PREFABRICATED BODYWORK IN FRANCE



# LIGHT METALS

NOVEMBER 1947

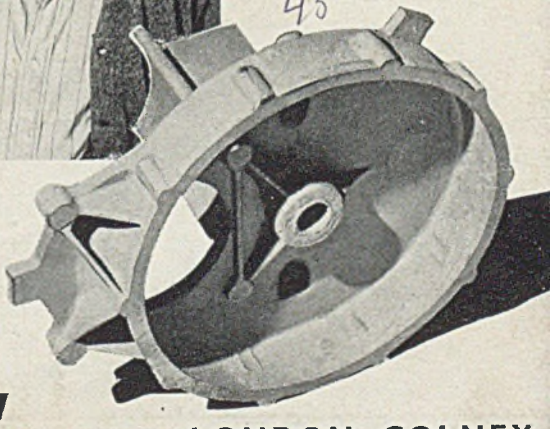
2/-



## A perfect Casting . . .

*Harley Street surgeon Michael Joyce* (JAMES MASON) *gains valuable information from caretaker Clay* (MORLAND GRAHAM) *in his search for the murderer of Emma Wright* (ROSAMUND JOHN). *A close-up from the film* "THE UPTURNED GLASS" *(G.F.D. Distribution). Yet another triumph for producer* SYDNEY BOX *and actor-producer* JAMES MASON*—due to a perfect casting.*





In the production of our high grade aluminium alloy castings we, too, gain valuable information — but on more scientific lines — by X-Ray inspections, capable of detecting the minutest flaw. Only when the X-Ray can find no fault are we satisfied that it is a perfect casting.

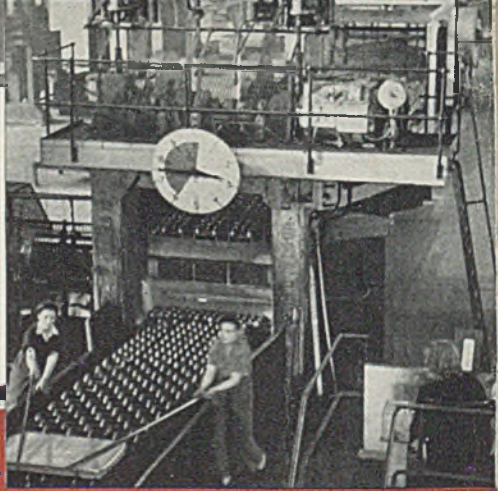
## A perfect Casting by

# JOHN DALE Ltd

LONDON COLNEY
HERTFORDSHIRE
*Telephone : London Colney* 3141

# ALUMINIUM

## AND STRONG LIGHT ALLOYS



*Rolling slab in hot mill*

## NOTCHED BARS & SECONDARY INGOTS

## ROLLING SLABS

## HOT ROLLED PLATES

## COLD-ROLLED SHEETS

## CIRCLES

If you have a problem, or if you contemplate using these metals for the first time, write or telephone us and we will place all our experience at your disposal and, if necessary, our technical representative will call and discuss your difficulty.

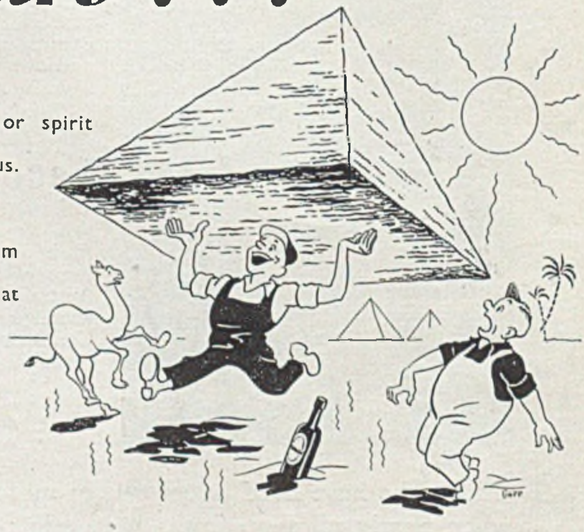
*Richard Thomas & Baldwins Ltd.*

WERN WORKS,
BRITON FERRY,
NEATH, GLAMORGAN,
SOUTH WALES.

Telephone: Briton Ferry 3211

TRADE TERMS TRAVESTIED · NUMBER SIX

# Strength at elevated temperature . . .



With acknowledgements to the famous Guinness poster

IT'S NOT A QUESTION of faith or spirit moving mountains or pyramids with us. That's not our line of business.

But when it comes to producing aluminium light alloys, which show real strength at elevated temperature, then we are confident that we have got some in the TJP range which will give complete satisfaction. These are very valuable where pistons are to be fabricated, because they will stand up to quite severe service conditions at high temperature.

When you want such alloys let us help you. Every consignment will be consistently reliable, and correct to specification, as our own chemical and physical laboratories perform strict and regular tests at every stage of manufacture.

**T. J. Priestman LIMITED**

ALUMINIUM ALLOYS · BIRMINGHAM · 12 · Vic: 2581-5

ALUMINIUM TPJ BRAND ALLOYS

# ELEKTRON MAGNESIUM ALLOYS

## *add* LIGHTNESS

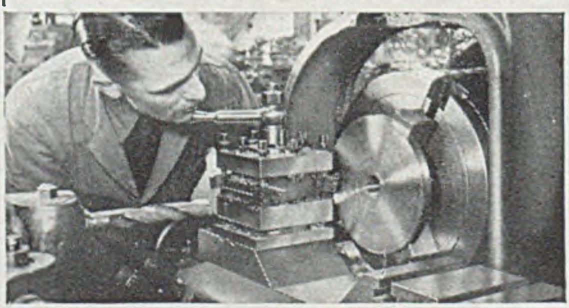
**and increase cutting speeds–with only minor changes in workshop practice**

ELEKTRON is the fastest cutting constructional metal in existence—in fact its cutting speed is limited only by the speed of the machine. The advantages are obvious:—Reduction of machining time, reduction in power consumption, excellent surface finish, longer life of tools. And because of its extreme light weight ELEKTRON castings are easier to handle.

The machining technique of ELEKTRON does not differ greatly from that of other metals. Standard tools are used, and scruffing and routing operations can be carried out with ordinary wood working equipment.

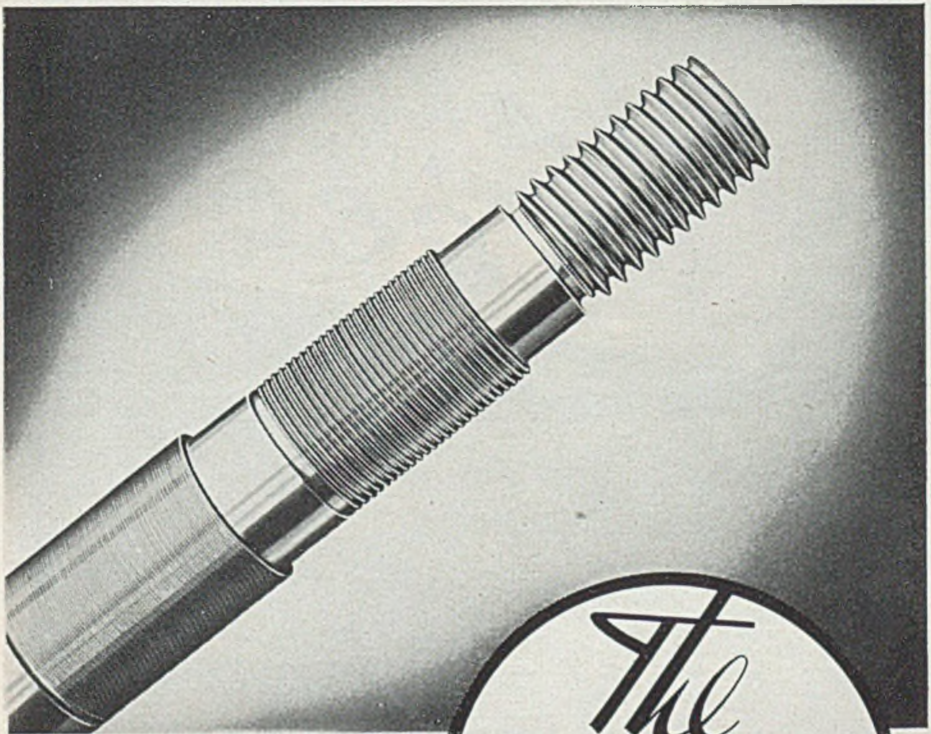
### CHANGING TO ELEKTRON

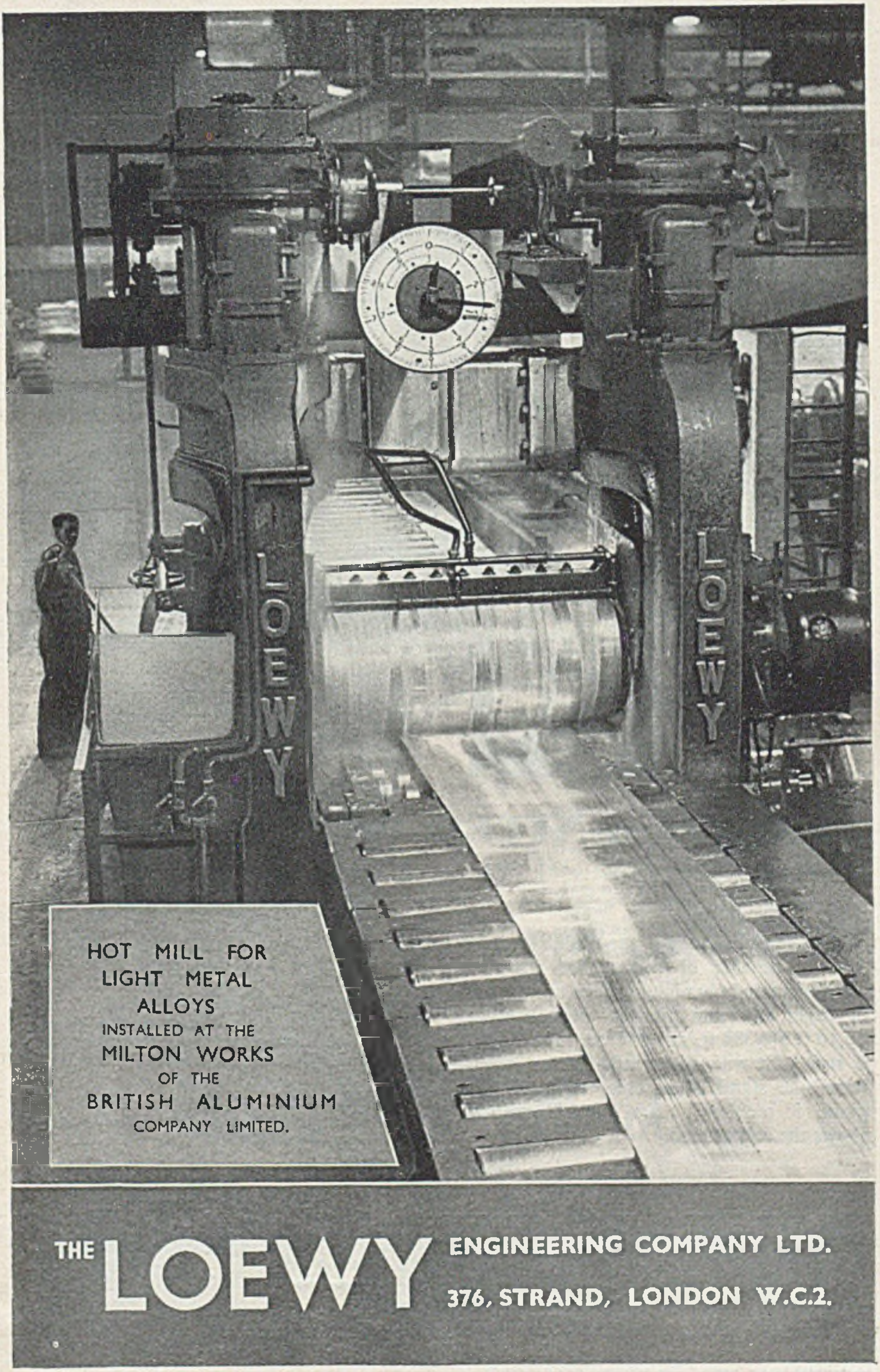
Your first step is to consult F. A. Hughes & Company Ltd., who can help you with further information. There's not a lot of difference between the handling of ELEKTRON and that of other light-weight alloys, but there is a tremendous improvement in the results you obtain once you change to ELEKTRON. Write to Metals Department.

