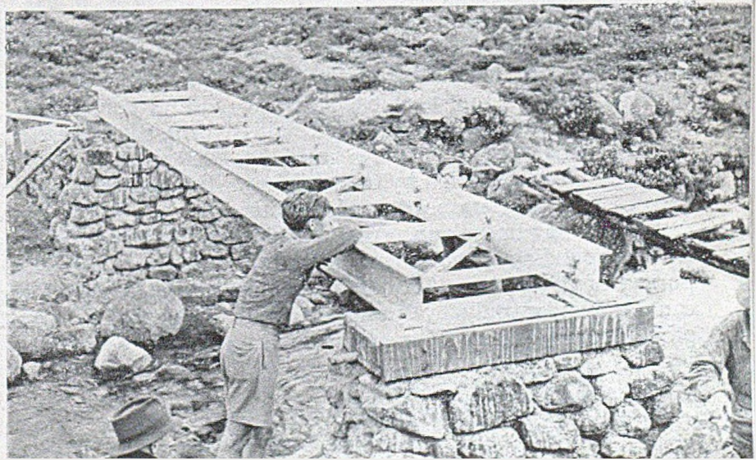
In appreciation of the services of

JAMES A. PARKER

to Mountaineering in Scotland

ERECTED BY THE CAIRNGORM CLUB AUGUST 1948

SPEYSIDE	miles	DEESIDE	miles
Lairig Ghru summit 2733 ft.	6¼	Derry Lodge	2
		Linn of Dee	6
Colyum Bridge	14	Inverey	8
Aviemore	16	Braemar	12½



Advances in
MAGNESIUM TECHNOLOGY

Recent Developments in Magnesium Technology Indicate that in the Future, Alloys are Likely to be Based Upon Systems Incorporating More or Less Substantial Proportions of Zirconium and Cerium, Together with Trace Quantities of Beryllium

ACCEPTED magnesium alloys for working and casting, as evidenced by the subjects of official specifications, consist chiefly of alloys with aluminium additions up to 11 per cent., and with zinc up to 1 per cent. Additions of manganese up to 0.4 per cent. are usual to effect improvement in corrosive resistance. Approved magnesium materials outside these general terms are (1) the binary magnesium-manganese alloy containing about 2 per cent. manganese used for casting and rolling, and (2) the later foundry alloy containing tin, silver, and aluminium. Table 1 shows the compositions of some magnesium alloys for aircraft use.

These alloys, whilst of demonstrated worth in normal engineering conditions, are generally poor in mechanical strength at elevated temperatures. Further, in melting and heat treatment processes, oxidation has to be restrained by the use of special fluxes and inhibiting substances. For example, the alloys mentioned above require protective fluxes during melting, and pouring through an atmosphere rich in sulphur dioxide into the mould; sand casting necessitates the use of sand containing sulphur, boric acid, and ammonium bifluoride, singly or in combination. During heat treatment at about the eutectic temperature, aluminium-manganese base alloys must be protected from oxidation by the maintenance of a definite proportion of sulphur dioxide in the atmosphere. Alternatively, the surrounding atmosphere may be purged of its oxygen. Serious oxidation can be avoided only by means of such process complications. The production of fine grained material is achieved by superheating the molten alloy at a temperature of about 900 degrees C. Practically, the requirements briefly enumerated here adversely affect the economics of production in magnesium-base alloys because of their influence on labour and indirect material costs. By comparison, aluminium-base alloy melting and processing treatment are simple, and do not suffer these complications.

Recent magnesium alloy developments are important because they indicate that the disadvantages hitherto associated with magnesium alloy technology may soon be removed. Indeed, future large-scale use and application will present metallic materials having no greater processing difficulties than are associated with aluminium alloy founding.

Experiments with cerium additions either alone or with manganese, date back possibly 10 years or more; the aim was primarily to produce an alloy for wrought purposes having superior creep characteristics at high temperatures. Exploratory work at the N.P.L. may be recalled.

In brief, it was found that additions of aluminium up to 7 per cent. increased the tensile strength of magnesium over a temperature range up to 300 degrees. Binary alloys containing 2 per cent. and 6 per cent. silver were similarly tested, but here the effect of the added element was not as marked as in the case of aluminium. A ternary alloy containing 7.45 per cent. aluminium and 2 per cent. silver showed, however, a marked improvement in tensile strength at temperatures up to 200 degrees C. beyond which the strength rapidly declined.

In similar investigations of the calcium series, no particular advantage in respect of mechanical properties was found, although it was noted and published, probably for the first time, that the molten alloy showed little tendency to burn, and that the solid material resisted oxidation to a remarkable degree. True the alloys contained 0.35, 2.27 and 2.64 per cent. calcium, but later work has demonstrated that calcium additions of the order of even 0.1 per cent. to the normal alloys have a marked influence in reducing molten metal oxidation.

Of the systems explored, that of cerium was perhaps the most promising, for it was found that small additions of 1.0 per cent. had a striking effect on the Brinell Hardness of magnesium at 300 degrees C. There were practical difficulties, however, in the alloying process, for, as will be seen, cerium oxidizes at ordinary temperatures with great readiness, whilst at the temperature of molten alloys losses due to oxidation were so excessive as to create difficulty in controlling composition. Again, treatment with the fluxes ordinarily used for refining and protecting molten magnesium further caused certain losses. Additions of small amounts of calcium improved the oxidation characteristic to some degree.

Nickel and cobalt additions were separately made to the cerium alloys, but such alloys were found to be very low in corrosion resistance.

Much work was done in private laboratories just prior to World War 2 on some of the systems mentioned above. It will be seen later, that although these alloys for one reason or another were not completely successful, several of the lines indicated have culminated in the recent developments.

In passing, it is perhaps of interest to recall that the three metals now being used in magnesium development were all isolated some 120 years ago: zirconium in 1824 by Berzelius, cerium in 1826 by Mosander, and beryllium in 1828 by Wöhler. The specific gravity of these metals are respectively 6.4, 7.04 and 1.82; it is only beryllium, therefore, that can be described as a light metal.

Zirconium in the form of its compounds is widely distributed in the earth's crust, being 12th in the abundance of the elements. It is found as silicate; and the oxide, prepared from it, is reduced under certain conditions; by calcium in the presence of calcium chloride. A pure form of zirconium produced from zirconium tetra-iodide is extraordinarily ductile and may be

TABLE 1.—Composition of some Magnesium Alloys for Aircraft use.

Spec. Ref.	Al	Zn	Mn	Cu	Fe	Ni	Si	Sn	Use
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	
DTD596	7.5–9.0	1.0 max.	0.15–0.4	0.15 max.	0.05	0.01	0.30 max.	0.10 max.	Castings
DTD136b	9.0–10.5	1.0 max.	0.15–0.4	0.15 max.	0.05	0.01	0.30 max.	0.10 max.	Castings
DTD281	8.0–11.0	1.0 max.	0.5 max.		Impurities—not more than 1.0				Castings
DTD289	8.5 max.	3.5 max.	0.5 max.		Impurities—not more than 1.0				Castings
DTD88b	11.0 max.	1.5 max.	1.0 max.		Impurities—not more than 1.5				Forgings
DTD259	11.0 max.	1.5 max.	1.0 max.		Impurities—not more than 1.5				Extrusions
DTD118	0.2 max.	0.2 max.	2.5 max.	0.2 max.	Impurities—not more than 0.5				Sheet
DTD350	2.0-6.0	—	0.6 max.		Ag: 0.25-4.0			3·0–10.0	Castings
DTD120a	9.0 max.	1.5 max.	1.0 max.		Impurities—not more than 0.5				Sheet

worked to fine wire and thin sheet in the cold. there is a reaction between zirconium chloride and magnesium giving magnesium chloride and zirconium metal. The pure metal is hard and extremely resistant to corrosion.

Fox and Bushrod (B.P. 591,225) have shown that when a molten magnesium alloy containing iron as an impurity in quantities above the average proportion in commercial alloy is acted upon by a small quantity of zirconium or by a reducible salt of the metal, the iron content is appreciably reduced by the formation of a high melting-point compound which is precipitated.

The material commonly called cerium is frequently the "alloy" ("mischmetal"), containing about 50 per cent. cerium, 40 per cent. of cerium group metals such as lanthanum, samarium, neodymium and praseodymium, the balance consisting of yttrium and iron.

Freshly cut cerium tarnishes readily in air and decomposes water at ordinary temperatures, thus indicating that it is rapidly oxidized. In aluminium alloys cerium is said to have a similar effect to titanium.

In consideration of the low specific gravity of beryllium, it was at one time conjectured that the metal might be profitably alloyed with magnesium or aluminium.* Efforts in this direction have generally proved disappointing. According to modern production methods, the metal is produced by electrolysis of fused halide mixtures, followed by vacuum distillation under controlled conditions. In appearance, beryllium is similar to aluminium and magnesium. Chemically, it is reactive at high temperatures with oxygen, and is therefore employed in the melting metallurgy of copper and nickel as a deoxidizer. Nevertheless, it is corrosion-resistant at ordinary temperatures. Of the various possibilities of the use of the metal in light alloy technology, the only one that has been demonstrably proved is its effect of restraining oxidation of molten magnesium alloys, small additions of from 0.005 per cent.-0.10 per cent. are said to enable magnesium alloys to be maintained in the molten condition and cast without the use of protective fluxes or atmosphere.

It has been disclosed recently that German metallurgists were studying alloys of magnesium with zirconium as far back as 1938, but such were the difficulties encountered that work stopped. Small additions of zirconium to pure magnesium or to magnesium-zinc alloys reduced the grain size, in the case of magnesium, from 2 mm. to approximately 0.1 mm., and later the well-known English company, Magnesium Elektron, Ltd., commenced an exhaustive research as to the possibilities suggested by the preliminary German studies.

It was found that the chemistry of zirconium was largely unknown; indeed, published information was often misleading. Solutions to most of the problems were solved by 1943 and a draft specification was submitted to the Ministry of Aircraft Production. Unfortunately, the method then used for the introduction of zirconium apparently resulted in a type of chloride contamination, quite unconnected with melting and refining fluxes used according to normal and proved practices. Success finally came by use of a specially dense flux which settled the contaminating chloride impurity; now flux-free alloys can be obtained.

The use of these alloys for the production of castings introduces another difficulty. In the production of wrought forms, the alloyed material is usually used directly with the billet or rolling slab moulds, whereas foundries producing castings usually utilize pre-alloyed ingots, which, of course, necessarily results in twice-melted material. Alloying metals which undergo deterioration in quantity or quality during the melting process, therefore suffer a double degradation when ingots are melted for foundry use. The problem in this respect

* It may also be noted that the addition of traces of beryllium to aluminium alloys containing relatively large quantities of magnesium completely inhibits the reaction between the molten metal and the moisture in sand moulds, thereby eliminating the necessity for using inhibited sands. It is indicated, however, that these additions have an adverse effect on the degassing problem and tend to aggravate the occurrence of pin-hole porosity.

in the case under review was that of zirconium loss; correction was made by means of a master alloy and a master zirconium-bearing salt.

The attractive mechanical properties of these alloys are adversely affected by trace impurities. A draft official specification gives maximum impurity limits as follow: Iron, 0.01 per cent.; silicon, 0.01 per cent.; copper, 0.03 per cent.; nickel, 0.005 per cent. It is clear that great care will have to be used in foundries in order to maintain the purity standard required.

Corrosion resistance of these alloys is high and compares favourably with the superpurity alloys. The inherent stability can be further enhanced by one of the protective treatments given in D.T.D.911A.

Zirconium alloys are easily worked hot from cast stock, due principally to the greatly reduced grain size. Indeed, following extrusion, magnesium alloy can be produced having a grain size smaller than 0.003 mm. This dimension is smaller than obtained in any other non-ferrous metal. The mechanical properties, compared below with present standard specifications, are due to extreme fine grain.

A recent patent specification, B.P.603,150 (J. Stone and Co., Ltd., Murphy and Payne), describes a magnesium-base alloy containing zirconium and cerium produced with the aid of beryllium, this alloy would appear to represent a distinct advance in alloy technology

As has been pointed out, zirconium and cerium tend to be lost from magnesium alloys during melting on account of their reactivity with the necessary fluxes. It has been found that the presence of beryllium gives a self-protective alloy which does not require the use of fluxes during melting nor the use of a protective atmosphere during holding for periods in the molten condition. Beryllium-magnesium alloys cannot be economically produced at the present time, and therefore a means must be sought by which beryllium may be introduced to the base alloy. It was found that a silver-beryllium pre-alloy was suitable, for (1) silver was without effect on the grain refining mechanism conferred by zirconium, and (2) silver was, in any case, an advantageous addition to magnesium alloys, particularly for use at high temperatures.

Further, silver can be alloyed with

TABLE 2 (Due to Ball).—Comparison of Mechanical Values—Zirconium Alloys and Standard Alloys.

Alloy	0.1 per cent. P.S.	U.T.S.	E per cent. on 2"	Cold Bend
Sheet				
ZR (Zr alloy) annealed. Draft DTD626 ..	24,640	38,080	8	4T
DTD120a (min. spec. requirements)	15,680	35,840	10	6T
Extrusions				
ZZ (Zr alloy). Draft DTD733 (up to and including 3" dia.)	38,080	51,520	8	—
DTD259a (up to and including 3" dia.)	24,640	38,080	10	—
Castings				
Zirconium alloy 24 1/2 Z	17,900-19,000 p.s.i.	35,000-37,000 p.s.i.	10.8	—
As-cast sand cast bar				
DTD596 (min. spec. requirements)	—	20,160 p.s.i.	2	—
DTD136b (min. spec. requirements)	—	17,920 p.s.i.	—	—
Zirconium alloy 24 1/2 Z	21,000-23,000 p.s.i.	36,000-40,000 p.s.i.	9-7	—
Heat treated				
DTD289 (min. spec. requirements)	—	29,120 p.s.i.	6	—
DTD281 (min. spec. requirements)	—	29,120 p.s.i.	4	—

zirconium, and a pre-alloy of these metals in suitable proportions provides a convenient means of introducing zirconium. The compositions of these silver pre-alloys are such that the ultimate alloy contains 2 per cent. silver, 0.05 per cent. beryllium and 0.75 per cent. zirconium. Cerium is added as misch-metal or as a magnesium-cerium alloy; a typical composition is given as: Silver, 2 per cent., beryllium 0.05 per cent., zirconium 0.75 per cent., cerium 3.0 per cent., magnesium remainder.

Other alloying ingredients that may be used in similar alloys are limited to those that do not form a high melting point compound with zirconium, and the patent specification states that permissible alloying elements in this connection are zinc, cadmium, silver, thallium, thorium, copper, bismuth, lead and calcium. The suitability of a metal may be tested quite easily; it is added to a zirconium alloy containing a known amount of zirconium and checked by analysis and by examining the resultant metal. If the zirconium content remains unaltered and the grain size has not become enlarged, the added metal is permissible. It is of interest to note that aluminium is not present in the list of these metals and must not, therefore, enter into the composition of the zirconium alloys.

The applicants of the patent briefly described above were also responsible for an earlier specification (B.P. 578,977), in which a normal aluminium-type magnesium-base alloy containing an addition of beryllium was claimed for the production of pressure-die castings.

. . . . artistic people working for discriminating customers . . .

ARE THEY REALLY NECESSARY?

—asks George Fejér, M.S.I.A., Dipl. Architect, E.T.H. (Zürich)

"I HAVE read a spirited and somewhat venomous attack in your December issue, directed against the idea of industrial design in general, and the faculty of Royal Designers for Industry and the Council of Industrial Design in particular.

"Your criticisms of the Exhibition of 'Design at Work' were forcefully expressed, both in your Editorial opinion and in an article which appeared on pages 684 and 685. With much quoting of Latin your Editorial went in a big way for the distinguished planners, presumably moved by a chivalrous motive to protect the little man, the ordinary technician, against a new kind of interference from unexpected quarters. I am not quite certain whether your attack was also directed against the rank and file of designers for industry, to which I belong, or whether it was mainly the governmental backing of the Show that made you angry.

"I think criticisms of this kind are very healthy in some respects, as they do make us think again about points which appeared obvious before, but I do feel that your comments should be heard side by side with opinions of others who are engaged on the difficult task of designing for industry.

"From the whole tenor of your Editorial opinion and the article mentioned above, I felt one accusation emerging which seemed to add up to one thing, almost as if you were asking: 'Are Designers really necessary?' In this I am naturally biased.

being actively engaged on the imagining of products for mass production, and my answer is naturally 'Yes.' We Designers cannot help feeling that our job is of service to the public, though sometimes conflicting with well established sectional interests.