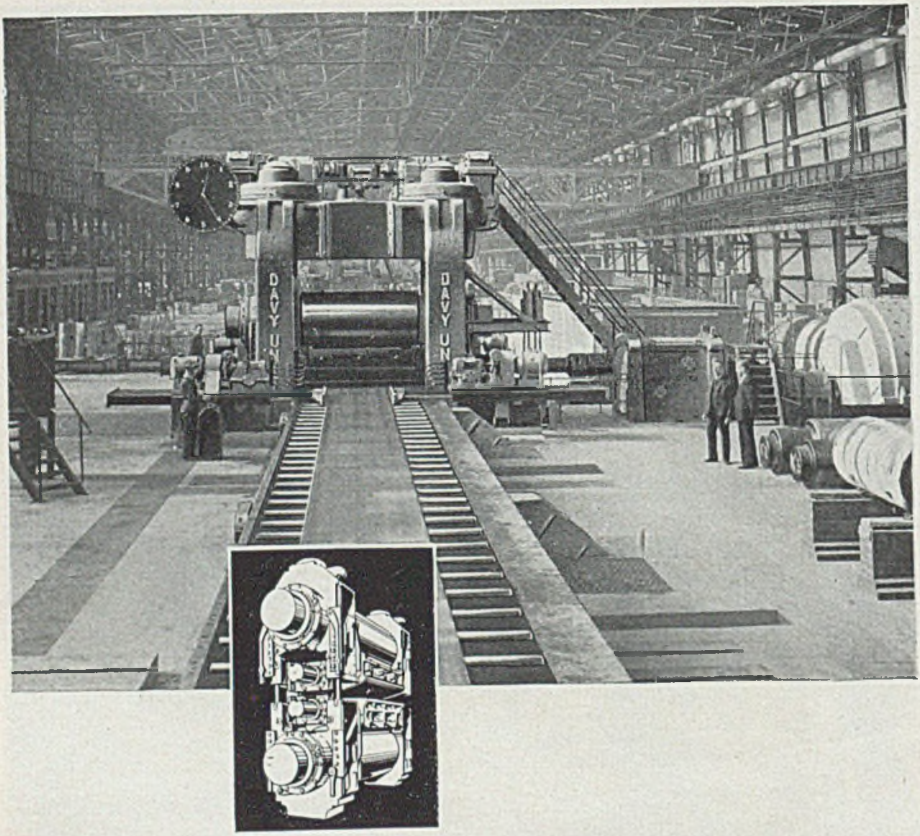


F. A. HUGHES & CO LTD · ABBEY HOUSE · LONDON N.W.1

L11324B




LOEWY
LOEWY
HOT MILL FOR
LIGHT METAL
ALLOYS
INSTALLED AT THE
MILTON WORKS
OF THE
BRITISH ALUMINIUM
COMPANY LIMITED.
THE LOEWY ENGINEERING COMPANY LTD.
376, STRAND, LONDON W.C.2.




# A DAVY-UNITED ROLLING MILL

## AND ITS ROLL ASSEMBLY

THIS 23″ and 52″ x 96″ Four-High Reversing Mill is capable of rolling hot slabs of aluminium and aluminium alloys up to 1 ton in weight, and from 1″ to 1/8″ thick at speeds up to 0/240/384 ft. per minute. The design is such that with slight modification it can form one stand of a three stand tandem plant, if required. The inset illustration shows the roll assembly.

The mill has these notable features.

Self-contained hydraulically operated top roll balance system.

Enclosed two-motor operated screwdown, the bottom casing of the enclosure formed integral with the roll housings, preventing escape of oil.

Pinion housing of massive proportions and totally enclosed.

Back-up rolls fitted with Morgoil bearings.

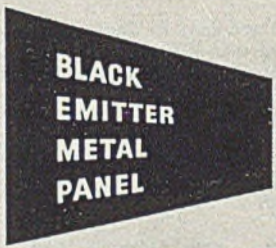
*This plant is installed at the Falkirk Works of the British Aluminium Co.*

**DAVY AND UNITED** *Engineering* COMPANY LIMITED SHEFFIELD

*Proprietor of:*
DUNCAN STEWART & COMPANY LIMITED, GLASGOW
DAVY AND UNITED ROLL FOUNDRY COMPANY, BILLINGHAM

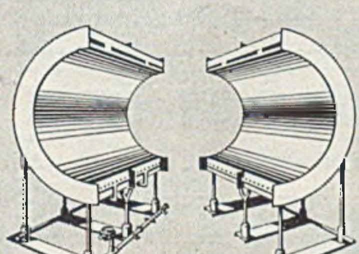
*Associated with:* UNITED ENGINEERING AND FOUNDRY COMPANY, PITTSBURGH, U.S.A.

# QUICK DRYING BY INFRA-RED

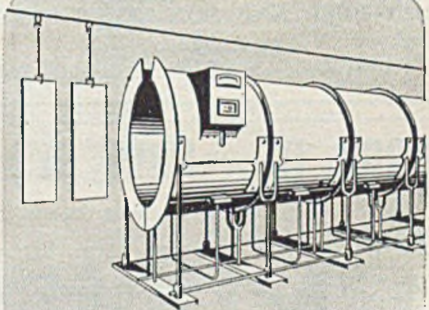



1 TAKE A SOURCE OF RADIANT HEAT . . .

2 EQUIP IT WITH GAS FIRING . . .



3 USE IT IN THE FORM OF EXTENSIBLE UNITS . . .



4 AND YOU GET THE SIMPLE INFRA-RED TUNNEL

The gas-fired infra-red drying tunnel is robust, compact, inexpensive . . . easily constructed in different shapes and sizes without complicated auxiliary apparatus . . . giving even distribution of radiation and wide range of flux density at the turn of a tap . . . no material difference in drying time due to colour . . . low capital and fuel costs. Technical literature free on request.

FOR SIMPLICITY AND CONTROL THE CHOICE WILL BE

**GAS**

BRITISH GAS COUNCIL · 1 GROSVENOR PLACE, LONDON, SW1

VOL. X. No. 118. NOVEMBER, 1947

LIGHT METALS

*Proprietors:*
TEMPLE PRESS LTD.
*Managing Director:*
ROLAND E. DANGERFIELD

*Head Offices:*
BOWLING GREEN LANE,
LONDON, E.C.1.
*Telephone: Terminus 3636.*
*Inland Telegrams:*
*"Pressimus. Phone, London."*

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

*Editor:*
E. J. GROOM, M.Inst.MET

*Branch Offices at*
BIRMINGHAM,
COVENTRY,
MANCHESTER
and
GLASGOW



# EDITORIAL OPINION

## Importance of Being Earnest

FASHIONABLE cults and popular enthusiasms are, alike, of an unenduring nature. Good or bad, they are initiated, as a rule, by the reasoned efforts of the few, and, sooner or later, perish under the uncritical adoption of the many, their original purpose or inspiration forgotten or so far perverted as to be unrecognizable.

Mackay, in his "Extraordinary Popular Delusions," records sufficient instances of this aberration to indicate that, without due care, even the most well-intentioned scheme may become addled. To-day, it would seem scientific and technological research are thus threatened. As other hopes of quick relief fade, "research" is acclaimed as the magic potion destined to cure the latest crop of ills which afflict an aching world.

Now the term "research" (no matter in what line) denotes not merely activity of a certain kind; it implies also a mode of thinking just as dependent, in its highest form, on inborn capacity, as does supreme aptitude in the arts. A few changes in the educational system (misunderstood, anyway, by the bulk of population) can no more turn us into a race of scientists than it could convert us all into first-rate poets or singers. Those acclaiming so loudly and so blindly to the masses the all-healing virtues of scientific research, are, we know, not those engaged in its pursuit: they are doing a disservice to science, to scientists, and to the State, for there is being deliberately created in the minds of the people an entirely false idea of the nature and goal of the research workers' effort.

In this country and elsewhere, appointments under Government-directed research schemes tend to be regarded with increasing disfavour by the better part of the younger school of scientific workers. This is not always because the remuneration is poor (and it often is lamentably so), but, rather, because the mentality, manners and approach which can organize and control labour for retail trade in postage stamps and dog licences, are not always adequate to cope with the broader, freer needs of creating intelligence.

That a dangerous state has been reached in this new concept of State-regimented research, is reflected in comments passed by the chairman at a recent meeting of a Select Committee to inquire into expenditure on an atomic energy project. Pertinently, he asked what public benefit was expected to be derived from the gigantic sums already expended on a task but half accomplished; he pointed out how, continuing at the present rate, not only would the financial resources of this country be outpaced but those of the whole world as well. This, he intimated, had already happened in the case of aeronautical research.

Cults, as they become fashionable, provide a happy hunting ground for the opportunist; that of scientific research is no exception, and recognition of this fact is becoming a source of disquiet, often of irritation, to thinkers in every branch. Occasionally truth prevails, as in a recent instance, where a biologist questioned the "talent spotter" who had accosted him, as to the ultimate purpose of the work he was being invited to undertake. The tout retired discomfited for, frankly, he did not know, but realized that to refer to the publicity value of a great big laboratory full of new shiny apparatus, and to the various rebates which would be claimed by the promoters on expenditure debited to the same, might not strike the right note with this particular candidate.

The importance of being earnest in our approach to this problem is, to-day, most real. Never before in world history is so much lip service being paid to freedoms of thought and action which exist, now, only as fast vanishing quantities—mere paper values—in our lives. In such circumstances, the integrity of scientific thought and application and the just apportioning of a true balance between these and the arts and humanities, can alone be relied upon to prevent the deification of talents which, lifted from their proper setting and forcibly inflated, must inevitably bring disaster and call progress to a halt.

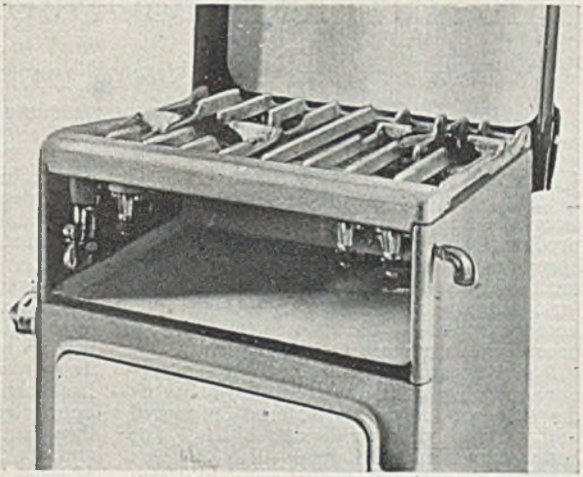
## Contents



*"LIGHT METALS" is published in London, England, on the first Wednesday of each month.*
*Annual Subscription Rate: 26/- post free. Shorter periods pro rata.*

# "STANDING UP TO IT!"

THE subject of the human story which follows is a "Wendy" gas cooker, by Willson - Mathieson, Ltd., which has done and, indeed, still is doing yeoman service in the kitchen of a housewife who has every reason to be proud of it, for it is no ordinary cooker, is this one.



HERE is the Willson-Mathieson "Wendy" gas cooker showing the aluminium-alloy bars as they appear after 11 months use. Note especially, absence of any sag or warping.

When first delivered, the grate bars above the burners were in vitreous-enamelled cast iron. Now these for some time gave a very satisfactory performance, but after a while, began to show signs of hard wear, the enamel having chipped in several places, more especially where flame impingement had occurred, with the result that unsightly corrosion of the underlying iron became very obvious.

Fortunately, this state of affairs presented a long-desired opportunity: would aluminium stand up to "it"? (No attempt was made to define "it.") There was only one answer to this question. Some light alloy bars would have to be cast and put in place of the cast iron bars complained of. Using, therefore, the originals as patterns, a new set was produced in sand, in an alloy of the D.T.D.424 type. Without further ado, and without any surface treatment, the light-metal bars were then put into service.

That was 11 months ago, and they have certainly done overtime since. Vegetables and fruit have been boiled on and over them, so has jam (20 lb. at a time); bacon, sausages, eggs and other delicacies have been fried upon them. Christmas puddings and babies' napkins have all been given a turn.