"Let me hasten to say that I am neither a member of the Council of Industrial Design, nor am I one of the chosen few who have received the distinction of R.D.I. I am just a typical ordinary practising designer and my views are probably, though not necessarily, shared by many of my colleagues.

On Whose Side is History?

"Your Editorial attack starts with a quotation to prove that traditional authority can often hamper the spread of knowledge. I think this is delightfully beside the point when you try to make out a case against Designers. You write of . . . 'enthusiasm, divorced from popular taste and springing from sources obviously remote from manufacturing practice, stands self-condemned as an outcome of petulant reaction to the restraining wisdom of tradition. . . .'

"No need to pretend that present-day popular taste or current manufacturing practice have any firm foundation in the fine design tradition that made British goods world famous in the past. Surely something went wrong on the cultural side when the switch over from handwork to machine work was introduced, and many of us believe that it is the task of our generation to try to put things right again.

"Take any historical example of good design—for instance, eighteenth-century furniture, silver, glass, pottery, etc., and on closer examination you will find that these things have almost invariably been produced or designed by artistic people who were moved by a sincere desire to serve a discriminating public. To-day the public is not very discriminating and maybe the people who produce a great volume of designed articles are not all anxious to examine the artistic or cultural side of the goods. Naturally they are preoccupied with the steady flow of production rather than with excursions into the confusing realm of visual arts. To-day we have become so terribly production minded that some people believe that markets exist just for the purpose of keeping production going. Some of us believe that the ultimate consumer is quite an important chap and his requirements and fancies are worth studying.

Who Are the Designers?

"We all do design jobs when we exercise our judgment in choosing and selecting things we use ourselves. I always like to think of design work as a chain of decisions taken in the process of imagining a thing which does not yet exist. All men and women do this sort of work at some time or other. Take the case of a housewife deciding on curtain and upholstery materials that would 'go' with a certain kind of furniture in a particular type of room. If she cannot choose herself, she will probably ask someone with more experience (but would not necessarily be swayed by advice of a man who has only one kind of fabric in stock). The point is that in the matter of judgment we have, every now and again, to rely on consultation with people who have slightly more experience of a particular kind. We could choose our own patent medicines from advertisements in the Sunday papers, but nevertheless many of us prefer to ask a medical practitioner every now and again. When we build a factory or a non-standard house we could undoubtedly decide on all the details and features ourselves, nevertheless there are such people who are trained architects, and their judgment is likely to be nearer to the mark.

"All that the 'Design at Work' Exhibition has set out to do was to convince people that Designers as professional people are *also* at work, that they are available to assist as and when their services are necessary. The Exhibition showed very clearly that Designers are part and parcel of the producing team which includes, from the Managing Director to the ultimate consumer, everyone who has some measure of influence on the shaping of the product.

"The 'case history' exhibits have shown fairly clearly what the Designers did in one or two instances and how they set about tackling the job.

"To say that the profession is new is probably not quite accurate, as there is definite information that throughout history, and especially during the eighteenth century, professional designers have been busy in creating many of the goods which we now regard as outstanding examples of industrial art.

Unrepresentative ?

"Your most severe criticism, which was levelled against the Show at Burlington House, was that the R.D.Is. and their exhibited work are not at all representative of the sum total of industrial achievements for this country. Naturally, this is very true. It can hardly be otherwise. A show that will really represent the excellence of British industrial design will be a team job that will take all our time to stage between now and 1951. 'Festival Britain' is the forum on which *all* Britain must co-operate to make it a success. No one has ever pretended that there are only 40 good designers in this country, nor that the products they have helped to produce are best sellers. I presume the real reason for the R.D.I. Show was a practical one. It was probably much easier to collect material from the work of 40 people than to assemble a huge show that would give an idea of all designers' work.

An Exclusive Group

"I can see nothing wrong with distinctions being conferred upon professional people who do their job *consistently well over a number of years.* To be a Member of the Faculty of Royal Designers for Industry is a distinction, but it does not mean any economic, business or political advantage for the members concerned. How and why the figure of 40 was arrived at, I do not know, but it is in the nature of such distinctions, I presume, that it would lose its charm if hundreds or thousands were admitted who seemed to deserve such merit.

Not So Strange!

"Your Reviewer writes about the Wedgewood Teapot design: 'The really strange and instructive feature about this was that the artist or designer has also planned or constructed a whole large works for the pottery manufacture . . . .' Instructive—Yes, but strange? Not at all. By now many people have come to realize that the visual arts are just as indivisible to-day as they were in times of Wren or the Adam brothers. It is not strange that people with sound training in architecture should also be actively engaged in the other branches of visual arts, provided they also master the technique of these other branches. A fair proportion of the practising industrial Design Consultants has been recruited from people with an architectural background—roughly one-quarter in the case of the R.D.Is. Narrow specialization is a recent trend of questionable merit. Many industrialists share the view that it is a good thing that people with the necessary training and imagination should exert some co-ordinative influence over the specialists.

Those Credits

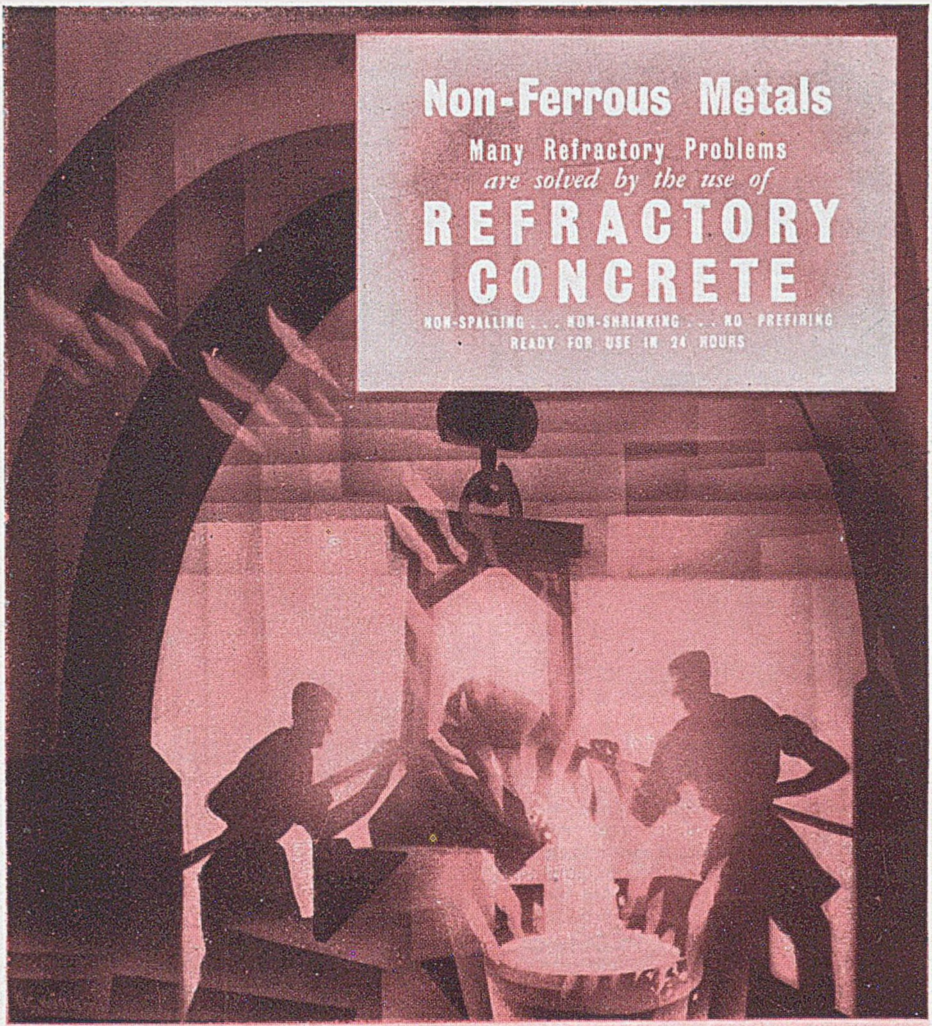
"You seem to be particularly annoyed about the credits that were given to the Designers of products, whilst not much was said or written about the crowds of technicians who were also actively engaged on those jobs. We must get one thing clear. This was an exhibition on the subject of Design and Designers. Had it had the title of 'The Pattern Maker's Art,' or 'The Influence of Salesmanship,' then it would have been quite legitimate to pick out in large letters the names of pattern makers or salesmen respectively.

"The whole question of credits surely hinges on one point. The man who is prepared to back a product with his reputation, and be identified with it, should be mentioned in connection with that product on suitable occasions. To make a list of credits too long would become ineffective and tedious, as all film-goers know. Furthermore, there is no need to quote people who carry out instructions with which they do not necessarily agree whole-heartedly.

"Incidentally, Consultant Designers reserve the right that their name should *not* appear in connection with a product which the client has modified without their consent.

"I cannot help feeling that the credits are due for the extra responsibility, and to make someone specially responsible for the creation and co-ordination of a project has its advantages all the way round. When the Designer knows that he will stand or fall with the success of a job, he will do everything in his power to 'sell' the idea to his collaborators and make them, too, enthusiastic about the scheme. If there is complete anonymity and no one is particularly responsible for the creation of a new product, all this extra, often unpaid (or unpayable) energy remains unused; furthermore, there are no real pants to kick when things go wrong!"

You comment, "to-day, the public is not very discriminating . . . ." Our own opinion of the the situation is that the public is financially too ill-equipped to be anything else but resigned, nevertheless, it has a vague inkling of what it would like, if it could afford it. Thus the public disagreed with "Design at Work" solely because, in fact, it was discriminating and realised that the exhibits featured were out of harmony with true cultural progress.—Ed.



Extensively used for dampers, flues, lids, floors, brick setting, crucible furnaces, melting furnaces and producer linings for the following reasons: Precast units are free from spalling; and because of the durability and permanence of this material. Write for descriptive and technical literature dealing with refractory concrete or send your enquiries to our Technical Service section whose advice is freely placed at your disposal.

CIMENT FONDU
ALUMINOUS CEMENT

Issued by **LAFARGE ALUMINOUS CEMENT CO. LTD., 73 BROOK ST., LONDON, W.1.** *Telephone:* **MAYfair 8548**

3-934

NEWS
General, Technical and Commercial

THE Olympic Torch (High Duty Alloys Ltd., Slough. See "Light Metals," 1948/11/442) relaxes! Pictured here is Miss Joan Sterndale Bennett, in her far-from-serious sketch "The Torch Singer," in the revue "What Goes On?" recently presented at the Players Theatre, Villiers Street, Charing Cross, London.

Continuous Anodizing

IT has been announced that Alumilite and Alzak, Ltd., have come to an arrangement with the Nordisk Aluminiumindustri whereby they have secured the rights in Great Britain and the British Commonwealth for the installation and operation of continuous anodizing and lacquering plants for sheet and strip aluminium.

The economy of this process fills a long-standing need in the sheet metal trade, and will prove of particular interest to all those connected with the canning, packaging and closure and allied industries. The company will be pleased to give information to all organizations interested in the project.

Personal Note from Midland, Michigan

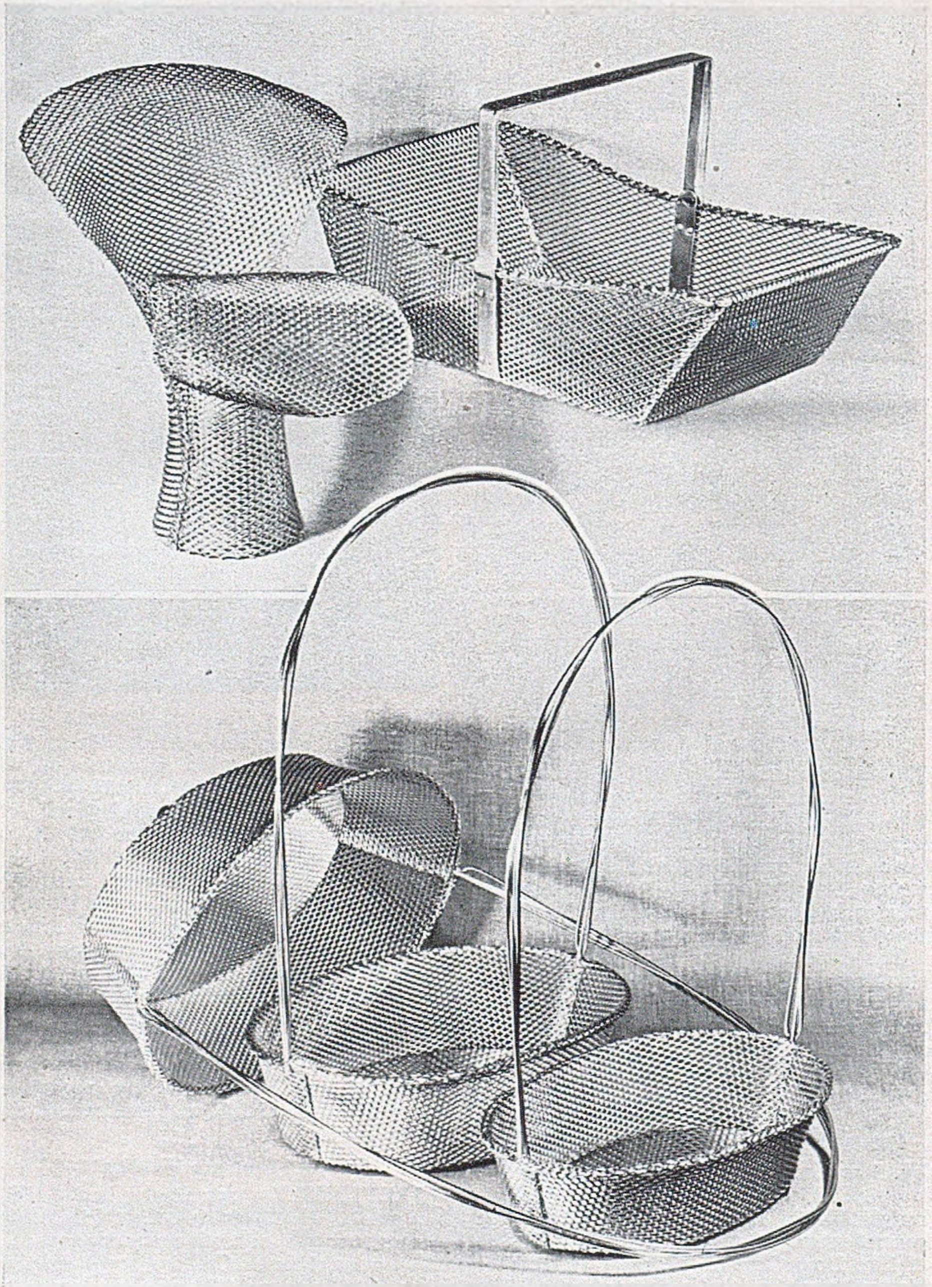
WE are informed that our old friend Dr. T. H. McConica, III, has announced his resignation as technical assistant to the general manager of the magnesium division of The Dow Chemical Company to devote his full time to the managership of The American Ski Company of Clare, Michigan.

Dr. McConica has been associated with Dow for the past ten years and has been active in many phases of magnesium development over this period. He is well known throughout the industry as an authority on magnesium, and in 1945 travelled in Germany and England on magnesium investigation for the U.S. Army Quartermaster Corps.