Even the most sceptical would have to admit that, in their still short life, they have seen plenty of variety, yet, contrary to expert prejudice, no attack has resulted from innumerable spillings and boilings over, no oxidation or melting has occurred due to flame impingement, and there are no signs of bending, twisting or warping. In fact, those aluminium bars look better now than they did on the day they were installed, for they have been washed in soapy water and have acquired a really handsome finish with the aid of Vim and wire wool.

The final word in all matters of household ethics must, of necessity, rest with the housewife herself. Well, the lady in this case is more than pleased; she likes the clean, bright look of the aluminium bars; she even appreciates their lightness as compared with the depressing weight of their dirty, black, heavy predecessors. It was only with the greatest difficulty that they were one day borrowed and taken back to the foundry for inspection, this being allowed, only after a solemn promise had been given, that, without fail, they would be returned by tea-time!

# *Light Alloys in* THE INTERNAL-COMBUSTION ENGINE

## *Continuing from "Light Metals," 1947/10/548, and Concluding the Section of the Account Dealing with Light-alloy Pistons*

PRODUCTION of pistons may be by casting, forging or pressing. The smallest sizes of automobile engine piston are mass-produced by gravity die casting for cheapness; the larger Diesel engine pistons must of necessity be produced as sand castings. Forging results in a more dense and homogeneous structure than casting, but not necessarily in a more reliable structure.

It has become possible, recently, to produce forged pistons of very high quality by the use of extruded material produced initially from pressure-die-cast billets. The grain size of material obtained in this way is extremely fine and, by its use, it has been found possible to increase the strength of the piston by about 15 per cent.

Forging is slower than casting and more costly, whilst it must not be forgotten that the cast form is superior in creep resistance to the wrought material. One way in which forging is of value is that it limits design to the very simplest; the ease with which ribs and other frills are made possible by the casting process is a temptation which often overcomes the better judgment of the designer, and it has been suggested that much good would result if Diesel engine pistons were to be designed as forgings and then produced as castings!

In cases where concern has been felt about the success of light alloys, cast- or forged-in steel reinforcing or heat-resisting members have been introduced. One of the greatest problems associated with light alloy pistons is that of ring groove wear and an aluminium alloy piston of German origin has been fitted with a cast-in iron ring carrier. Cast pistons have also been provided with copper or un-alloyed aluminium elements cast into the crown to achieve a better heat conductivity. In other cases, the crown has been made of Y alloy and the skirt of aluminium-silicon alloy, the denser copper-containing Y alloy contributing to a slightly improved heat conductivity and the low density aluminium-silicon alloy being used in the skirt, partly to minimize weight and partly because this alloy is amenable to anodic oxidation, as will be discussed later. Attempts have also been made to exploit the considerably better heat conductivity and higher melting point of copper by using copper-clad aluminium (Cupal) or copper plates, but these have not been successful. Such devices as the above are in any case in the nature of novelties and quite unnecessary in standard practice.

In some cases bi-metallic construction has been taken a good deal further to achieve specific results. For instance, a piston with steel skirt and aluminium crown has been used, whilst the Patented Flower bi-metal design once used in Wolseley engines has been illustrated,* also the Invar-Strut controlled clearance piston in which the thrust faces are air-insulated from the crown and are supported on a low-expanding strut of invar through the piston bosses. A 27½-in. bore marine Diesel piston with steel crowns and Ceralumin centres was described during the discussion on Mortimer and Paige's paper. An important feature was that the higher coefficient of expansion of the light alloy automatically tightened up the piston assembly without requiring excessive tightening of the central piston nut. In one ship some trouble was experienced due to inferior casting resulting from faulty design, but in another ship, with modified design, these bi-metallic pistons worked very well. The use of light alloy centres in this case saved ½ ton per piston. The use of aluminium piston-cooling brackets and parts affected a further saving and to-day, compared with a total reciprocating weight of 5 tons without aluminium, it is possible with aluminium piston centres, guide shoes and piston-cooling gear to get down to 4¼ tons, which, for a given maximum inertia force, would enable the speed of the engine to be raised from 108 r.p.m. to 150 r.p.m. The cost and weight per b.h.p. would be almost directly reduced. In another contribution to the discussion, it was stated that the Petter two-cycle piston employs cast iron for the tubular body and Loex for the spherical bearings.

In many cases it is possible to repair large light alloy pistons by an extension of the process of casting-in inserts. Thus, a large piston from one of Fraser and Chalmers big Diesels was badly damaged as the result of broken piston rings. The damaged and burnt section carrying some of the rings was removed by turning and a new section was

* See however, communication from Wolseley Motors Ltd., 1947/10/406.

cast into the piston by dovetailing. The repair was completely satisfactory.

The use of light alloys becomes increasingly attractive as the size of the piston is increased if only because it raises by a very large amount the upper limit to the size of piston which can be overhauled by hand without resort to chain or rope blocks. This is quite an important point in practice, particularly in the confined spaces existing in the engine rooms of many naval vessels.

**Piston Deterioration**

Piston deterioration may be due to wear on the rings and grooves or to wear of the skirt. Dealing first with the wear of rings and grooves, this is inevitable with any type of piston, though admittedly it is a little more rapid with light alloy grooves than with cast iron. There may also be more wear of the rings where light alloy pistons are employed, because the light alloy is soft enough to retain carbon, which acts as an abrasive. It is for this reason that some designs incorporate bands of high expansion iron in which the grooves are cut.

Another remedy lies in the use of anodic oxidation to provide a thin but tenacious and extremely hard film, and this method of reducing wear has been extensively employed to check wear on the skirt.

Deterioration of the piston structure in the neighbourhood of the rings results from a variety of causes. Felt filters on the air intake have proved effective in keeping out fine sand particles, which occasion much difficulty in desert regions. Trouble consequent upon overheating has been largely met by cast-in protecting rings and ring supports, both of which may be in a simple cast iron or in a special alloy steel. Good results have been achieved by providing the lower side of the top piston-ring groove only with a wear-resistant face. A slight radius at the bottom of the groove has also been shown to give improved life.

The piston skirt may be considered as a sliding bearing operating under high specific pressures and at high temperatures.

As such it is subject to wear and hard resistant coatings are justifiable, but, in considering the best form of protection to apply, frictional effects must not be lost sight of. Of the power output of the average power unit in road transport vehicles, 10 per cent. of the total engine capacity is dissipated in overcoming friction losses and, of this 10 per cent., some 2.25 per cent. is caused by piston and piston rings.

Apart from normal bearing friction losses which occur in the pistons, this unprofitable use of power is still further added to by additional friction arising as a result of non-uniform expansion of the piston (and possibly also of the bore). In the case of the piston, deformation under heat may occur as a result of unsatisfactory design or the use of an alloy of unsatisfactory composition. In general, the better mass-produced pistons exhibit this abnormal loss within very constant narrow limits.

Two further causes of deterioration call for comment. One, which exists more in theory than in practice, is concerned with the effect of the high temperatures produced in the combustion chamber on the aluminium piston crown. The other is a very real problem and is concerned with the relatively high rates of wear that occur during the running-in period and during momentarily unfavourable conditions that inevitably occur in service.

Modern pistons are finished to a high degree of perfection, but nevertheless they are still far from being smooth in the real sense of the word. Under the microscope successive furrows and grooves appear as waves or hills with deep gaps between, the crests of the hills showing a relatively loose connection and anchoring with the basic structure. When the piston slides in the cylinder these projecting, brittle crests form the first support. The high specific loads and the relatively low strength of the rough part of the surface lead to continual reduction of the projecting points, a process further increased through the nearly rectangular crossing between feed ridges and the sliding direction of the piston. This process of wear is supposed, theoretically, to continue until the gaps and irregularities are ironed out, and a uniform support of the piston surface at the simultaneously smoothed cylinder surface is achieved. Hence, it is only natural that the degree of wear is higher at the beginning of the running-in process. There is a danger, however, that when the small and rough projections slide one over the other, locally high pressures and high friction forces, accompanied by increased temperatures, result, with the danger of impairing the continuous oil film between the two running surfaces.

The resultant of these factors may lead to a transgression of permissible stress limits, and, therefore, to damage of the running surfaces in the form of local or extensive flow of metal and ultimately to seizing of the piston. It is in order to prevent this that the so-called running-in period has been provided, during which the rotating speed of the crankshaft is limited. Such increased stresses at the piston surface are, however, experienced not only during the running-in period, but also when irregularities in engine operation occur owing to faults in the oil film, for instance, on rapid starting or due to the effects of overheating. Such a condition also arises when the engine is cold and the choke is used too freely. In such a case, instead of a mist, a fluid fuel spray is generated which washes away oil from the cylinder and piston walls.

Besides undesirable dilution of the lubricating oil, swamping with fuel frequently causes point-like attacks with embedding of worn-off iron particles from the cylinder and piston rings, and of carbonized oil particles in the piston surfaces, as well as seizing ridges. This form of deterioration is, therefore, not limited to the running-in period and it becomes all the more serious in consequence. It has been noted that on starting from cold aluminium pistons have a greater tendency to seize than cast iron. This greater tendency is particularly noticeable with the aluminium-copper alloys and is less pronounced in the eutectic and hypereutectic aluminium - silicon alloys. Seizing on the piston skirt is said to be particularly apt to occur if porous chromium plate is used on the walls of the cylinders, although no explanation for this phenomenon is given. From the same source a recommendation is given to eliminate this danger by providing the skirt with an anodic coating which should be at least 10-30 microns thick.

### Surface Treatment of Light-metal Pistons

To alleviate these various causes of deterioration and to reduce the friction between piston skirt and liner various forms of surface treatment of the aluminium piston have been devised, of which the most important are:—

(1) Oxidation of the aluminium surface by anodizing or by chemical treatment.

(2) Tinning of the surface of piston or cylinder bore.

(3) Cadmium plating of the piston surface.

(4) Lead plating of the piston surface.

(5) Graphitizing of the piston surface.

Before considering these various treatments in detail, it may be as well to consider what are the desirable qualifications of a successful surface treatment. First, any film produced must possess a strong adhesion to the basic material of the piston surface. It must have favourable running and self-lubricating properties, capacity for plastic deformation without loss of adhesion to the base, resistance to wear and to dissolution or attack by oil and fuel. Ability to retain oil is valuable in supplementing self-lubricating properties.

Of all the various surface treatments so far devised, the one which has achieved the most widespread popularity is electrolytic anodizing; and yet this is the surface finish which, in many ways, is farthest from the ideal treatment detailed above.

By means of various anodizing techniques, light-alloy pistons can be provided with an oxide film 0.01-0.03 mm. (0.0004-0.0012 in.) thick. This is strongly adherent and glass hard. It will be appreciated that just as glass paper is an abrasive whereas glass is not, so detached particles of anodic film can be very damaging although the intact anodic coating possesses no abrasive qualities at all. The high hardness of the oxide layer does, however, prevent the embedding of foreign particles, and it gives effective protection against the formation of corrosion points in the case of cold starts and swamping with fuel. The oxide film produced in the anodic process is always porous initially and by suitable control of the treatment it is possible to produce a film which is riddled with very fine pores capable of absorbing and retaining oil. Theoretically this would be an extremely valuable property in this application, since the oil might tend to seep out

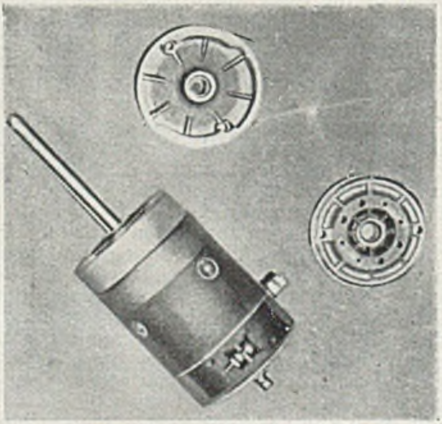


Fig. 31.—Starting motor for Ford. The end bells, shown separately, are cast in ultra-light alloy, and weigh, respectively, about 3½ and 5½ oz. each.

whenever the surface loading became excessive. Thus, unfavourable conditions during starting and on other occasions could be safely encountered. Unfortunately, the included oil tends rapidly to become resinous, deterioration being perhaps catalysed by the presence of the anodic film, thus blocking the capillaries, whilst changes in the structure of the anodic coating close up the pores in any case so that reimpregnation is not possible. Therefore, anodizing has only an initial protective action in the case of emergency running conditions, and after the initial period during which it is effective, it becomes, according to several writers, positively dangerous.

It does, however, act as a mechanical barrier tending to prevent welding of the light metal to the cylinder bore and its function must be considered in the light of

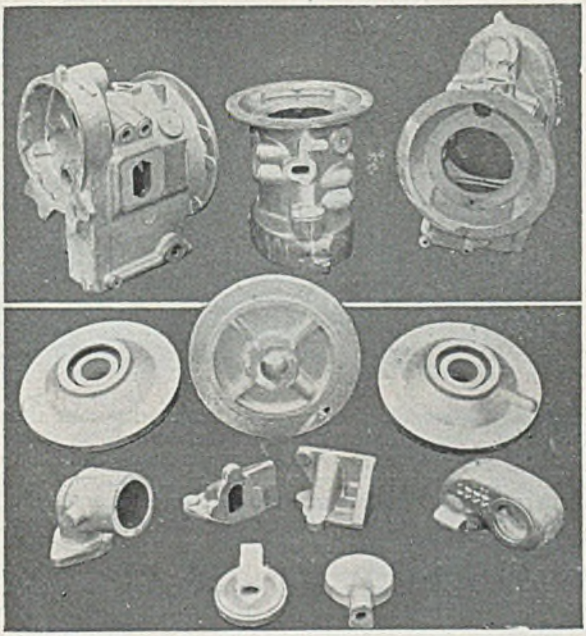


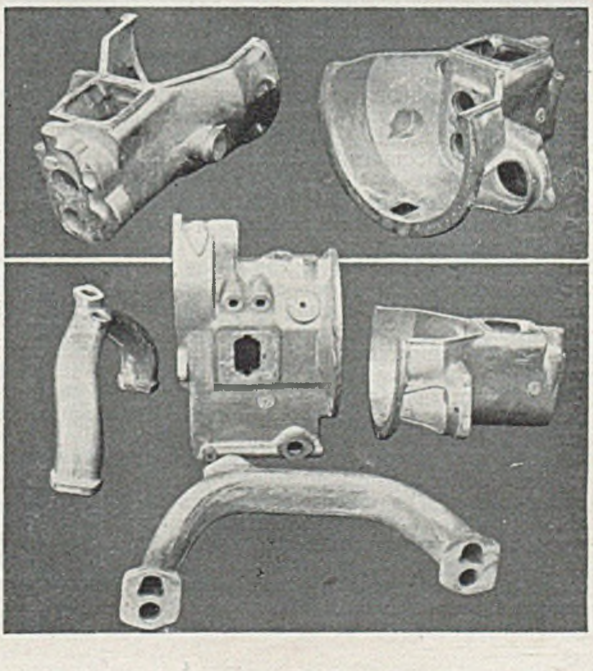
Fig. 32 (above) and 33 (below).—Aluminium castings for the Jowett "Bradford" utility car. Various views of the numerous components are shown and special attention is directed to the induction manifold with the integral water circulating passage — below, right. (Courtesy Robert's Castings Ltd., Colne Road, Huddersfield and Jowett Cars Ltd.) See also Fig. 34 overleaf.

formed colloidal suspension, or, better, by arcing (preferably with a.c. current) between supplementary lead, tin or cadmium electrodes immersed in the bath. Additional cooling of the bath would be required in this latter case.

In the case of lead, attack of the metal by the electrolyte, or by nascent oxygen at the anode, would be inhibited by the formation of insoluble films of lead chromate or lead dioxide. Such surface films would also tend to inhibit the tendency of colloidal metallic particles to migrate to the cathode surface. Such addition to the anodizing bath would necessarily involve some modification of the normal anodizing conditions. For the production of graphite coatings adsorbed upon anodic films, it would seem that one or other of the usual electrolytes could be employed in the presence of a disperse phase of so-called blue graphite, or of graphitic acid, either of which, by subsequent relatively low-temperature treatment, may be reconverted to normal graphite. Schwarz indicates that preliminary tests have indicated

this action and of its wear-resistant character. Better results might be obtained could the proved valuable properties of a hard aluminium oxide coating be combined with those of an extreme pressure lubricant. Schwarz[7] considers that this might be achieved by a process akin to the Ematal process[8], but using instead of inert oxides such as those of titanium, substances possessing definite lubricating properties which would be caused to be adsorbed on to the capillary walls of the anodic film. Suitable substances would be metals, such as lead, or graphite.

Adsorption of metallic lead, tin or cadmium would be obtained by anodizing in a bath either of the sulphuric-acid or chromic-acid type, in which was suspended a metallic "fog" obtained by mechanical dispersion of an extremely fine powder, addition of a pre-



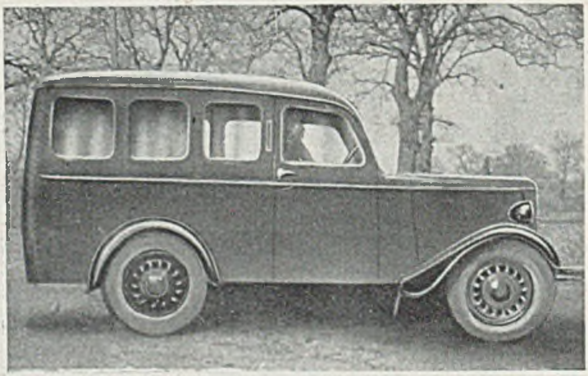


Fig. 34.—The Jowett "Bradford" utility car. Powered by a water-cooled flat twin embodying numerous aluminium components (as shown in Figs. 32 and 33), this car carries six with ease. The side panels of the bodywork are of aluminium sheet on plywood.

that suspension of "free" graphite does not yield satisfactory results.

N. D. Tomashoff(9) has examined the mechanism of the anodic process and the fundamental principle underlying the formation of anodic film and he has applied the deductions drawn therefrom to the production of films of value in the development of improved service characteristics in internal-combustion engines. The aluminium oxide which forms the anodic film is one of the best refractories known, stable up to 1,500 degrees C. and, consequently, the heat-resistance of anodic films is also very high. In practice, the maximum working temperature of anodized surfaces is the melting point of the metal, provided that mechanical requirements are satisfied by the hot metal. If the working conditions of the part involve heating from one side only, the other side being cooled, then the film on the side being heated, by preventing the transfer of heat to the metal, will act to prevent the metal from melting. The heat conductivity of the anodic film is low and, in consequence, Tomashoff claims that anodizing of the crown of the piston can be used to provide thermal insulation and thereby reduce the flow of heat from the combustion chamber to the piston.

Rough calculations indicate that with an anodic film having a thickness of the order of 200 microns, the transfer of heat from the combustion chamber to the piston will be reduced some 25-30 per cent. For one and the same rate of cooling of the piston, this would result in a marked reduction in the working temperature of the piston and a reduction of the heat losses from the engine. The aim here is contrary to the requirements previously expressed and is probably of greater importance to Diesel engine manufacturers, since engines of the Diesel type require a hotter combustion chamber than do petrol engines. The presence of the hard durable oxide film on the crown of the piston would serve to protect the piston against the destructive effect of detonation. In some cases, as, for example, when obtaining increased output from the engine, Tomashoff considers it advisable to anodize the compression ring grooves at the same time as the crown of the piston. This could reduce the working temperature of the compression rings and prevent the carbonization of the oil which causes a deterioration of the anti-frictional properties of these rings.

The hardest anodic films have a hardness on Moh's scale of between seven and nine, i.e., between that of quartz and corundum, but the more porous films are softer. The hardest films are obtained on pure aluminum or on aluminium alloys with a homogeneous structure. The hardness of the films is not uniform over their thickness. The hardest, and also the densest, are the layers adjoining the metal; the outer layer of the film has the lowest hardness and density. Tomashoff has compared the scratch hardness values of aluminium oxide films and some other materials as follows:—

| | |
|---|---|
| Aluminium (polished surface) | 80 |
| Anodic oxide film— | |
| Surface zone ... | 140 |
| Middle zone ... ... | 3,000 |
| Inner zone ... ... | 5,000 |
| Razor steel ... ... ... | 1,500 |
| Glass ... ... ... ... | 2,000 |
| Hardest chromium plate ... | 3,100 |

As the data show, the hardest anodic films exceed the hardness of hardened steel and of chromium plate. In some tests on the wear resistance of a piston alloy in contact with a steel roller, it was found that when tested with lubrication the unanodized alloy suffered considerable wear, some of the light alloy smearing on to the steel. During the same period an anodized specimen of the alloy showed no measurable wear and did not wear away the steel roller.

In tests without lubrication the anodized specimens again proved superior, suffering less wear, causing much less wear of the steel, and having a lower coefficient of friction.

Whatever may be the merits or demerits

of anodizing as a surface treatment for aluminium alloy pistons, and modern technical opinion appears to consider that there are more demerits than merits, it is certainly very popular in practice and very large numbers of pistons for both petrol and Diesel engines are regularly being treated in this way. Alumilite and Alzak, for instance, in one of their advertising pamphlets, claim that, in America, practically the entire production of light alloy pistons by Ford, Chrysler, Lincoln and Cadillac are being treated by the Alumilite process.

Anodizing of pistons is, in practice, chiefly restricted to the cast silicon-aluminium alloys, which anodize more readily and more satisfactorily than the copper-containing alloys. Here again, although the basic method of treatment is one of the well-known processes which are being applied to a wide range of aluminium goods in all branches of industry, many variations have been suggested for this specific application. Thus, U.S. Patent 2,111,377 claims the process of anodizing aluminium - silicon (about 12 per cent. Si) alloy pistons for internal-combustion engines by suspending them in 13 per cent. sulphuric acid solution at 21-23 degrees C. and applying a 60-cycle a.c. current initially at 12.5 volts for about three minutes and finally at 24 volts for about 20 minutes to produce a hard protective coating. Considerably better service properties can be obtained by chemical oxidation, which, in contrast to the electrolytic method, provides considerably softer and thinner films, capable of retaining oil and possessing limited resiliency in the case of local high stressing. Wider application of these methods has, however, been hindered by the introduction of more promising protective films, of which perhaps the most noteworthy is tin. The favourable emergency-running properties of tin-base bearing alloys have long been recognized. Protection of highly stressed piston surfaces by a tin layer is said to have been adopted during the first world war to remedy bad running conditions in light forged-steel pistons for aircraft.

Considerably later, General Motors electro-deposited tin on cast-iron pistons, the main idea being to make the surface safe against "seizing" in the case of overloads.

It was natural, therefore, to attempt the improvement of light alloy pistons by coating them with tin. Electro-deposition was found to be difficult and better results were obtained by a straightforward dipping method, applicable to all light alloys, whether in the cast or forged condition.

The pistons, after machining, were plated by immersion in a hot solution of sodium stanate, which deposited a film of tin without the use of external electro-motive force. Microscopic examination of the tin coating is necessary to control its thickness, continuity and adhesion. Only a small amount of tin is deposited; for an ordinary automobile engine piston this is usually around 1-1.5 g. per piston.

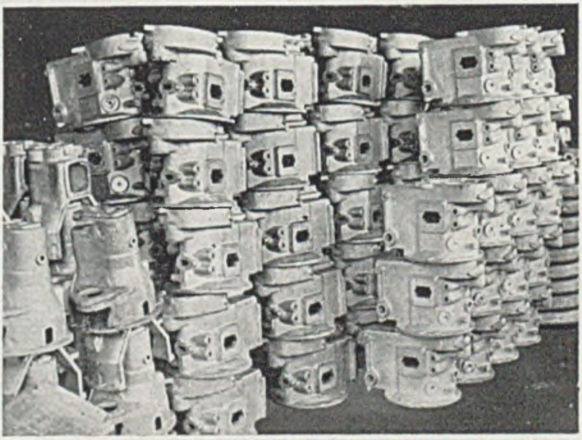


Fig. 35.—Gear-cases and crank-cases for the Jowett "Bradford" utility car. (Courtesy, Robert's Castings, Ltd., Colne Road, Huddersfield, and Jowett Cars, Ltd.) See also Figs. 32, 33, 34

The tin layer has satisfactorily fulfilled all expectations with regard to acceleration of the running-in process and the protection of the running surface in the event of lack of lubrication, as well as against pin-point corrosion during cold starting. Tin-coated light alloy pistons are of particular value in highly stressed engines. Their use has enabled smaller clearances to be employed in the U.S.A.