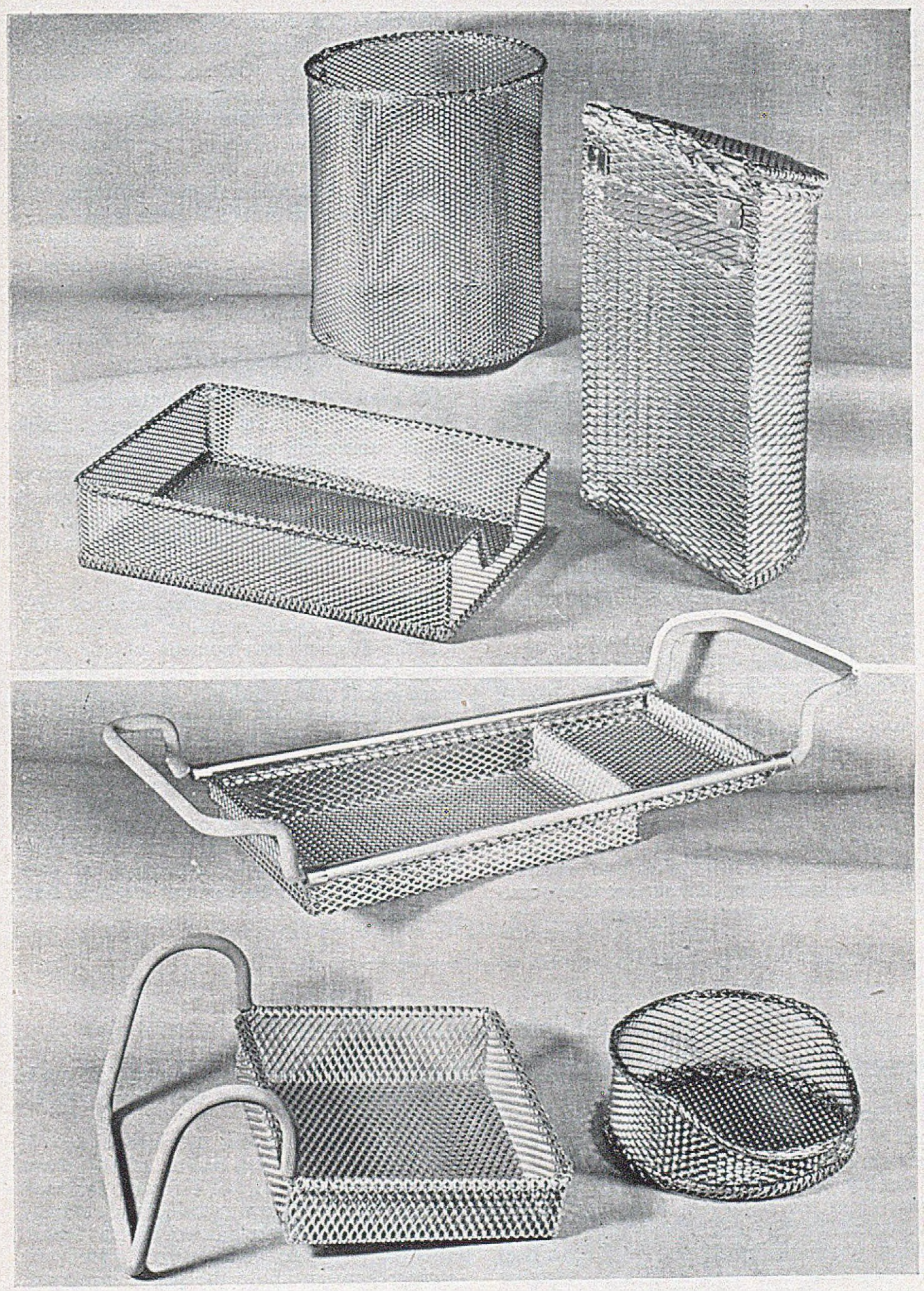
The American Ski Company, originally organized by Dr. McConica, is the home of the magnesium ski as well as other articles of ski-ing equipment. The company has recently broadened its activities to include production of magnesium snowshoes and development of other applications of the ultra-light metal. Keep us posted, Dr. McConica, on what is happening! We are interested, you know, in seeing magnesium forge ahead in U.S.A. and everywhere else in the world!

Cold Pressure Welding

PREVIOUSLY described in "Light Metals" (1948/11/406), the cold pressure welding process for aluminium, developed by the General Electric Co., has now been published in a booklet available from the G.E.C., Magnet House, Kingsway, London, W.C.2. A full description of the process is given in the booklet, and the various applications are illustrated.



FABRICATED by Frank Bros. of New Malden, Surrey, this range of "Peter Brand" products demonstrates in a striking manner the artistic utilization of expanded aluminium (manufactured by the Expanded Metal Co., Ltd.).



Finish is by anodizing and dyeing, a dual process which ensures permanence, both of the surface and the colour. Unlike woven wire, expanded metal is of "unit" construction; shifting of individual "strands" cannot take place.

Automatic Plating Plants

THE latest developments in fully automatic electroplating plants are dealt with in a catalogue recently produced by W. Canning and Co., Ltd., of Great Hampton Street, Birmingham, 18.

Recent Intelligence

THE following announcements have been received:—

Renfrew Foundries, Ltd., Hillington, Glasgow, announce that as from January 1, 1949, fully qualified sales engineers have been appointed to five areas, covering England, Scotland and Wales. They are as follows:—

Scotland.

R. McGlashan, Renfrew Foundries, Ltd., Hillington, Glasgow, S.W.2. Telephone, Halfway 3391.

South London and Southern England.

J. S. Thompson, 53, Tudor Way, Hillingdon, Uxbridge, Middlesex. Telephone, Uxbridge 1633.

Midlands and Wales.

J. A. K. Fergie, The Leys, Adderbury, Banbury, Oxfordshire. Telephone, Adderbury 224.

Northern England.

A. J. Hebden, 41, Nab Wood Crescent, Shipley, Yorkshire. Telephone, Shipley 51929.

North London and Eastern Counties.

E. P. Mendoza, 16a, Green Court, Green Lane, Edgware, Middlesex. Telephone, Edgware 8954.

This reorganization has been undertaken in order that their contact with industry, both in connection with sales and technical problems concerning aluminium-alloy castings, may be further improved.

Siemens-Schuckert (Gt. Britain), Ltd., Great West Road, Brentford, Middlesex, announce that the whole of the share capital of the company has been acquired from the Custodian of Enemy Property by Bryce, Ltd., of Kelvin Works, Hackbridge, an associated company of The Hackbridge Cable Co., Ltd. The new proprietors wish it to be known that the present policy in connection with the sales and technical developments of the range of products at present manufactured by Siemens-Schuckert (Gt. Britain), Ltd., will continue, and that it is their intention gradually to widen the range of equipment manufactured.

Richard Thomas and Baldwins, Ltd., Briton Ferry, Neath, Glamorgan, South Wales, announce appreciable reductions in the new price list for heavy-duty pressed aluminium-alloy rainwater goods. This is made possible by the increasing demand for these and by improved methods of manufacture.

S. Wolf and Co., Ltd., have acquired additional factory space in Acton, London, W.3, for the further development of the Wolf range of portable electric tools. It is anticipated that the additional productive area now available will be in full operation within the end of four to five months.

The A.P.V. Company, Ltd., Wandsworth Park Road, London, S.W.18, have appointed Green Brothers, 62, Upper Brook Street, Manchester, as their agents in Lancashire and Cheshire for A.P.V. aluminium and gun-metal castings and Paramount stainless steel castings.

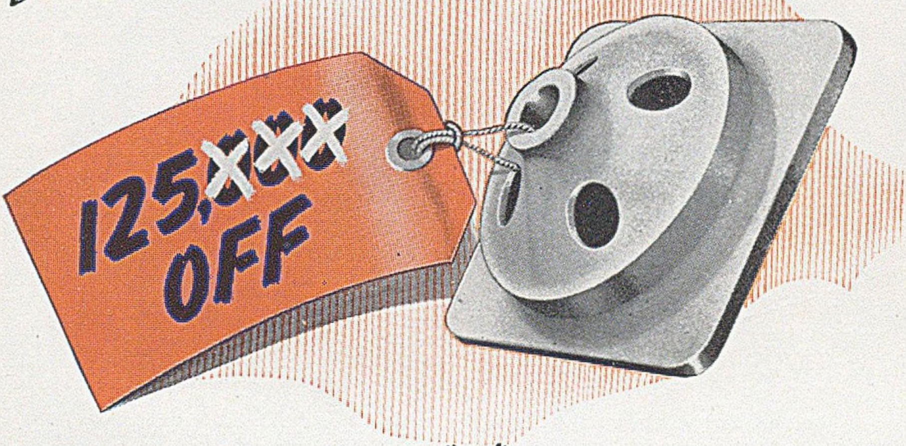
SPANISH JOURNEY

WHEN, appropriately briefed, I embarked on what might well be called "my quest for aluminium in Spain," it seemed to me that it was reasonable to start at the consumer's end of the trail.

Having, after endless searching, failed to discover in my Barcelona hotel any of the aluminium fixtures and utensils usual in such places, I asked a friend who seemed to deal in everything from cork to cinemas whether there was, in fact, a single aluminium article to be found anywhere in the city. "Yes—plenty of aluminium goods in the shops. Kitchen utensils, sports goods, toys, water bottles, forks, spoons and cutlery, all made in Spain. You will find them everywhere," he told me.

He was charming but over-optimistic. It was only after a long search of the shops of Barcelona that at last I found, far back in a dimly lit window, a remarkable display of nearly all the goods listed by my friend. Lest the passer-by may labour under any misapprehension about the goods displayed, the shopkeeper had spread across the window a streamer with the word "Aluminio" printed in bold characters upon it. I entered the shop to examine more closely these

Mechanised casting speeds for short runs



TAKE OUT THE "O"s

but keep the speed!

"*Large castings, vast quantities*"—this is not *all* the Renfrew picture. Less spectacular, but equally important, is the volume of small orders for aluminium alloy sand or die castings—simple or complicated, small or large—which are handled by our mechanized production lines at high speed and low cost. That is why more and more manufacturers let Renfrew hold their equipment. They know they can rely on Renfrew for quick delivery of sound castings at the right price.

NOT TOO BIG · NOT TOO SMALL · JUST RIGHT FOR YOUR CASTING NEEDS

RF **RENFREW FOUNDRIES LTD**

Associated with ALMIN Ltd.

HILLINGTON, GLASGOW, S.W.2. *Telephone HALFWAY 3391*

bright and shining articles, only to discover that they were—well, not aluminium, tinplate possibly, but certainly not light metal. In fact, from that day until my departure from Catalonia I saw no genuine aluminium article whatsoever displayed for public purchase. Nor did I find any evidence that aluminium is used for fittings in buses, trains or any other vehicles. One might have felt oneself in a land where bauxite and its products had never even been heard of.

This last, at any rate, would have been a false impression. It is not lack of knowledge of the uses of aluminium nor the absence of desire for such refinements as

PERPETUAL calendar manufactured in aluminium sheet for Mono Pumps Ltd. by the Metal Box Co.

aluminium furniture and the use of aluminium in architecture that explain the apparent scarcity. The fact is that, hitherto, Spain has depended almost completely upon imported bauxite and aluminium ingots and her economic situation has simply not permitted the import of these materials.

It must be remembered that, for the best part of 20 years, Spain has been out of the main current of world trade. First her own civil war and then World War II shattered what was never a very firmly founded economy. It is true that trade agreements have recently been signed with Great Britain and other countries; but Spanish coffers still lack the foreign exchange without which it has, up to now, proved impossible to do business.

Until very recently Spain had to purchase practically all her bauxite from France and aluminium ingots from Canada. The balance of production was obtained from scrap aluminium, which also had to be obtained very largely from abroad. This fundamental fact must be borne in mind when considering any aspects of industry in the peninsula.

Hitherto, Spain was thought to have no bauxite of sufficiently high grade for making aluminium, though there were known to be low-grade deposits in Catalonia—I use the past tense advisedly. The mineral was transformed into metal at the only existing smelter at Sabiñanigo (Province of Huesca). The production here during the years 1946 and 1947 was as follows:—

Month.	1946. Tons.	1947. Tons.
January	91	74
February	59	20
March	—	48
April	61	49
May	110	98
June	114	104
July	115	111
August	105	111
September ...	92	109
October	86	109
November ...	78	73
December	75	60

A very small amount of this production was distributed to manufacturers for civil uses, the major part going to State-controlled enterprises for use in the manufacture of aircraft, engine parts and the shipbuilding industry. Thus, although industry is equipped to utilize aluminium and, for example, canners are particularly interested in using aluminium containers, all enterprise has been hindered by the non-availability of raw materials. When adequate supplies are available Spain will be able to produce a wide range of articles and to expand the scope of the industry.

Whilst, as I have said, bauxite is imported from France and virgin ingots come principally from Canada, some "round-about" imports from Belgium have been reported during the past few months. Scrap is obtained from any available source. Some is collected internally and light purchases have been made in the United Kingdom. Nobody who knows Spain will be surprised that statistics on imports are not available. Import licences must, of course, be obtained from the Spanish Ministry of Industry and Commerce, whose officials, with varying efficiency, have regard to the availability of currency and the essential character of the import.

There is, it appears, no permitted importation of manufactured aluminium articles and the most important producers in Spain are S.A. Industrias del Aluminio, Orfevres de España S.A. and Cubiertos dé Aluminio Ribera S.A., all of Barcelona.

Up to this point I have been careful not to use the future tense in connection either with the production of bauxite or with the consequent manufacture of aluminium. It looks as though the discovery of very substantial bauxite seams in Catalonia may very soon change the whole picture. La Alquimia S.A. have been carrying out investigations and report that there are probably six million tons of very high grade ore, having an alumina content of some 60 per cent. in the area. This is likely to cover Spanish needs for half a century to come; and extensive prospecting is in progress in other areas also. La Alquimia S.A. has set up an experimental plant in Barcelona and has now demonstrated that Spanish bauxite is suitable for extracting alumina by the Bayer process. The same company's plant at Tarragona is expected to be in produuction soon and will be capable of an annual production of 20,000 tons of aluminium oxide.

Authorizations for aluminium production have so far been issued to the following concerns:—

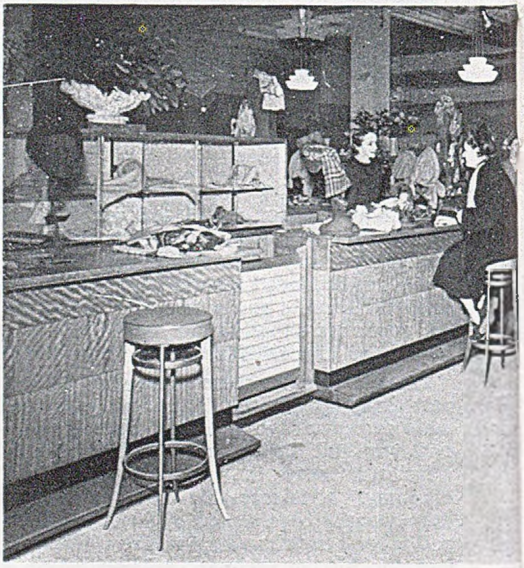
"Aluminio Espannol S.A.," with a plant at Sabiñanigo, where the capacity is over 2,000 tons annually.

"Empresa Nacional del Alumino," which commenced the construction of a plant in Valladolid in 1941 with a capacity of 5,000 tons annually.

The "Sdad. General del Aluminio Español" has been permitted to install a plant which is expected to have a capacity of 2,000 tons annually.

As to the recovery of aluminium from scrap, 2,000 tons a year is said to be the capacity of a plant projected at Aviles.

In view of the figures given above for Spain's production of aluminium during 1946 and 1947—some 1,000 tons—it seems that, if all these plans reach fruition the industry will undergo a spectacular revolution before very long. Those interested in manufactured goods in aluminium (kitchen ware, sports equipment, etc.) may find matter



ABOVE: Cast-magnesium stacking chair with black polythene sprayed finish, upholstered in a new material developed by British Celanese Ltd. This is about 0.09 in. thick and consists of Celastoid sheet laminated with a Celanese fabric Extruded section in black Celastoid forms the border of seat and back. Right: Haberdashery section of Harrods Ltd., Knightsbridge, London, showing cast magnesium stools upholstered in Melloroid plastic. (Craftsmen : J. Starkie Gardner, Ltd.)

for study in the catalogue of S.A. Industrias del Aluminio, of Barcelona.

HAROLD CHAMPION.

Aluminium Paste

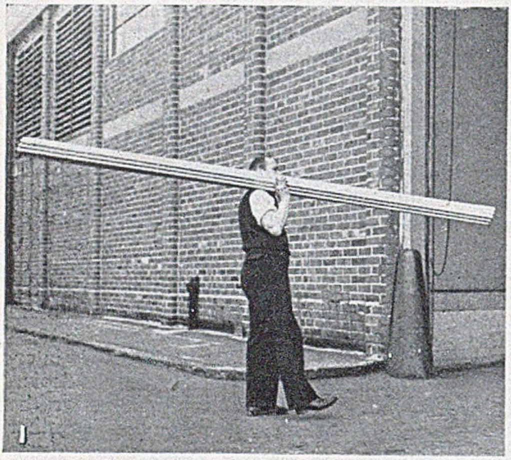
AN excellently compiled publication dealing with the characteristics and uses of aluminium paint has recently been produced by The British Aluminium Company, Ltd.

The reader is first given a description of the nature of the paste and the reasons why it is superior to the normal standard varnish powders, followed by a chapter on its characteristics. These include: durability; reflectivity and emissivity; moisture resistance; hiding power; covering power; weight: toxicity and electrical properties. The painting technique is dealt with in the next chapter, which is sub-divided under the following headings: Preparation of Surface of Painting, Recommended Paint Coats, Paint Vehicles, Mixing of Paint, Application of Paint, General Considerations. In the concluding chapters the testing and storage of the paste are dealt with and the properties of B.A. aluminium paste are studied.