A thin cadmium layer can be applied by electro-deposition to iron and light-alloy pistons. It has about the same emergency running properties as the tin layer, and is resilient and plastic at low specific pressures. The excellent affinity of the protective layer for oil assists in the formation and maintenance of a coherent lubricating film. Where the oil film is destroyed owing to locally high specific pressures or hot points, the protective metal layer acts as an emergency lubricant. Cadmium plating is used to only a small extent and its application is restricted to certain cast-steel pistons employed in the U.S.A., although its potentialities are much wider.

The high plasticity of lead has suggested its use for films on light-alloy pistons in order to obtain rapid running-in, and as a protection against scoring of the sliding surfaces when lubricant is lacking.

The lead is applied as a thin film on the sliding surfaces of cast or pressed light-alloy pistons by electro-deposition, or by dipping. At first it proved difficult to obtain good adhesion, which was attained only after a grease-free porous-base surface (in which the lead particles were solidly anchored) had been obtained by special pre-treatment. In its mode of effect lead plating is similar to tinning, but, according to Nitzshe[10], light-alloy pistons coated with lead exhibit running characteristics superior to those possessed by tin-coated pistons. The process, developed by Perner, involves the immersion of the piston in a solution of lead salts. It is claimed that, in comparative tests involving the cold-starting of an engine fitted for the various tests with untreated, anodized, tin-plated and lead-coated pistons respectively, the immediate application of a full load after starting resulted in early seizure of the untreated and tin-plated pistons. Also, it is claimed that in an engine running without lubrication, lead-coated pistons were the last to seize.

The results of these tests are, in certain respects, at variance with those obtained in previous tests. It would seem that an exhaustive series of trials of pistons with various coatings and running under conditions of boundary lubrication is called for if the authenticity of the various claims is to be subjected to verification. To some extent the claims put forward by German engineers may be a little biased in favour of lead, since, in that country, lead was less scarce during the war than either tin or cadmium. The weight of lead per piston of medium size is not usually much more than 1 gram.

The excellent sliding properties of finely distributed colloidal graphite are well known and have been extensively exploited. In the engine, addition of colloidal graphite to the lubricating oil improves the running-in process. To give the sliding surfaces of machine elements a thin protective film of this special material, solid binding to the piston surface is necessary. Filling of machining ridges by fine graphite produces a smoothing between projecting crests and valleys, whilst the graphite layer further supports the formation of a coherent oil film. Service data confirm these advantages. The film gives effective protection, both during reduced running-in periods and for cold starts. Graphitizing is at least equivalent to tin and lead plating, and the method is applicable for all light alloys used for pistons.

**Production of Light Alloy Pistons**

We do not propose to discuss any features of the operations of casting and forging in these pages, except to point out that size limitations point to sand casting as the obvious method of producing large Diesel engine pistons, whilst permanent mould die casting is the most economical method of mass-producing pistons of smaller sizes. We are, however, interested in what happens to the casting or forging before it becomes a finished piston, and here, unfortunately, little information has been made available.

The first main process inevitably consists of one or more roughing operations of increasing surface finish. Great economies have been effected in this direction in recent years, and some particularly good work has been done in Germany, where the incentive to economize in labour and metal has been felt for more years than it has in this country. Ten years ago the weight of the piston as-cast was nearly double the weight of the finished job, whilst, to-day, in the as-cast state the piston weighs only some 15 per cent. above finished weight. This result has been achieved, first, by eliminating risers and, secondly, by the use of a permanent mould producing two pistons at once. Both melting costs and plant in use are thus saved.

In connection with forged pistons, the tendency has always been to forge to finest possible limits, thereby reducing machining times and loss of material as swarf.

As contrasted with those in Germany, piston manufacturers in other countries, whilst equalling German production rates, still waste considerable amounts of metal.

Roughing is followed by an intermediate annealing operation to remove stresses, after which the final surface is obtained either by wet grinding with fine-grained grinding wheels or precision turning with diamond or sintered-carbide tools.

The surface finish produced by both processes is approximately equivalent and satisfactory. The annealing or rather stress-relieving treatment referred to above is important. Murphy has dealt with this aspect of the subject in some detail[2]. Internal stresses in light alloy castings intended for engineering applications may be objectionable for two main reasons. The first is the distortion which is liable to occur when a casting having internal stresses is machined, with consequent release of stresses. Deformation of this nature is troublesome when it is desired to machine the castings to close limits of accuracy. The second reason is that the internal stresses may represent a dangerous supplement to the stresses imposed by the external loads of normal service.

Recognized sources of internal stresses in castings are non-uniform cooling of the casting in the mould following solidification, non-uniform cooling in heat treatment and changes in volume accompanying constitutional transformation.

The determination of the magnitude of the internal stresses in castings, especially if they are of irregular form, is a matter of considerable difficulty and uncertainty. Guidance as to the effects of various thermal treatments on the relief of internal stresses can however, be fairly simply obtained. Experimental methods described by Murphy include one in which rings cut from cast light-alloy cylinders are subjected to the treatment under investigation, then cut and the amount of spread or other movement measured. In this way it was found that to obtain an adequate relief of stresses in Y alloy whilst maintaining maximum Brinell hardness it was advisable to follow the normal heat treatment of 6 hours at 530 degrees C. by quenching in boiling water and tempering for 16 hours at 175 degrees C. The actual experimental results quoted by Murphy are very enlightening. Unfortunately, similar investigations on other heat-treatable alloys do not appear to have been published.

Mahle has described the finishing of light-alloy aircraft pistons as practised in Germany during the war.(5) The finish machining was carried out on specially developed equipment, all operations being so simplified and sub-divided as to be capable of execution by unskilled labour. Owing to the current shortage of industrial diamonds in Germany, sintered-carbide-tipped tools were used for finishing; they gave a very fine surface finish, almost comparable with that achieved by diamond turning.

During the past few years, many comparative studies have been made of the surface finish attained by diamond turning, sintered-carbide turning and grinding, as a result of which it has become possible to lay down standards in this regard. Profile grooves exceeding 0.007 mm. are considered as unsatisfactory. Profile grooves not exceeding 0.002-0.005 mm. in depth are considered as desirable.

Examination of pistons which have actually been in service for prolonged periods shows that 99 per cent. of them at the end of this period still exhibit turning grooves or grinding scratches, indicating that skirt wear is probably always very low, wear occurring either in the cylinder bore, on the piston rings, or in the piston-ring grooves.

It would seem, therefore, that, even under the arduous conditions imposed upon pistons in the present-day aircraft engine there is, in this regard, little call for further improvement in the finish of the piston skirt. As to protective films applied to the skirts with the intention of minimizing corrosion-erosion phenomena when starting from cold, Mahle maintains that these in any case adhere better to somewhat rough surfaces.*

In contrast to cast-iron pistons, light-metal pistons present few difficulties in machining; clean cuts are made and severe deformation and tearing such as occur when turning cast iron are far less likely to take place. Breaking out of the machine surface during use which may occur with cast iron is not encountered in the case of aluminium. Mahle considers that whilst further improvement in surface quality is possible by means of superfinishing to give profile depths in the order of 0.001 mm., the general introduction of this system into mass-production schemes does not at the present time appear to be especially necessary. Furthermore, polishing of the piston skirt adopted as a standard in mass production for some years has also been abandoned without ill result.

As a proof of the relatively minor effect of the smoothness of the piston skirt on cylinder-bore wear, Mahle mentions that, where the actual skirt and cylinder wall come into contact, i.e., at lower dead-centre, there is no measurable wear, whilst at the contact areas between the piston rings and the cylinder walls at the upper and lower dead-centres marked scratching does take place.

Finally, the finished piston skirt is provided with a protective film to guard against damage during cold starting or under emergency conditions, such as during periods of insufficient lubrication or when the cooling water supply to the cylinder has failed. Formerly, in Germany as elsewhere, an extremely thin coating of tin was used for this purpose, but during the war, in order to economize in raw materials in short supply, lead or graphite was employed. The Mahle concern has developed a special technique for the mass-production application of these last two protective media, of which graphite caused considerable difficulties for some years.

The provision of porous anodic coatings on aluminium pistons is particularly popular in America, where huge automatic anodizing plants have been installed to perform the operation on a mass-production basis at a minimum cost.

Sometimes anodizing is employed as a preliminary to the deposition of tin or other metal by electrolytic methods. Thus B.P. 573-431 claims the production of aluminium or aluminium-base pistons by anodizing followed by the electrodeposition of a metal

---

* In the German original no direct evidence is brought forward to substantiate this statement.

such as tin or lead having high ductility. Electrodeposition on to aluminium presents many practical problems and the process requiring the preliminary formation of an anodic coating is one of the methods which have been developed specifically to overcome inherent difficulties; coating by immersion in molten tin or other metal is safer, more simple and in general to be preferred where applicable.

Electrodeposition possesses the advantage over simple immersion in that it affords the opportunity for some control over the porosity characteristics of the coating and that it can be used to apply coatings of high melting metals such as chromium. Electrodeposited coating do, therefore, offer the possibility of impregnation with oil or other lubricant, a possibility which has already found application both in the internal combustion engine and in other branches of the engineering industry in the formation of porous chromium-lined bearings and cylinder walls.

Sometimes, particularly in the case of the larger pistons, surface rolling is carried out on the finished manufactured piston by means of a specially hard steel taper roller, the piston being revolved in a lathe. This burnishes and hardens the metal surface. This practice has many disciples but at the same time it has just as many opponents who maintain that it closes up the fine pores which are so valuable for absorbing oil. Rolling the inside walls of the piston lands is less frequently performed although less criticism of this practice is to be heard.

A certain amount of controversy has taken place over the relative merits of sintered carbide and diamond tools for the finishing of light-alloy pistons. Mahle maintains that by the correct use of carefully sintered-carbide tools a surface finish is attained on the piston similar to that resulting from diamond turning. Nevertheless, the durability of carbide tools is much less than that of diamond tools. A facet-diamond tool may dispose of 1,000-1,200 pistons of a given type before readjustment is required, whilst the sintered-carbide tool can deal with only 80-100 of the same type without readjustment; thus the efficacy of the diamond tool is 12 times as great as that of the sintered-carbide tool before it must be removed from the machine for relapping, and it is found that the effective life of the diamond tool is some 50 times as great as that of the sintered-carbide tool.

Misleading data have been quoted giving figures based on a production of 2-3,000 pistons as a possible limit before regrinding of the sintered-carbide tool becomes imperative. On this basis, the tools would be relapped 25-30 times before regrinding—a manifest impossibility.

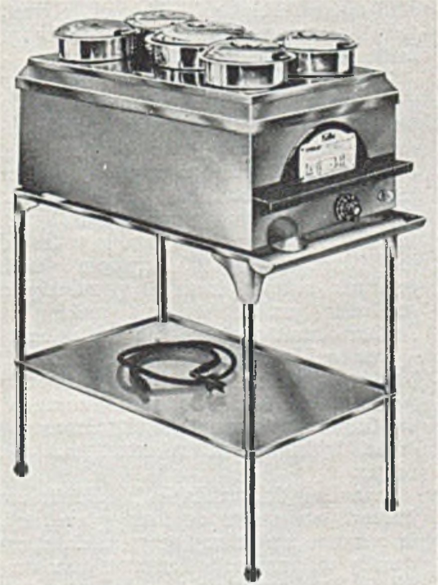
The rear-adjustment angle should be selected as small as possible in order to obtain a good surface finish with diamond turning. Earlier researches indicated that, when turning aluminium, the best surface finish was obtained with radiused diamond tools presenting no actual rear-adjustment angle. In England and in Germany alike there is still some difference of opinion as to whether a radius or a facet gives the better surface finish. Mahle, however, has no doubts about the matter and states that the facet diamond has been adopted as standard practice by the Mahle concern.