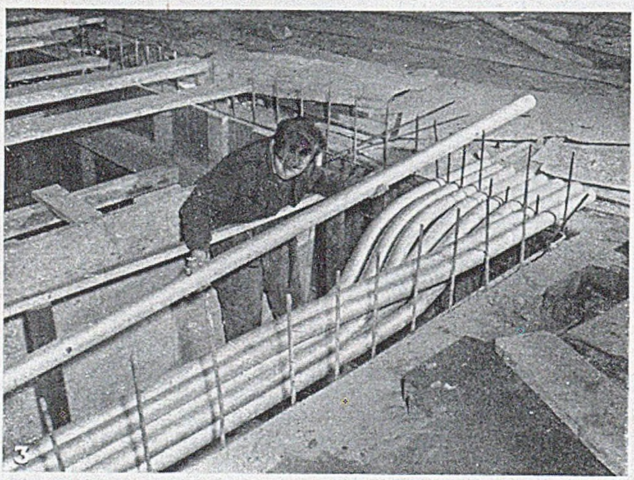
The text is liberally interspersed with illustrations depicting the extensive uses for the paint, the whole bound together to form a pencil slim volume containing interesting data clearly and concisely set out in a manner pleasing both to eye and understanding. We congratulate B.A. on this latest publication and recommend it as a valuable addition to the bookshelves of all interested. Copies may be obtained on application to the British Aluminium Co., Ltd., Salisbury House, London Wall, London, E.C.2.

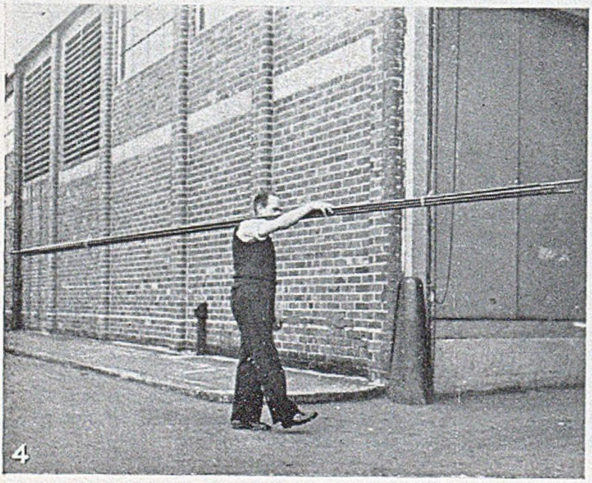
ABOVE and below: A general and more intimate picture of an interviewing cubicle at Harrods Ltd., Knightsbridge, London, with small period design cast magnesium furniture upholstered in Ryjack plastic fabric. (Craftsmen: J. Starkie Gardner Ltd.)

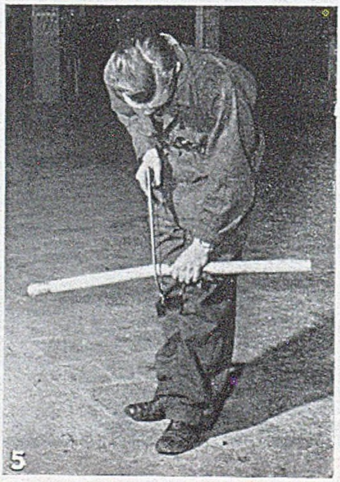
ABOVE: Tip-up stacking seats in magnesium for theatres and lecture halls, showing the framing and also the upholstery in Melloroid plastic material. (Craftsmen: J. Starkie Gardner Ltd.)

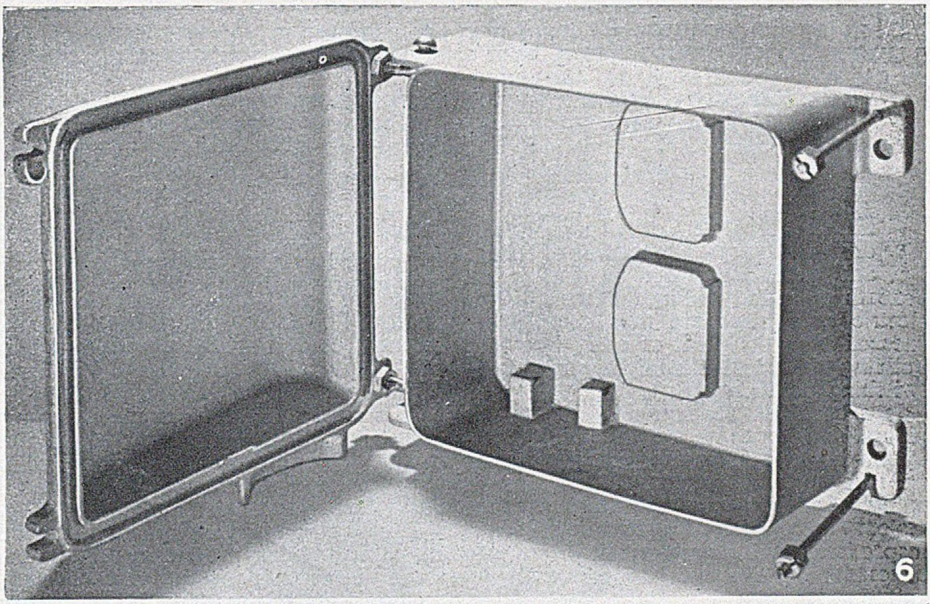


ALUMINIUM CONDUIT. The installation of aluminium conduit: (1) carrying 240 feet of aluminium conduit weighing 60-lb.; (2) setting 1 in. diam., aluminium conduit; (3) 4 in. diam., aluminium conduit set for fixing in cable trench of motor house; (4) carrying 82 ft. of steel conduit weighing 60 lb. (contrast this wasted effort with the commendable economy demonstrated in Fig. 1); (5) cutting 1.5 in. diam., aluminium conduit. (All illustrations on this page, courtesy Northern Aluminium Co. Ltd.).

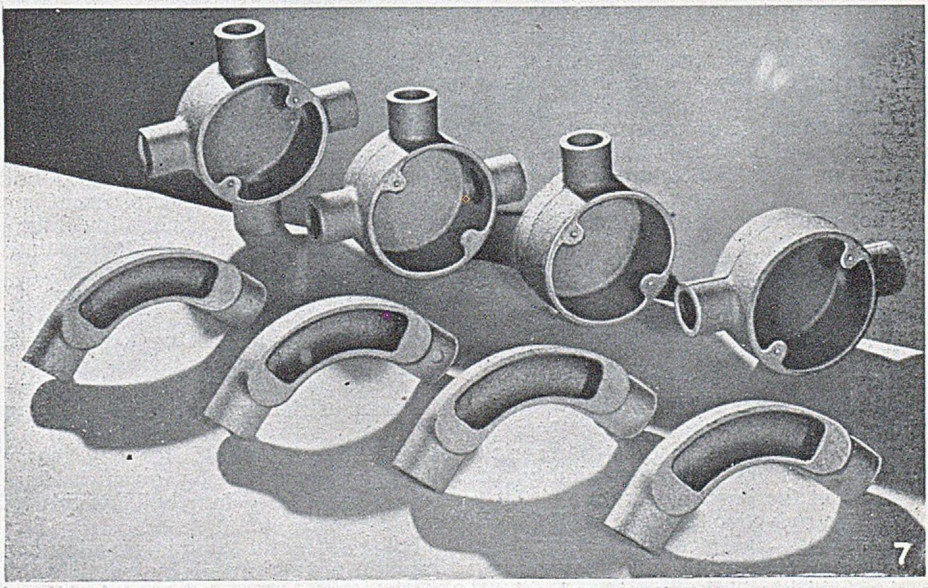








6



7

ALUMINIUM CONDUIT ACCESSORIES

Pictured above are some of the electrical conduit accessories sand cast in "Hiduminium" 51 by High Duty Alloys Ltd., Slough, for Simplex Electric Co., Ltd. Proven by long periods of service in this sphere of application, aluminium alloys have distinct advantages over the more usual cast-iron or pressed-steel fittings. Not only does the high corrosion resistance of these alloys obviate the need for protective paint but it also contributes towards good electrical conductivity to maintain a good "earth" and eliminate radio interference.

Aluminium Conduit and Accessories

J. L. Simpson Discusses the Use and Advantages of Aluminium Alloy Conduit for Electric Wiring and Reasons for the Development of Accessories in Zinc-base Alloy.

THE conduit system of wiring consists of a continuous connection of tubes and boxes which can be run on or beneath wall and ceiling surfaces. The electric conductors are thus completely encased from the point of entry into the building to the individual light, power and switching points.

It is usual for the complete system of piping and boxes to be installed, after which the conductors are pulled through and connections made. For this reason many of the component units of the system are provided with detachable inspection covers, and certain types of boxes have alternative and interchangeable covers.

Variations in detail to the normal system provide for complete weather and watertightness and security against external fire and internal explosion. These are the subject of standard specifications. Junction boxes are normally supported by the tubes connected to them, but in some cases the back plates are drilled for independent attachment to wall or ceiling.

The size of conduit used for any particular job is selected to carry the required number and size of conductors and allowance is generally made for extra wires being required and for existing wires to be renewed or diverted.

The availability of steel strip and castings for the manufacture of electrical equipment, in particular, conduit and conduit accessories, has become extremely limited in this post-war period and there seems little possibility of changes in the immediate future.

The introduction by the G.E.C. of a complete rigid conduit system in aluminium alloy with zinc-alloy accessories (which will be considered subsequently) has resulted in a range of equipment which is outstanding for quality and technical accuracy when compared with the older steel and cast-iron.

The special aluminium-manganese alloys used for the conduit tubing has resulted in a tube which is corrosion resistant to a high degree and which is manufactured strictly in accordance with the British Standard Specification where it applies, and, therefore, has the correct gauge or wall thickness for screwing electric thread or gas thread. At the moment it is only being produced in the heavy gauge to class "B" limits of the specification.

It is suitable for use in domestic and industrial installations, including the chemical, paper and food-producing industries, to mention only a few, and is unaffected by salt-laden atmospheres.

It is superior to steel in that it requires no paint or other protection for outdoor work and its resistance to lactic acids and ammonia make it particularly suitable for agricultural and dairy installations, where, in the past, steel has not stood up to these conditions very well.

B.S. Standard 31 states that, unless otherwise specified with the order, all steel conduit and steel or iron fittings shall be stove enamelled jet black, galvanized by the hot process or Sheradised both inside and out. As this requirement is to protect against rust, light-alloy fittings would, in general, only need to be painted or anodized as a decorative finish.

There is a standard bending test for the protective coating on conduit; it shall be capable of being bent through an angle of 90 degrees round a mandrel of radius equal to six times the outside diameter of the conduit, without damage to the galvanized, Sherardised or enamelled coating. If, for any reason, aluminium conduit be given a finish before being fitted in a building this test would apply.

Being rustproof, aluminium-alloy conduit will not stain walls or buildings, but care must be taken when embedding it in plaster, because its behaviour under special conditions set up by certain brands of plaster may be doubtful, especially in those plasters containing gypsum and chlorides where damp is present. However, in this respect aluminium conduit cannot be considered inferior to steel, because severe reaction from some plasters on steel conduit has been a common occurrence in the past and has resulted in stained walls and decorations.

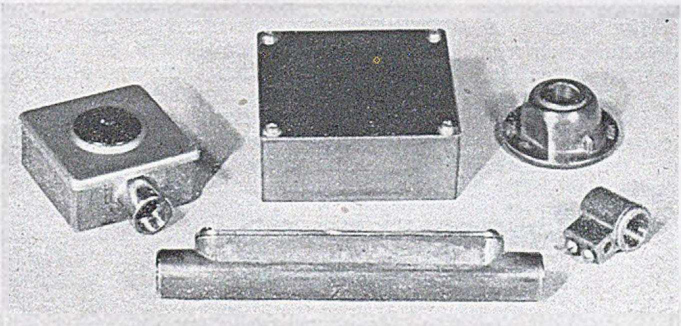
When aluminium conduit is buried in concrete, there is a superficial attack on the surface of the tube during the setting period, but as soon as this dries, and provided it remains dry, there is no further corrosive attack, and the conduit may be used with confidence without further protection. However, in situations where the tube may suffer from dampness or periodical wetting the attack may be continuous, and the only remedy is to treat the tubing beforehand with bitumastic or pitch.

Electrical conductivity is high, and perfect continuity is obtained with screwed joints when used with the die cast accessories to be described in the concluding section of this account.

Manipulation of aluminium-alloy conduit is comparable in every way with that for steel, provided that the operator uses it intelligently and realizes from the outset the essential differences in the characteristics of the two types of conduit tube. The alloy is softer than steel, but is, nevertheless, extremely ductile, and experience has proved that tools designed with sufficient bearing surfaces and adequate radii will make excellent bends. Hand bending on a setting block can be successful if care is exercised, but for the best and quickest results, a portable or bench type of bending appliance with the necessary range of formers is to be preferred. Threading can be satisfactorily carried out with the standard conduit screwing tackle, but the softer characteristics of the metal must again be considered and precautions taken to see that the dies are sharp, clean and well lubricated with the correct lubricant.

The problem of obtaining quantity production of good-quality castings in malleable and grey iron for conduit fittings would appear, at present, to have no solution, and it has become imperative to find a replacement.

Conditions of service under which equipment of this nature must operate are varied in the extreme, and range from all types of domestic and industrial installations to specialized applications for the services and for agricultural purposes; it must be suitable for use in this country and abroad, and must have a high degree of mechanical strength and absolutely first-class electrical characteristics. The manufacturer must endeavour to find a medium which will allow him to cater for all these diverse requirements and at the same time meet the existing, though vitally necessary, safety regulations and specifications. Above all, he must be able to sell at an economical figure.



GROUP of G.E.C. zinc-base accessories suitable for use both with aluminium and steel conduit. One of the examples shown incorporates an aluminium cover plate, whilst the switch is principally of plastic totally encased in a zinc-base pressure die casting.

Among the many materials considered for this purpose, the aluminium and zinc alloys have received special attention, and the Research Laboratories and Conduit Department of the G.E.C. have carried out a considerable amount of investigation in this particular field.

Results have not been achieved easily, because although the versatility of application of aluminium and zinc alloys is to-day unlimited, the use of these metals for electrical equipment has brought problems which have required intensive research and necessitated special methods of fabrication in manufacture. The big problems have been those of corrosion (corresponding to "rusting" in the case of ferrous alloys) and the avoidance of incompatible metals in the building up of multiple units, such as switch-box combinations, inspection fittings, etc. The greatest difficulty has been to find materials which would allow the simultaneous use of steel tubing as well as light alloy, and at the same time give complete and efficient electrical continuity during the lifetime of the installation, which may be upwards of 30 years.

It is impossible to guarantee the complete absence of moisture in a conduit installation, because although it may be painted or given a protective coating of some sort, the essential metal-to-metal joints must be preserved to ensure earthing, and the formation of any rust or other corrosion products at these points must at all cost be avoided. It is for this reason that a zinc-base alloy has been chosen for the conduit fittings made by G.E.C. rather than aluminium, in order that they may, at will, be used with either steel or aluminium tubing.

Consideration had to be given to many other factors also, including ductility, castability, etc., and for these reasons mazak alloy made and cast to B.S.1004a was the final choice for the principal items in the wide range of patterns listed by G.E.C. For certain specific types of installation, however, an extensive range of fittings cast in L33 and other aluminium-silicon alloys is produced, but generally in these cases only aluminium conduit tubing is used in the final combination.

Production of die-castings with a full degree of soundness and dimensional accuracy suitable for the manufacture of electrical and conduit fittings calls for intensive care and close laboratory control throughout the production cycle. Great harm has been done by the production of conduit fittings made from recovered metal of unsuitable or uncontrolled composition by inexperienced casters with no knowledge of the electrical requirements of the fitting, or with any idea of the responsibility which the installer must take for the equipment he uses. Such faulty material has frequently found its way on to the market and has in the past tended to give rise to an unfortunate reaction on the part of electrical contractors and users.

These difficulties can be overcome in time, and then only by the production of equipment made to the highest specifications by reputable manufacturers whose methods inspire confidence. The design of G.E.C. accessories is to B.S.31 where it applies, and very strict precautions are taken to ensure that the alloy is cast to the specification B.S.1004a and that contamination cannot possibly occur, so eliminating the risk of embrittlement of the casting in service.

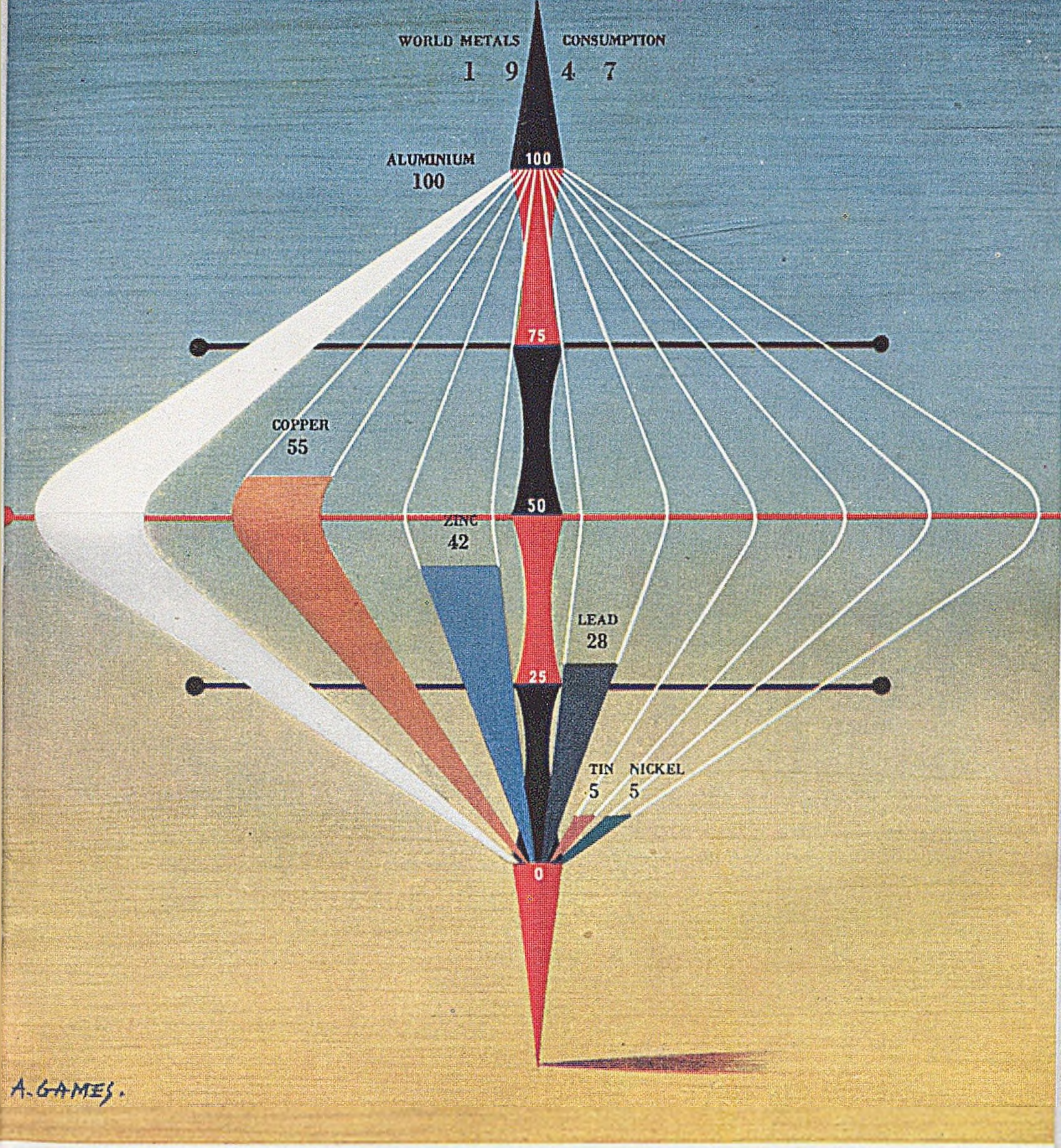
The ultimate destination and the conditions under which these accessories will have to operate cannot be foreseen by the manufacturer, and, therefore, he must take steps to ensure that they will stand up to their job under all known conditions, and that any limitations as to their use are made known.

The range of conduit accessories referred to here is completely passivated before machining, so that all threads are clear and metal-to-metal joints are assured for electrical continuity. This passivating process increases the natural corrosion resistance of the alloy when used in extreme conditions and affords a key for the colouring medium or paint used after installation.

Comparative tests of the mechanical strength of these zinc-base accessories have been carried out both in the laboratory and in the field, with results which have fully justified the confidence placed in the alloy by those responsible for its choice. They have proved themselves fully capable of withstanding the stresses and strains normally applied to this type of equipment during erection, but it must be admitted that in extreme conditions they probably require a little more care and intelligent handling from the operator than similar components in ferrous metals. However, for the majority of electrical installation requirements, the die-cast zinc-base accessory is ideal.

The relatively high corrosion resistance in ordinary atmospheres and the extremely low rate in heavily polluted atmospheres, of the zinc alloy, make it suitable for outdoor installation in place of the usual galvanized-iron accessory, and experience has proved how well it withstands these conditions both at home and overseas. Satisfactory service in salt-laden atmospheres and actual salt spray has also been experienced.

The combination of aluminium-alloy tube and zinc alloy die cast accessories has formed a valuable addition to the range of electrical equipment for export, and, because of its lightness, is much easier to handle on the job and quicker to erect, resulting in an appreciable overall saving.


WORLD METALS CONSUMPTION
1 9 4 7
ALUMINIUM
100
100
75
50
25
0
COPPER
55
ZINC
42
LEAD
28
TIN
5
NICKEL
5
A. GAMES.

MORGAN BALE-OUT FURNACES

FLEXIBILITY

Fast melting from cold start on initial charges, 400 lb. aluminium in 1½ hours, wide turn-down range of burner for economical holding.

LOW FUEL CONSUMPTION for example, 100 lb. aluminium per gallon of oil, continuous melting.

ECONOMY OF FLOOR SPACE. 400 lb. output of aluminium per hour (continuous production) on 8 square feet of floor.

METALLURGICAL CONTROL. Plumbago basin ensures accurate control of charge composition and freedom from contamination.

LOW COSTS. Capital, installation and maintenance costs are low.

RANGE: Oil & gas fired: Aluminium 100 lb. to ½ ton. Bronze 200 lb. and 400 lb.
Gas fired natural draught: Aluminium 100 lb. Coke fired: Aluminium 100 lb.

A MORGAN product

THE MORGAN CRUCIBLE COMPANY LTD., LONDON, S.W.11. BATTERSEA 8822

CATHODIC PROTECTION

The Second Part of this Review, Continued from "Light Metals," 1948/11/681, *Concludes the Discussion on the Anodes Themselves and Considers the Problem of Backfills.*

CONTINUING the discussion on magnesium-ribbon anodes, it may be observed that those without the iron-wire core may, in service, be entirely corroded away, thus severing the circuit, or become so reduced in section as to introduce appreciable extra resistance into the circuit and thus reduce the protective effect of the magnesium. The iron wire ensures that the resistance of the circuit will not become excessively high, though its own resistance is by no means negligible, about 10 ohms per 1,000 ft.

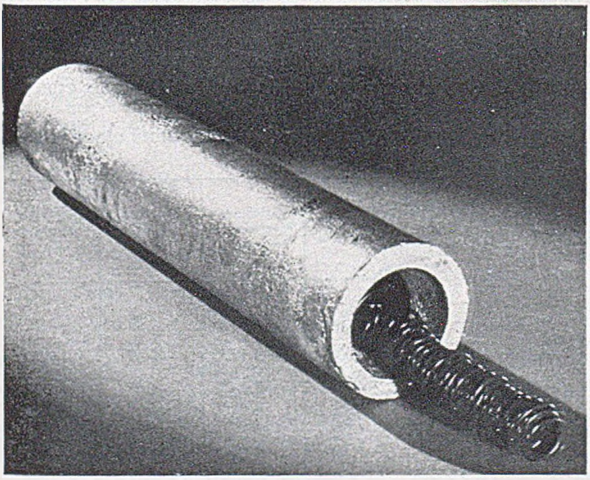
An important advantage of this type of anode is its suitability for use in soils of high resistivity, where cast anodes may be unsuitable on account of their low current output, due to their location further away from the pipe. It is claimed that installation of ribbon-type anode is faster, simpler and less expensive than that of the conventional types of anode. Moreover, it gives more uniform current distribution than is obtained with isolated anodes. The current generated is more efficiently used. The ribbon anode is wound on reels and is available in lengths of 1,000, 2,000 and 5,000 ft.

With the magnesium-ribbon type of anode the number of amp-hrs. per ft. can be taken as being, on the average, around 100. Worked out on the total weight of the anode, that is to say, the weight of the magnesium itself plus the core, this amounts to about 400 amp.-hrs. per lb.

Aluminium Anodes

The possible use of aluminium anodes for the cathodic protection of steel structures has been fairly fully investigated, mainly in the laboratory, but also under actual practical conditions to some extent, though the information available from the latter source is less than that relating to the use of magnesium anodes. Whilst it is, of course, necessary to await the results of long-time service in actual application before drawing final conclusions about aluminium anodes for this purpose, nevertheless, such results as have so far been obtained are certainly encouraging and are sufficient to point to the best alloys to use for the job and to the correct type of backfill to use with them.

With regard to composition of the anodes, the indications are that systems containing zinc are the most suitable for this purpose. Such alloys have a solution potential more negative than pure aluminium in many solutions. Hoxeng, Verink and Brown[7] have described tests on alloys containing 1, 5 and 10 per



LATEST type of magnesium anode developed by the Dow Chemical Company of America, before installation.

cent. of zinc. These were tried out under service conditions, using a lime-salt backfill, over a period of more than a year, and although the solution potential increased appreciably with the increase in the zinc content of the alloy, and in all three cases remained fairly steady throughout the period of the test; nevertheless, the anode-to-soil resistance of the 5 per cent. zinc alloy was lower than that of the other two. The currents given per lb. by the 1, 5 and 10 per cent. alloys were, respectively, 735, 510 and 405 amp.-hrs. It was considered that, on the whole, the 5 per cent. had the most promising overall characteristics for use as an anode material. Two such anodes coupled to pipes having a pipe-to-soil potential of 1.0 and 0.7-0.8 volt for about eight months were shown to have substantially the same operating characteristics, the polarization being the same in each case, in spite of the much greater current which the one connected to the more cathodic pipe was delivering.

Mears and Brown[1] have measured the solution potentials of a variety of aluminium-zinc alloys exposed to various solutions. The results of their tests are given in Table 4, from which it is seen that the presence of zinc in the alloy appreciably raises its solution potential in most media, except the alkaline ones. As mentioned elsewhere, in many solutions the potential of zinc is higher than that of aluminium (see Table 2. The additions of relatively small amounts of zinc as an alloying constituent to the aluminium bring its potential up nearly to that of zinc in most cases.

The beneficial effect of zinc additions to aluminium was borne out by actual installations in soils, though the period of the test was too short to draw definite conclusions. However, an alloy with 1 per cent. of zinc was superior to commercial purity aluminium, while one containing 6.5 per cent. of zinc and 0.5 per cent. of copper was even better.

Operating Characteristics of Anodes

The potential of the anode under conditions of service must be sufficiently anodic with respect to that of the structure to be protected as to cause an adequate current to flow through the circuit. Obviously, the greater the difference between the two potentials the greater the driving force available and the greater the amount of pipe, etc., that can be protected by a given anode.

Polarization is, of course, a point of considerable practical importance, for if serious polarization of the anode does occur, it will reduce the effective potential below that indicated by the open circuit potential measurement. Polarization of the pipe (i.e. the cathode), on the other hand, is obviously desirable, as it exerts a protective effect. Anode polarization is often taken to mean, not only the true polarization at the anode surface but also the IR drop in the backfill, and anode-to-soil resistance is the difference between the open circuit and closed circuit potentials of the anode divided by the current

TABLE 4.—Solution potentials of aluminium-zinc alloys referred to N/10 calomel electrode.
(All solutions 1 molar unless noted).

Metal	Sodium Chloride	Sodium Sulphate (Sat.)	Hydro-chloric acid	Sodium Hydroxide	Sodium Car-bonate	Trisodium Phosphate	Calcium Hydroxide (Sat.)	Calcium Carbonate (Sat.)	Calcium Sulphate (Sat.)
Aluminium 2S	−0.85	−0.50	−0.88	−1.47	−1.35	−1.32	−1.54	−1.04	−0.77
Aluminium +1% zinc	−0.96	−0.76	−1.02	−1.56	−1.54	−1.53	−1.57	−0.99	−0.70
Aluminium +5% zinc	−1.04	−0.82	−1.08	−1.58	−1.50	−1.54	−1.57	−1.05	−0.82
Aluminium +10% zinc	−1.05	−0.66	−1.12	−1.58	−1.52	1.53	−1.58	−0.98	−0.84
Aluminium +15% zinc	−1.02	−0.62	−1.12	−1.55	−1.53	−1.49	−1.54	−0.87	−0.80

flowing. It is obviously desirable to keep this figure as low as possible. It is convenient to use this factor in practice rather than to distinguish between the various components which account for the increased resistance, i.e., true polarization, IR drop at anode surface and IR drop in the backfill.

The stability of anodes and backfills is obviously of considerable importance in practice, as naturally these installations are expected to operate for many years without attention. Laboratory and small-scale trials give a good indication of what can be expected from various anodes and backfills; prolonged field tests are now required.

Operating Characteristics of Magnesium Anodes in Sea Water

Humble[8] describes tests on six magnesium and magnesium-alloy anodes in sea water. The composition and solution potential of these materials are given in Table 5. It is seen that their solution potentials in sea water do not vary much one from the other. Moreover, it is found in all cases that there is little change in the solution potential during exposure to sea water, that is, that there is little polarization, presumably on account of the fact that in sea-water exposure the corrosion products of magnesium and its alloys are non-adherent and are, therefore, unable to form a protective film. This applies even when the current densities are considerable. In fact, magnesium is not liable to polarization in any conditions, excepting, perhaps, in the presence of chromic acid and a small number of less-common media. Not all these alloys are used on a commercial scale in sea-water service, the one containing 6.5 per cent. of aluminium and 3.4 per cent. of zinc being the most commonly employed.

Although the solution potential of all the materials mentioned is about the same in each case, the number of ampere-hours per pound that can be expected from the various alloys varies considerably. Moreover, it will also vary with the current density at which the anodes are operating, increasing current density giving increased efficiency, the curve current density-ampere-hours per pound tending to flatten out at a definite value for each alloy. Thus at a current density of 1,000 ma. per sq. ft. the number of ampere-hours per pound obtained from the alloy containing 3.4 per cent. of zinc is about 500, whereas the pure magnesium only gives about 400. In this connection an interesting and important point is brought out by this work with regard to the former alloy. It was found that whilst the figure given above was correct, based on three months' exposure in sea water, nevertheless, if the alloy was immersed for a further three-month period, the amount of current per pound was of the order of 615 ampere-hours at a current density of 1,000 ma. per sq. ft. The author ascribes this to the fact that inverse segregation took place during casting, giving an aluminium-rich skin on the outside of the anode. This skin, being cathodic to the rest of the alloy,

TABLE 5.—Composition and anode potentials of magnesium alloys.

Alloy	Al	Cu	Fe	Ni	Mn	Zn	Solution potential v. saturated calomel electrode. (Volts).	
							Open Circuit	Closed Circuit
Pure Magnesium	<0.01	<0.01	0.027	<0.001	0.10	0.01	−1.63	−1.56
Dowmetal FS−1	2.6	0.003	0.005	<0.001	0.4	1.1	−1.54	−1.42
Dowmetal H	6.0	<0.01	0.009	<0.001	0.26	2.5	−1.51	−1.46
Dowmetal H−1	6.5	<0.01	0.001	<0.001	0.24	3.4	−1.51	−1.47
Dowmetal J−1	6.5	0.005	0.001	<0.001	0.23	0.78	−1.50	−1.46

stimulated local corrosion, such as pitting, and led to a falling off in efficiency. During the first period of exposure this outer skin was presumably corroded away, so that for the second period the alloy corroded more evenly, without intense local attack, so that there was an increase in efficiency.

The solution potentials of pure magnesium and of the alloys mentioned are all adequate for the purpose of protecting steel in sea water. Taking the protective potential required to polarize the steel as 0.78 volts against the calomel electrode, even the alloy with the lowest solution protection has a sufficiently high one to ensure a good flow of current.