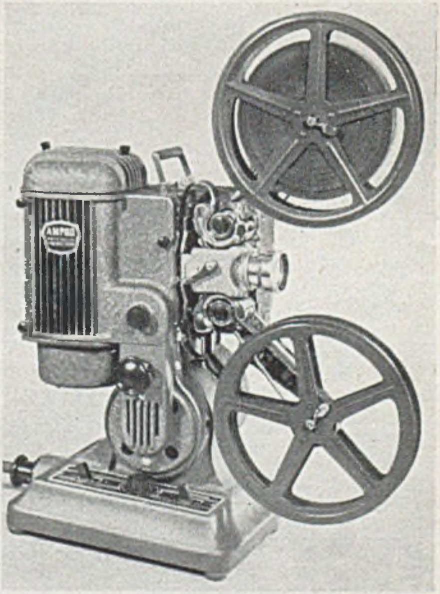
Modern piston production has been greatly helped by the development of X-ray methods of inspection which are particularly applicable to the examination of light-alloy castings and forgings. Radiography has enabled the rejection of unsound pistons before they have reached an expensive machining stage. More than this, radiography, by revealing the extent, position and type of hidden defect, has assisted the foundry in the production of better castings. The three main difficulties which have had to be overcome in the development of really sound light-alloy pistons have been blowholes off cores, pinhole porosity in the crown of the piston and dross inclusions. Radiography has demonstrated the extent and position of these defects in a way which machining could never have done, and without doubt has played a very important part in the improvement of cast pistons. When dealing with cast Diesel engine pistons, particularly those of the larger sizes, it is seldom possible to produce a casting which is free from all visual evidence of defects. Blowing may take place off the chills and patches of oxide may occur perhaps where the sand was not properly conditioned, whilst not infrequently there may be characteristic surface evidence of shrinkage at the junction of differing sections or perhaps near an in-gate or at the base of a riser.

X-ray inspection may also be employed for the routine control of uniformity of production. Other tests for this purpose include tensile and composition tests carried out on the finished job, bursting tests carried out on plate specimens machined from the piston crown, rings cut from the piston skirt are subjected to bending tests, whilst hardness determinations are carried out on the piston crown. Spectrochemical analysis may be used for controlling composition, thereby avoiding unnecessary destruction and saving both labour and time. In examining new designs, the strain measuring method of Maybach (with lacquer films), and fatigue tests by means of the Schenck machine are employed.

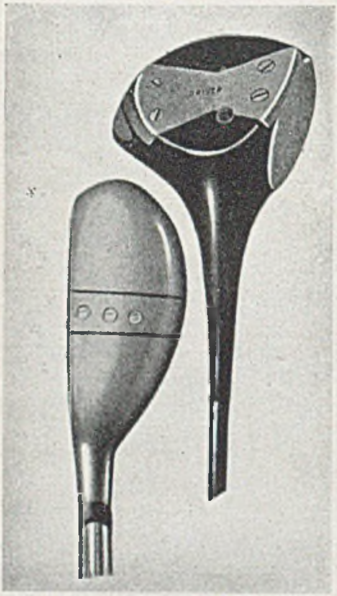
(*To be continued*)

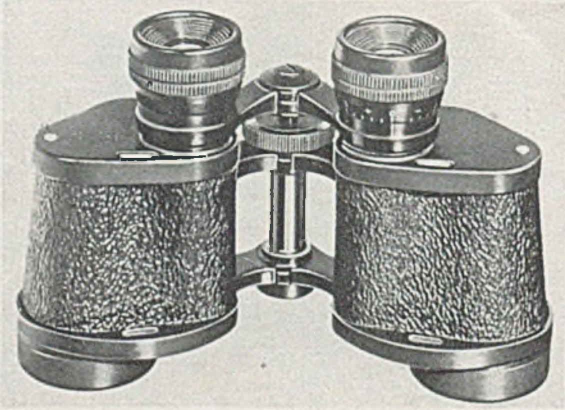

AFTER the final London showing of "Britain Can Make It," the Council of Industrial Design announced that the exhibition would go on tour. Regular readers of "Light Metals" will recall that Passingham offered scathing criticisms of the original presentation, especially



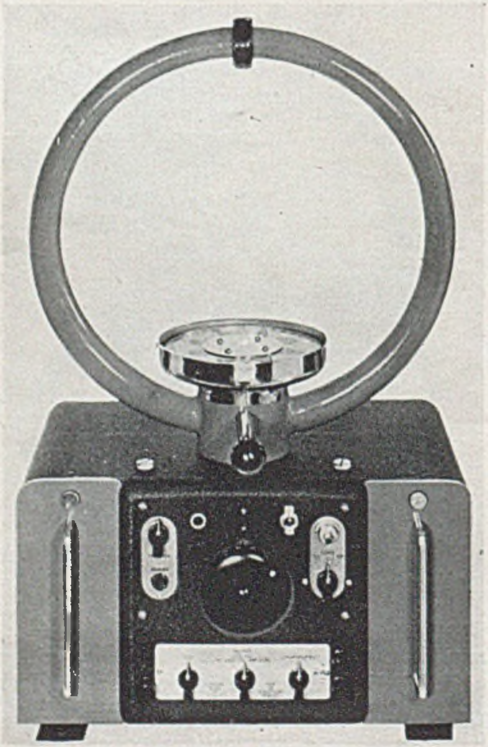


PICTURED at the top of the page is an electric floor polisher incorporating aluminium castings. **(Vactric Ltd., Chapelhall, Lanarkshire. Tel. Airdrie 2455).** Immediately above at the left the "Waterless Bain-Marie" made almost entirely of aluminium **(John Kelly and Son, Rose Street Works, Edinburgh, 2. Tel. Edinburgh 32245)** : at the right a 16 m.m. film projector, predominantly of aluminium **(Kelvin, Bottomley and Baird Ltd., Hillington, Glasgow, S.W.2. Tel. Halfway 3331).**





AT the left, above, two views of the "Mamba Model Wood" with an aluminium sole plate: the exhibitors **(John Letters and Co. Ltd., 179 Howard Street, Glasgow, C.1. Tel. Bell 3119)** also produce an aluminium putter. (Above, right) Prismatic binocular C.F.10 with body and small parts in aluminium **(Barr and Stroud, Ltd., Anniesland, Glasgow, W.3. Tel. Scotstoun 4241).** (Below) A radio direction finder, with case, panel and chassis of aluminium for lightness and non-magnetic properties **(Coastal Radio Ltd., Hope Crescent, Edinburgh 7. Tel. Edinburgh 26224).**



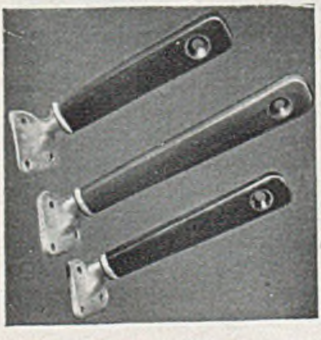
with regard to layout. It is of interest, therefore, to see what changes have been made for "Enterprise Scotland."

Obviously, careful thought has been given to the problem of converting a part of the Royal Scottish Museum, Edinburgh, into a show-place for the latest products of Scottish initiative. A greater measure of success has been achieved than at the London showing; but, again, the designers have been unable to avoid the "one-way-street" principle which prevents visitors from re-examining a particular article without making a further circuit of the whole exhibition.

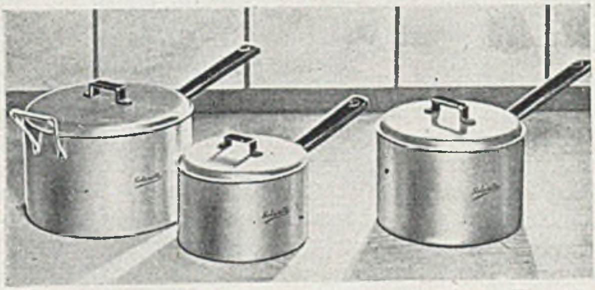
One exhibit, "Scotland To-morrow," was disappointing for a theme with such possibilities. Alas! the only glimpse of the future was a map showing industrial areas, hydro-electric schemes, and air routes.

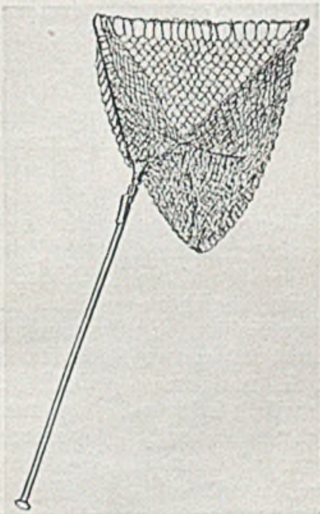
Some of the exhibition's aluminium interests are shown on these pages, and, in common with many other exhibits, are worthy of praise. The most striking single item was the St. Andrew statue. Walter Pritchard created this 25-ft.-high centre-piece of sheet metal, both aluminium and brass, and it is probable that, in the correct setting, the work would be described as masterly, but, wrongly, it was confined in a small

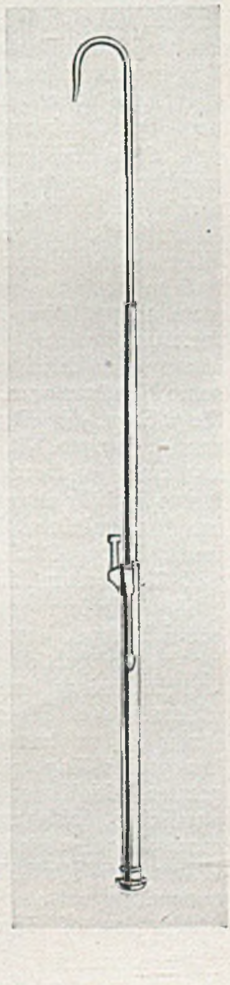

lobby, where only the lower half could be seen without craning the neck. Surely a better position for the statue would have been outside the exhibition, to be admired from a distance where twisted metallic details would merge, maybe, into unexpected grandeur. In this event, the designer would perhaps have specified aluminium throughout, to resist the ravages of the weather, and taken advantage of dyed anodic coatings for colour effects. But that, to misquote Kipling, is another statue.



PICTURED at the left is the Goblin "Monarch" vacuum cleaner with aluminium parts. **(British Vacuum Cleaner and Engineering Co. Ltd., Broxburn, West Lothian. Tel. Broxburn 194.)** Below: a set of "Solarette" stewpans. **(Scottish Aluminium Ware Limited, Industrial Estate, Larkhall, Lanarkshire. Tel. Larkhall 281.)**







ABOVE: "Viking" folding-type landing net with aluminium-alloy arms and handle. At the right: "Lightweight" telescopic gaff in aluminium alloy with a stainless-steel hook. Open length 37 ins., closed 16 ins., and weight only 12 ozs. **(Both by J. S. Sharpe, 35, Belmont Street, Aberdeen. Tel. Aberdeen 4066.)**

AT the left: three pan handles in plastic material with aluminium inserts. **(Aeroplastics Ltd., Earl Haig Road, Hillington, Glasgow, S.W.2. Tel. Halfway 1683.)**

# aluminium—art and export

FEW people will not remember the gaily coloured and beautifully decorated metal boxes which in pre-war years brightened grocers' and confectioners' windows at Christmas time, and found a place of honour on many a rural cottage mantelpiece. Under austerity conditions these containers have disappeared from our shops; they are not, in fact, permitted for the home market; but their manufacture is still continued. The producers of these elaborate packages have found new markets for the products of their craft, and these descendants of the humble tin box on which was transferred some small design are now earning dollars on New York's Fifth Avenue and in many other American cities, as well as export markets elsewhere.

Faced with the non-availability of tinplate, the traditional material, the manufacturers turned to aluminium, an alternative which appeared to possess some disadvantages. It did not possess the inherent rigidity of tinplate in comparable gauges. It could not be angled so acutely without danger of fracture. It was initially more expensive, and fabricated aluminium faced an American import duty of 45 per cent., compared with 22½ per cent. for fabricated tinplate.

The problem of its lack of rigidity could be overcome during manufacture by the introduction of beads, curls, folds and embossings, but these expedients had, of course, to be incorporated into the design as unobtrusively as possible. The increased selling price resulting from the greater initial cost and higher duty on aluminium could only be met by even more attractive designs produced with a view to their suitability as re-use containers.

A review of American tastes in bric-a-brac was carried out. It was found that there was a strong preference for the design and appearance of European porcelain and pottery and Russian and French enamel, whilst marine pictures and old country cottages, which to a tradition-loving maritime nation like ourselves always have a somewhat nostalgic appeal, were not generally appreciated in America. Another point discovered was that a high-quality container of this type should not have the plain metal showing on the inside; it must be covered with gold lacquer, and for this purpose an odourless lacquer was used.