With regard to the current required to protect by cathodic means steel exposed to sea water, Humble has made a number of very important observations. His results apply to sea water not in movement. He found that, while sand-blasted steel would eventually be protected by applying a current density of about 6 ma. per sq. ft. for a long enough period, nevertheless, it was more economical to arrange to apply a high initial current for a few days and to then continue the protection with a considerably reduced current, say, about 3 ma. per sq. ft. The reason for this is that, as is well known, sea water tends to deposit a coating consisting mainly of calcium salts on the cathodic areas of a corroding metal. Alkali is produced at the cathodes and this increases the pH of the water in the immediate vicinity and allows the precipitation of calcium carbonate and magnesium hydroxide, which are usually deposited as a firmly adherent film. To what extent such deposition would occur in rapidly moving sea water is not known, but one would expect it to be less because the movement would remove traces of alkali from the vicinity of the cathode as soon as they are formed, thus preventing the build-up of the requisite pH. However, when such deposition occurs the film produced has good protective properties, as it prevents access of oxygen and allows the pH of water in contact with the metal surface to increase above that of normal sea water and thus tends to prevent the corrosion of the iron.

By protecting the metal in this way, the amount of current needed for cathodic protection is considerably reduced. It is found that a current density of 20 ma. per sq. ft. is sufficient to bring about the precipitation of the calcareous scale, though in practice it would be wise to use two or three times this current. The period for which the initial high-current density would be required naturally depends on the actual value used, but Humble obtained good results with 50 ma. per sq. ft. for five days. After this period it was possible to maintain more or less complete protection with a current density of 2 to 3 ma.

The economy achieved by using the high initial-current density is clearly seen from the following figures. If we first consider the constant application of a current density of 6 ma. per sq. ft. for a year, the number of amp.-hrs. expended works out to 52.56, whereas with an initial-current density of 5 ma. per sq. ft. for five days, followed by a constant current of 3 ma. for the rest of the year, the total number of amp.-hrs. is only 31.92, representing a saving of 20.64 amp.-hrs. per year for every foot of surface protected, i.e., a saving of about 40 per cent.

On the other hand, it is, of course, necessary to make arrangements for applying the initial high current, either by means of additional anodes, or with an electric generator, so that the expense involved in this has to be deducted from the saving effected in the way mentioned.

In much the same way, if steel is allowed to rust before cathodic protection is applied, the time required before protection is achieved at a given current density is less than it would be if clean steel had been used. For example, Humble found that after 72 days plates that had been rusted by exposure to sea water for three months were protected by a current density of 10 ma. per sq. ft., whereas 104 days was required on clean steel plates which had been sand-blasted. The explanation is, presumably, very much the same as in the case given above, namely, that during the rusting process a calcareous deposit is formed at the cathodic areas, thus reducing the amount of current required subsequently when the iron is cathodically protected.

With rusted steel, a high initial-current density may also be used, as with bare steel. If the rust has been formed by immersion in sea water, or if it is atmospheric rust, the application of a current of 50-400 ma. per sq. ft. removes it and then the calcareous film is formed on the bare steel. However, heavy rust caused by prolonged immersion in sea water is not normally removed in this way, but pores in the rust coating are filled with the deposit mentioned, and it is found that the resulting coat of rust, plus the deposit, gives protection of the same order as that produced by a calcareous coating on bare steel. A current density of about 3 ma. per sq. ft. is adequate to provide continuous protection on this type of coating after an initial high-current-density treatment.

Backfills for Magnesium Anodes

Laboratory work reported by Robinson[3] showed that the rate of local attack as distinct from useful corrosion and the rate of increase in local reaction with increasing current density were both much less in sulphate electrolytes than in chloride solutions.

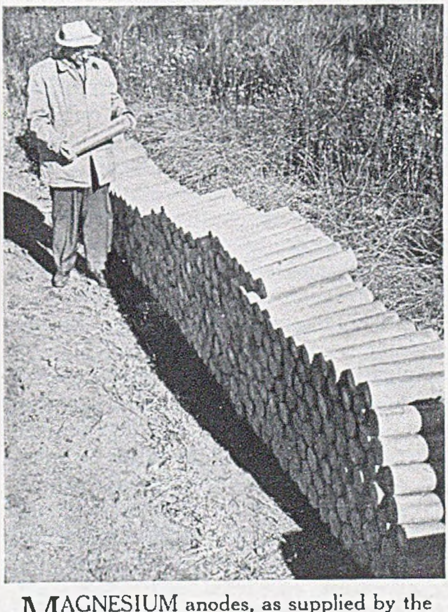
A variety of different backfills for magnesium-base anodes have been tried out in practice, though not over as extended a period as one could wish. Robinson gives figures for percentage current efficiencies for different alloys in a variety of soluble backfills, which were applied by mixing the chemicals in question with the excavated earth and returning the mixture to the hole around the anode. It is not possible to draw any definite conclusions from these tests because, with different alloys, the relative merits of different backfills vary considerably.

However, subsequently, backfills in which bentonite was used were tried out. The bentonite was mixed with water into a slurry, various additions were made and the mixture poured into the hole around the anode. Hart and Titterington[4] recommend the following backfills:—

(a) For low resistivity soils—
 3 parts bentonite.
 1 part ground gypsum.
(b) For high resistivity soils—
 2 parts bentonite.
 1 part ground gypsum.
 1 part anhydrous sodium sulphate.

They recommend further that in acid soils such as bog or peat marsh, one part of magnesium hydroxide be added to the above mixtures. The function of this is to raise the pH of the backfill and this reduces the lowering in efficiency which would result from acid attack on the magnesium. They recommend the same addition in cases where commercial purity magnesium is used as the anode material.

The use of this type of backfill has several advantages over that obtained by mixing chemicals with the excavated earth. In the first place, it is not possible



MAGNESIUM anodes, as supplied by the Dow Chemical Company of America, ready for installation underground.

to obtain uniform contact between the backfill and the surface of the anode with the latter type, whereas with a slurry of bentonite this aspect presents no difficulty. Moreover, the bentonite slurry is much more likely to be uniform in composition than a soil mixture. Furthermore, the bentonite should be very effective in preventing leaching out of the chemical mixed with it, and also it has excellent stability against weathering.

Raclot[5] makes several suggestions for backfills for use with magnesium anodes. For small installations in approximately neutral soil he suggests either sawdust or silica gel or alumina gel soaked in a salt solution. Sawdust, we suggest, may be dangerous as wood acids may result in adventitious attack on the magnesium, whilst the nature of the salt solution is critical; NaCl would be useless! For larger installations he makes the following recommendations:—

(1) For a basic or weakly acid soil of good conductivity, a mixture of one part of calcium sulphate or natural gypsum and four parts of bentonite. If calcium sulphate is used it should be mixed rapidly with a large volume of water to prevent its setting.

(2) In basic or weakly acid soil with poor conductivity, the same mixture as above, but with the addition of one part of either sodium sulphate or zinc sulphate to every five parts of the mixture.

(3) In soils that are definitely acid, either of the two mixtures given above is used, depending on the conductivity of the soil, and either one part of magnesium hydroxide or a half part of zinc hydroxide to every five parts of the mixture.

Actually, the precise composition of a backfill for magnesium anodes is not of great importance. Provided that the soil environment be moist, neutral or alkaline, and free from chlorides, no backfill is necessary; when in doubt, bentonite with calcium sulphate and magnesium hydroxide may be recommended.

Backfills for Aluminium Anodes

The tendency of aluminium to form a protective oxide film in atmospheric and many aqueous exposures is well known. The film is firmly adherent and is a good insulator, and it is thus clear that for an aluminium anode to function satisfactorily it is essential to minimize the formation of such a film, otherwise the anode will become partially or wholly ineffective. Aluminium anodes buried in many, in fact, in most, soils would form such a film and the use of the correct backfill is therefore of particular importance in this case. Hoxeng, Verink and Brown[7] have described work carried out on various backfills for aluminium. Early work indicated that the presence of lime and sodium chloride in backfills was beneficial. The first of these is desirable in that it raises the pH of backfill and it is found that the potential of aluminium anodes is usually higher in contact with alkaline materials than in contact with neutral or acid solutions. Moreover, the corrosion products formed at the surface of the anodes are not only less adherent under these conditions, but are also more soluble in the alkaline medium than if the surroundings were neutral. Both the latter factors tend to reduce the polarization of the anode. Chloride ions have the same effect in that they reduce the resistance of the backfill and also of the film of corrosion products that forms on the aluminium.

Laboratory tests indicated that in a lime-salt backfill as mentioned above the solution potential on open circuit was fairly steady, but that there was an appreciable decrease in current as the corrosion of the anode proceeded, due to an increase in the anode-to-soil resistance. With this type of backfill the current supplied by an anode containing 5 per cent. zinc was, on the average, 480 ampere-hours per lb.

In a service test which was run for over a year the 5 per cent. zinc alloy gave a current of 510 ampere-hours per lb.

By using a backfill containing salt and calomel the anode was found to have a higher solution potential and to show less polarization than when the backfill con-

GALVOPAK magnesium unit showing coiled lead wire and installation instructions. The unit is here pictured ready for setting in position.

tained salt and lime. The average current supplied by the anodes in question in this type of backfill was about 515 ampere-hours per lb.

In a service test run for about eight months two alloy anodes containing 5 per cent. of zinc gave a current of 430 and 485 ampere-hours per lb. respectively.

It was found that the use of lime, salt and calomel simultaneously in the backfill gave still more satisfactory results, and although the solution potential of the anode was not as high as in the latter case, the total current per lb. of anode was about 710.

Mears and Brown report on some experiments in a clay soil using various types of backfill. Using a clay backfill with a 5 per cent. sodium chloride admixture the current output of both commercially pure aluminium and of two aluminium-zinc alloys was much greater than when no chloride was mixed with the clay. This admixture of chloride was also tried with zinc anodes, the current output of which, in untreated clay, was much greater than that of any of the aluminium-base materials. In the presence of chloride, however, although the current output of the zinc was also appreciably improved, the increase was proportionately much less than with the aluminium and aluminium-alloy anodes.

When the clay was treated with 5 per cent. of lime in addition to 5 per cent. of sodium chloride the current output of the aluminium-base alloys was increased still further and now exceeded that of the zinc anodes exposed to chloride admixtures. The addition of lime caused a drop in the current output of the latter compared with exposure in the clay-chloride backfill.

Packaged Backfills

Attention has been given to the possibility of using packaged backfills with anodes. These consist of a mass of cement-like appearance round the anode, the material in question having incorporated in it the chemicals necessary to ensure the optimum functioning of the anode. Several advantages have been claimed for this type of backfill. An important one from the practical installation point of view is that their use reduces considerably the time of installing the anodes. Moreover, made under scientific control in the factory, the packaged anode is more likely to be constant in composition and to represent the best that can be obtained. In the field, when wet backfills have to be used, consisting perhaps of several ingredients, there is plenty of chance for mistakes to be made and for variation to occur. In wet, marshy ground or in ground liable to flooding, the slurry type of backfill may be rapidly dispersed, with the inevitable reduction in effectiveness of the anode. It is not at all unusual in such localities for the whole of the backfill to be completely displaced from around the anode. On the other hand, it should be noted that, in wet ground, the chief object of the backfill, namely to establish good electrical contact, is automatically attained *without* the use of a backfill!

Packaged backfills show great promise,

though it must be admitted that the amount of experience with them in practice is limited, but that which is available certainly confirms their potential usefulness.

Hoxeng, Verink and Brown[7] carried out some tests on packaged aluminium anodes. These indicated that a 5 per cent. zinc alloy set in a magnesium oxychloride cement gave about the same results as the same alloy in a lime-salt wet backfill. A current of 480 amp.-hrs. per lb. was obtained in both cases. When mercury salts were added to the backfill, the current output rose to about 720 amp.-hrs. per lb., which is as good as any of the figures obtained for wet backfills with this type of anode.

A 1 per cent. zinc alloy set in a magnesium oxychloride cement without addition of mercury compounds was shown to be definitely superior to the same alloy in a wet backfill of lime-salt in tests lasting for over a year. Not only was the solution potential higher in the former case, but the anode-to-soil resistance was lower and the anode had better stability. Moreover, the current per lb. was 825 and 1,050 amp.-hrs. in the case of the two alloy anodes in packaged backfill, but only 735 amp.-hrs. in the wet backfill. Another type of packaged backfill used was lime, magnesium chloride and sand. This, too, was better than the wet backfill, though not as good as the oxychloride type mentioned above.

WORKMAN lowering a packaged magnesium anode unit into hole adjacent to pipeline to be protected.

A five per cent. zinc alloy in a magnesium oxychloride backfill containing mercury compounds was found to have a superior performance to the same alloy in either lime-salt or salt-calomel wet backfills.

Light Metal Anodes Used in Conjunction With Applied Current.

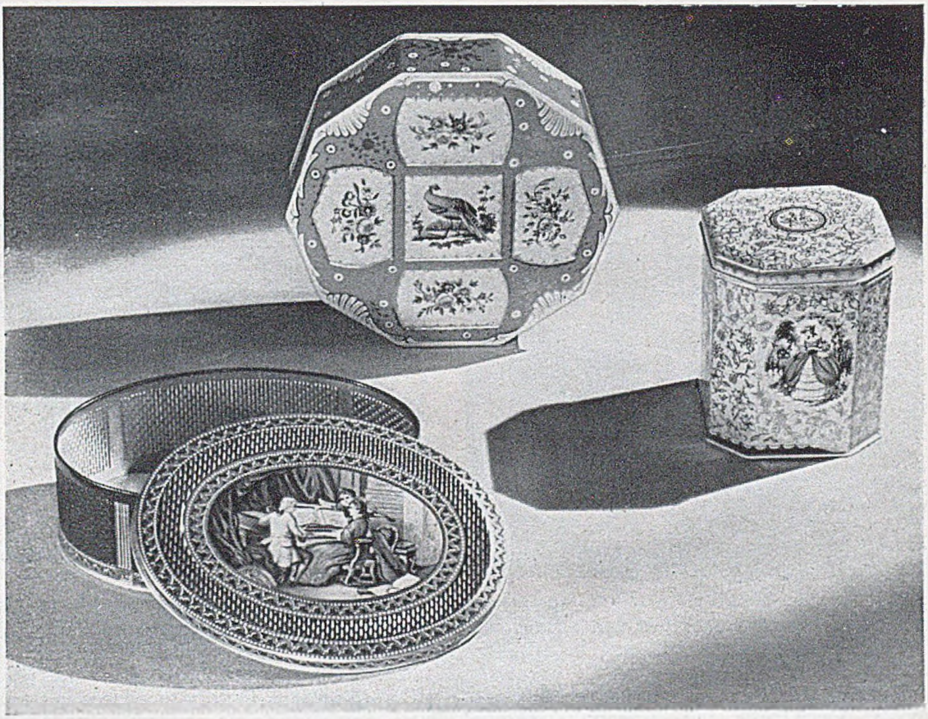
Sudrabin and Mears[9] have described the use of aluminium anodes for the protection of water storage tanks of various kinds. In this case, however, the aluminium anodes are used not as galvanic anodes but as electrolytic anodes. That is to say the protection of the tank is brought about by applied external current. Some thousand installations of this type are in use and they range from tanks of a few gallons capacity to those of several million gallons capacity. Cathodic protection of water tanks using applied current has been used with other types of metallic anodes for 10 or 12 years, but aluminium has only been used for the purpose for four or five years.

The advantages of aluminium anodes in this application are as follow: The weight loss per ampere-hour is much less than that of steel, in fact, less than a third, so that for a given life much less metal is required, and this greatly reduces installation and handling costs.

(To be concluded.)

REFERENCES.

(7) *Corrosion* 1947/3 (6), 263; (8) *ibid.* 1948/4 (7), 358; (9) *Amer. Inst. Elect. Eng.* 1947/66, 197.

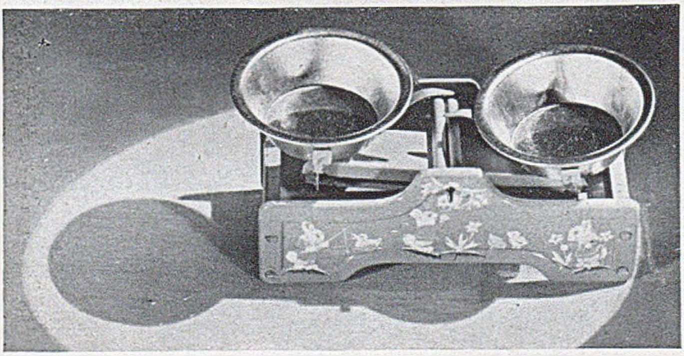


Art and the Container

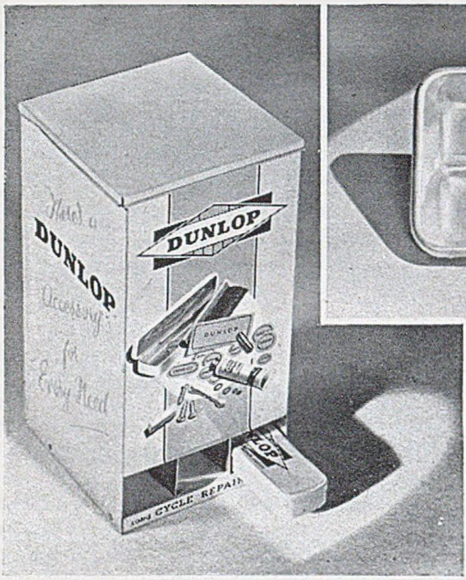
WE have on previous occasions in these pages illustrated containers of various types, manufactured by the Metal Box Co., Ltd. (see, for example, "Light Metals," 1947/10/565 and 1948/11/649). In the accompanying pages is shown a somewhat fuller range of the company's manufactures see during a recent visit to the factory at Mansfield and to neighbouring plants, referred to as Sutton 1 and Sutton 2.

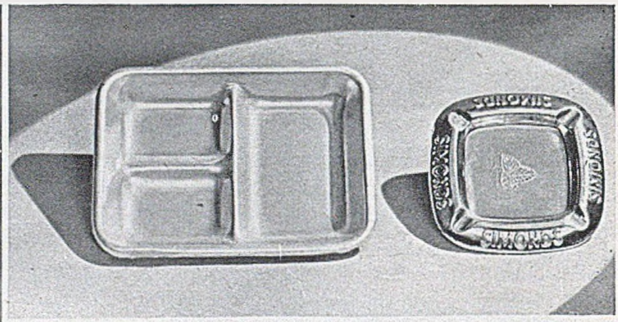
The last of these plants is devoted to the production of open-top cans solely in tinplate. It is equipped with the most up-to-date

PICTURED above are three most attractively decorated containers produced in multi-colour printed aluminium sheet by the Metal Box Co., Ltd., at its Mansfield Works. Characteristic "smoothness" is a feature of colour printing on aluminium.



ILLUSTRATED at the left is one example of a very extensive range of toys produced in colour-printed aluminium sheet at the Sutton 1 plant of the Metal Box Co. No dangerous sharp edges on light metal!





ABOVE, are shown, at the right, an ashtray pressed in aluminium sheet. Adjacent may be seen a light pressing in thin gauge aluminium. This item is adopted for serving food in passenger aircraft.

AT the left is shown an irregular built-up container in aluminium sheet produced at the Mansfield factory of the Metal Box Co., Ltd. Quality of finish and eye appeal generally are very noticeable in this instance.

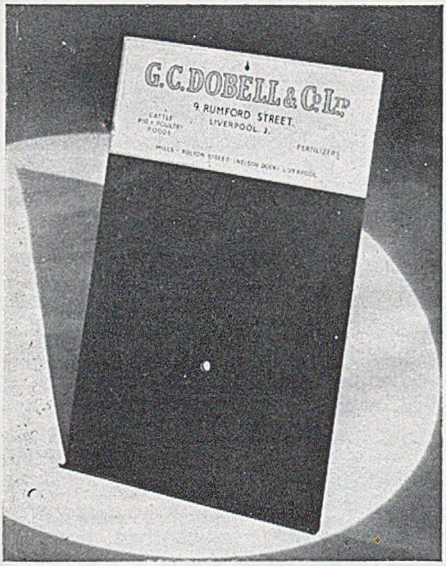
plant and despatch facilities, but as it does not utilize aluminium will not be further discussed here.

Sutton 1 plant comprises printing departments, which serve the company's various factories as a whole and print sheets of both tin-plate and aluminium according to works' and customers' requirements. Production is very high, being at the rate of 4,000 per hour. The general sequence of operations entailed comprises lacquering, machining, cutting and printing. Stoving of the lacquers is carried out in gas-fired furnaces. Also forming part of the Sutton 1 plant are those departments engaged on the manufacture of toys. These are exclusively in aluminium sheet and because the range of designs and operations is so wide, entail the use of a considerable amount of hand-work and of smaller hand-operated tools.

The Mansfield factory produces general lines, again both in tin-plate and aluminium, the latter being used in very considerable quantities. The range of articles produced in aluminium is broadly represented in these pages and includes circular built-up containers, many of which are most artistically decorated; irregular built-up containers, that is those, say, of rectangular or shaped outline, such as are illustrated here; again, many of these are of the highest artistic merit.

Next, there are printed show cards of all types, sizes and designs, and it is interesting

MOST attractive of all the irregular built-up containers produced at the Mansfield factory of the Metal Box Co., Ltd., is this fancy casket in aluminium sheet, decorated by printing with photographic reproduction of turkey-red-burr veneer.



REPRESENTATIVE of one range of products from the Mansfield Works is this darts score board. Again, it is made of aluminium sheet with the "working" surface finished in dull black.

to note that these are almost exclusively of aluminium and constitute a growing production item in the factory.

Finally, there are the waiter trays, again in aluminium, bearing a variety of designs, some of a purely proprietary nature, others intended for purely artistic effect. Ash trays are also made here, and one of particular interest is the small pressed receptacle for food, which we illustrate elsewhere; this finds a specific use for the catering service in passenger aircraft.

A particular section of the Mansfield factory is devoted to the production of smaller aluminium containers by impact extrusion, these ranging in size from 12½ mm. by 24 mm. to 63 mm. by 160 mm. They are used for innumerable purposes and are of especial value for the packaging of pharmaceuticals.

The specialized aluminium manufacturers referred to in this account find a ready export market. Some are destined for the U.S.A.

We will conclude by referring to one fancy box of most delightful design, produced, however, in tin-plate, by a process known as bulging. For this operation, by the way, the Metal Box Co., Ltd., has designed and patented a special machine. We should like to see this bulged container made in aluminium.

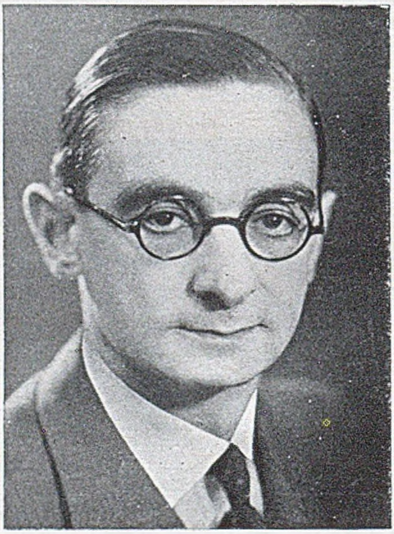
ABOVE, a very popular line of products is represented by the waiter tray in aluminium sheet printed with well-known proprietary designs or artistic motifs.

DISPLAY cards, small pressed containers, and impact-extruded containers, all in aluminium, are manufactured in endless designs and numbers by the Metal Box Co., Ltd.

Evolution of the Aluminium Industry in France

Address Delivered by M. André Dumas, Director of L'Aluminium Français, at the Opening of a Regional Information Centre at Lille.

MY debut as an engineer was made at the aluminium works of Saint Jean de Maurienne, 25 years ago, and my knowledge of that industry, incidentally, a closely guarded one at that time, was confined to several pages in a treatise on metallurgy. This shows the modest position then held by aluminium, for the book in question was a voluminous one. In a quarter of a century world production has increased almost six-fold, from 180,000 tons in 1925 to 1,050,000 tons in 1947, whilst that of copper has increased by only 36 per cent., and that of lead has, significantly enough, actually diminished by 30 per cent.



M. André Dumas

Aluminium, which has had an exceptional career, has now become the most important of all non-ferrous metals, the production of which, by volume, represents a figure double that of copper. There is no doubt that the 1914-1918 war stimulated immense progress, for the record in production was reached in 1943 with 1,950,000 tons, with a world capacity production, already installed, of 2,400,000 tons.

The fabricating industry has, during the same period, made equal progress, and to-day we have the most modern quantity-production plants, equal to those of steel works, and equipped with rapid production lines. After the return of peace and the disappearance of great armament demands, a painful awakening might have been expected. Prophets predicted a crisis, and American production was deliberately reduced in 1944, whilst numerous production and fabricating plants were closed. The rapidity with which war stocks were re-absorbed, however, soon caused producers to accelerate work again, and fabricating units which had been closed were reopened.

Better still, Alcoa, in the United States, is at the moment completing the world's most up-to-date continuous rolling mill for aluminium, the output of which should attain 40,000 tons per month. Thus, so prodigious a development, due in part to events, is in no way artificial. Quantities consumed in 1947 reached, in the U.S.A., 850,000 tons, and in Great Britain, 276,000 tons, that is to say, six times the consumption of 1937. The influence of armament is, to-day, no longer preponderant, for aluminium has found so many new applications in the civilian world. Consumption, moreover, has developed to such an extent in all countries, whether or not they are aluminium producers, that the metal is, universally, in somewhat short supply.

Given so favourable a situation, one would have expected to see a rise in selling price. On the contrary, whilst there have been important fluctuations in the prices of other metals, copper in particular, that of aluminium has fallen steadily, passing, in America, from 20 cents in 1939 to 15 cents in 1941, a rate at which it has remained almost stationary ever since. It is the only metal which is actually cheaper to-day than in 1939. During the same period, copper has risen 92 per cent., zinc 137 per cent., lead 240 per cent. and brass 103 per cent.

This argues a wise and healthy policy on the part of producers, who have resisted all temptations, persuaded as they are that in order to sell in quantity one must be satisfied with reasonable profits. At the same time, they have not hesitated to assist their clients in reducing works costs by improved technical methods.

Such to-day is the situation in the world market for aluminium, in which America now leads, thanks to the war. Faced with so rapid an evolution, some may be wondering what has happened and what is likely to happen to the French industry, for our country was the cradle of aluminium. No doubt, France has lost her former leading position, but it must be admitted that she still shows signs of great vitality.

At the time of the 1940 Armistice, French production had been raised to 95,000 tons, but during the four years which followed, factories were put to sleep. Not only was it impossible to maintain the plants, but severe war damage ensued. Now, in less than three years, France has treated her wounds and should be capable of producing those 95,000 tons again, if electric power could be supplied in sufficient quantity.

A regular two thousand million kWh are needed, but the existing allocations of power will not permit a production of more than 63,000 to 65,000 tons for 1948. Moreover, a working regime has been imposed which brings monthly production in winter down to one-third of that possible during summer months. This is a most serious matter for an industry requiring a regular supply of electric current.

Before the war, producers installed their own hydro-electric stations, and, in order to maintain a regular supply of power throughout the year, constructed artificial lakes. By this means they had obtained a more than adequate power supply, for the total output of their stations reached nearly three thousand million kWh per annum, that is to say, about one-twentieth of all French hydro-electric output.

To-day, French aluminium production depends solely upon allocations of electric power allotted to it; quotas which permit only about two-thirds of its real capacity.

What are the present needs of the French market? Certainly much in excess of national production, because we have to import, either by way of having our own alumina reduced in Norwegian or Canadian factories, or by bartering alumina for aluminium with Austria or Switzerland. By these means we arrive at 85,000 tons of light metal for the home market, to which can be added 20,000 tons of metal obtained from scrap.

Thus, our total resources (representing less than half those of England and less than one-eighth those of the U.S.A.) do not yet permit free consumption of aluminium. That is to say that the demand has more than doubled since the war, whilst aviation and armament demands are now very modest; lower than in 1938. Civil employment of the metal has developed greatly, and in the most diverse fields, for the shortage of currency from which our country suffers limits our imports of copper, zinc, lead and brass, for which aluminium can, in many instances, be substituted. Thus, to avoid putting a brake on many sectors of our national recovery, it would suffice to allot sufficient quantities of electricity for the production of aluminium. Producers have already prepared a programme of extension for their installations which should not take long to complete.

We must not forget the place once

occupied by France in the export world and which she intends to regain.

Let us remember that in 1938 France figured amongst the world's principal exporting countries, as one-third of her products went to foreign markets. Since the liberation she has made contact with former buyers, developing her chief effort in semi-manufactured forms or even finished ones requiring more work and less of that metal so badly needed in the home market.

One portion of the currency brought in by these exports has, incidentally, allowed the purchase abroad of the necessary metal in ingots. By these means we have been able, during 1947, to export to 27 different countries. The present financial situation is, nevertheless, slowing down our effort; it calls for sacrifices from our industry which cannot be supported much longer unless some change re-establishes equilibrium between the real purchasing power of our money and its value in relation to the dollar.

Before the war we were able to deal successfully with foreign competition. Although to-day the great Canadian and American producers benefit by specially favourable conditions (considerable increase in their plants financed by the State, or almost written off by important war-time sales, together with freedom in supplies, regular electric power and stability in prices) we are convinced that our country is still capable of putting up a fight, all things being equal, for France does not lag on the technical side. She bows to no foreigner there.

The electrolytic process of extracting aluminium, now universally employed, remains, even to-day, in its general lines, as devised in 1886 by the French engineer Héroult. Since then, a series of improvements has been brought about, largely due to French genius (Sodeburg electrodes, very heavy amperage furnaces, etc.). Our laboratories are working now on different lines, towards the perfecting of processes entirely apart from electrolysis. They may be able to utilize less pure ores and consume less energy, thus leading to a reduction in first cost. We know that in this field foreign countries are not in advance of us.

Considerable progress has been made in the domain of fabrication by the use of a continuous production line. The Société du Duralumin was the first to adopt this idea and lay down the first plant. Ordered in America, rolling mills for the Société were on their way to France when the Armistice of 1940 obliged ships transporting them to return to the United States. They were then erected by the American Reynolds Co. and allowed the production of Duralumin in important quantities for the aircraft industry. Since then, seven continuous rolling mills, derived from the first equipment, have been built in U.S.A.

After the Liberation, the French industry again took up the project which defeat had brushed aside. The great Issoire factory will, in a few months' time, be producing light alloy sheet 2.8 metres wide on a continuous production line.

In the matter of castings, a foundry analogous to the S.C.A.L. at Issoire will soon be capable of turning out large castings in quantity production. Installed in the Lyon area, at Arandon, it has the most powerful and modern plant. Thus, we see that in production and fabrication French industry has been able to overcome the handicaps imposed by war, and is already prepared to face the growing needs of our country.

Finally, what about the metallurgy of light alloys? Our research laboratory never ceased to work, even under the shadow of enemy occupation. It would take very long to give here a list of results achieved by this organization. Suffice to recall that in foundry technology, for instance, we owe to it the creation of A.P.M., the record characteristics of which have permitted so many striking successes; special alloys for decorative work; the creation also of a correct technique for the employment of aluminium-magnesium alloys; in the field of forging alloys, fruitful study of recrystallization and the perfecting of super-high-strength alloys giving an ultimate of 60 kg. to 70 kg. per sq. mm.; in the domain of protection and decoration, anodic oxidation and brightening.

There, in brief, are the problems faced by France as a result of the astonishingly rapid evolution of the aluminium industry, and there are the solutions we have brought about, confident as we are in the future developments of this metal. Doubtless, certain limitations will still retard our efforts; allocation of electric power, rates of exchange, impossibility of importing certain materials, and so forth. We hope, nevertheless, that although their elucidation does not depend upon us, these problems will also find their solution, and we will take for our motto the celebrated words inscribed on the Zuiderzee dam—" Industries that wish to live look towards the future."

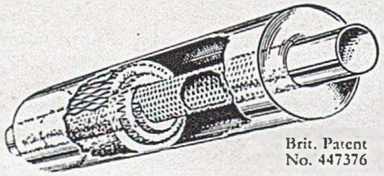
M. André Dumas' story of the rise, present state and future aims of the French Aluminium industry is both interesting and inspiring. In the light of current achievement we might almost say he has been too modest.

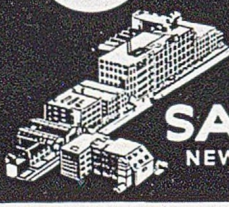
As reflected in a previous issue of " Light Metals," visitors to France become immediately aware of the extensive application to which aluminium is put in every department of domestic and industrial life and of the purposeful activity which lies behind it all.—Ed.