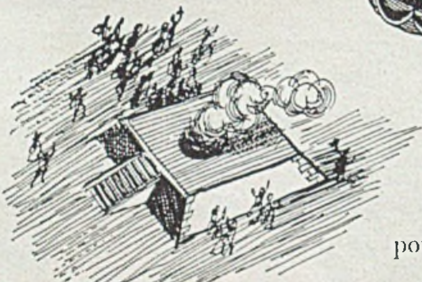
Faced with the problem of a new material and the result of the investigation in taste, the manufacturers set to work to redesign the containers from both a structural and a decorative point of view. The construction of each box was arranged to incorporate strengthening devices to compensate for the lesser rigidity of the aluminium, whilst decorative motives were suggested by old Dresden, Sèvres and Chelsea china and fragments of French and Russian enamel.

The final range, of which a selection is shown in full colour on the next page, pays tribute to British inventiveness and artistic skill. The aluminium containers, although more expensive, have been given a rigidity comparable to tinplate, their decoration is as attractive, although with a subtle softening of the colours, their feel is extremely pleasant, they are light to handle, and they will not rust. After serving their initial use, normally as containers for sweetmeats of various descriptions, they have numerous possibilities for re-use, such as cotton and embroidery silk boxes, jewel caskets, handkerchief boxes, biscuit and cookie boxes, and tea caddies.

Photograph by Hennell (Metal Box Co., Ltd.)

SELECTION of decorated metal boxes for export markets; fabricated in aluminium and coloured by a printing process. (Courtesy Metal Box Co., Ltd.)

# Man's first victory over g



Hot air won man's first victory over the power of g (gravity) and a lot of hot air has gone up since, but man is fast learning more and more how to reduce the power of g. We at H.D.A. do little else but help the good work along by inventing and perfecting alloys that are light but strong. All that is needed now is for more manufacturers to think in terms of these new metals, to enquire from us what can be done to combine lightness with strength and to

. . make light work of it with g **HIGH DUTY ALLOYS**

HIGH DUTY ALLOYS LIMITED, SLOUGH, BUCKS.
INGOTS BILLETS, FORGINGS AND CASTINGS IN 'HIDUMINIUM' ALUMINIUM ALLOYS
(Regd. trade mark)

# Melting High-magnesium Aluminium-base Alloys

*F. A. Allen, A.I.M., Discusses briefly the Nature and Properties of the Structurally Important Binary Aluminium Casting Alloys carrying Higher Magnesium Contents, describes requisite Melting Practice and Compares the Technique with that Demanded, on the one hand, by Normal Aluminium Alloys, and, on the other, by Magnesium-base Compositions.*

ALUMINIUM-BASE alloys in which magnesium is the principal alloying metal are a most important series of engineering materials. Wrought or cast, they possess high resistance to corrosive influences and are capable of attractive surface finishing to give a permanent polish, and of being beautifully anodized and dyed; further, in general, mechanical strength of the alloys is high.

Those to be reviewed are essentially binary compositions containing up to approximately 11 per cent. magnesium. It should be observed here that, at present, for various reasons, the most favoured range is that with magnesium between 3 and 6 per cent.

With magnesium percentages approaching the upper limit, difficulties of producing satisfactory castings are increased, and the alloys themselves tend to exhibit certain minor, but sometimes unfavourable, mechanical and chemical peculiarities.

The wrought alloys listed in BS/STA 7, a rationalized schedule of aluminium alloys issued in 1945 for Services use by the British Standards Institution for the Ministry of Supply, include the 5 per cent. magnesium alloy in the form of bar, sections, and forgings; tubes, sheet and strip in the soft or half-hard physical state; and welding wire and rivets, this latter use being covered by D.T.D.303. The 7 per cent. magnesium alloy in the form of extrusions or forgings, tubes, and sheet and strip, also covered by the D.T.D. specifications 297, 190 and 182A respectively, is also included in the above Services schedule. Neither of these alloys is heat treated, but depends for its medium strength upon mechanical working during production or upon cold work performed, for example, in the process of riveting.

One cast alloy of the high magnesium aluminium-base series contains between 9.5 and 11 per cent. magnesium is given in BS/STA 7, and is also covered by D.T.D.300. The alloy is heat treated to effect solution of the magnesium-aluminium constituent, and then it has valuable minimum specification tensile properties of 16 tons/sq. in. ultimate stress and 7 per cent. elongation on 2-in. gauge length, whilst a 0.1 per cent. proof stress of 10 tons/sq. in. may be expected. The alloy may be sand or gravity die cast, and resultant castings are used in conditions where high corrosions resistance is of the first importance.

The alloy to D.T.D.165 contains between 3 and 6 per cent. magnesium and is used in the as-cast condition. This alloy is used in moderately stressed conditions, and as with casting alloy D.T.D.300, castings composed of it may be highly polished or, alternatively, clear anodized with pleasing results. A similar cast alloy is known in America, although one has the impression that these alloys in general are not widely used there. Both the 3 per cent. and the 10 per cent. magnesium alloys are officially specified in France.

It may be expected that melting requirements are different from those for the more usual aluminium alloys on account of the magnesium content. Perhaps the specific technique applied to the alloys under discussion may be best grasped by contrast and comparison of the processes for aluminium-base and magnesium-base alloys first considered separately.

In brief, all aluminium alloys should be melted rapidly and used quickly with, if possible, the imposition of a maximum temperature not to be exceeded during the melting process. For it is well known that aluminium alloys rapidly absorb hydrogen at temperatures above 700 degrees C. The institution of 700 degrees C. as the maximum temperature may not always be practicable as the pouring temperature is often required to be higher than this. In this case, melting should be so arranged that the superheating is achieved in the shortest possible time and without holding at the more elevated temperature. When scrap is contaminated with water or organic matter, or when the ingots composing the charge are not gas-free, it may be found necessary to degas the melt by either chlorine, chlorine and nitrogen mixtures, or by proprietary chlorine-evolving degassing compounds. Aluminium alloys are further characterized by iron absorption to varying degrees, and therefore for work in which iron content cannot be allowed to increase, graphite or carborundum melting pots must be used. The high silicon aluminium alloys are particularly bad offenders in this respect and melting or holding in ferrous pots may result in such an increase in iron content that metal of little use may be produced. It is probably true that the magnesium-aluminium alloys do not absorb iron at the same rate, but even the small amount taken up is detrimental to corrosion resistance and where they are heat-treated, to the final properties. Fluxes for specific purposes may be used, that is, for simple washing of the metal bath to remove oxide films, or for grain refining for which boron salts are added. Nevertheless, it may be stated that given the right sort of raw material and the careful observance of operating temperatures, aluminium-base alloys may be successfully melted without the use of fluxes.

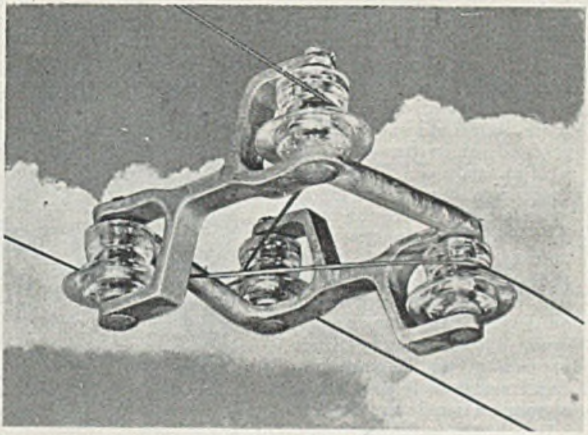
Just as the present commercially useful aluminium-base alloys under review are in essence binary alloys containing up to approximately 11 per cent. magnesium, so at the opposite end of the diagram, the magnesium-base alloys are essentially binary alloys containing up to 11 per cent. aluminium. These alloys, in contra-distinction to aluminium-base alloys, are melted in iron or steel melting pots, as they do not absorb iron. Magnesium alloys, too, do not absorb hydrogen to a marked degree, although British and American research has shown that a small amount is in fact dissolved; this small absorption being directly related to the property of micro-porosity, once thought to be characteristic of magnesium alloys. It is true to say, however, that magnesium alloys do not dissolve hydrogen to the same extent as aluminium alloys—"pin-holing" from this cause is never encountered. On account of the chemically active nature of the base metal, fluxes must be used for the two-fold purpose of protection from oxidation and for the removal of oxides or nitrides incidentally formed. In passing, it may be noted that metal loss during the melting process is practically all due to preferential oxidation of magnesium. Magnesium alloys undergo a grain refinement when they are super-heated to a temperature of 900 degrees C. and this process is normally part of the melting technique, although more recent developments have shown that grain refinement may be achieved by other means. The point is here, that as distinct from aluminium alloys, magnesium alloys are actually improved by super-heating. Fluxes for molten magnesium treatment contain substantial proportions of anhydrous magnesium chloride, and therefore effective separation of flux from metal must be achieved if corrosion is not to be set up in the finished castings.

The melting process for aluminium-base alloys containing substantial proportions of magnesium may now be considered in detail. In the first place, non-metallic melting pots must be used in order to eliminate iron contamination. Impurity content must not exceed specification values, as otherwise the inherent high corrosion resistance of the alloys is impaired. Further, these alloys, at least at the higher magnesium content, absorb hydrogen with great avidity, and it is vital, therefore, that the temperature is not allowed to exceed about 750 degrees C. The alloys do not undergo grain refinement on superheating as do magnesium-base alloys, and degassing and grain refining may be achieved by the use of proprietary compounds containing boron as the grain refining agent. It is considered that fluxes containing sodium salts should not be used, as some reduction to metallic sodium tends to occur with parallel adverse effect on mechanical properties. Due presumably to oxidation of the magnesium constituent to oxide—a voluminous compound—the alloys are "drossy" during melting. According to the best practice, therefore, the metal charge is protected by flux, as used for magnesium melting, as it melts, so that the resultant metal bath is protected by a fluid flux cover. If this procedure is observed it is probably not necessary to stir the flux into the metal as is done at the refining stage in magnesium alloy preparation, for little magnesium oxide will have been formed. Nevertheless, since the presence of oxide will give rise to discontinuities, and therefore, weaknesses in the resultant casting, flux refining is an excellent safeguard. The flux cover added during melting is removed and about 2 per cent. of the weight of the charge of flux is added, allowed to liquefy, and then stirred vigorously into the melt. The fluid flux will then rise to the surface; such is the difference in density of the aluminium alloy as compared with that of magnesium alloy that flux contamination need not be feared.

Pouring into the mould should be performed with care; the pouring lip should be placed as near as possible to the mould, and in the case of the 10 per cent. magnesium alloy a dusting powder, of sulphur and boric acid, to restrain oxidation, may be used.

# NEWS

## General, Technical and Commercial



### Magnesium on the Line

CARRIER circuits, the means by which many telephone conversations can be carried on over a single pair of wires, have been used by telephone engineers for some years. The technical problems, so often attendant with such inventions, may be overcome only after long experience, and in this particular case not the least of these has been interference.

Interference on carrier circuits, it has been found, can be overcome simply by crossing the two wires at the proper places along the line. This solution, however, proved too expensive, because, originally, the wires had to be crossed on the pole, which meant either moving the existing poles or installing new ones at proper intervals. Moreover, when new circuits were made it often meant moving a pole to permit crossing at a different point. The answer to this problem has been provided by the lightest structural metal—magnesium—which is used in construction of the "Case transposition bracket" pictured here.

The bracket is cast in magnesium and fitted with either glass or rubber insulators. Lightness—the whole assembly weighs less than 3 lb.—is an essential requirement, because the brackets are supported by the wires themselves and the increase in tension on the wire is many times greater than the actual applied load.

Another interesting feature in the design is that it allows the wires to be crossed at any desired point without cutting. Moreover, an insulating bushing allows circuits to continue without interruption, even if the insulator should break. The design is the work of Rogers Case of Transandean Associates Inc., in U.S.A.

### Surface Preparation

WE have received a comprehensive booklet from the Northern Aluminium Company, Ltd., on "The Surface Preparation of Aluminium for Paint Systems."

The subject is sub-divided into four main sections dealing with surface pre-treatment, paint treatment, lacquers and jointing compounds. In the section on surface pretreatment, are to be found amongst the methods described the anodic treatment, Alrok, M.B.V., and E.W. processes, phosphoric acid treatment and Chromodising. Some of these are proprietary systems.