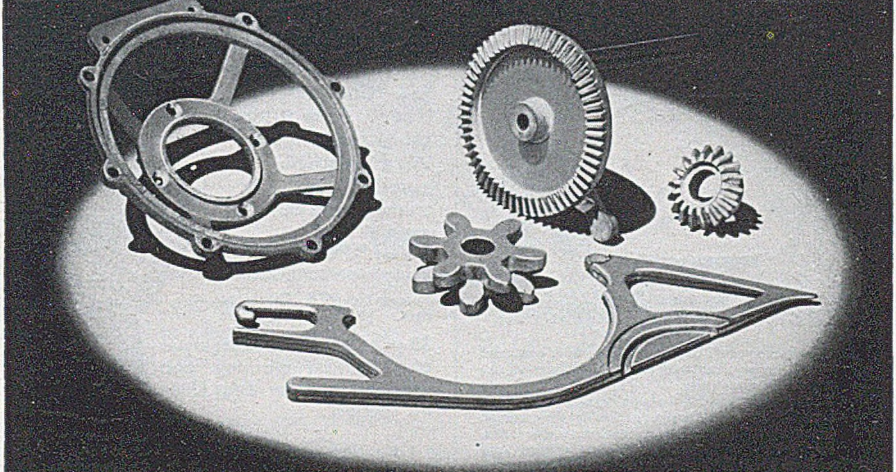
Index to Advertisers

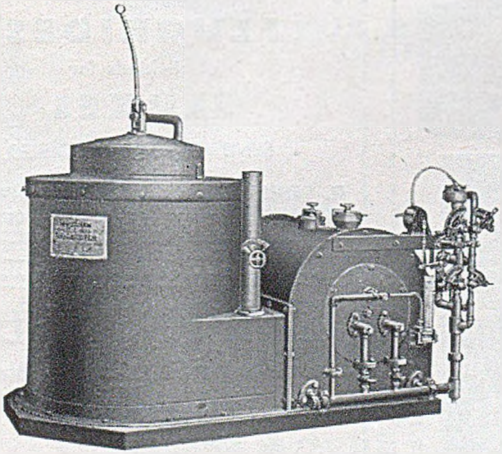
	Page
A.G.M. & Co., Ltd.	—
Acheson Colloids Ltd.	—
Acorn Anodizing Co., Ltd.	iv
Almex Recovery & Refining, The, Co., Ltd.	—
Aluminium Corporation Ltd.	—
Aluminium Union Limited	i
Association of Light Alloy Refiners	xix
B.K.L. Alloys Ltd.	xvii
Birlec Ltd.	vi
Birmetals Ltd. & Birmabright Ltd.	iii
Birmingham Aluminium Castings (1903), Ltd.	xxix
Blackwell's Metallurgical Works Ltd.	xl
Booth, James, & Co., Ltd.	ix
Brayshaw Furnaces & Tools Ltd.	xxxvii
Bridge Foundry, The, Co., Ltd.	xl
British Aluminium, The, Co., Ltd.	xxxiv
British Die-Casting & Engineering Co. Ltd.	xiii
British Gas Council, The	—
British Oxygen, The, Co., Ltd.	ii
Canadian Trade Commissioner Service	xli
Cellon, Ltd.	—
Chamberlain & Willows	xlii
Coley, R. J., & Son (Hounslow) Ltd.	xl
Commercial X-Rays Ltd.	xl
Cruickshank, R., Ltd.	xxxviii
Dale, John, Ltd.	Back Cover
Darwins Ltd.	xxii
Davy & United Engineering Co., Ltd.	xi
Dialoy Ltd.	xxiv
Dominion Magnesium Ltd.	xxviii
Doncaster, Daniel, & Sons, Ltd.	xxxviii
Dyson & Co., Enfield (1919) Ltd.	xxxvi
Essex Aero Ltd.	xx
Expanded Metal, The, Co., Ltd.	—
Eyre Smelting, The, Co., Ltd.	xxii
F. & M. Supplies Ltd.	—
Fielding & Platt Ltd.	—
Fordath Engineering Co. Ltd.	—
Foundry Services Ltd.	—
Frank Bros.	xlii
General Electric, The, Co., Ltd.	xv, xviii
Gibbons Bros., Ltd.	xii
Gilman, F. (B.S.T.) Ltd.	xli
Grundy, B., & Co., Ltd.	xlii
Haynes, Ford & Elliott, Ltd.	—
Head,Wrightson Machine, The, Co. Ltd.	—
High Duty Alloys Ltd.	xxvii
Hind, E. (South Bank) Ltd.	—
Hughes, F. A., & Co., Ltd.	vii

	Page
Ilfar Aluminium Co., Ltd.	xxxvi
Imperial Chemical Industries Ltd.	xxiii
Incandescent Heat, The, Co., Ltd.	—
Jenolite Ltd.	xxxix
Jones, Samuel, & Co., Ltd.	xxxvi
Kaye, E. & E., Ltd.	xxxix
Kent Alloys Ltd.	xxvi
Kodak Ltd.	—
Lafarge Aluminous Cement Co., Ltd.	xxx
Loewy, The, Engineering Co., Ltd.	xlv
London Metal Warehouses Ltd.	Inside Back Cover
Maybrey, H. J., & Co., Ltd.	xli
Medcalfe & Co. Ltd.	xxxi
Metal Finishes Ltd.	xxxviii
Mills, William, Ltd.	—
Ministry of Fuel & Power	xvi
Morgan Crucible Co., Ltd.	xxxv
Moyle, Victor, & Co.	—
Newton Victor Ltd.	—
Non-Ferrous Die-Casting, The, Co., Ltd.	xxxviii
Northern Aluminium Co., Ltd.	Inside Front Cover
Northern Metal Trading, Ltd.	—
Original Art Metal Advertising Co.	xlii
Palmer Tyre Ltd. (X-Ray)	—
Perry Barr Metal Co., Ltd.	—
Pitman, Sir Isaac, & Sons, Ltd.	xxxvi
Priest Furnaces, Ltd.	—
Priestman, T. J., Ltd.	x
Pyrene, The, Co., Ltd.	—
Renfrew Foundries Ltd.	xxxii
Robertson, W. H. A., & Co., Ltd.	—
Rollet, H., & Co., Ltd.	xliii
Rushton Organization, The, Ltd.	—
Sciaky Electric Welding Machines Ltd.	v
Scottish Aluminium Ware, Ltd.	xl
Servais Silencers Ltd.	xxxvi
Siemens-Schuckert (Great Britain) Ltd.	viii
Sklenar Furnaces Ltd.	xxv
Slough Metals Ltd.	xlii
Stein, John G., & Co. Ltd.	xxiv
Sterling Metals Ltd.	Front Cover
Technical Metal Treatments Ltd.	—
T.I. Al minium Ltd.	xxxiii
Thomas, Richard, & Baldwins, Ltd.	—
Universal Engineering Co. (Nottingham)	xxxvii
Ward, T. W., Ltd.	xxi
Warwick Rim & Sectioning Co. Ltd.	—
Willson Brothers of Epsom Ltd.	xxxviii









TRADE WITH CANADA

Enquiries regarding Trade
with Canada are warmly welcomed
and should be addressed to :

LONDON, HOME COUNTIES
AND SOUTH OF ENGLAND

R. P. BOWER, Commercial Secretary
Office of the High Commissioner for Canada
Canada House, Trafalgar Square, S.W.1

MIDLANDS, NORTH ENGLAND AND WALES

M. J. VECHSLER
Canadian Government Trade Commissioner
Martins Bank Building, Water St., Liverpool

SCOTLAND

J. L. MUTTER
Canadian Government Trade Commissioner
200 St. Vincent Street, Glasgow

NORTHERN IRELAND

H. L. E. PRIESTMAN
Canadian Government Trade Commissioner
36 Victoria Square, Belfast

Plan now to attend the Canadian International Trade Fair, Toronto, in 1949

ILLUSTRATION SHOWS TYPICAL SAND CASTING

MAYBREY *we can*

Specialists in
Sand & Gravity Die-castings

H.J.MAYBREY & CO. LTD.

WORSLEY BRIDGE ROAD · LONDON · S.E.26.

Telephone: BECKENHAM 0044

Sand Foundry:- Croydon Road, Elmers End, Kent.

GILMANS MULTIFLEX FLEXIBLE DRIVE MACHINES

Multiflex Flexible Drive Machines will save your organisation days of top-pressure production because they can be taken easily and quickly to whatever operation is required. They may save dismantling and re-erection of your most important installations.

There are Multiflex Models for either bench or floor mounting, and for every kind of metal-removing, filing, milling, grinding, sanding and polishing operation.

Multiflex Machines are at their best when used in conjunction with "Titegrip" Rotary Milling Cutters.

Please write for particulars or send details of any production problem which Multiflex Machines may solve.

GILMANS

F. GILMAN (B.S.T.) LIMITED

PIONEERS IN INDUSTRIAL FLEXIBLE DRIVE EQUIPMENT

Agents' 'phones
LONDON
Abbey 2104
NEWCASTLE
[illegible]
MANCHESTER
[illegible]
COVENTRY
[illegible]
GLASGOW
[illegible]
CARDIFF
[illegible]
SHEFFIELD
[illegible]
BELFAST
[illegible]

195, HIGH STREET, SMETHWICK 41, STAFFS

Phone: Smethwick 1202/5 (4 lines) 'Grams: Skatoskalo, 'Phone, Birmingham

expanded aluminium

stockists and specialists

If you have a product suitable for fabrication in expanded aluminium we can manufacture to your specification.
This material lends itself to colourful designs.

We already manufacture—

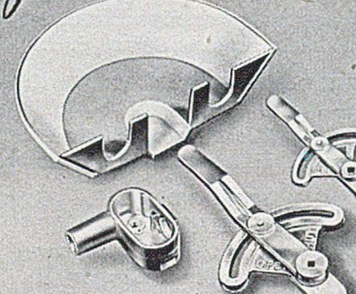
· WINDOW GUARDS · FIRE GUARDS · LITTER BASKETS · CLOTHES LOCKERS · GARDEN BASKETS · AIR FILTERS · MACHINERY GUARDS · PANELS · FOOD TRAYS, ETC.

Frank Bros

Manufacturers of **Peter Brand** Products

129, Kingston Rd., New Malden, Surrey
Malden 2779

Gravity DIE CASTINGS



in

ANTIMONIAL LEAD · ZINC · ALUMINIUM

by

Original Art Metal Ad. Co.

Established 1920

142, QUEENS RD., PECKHAM, LONDON, S.E.15
Telephone: NEW CROSS 3317

DIECASTINGS IN ALUMINIUM-BRASS-ZINC ALLOYS

Slough Metals Ltd

TRADING ESTATE · SLOUGH

WAREHOUSES, OFFICES AND
FACTORY PREMISES
FOR EARLY OCCUPATION
REQUIRED
IN LONDON AND SUBURBAN AREAS.

CHAMBERLAIN & WILLOWS
—— FACTORY AGENTS & SURVEYORS ——
have a large number of applications for Freehold or Long Leasehold premises.
Details in confidence to the Head Offices at:—
23, MOORGATE, LONDON, E.C.2
City 6013 (6 lines).

ALUMINIUM
STOCKS IN HAND

Specialists in
Aluminium Tubes, Rods and Strips

B. GRUNDY & Co. Ltd.
14, Devonshire Square
London, E.C.2

'Phone: **BIShopsgate 4547** (2 lines)
'Grams: "Selective-Ave-London"

CLASSIFIED ADVERTISEMENTS

Rate 4d. per word, minimum 4/-. Box Number Fee 1/-.
Press date for February issue - January 26, 1949.

Instructions should be addressed to "LIGHT METALS," Bowling Green Lane, London, E.C.1. 'Phone: TER 3636.

CASTINGS (SAND, GRAVITY OR PRESSURE DIE)

Kleenkast, Ltd., aluminium founders. Specialists: Letter makers, name plates, road signs, number plates. Sheen Lane, S.W.14. Phone, Prospect 4444. zzz-466

The Northern Diecasting Co., Ltd., Norcastal Works, Burnley, Lancs. Phone, Burnley 2236. Specialists in the production of gravity die castings in aluminium alloys. All trades. On approved lists. Air Ministry, Ministry of Supply, Admiralty. Inquiries invited. zzz-471

A. L. Dunn and Co., Ltd., New Inn Bridge, Foleshill, Coventry. Established 1924. Phone 88644. High-grade aluminium gravity die and sand castings. Expert technical advice given on design and specification. zzz-472

Edward Holme and Co. (1931), Ltd., Moss Lane, Altrincham, Cheshire. Pressure die castings up to 1¼ lb. in aluminium, silicon alloy, first-class accuracy and finish. zzz-473

Sand and gravity quality castings in all aluminium alloys. Our technical experts will be glad to give advice on casting problems! H. J. Maybrey and Co., Ltd., Worsley Bridge Road, London, S.E.26. zzz-475

Lavender, J. H., and Co., Ltd., Hall Green Works, Crankhall Lane, West Bromwich. Phone, Stone Cross 2273. Sand and gravity die castings in aluminium alloys. zzz-474

The Aluminium Castings Co., Ltd., Ingleston Foundry, Greenock. Solar ware and medium engineering, sand or gravity die castings. zzz-477

Capacity available for aluminium and non-ferrous castings. Inquiries invited for jobbing or repetition work for speedy delivery at competitive prices. Design of castings and pattern-making facilities also available. Strande Foundry Products, Ltd., Cookham, Berkshire. Phone, Bourne End 927. zzz-487

Aluminium. Capacity for gravity and pressure casting, large modern plant. Available ex stock: 50,000 cast aluminium wheels, with or without tyres, 6 ins. diameter. Box 6609, care of "Light Metals." zzz-494

CELLULOSE

Cellulose paints and synthetics, all colours and grades, for immediate delivery. Hire-purchase available for spraying plant. Samples 1s. 3d. "Plant Spraying" book, copyright, 3s. 6d. Cats., Trade Counter, 10-4 p.m. Leonard Brooks, Harold Wood, Essex. Phone, Ingrebourne 2560. zzz-480

NOTICES

WARNING NOTICE.

"GUMSTRIP"

is the Registered Trade Mark (No. 568652) of Samuel Jones and Co., Ltd., and its use in connection with sealing tapes or adhesives or gummed paper tape other than that supplied by Samuel Jones and Co., Ltd., is an infringement.

Appropriate action will be taken in all cases which come to the proprietors' attention of the use of this Mark in connection with goods other than those manufactured by Samuel Jones and Co., Ltd. 139-1115

PRODUCTION CAPACITY AVAILABLE AND WANTED

Metal powders and oxides. Quotations and samples on application. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-478

RAW MATERIALS AVAILABLE AND WANTED

Aluminium ingots for sale: 14 tons D.T.D.300, 21 tons Y-alloy, 14 tons cast aluminium. Inquiries and offers to Box 6879, care of "Light Metals." 132-1114

Aluminium-alloy sheets, brand new, in perfect condition, various sizes and gauges, offered at attractive prices. Please send inquiries to Box 5605, care of "Light Metals." 133-1113

Accurate powders for ceramic, alloy, plastics, paint, etc., industries. Dohm, Ltd., Pulverizers, 167, Victoria Street, London, S.W.1. 132-1110

Bentonite, Feldspar, Kyanite, quartz, all minerals. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-479

Cork. Cork. British Cork Mills, Ltd., 167 Victoria Street, London, S.W.1. Vic 1414-6. zzz-488

We buy surplus and redundant stocks in aluminium and alloy, copper, brass and steel. Write or phone Alreco, The Almex Recovery and Refining Co., Ltd., 1-3 Robert Street, Strand, W.C.2. Temple Bar 0902. zzz-498

SITUATIONS VACANT

None of the vacancies in these columns relates to a man between the ages of 18 and 50 inclusive, or a woman between the ages of 18 and 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1947, or the vacancy is for employment excepted from the provisions of that Order.

Representative required for a concern specializing in metal polishing. Excellent opportunity for a live man; good connection essential, part or full time. Salary and, or, commission. Box 7192, care of "Light Metals." 132-3

Experienced die designer required for light-alloy foundry situated in the Midlands. Applicants must have thorough experience of die design for gravity and pressure castings and be capable of applying modern labour-saving methods and of proving practicability of design and technique by actual demonstration. Replies, stating previous experience, salary expected, etc., to Box LM7193, care of "Light Metals." 132-2

Technician required for development work on aluminium in food-container industries. Preferred qualifications: A degree in metallurgy or chemistry, some experience in food packing and proficiency in one or more languages. Box LM7191, care of "Light Metals." 132-1

SITUATIONS WANTED

Progressive appointment with well-established company wanted. Applicant, available by arrangement, offers initiative, good experience in aluminium, copper, brass and white metals line, also in administration and organization, technical knowledge. Light engineering trade and representation also considered. Please write Box LM7190, care of "Light Metals." 132-x545

MISCELLANEOUS

Dohm, Ltd., pulverized raw materials everywhere, 167 Victoria Street, London, S.W.1. zzz-485

Printed in England and Published Monthly by the Proprietors, TEMPLE PRESS LTD., BOWLING GREEN LANE, LONDON, E.C.1.

Vol. XII. No. 132