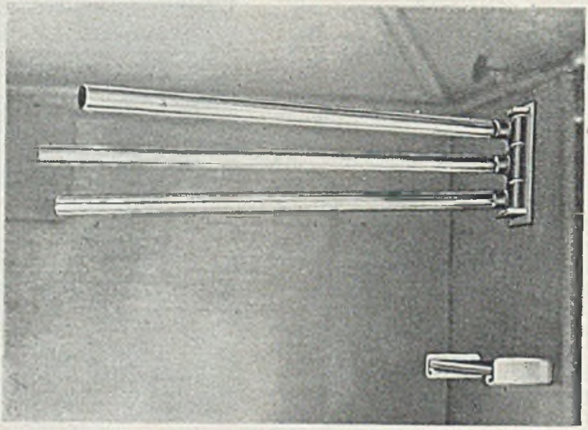
### A New Directory

RECENTLY published, The British Non-Ferrous Metals Directory provides a comprehensive guide to British suppliers of raw and semi-finished non-ferrous metals. It comprises a classified section, under which are listed, in detail, a wide range of non-ferrous products, together with their suppliers, and an alphabetical section giving full addresses, telephone numbers and telegraphic addresses of the companies concerned.

Produced in a convenient pocket size, this directory is obtainable from the publishers, Metal Information Bureau, Ltd., Princes House, 39, Jermyn Street, London. S.W.1, at 5s. per copy post free.

THE index to Volume IX of "Light Metals" is now ready, and is available on application, price 7d. post free.

WALL-TYPE airing fixture of novel design. It consists of three aluminium tubes, each 3 ft. long and each attached by a drive-on fit over a 9 in. length of ¾ in. gas barrel screwed, at its free-end, into a ¾ in. pipe T. The three assemblies thus formed are so mounted, one above the other in a welded iron bracket as to permit their being swung against the wall when not in use, or "fanned" out when on duty. This airer does not droop! Incidentally, there appears in the illustration a small marble shelf mounted on aluminium cantilever brackets.



### Water Purification

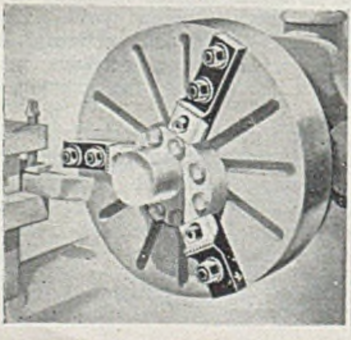
A DEVELOPMENT of considerable importance to the metal trades is the portable "Deminrolit" plant recently marketed by Permutit, which is designed to produce reasonable quantities of water of distilled quality "in situ." The equipment has great possibilities in connection with processes such as anodizing, electro-plating and for washing purposes, where solutions must be of a high order of purity to give the most consistent and effective results.

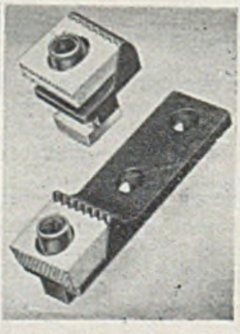
This portable model is the logical development of a process by which dissolved salts can be removed from a water supply at atmospheric temperature without the use of heat or power. It can supply up to 75 gallons between each regeneration, at a fraction of the cost of commercially distilled water. The water is demineralized by a chemical process known as ion exchange. It is extremely simple in operation, the equipment only requiring to be regenerated periodically as with the normal type of base-exchange water softener installation. Regeneration is effected by hydrochloric acid and sodium carbonate solutions prepared in a collapsible plastic tank. The process of regeneration is fool-proof since an electric tester is attached to the plant to indicate when regeneration is required and by turning a knob on the right-hand side of the indicator the full regeneration cycle is accomplished.

This plant, it is suggested, would be extremely useful to laboratories, or in fact for any industrial process calling for only reasonable quantities of water of distilled quality. Especially useful in this connection would be its use as a pilot plant to test new processes on a semi-production basis.

### Industrial Injury—Spot Welding

WRITING in the "British Medical Journal," June 14, 1947, p. 483, W. A. B. Reynard, M.B., Ch.B., Principal Medical Officer, Pressed Steel Co., Ltd., and F. Smith, M.B., Ch.B., F.R.C.S.Ed., Assistant, Accident Service, Radcliffe Infirmary, Oxford, record an unusual industrial hazard sustained by





PICTURED at the left are the "Maxigrip" universal clamps introduced by the Adam Machine Tool Co. Ltd., Acme Works, Waverley Road, St. Albans, Herts. These new clamps are compact, rigid and do not obstruct the machine table and in use are more versatile than the machine vice. In all, six different types are available.

those engaged on spot welding. Injury is caused to the fingers and hands of welding operatives, especially when using a stationary machine, by minute particles of steel carried by the spark which penetrate the flesh.

Reporting on twelve separate case-histories, it is shown that when injury takes place, a jet of sparks impinging on the hand causes a stabbing pain which is followed by swelling of the effected parts. After several days the swelling subsides but the patient may continue to suffer pain. Examination has shown that the discomfort is caused by microscopic fragments of metal embedded in the flesh. Removal of the particles differed from case to case. Poulticing was not completely effective and it proved necessary, in some cases, to open the wound or to use electro-magnetic methods in others.

All the cases reported were of spot-welders of steel and it is considered unlikely that similar trouble would be experienced in spot-welding aluminium, where sparking usually occurs to a lesser extent.

It might be pointed out that whilst injury results primarily from injected foreign bodies, the heating effect of the spark on the nerve endings is not to be overlooked. Hence, even where only pure sparking and burning occur (in the absence of "missile" particles), as in H.F. apparatus, disturbances and loss of digital sensitivity may be found in cases of chronic exposure.

### Adhesion of Rubber to Magnesium

A METHOD of bonding rubber to magnesium has been developed by the Firestone Tire and Rubber Co., Ohio, U.S.A., and is described in U.S. Patent No. 535,327. Briefly, the process involves treating the metal surface with fluosilicic acid, hydrofluoric acid and a glass, followed by baking. An adhesive cement is then applied and the rubber attached by pressure alone or by vulcanizing. No brass plating is required or involved.

### Retirement of F. W. Lewis, M.C.

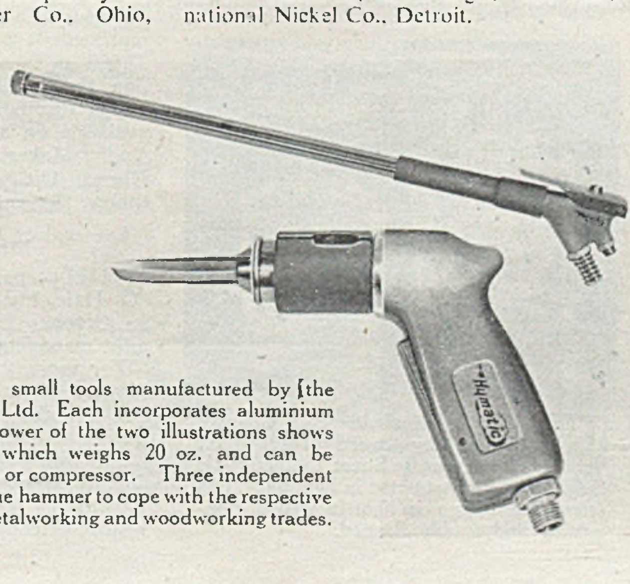
WE learn with regret that the founder of Perry Barr Metal Co., Ltd., F. W. Lewis, M.C., has retired from the office of managing director of the company. Notwithstanding a serious war disability of the 1914-18 war, he built the company as it is known to-day, beginning with the erection of his foundry by unskilled direct labour. In the early days he was metallurgist, salesman and production engineer all in one.

During the recent war the company's extraordinary effort in the production of cylinder heads for Bristol and Napier engines was led by F. W. Lewis, and his present breakdown in health, resulting in his retirement, is undoubtedly due to the trials of this war-time achievement. However, he remains a director of the company, and his advice and help is readily given to the board which is now representing the Birmal Industries, Ltd.

### American Foundrymen's Association

ANNOUNCING the research programme of the A.F.A., S. C. Massari, technical director of the international society of the castings industry, said that the light metals group will continue and expand the study of centrifugal casting of aluminium and magnesium.

Plans for the immediate future include the design of experimental castings and the compilation of data on such aspects as operational requirements, density, gram size, mechanical properties production yield and segregation. The research committee directing this work is under the chairmanship of R. F. Thomson, metallurgist with International Nickel Co., Detroit.




PICTURED here are two small tools manufactured by the Hymatic Engineering Co. Ltd. Each incorporates aluminium castings in its make-up. The lower of the two illustrations shows the "Hymatic" air hammer, which weighs 20 oz. and can be operated from any shop air line or compressor. Three independent kits of tools are supplied with the hammer to cope with the respective requirements of the building, metalworking and woodworking trades.

### James Booth Publication

UNDER the heading "Achievement." James Booth and Co., Ltd., have published a small booklet relating how the development of modern aircraft has taken place in conjunction with a parallel advance in light-metal technology. Starting with the "wood and string" days of Paulhan and Col. S. F. Cody, the pages record the advent of "Duralumin" and its introduction at the end of the 1914-18 war, and finish with the all-metal aeroplanes of to-day.

The booklet is attractively illustrated and indicates the contribution made by James Booth and Co., Ltd., to the achievements of aeronautical science.

### Lip-pouring Crucible Furnaces

WE have received an attractive brochure from the Morgan Crucible Co., Ltd., presenting their range of lip-pouring crucible furnaces. The furnaces are provided with power tilting, giving smooth, controlled pouring at speeds ranging from 20 lb. per min. to 2,000 lb. per min. (these figures refer to brass). They are made in the following sizes: 400 lb. (brass), 600 lb. (brass), $\frac{1}{2}$ ton (brass), $\frac{3}{4}$ ton (brass) and $\frac{1}{2}$ ton (aluminium). The first four sizes are suitable for melting aluminium and the last has been designed specifically for this metal. The furnaces can be either oil or gas fired, according to the burner fitted.


REGISTRATION plate, black-dyed anodized ground with number in undyed anodic finish, as fitted to the car of Her Royal Highness Princess Elizabeth, C.I. (*Rushton Organization.*)

### Gauge and Tool Makers' Exhibition

THE next Gauge and Tool Makers' Exhibition will be held in both the Old Hall and the New Hall of the Royal Horticultural Society in Vincent Square, London, S.W., from January 26, 1948, to February 6, 1948. The Gauge and Tool Makers' Association have invited the co-operation of the National Federation of Engineers' Tool Manufacturers on this occasion.

The total area for the joint Exhibition, as represented by the two halls, will be 32,000 sq. ft. and, as at the previous Exhibition, the stands will be of uniform size and design throughout. Further particulars are available on application to the Gauge and Tool Makers' Association, Standbrook House, Old Bond Street, London, W.1 (phone, Regent 3451-2).

THE "Cidu" household scale, capacity up to 7 lb., by Speed Tools Ltd., Veneker House, Gresse Street, London, W.1. Substantially constructed in light alloy, this streamline design is light in weight, non-rusting and readily cleaned.

### Mr. R. D. Carr Dies

WITH deepest regret, the directors of John Dale, Ltd., announce the sudden death, on October 19, of Mr. Robert Dale Carr, joint managing director of the company.

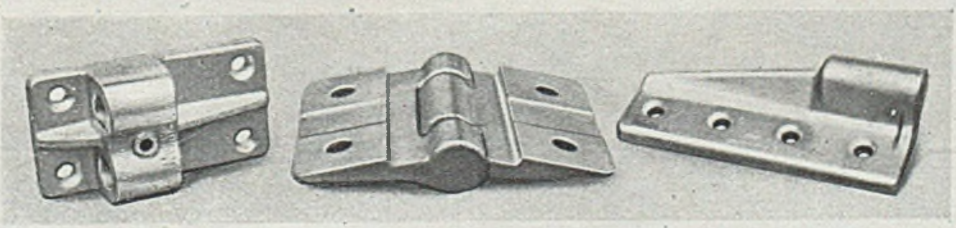
For more than 50 years Mr. R. D. Carr devoted his entire interests to the business, and the directors take this opportunity of paying tribute to his work.

He will be greatly missed by numerous friends in all walks of life and, with his passing is severed a link with industrial history extending back for many generations.


ON OCTOBER 8 the largest land-plane in the world, the Brabazon I, was named by Air Marshal Sir Alec Coryton and moved into the special assembly hall prepared for it at Filton, near Bristol. So outstanding an achievement—the construction of this giant—must necessarily tend to overshadow other important aspects of the complete project.

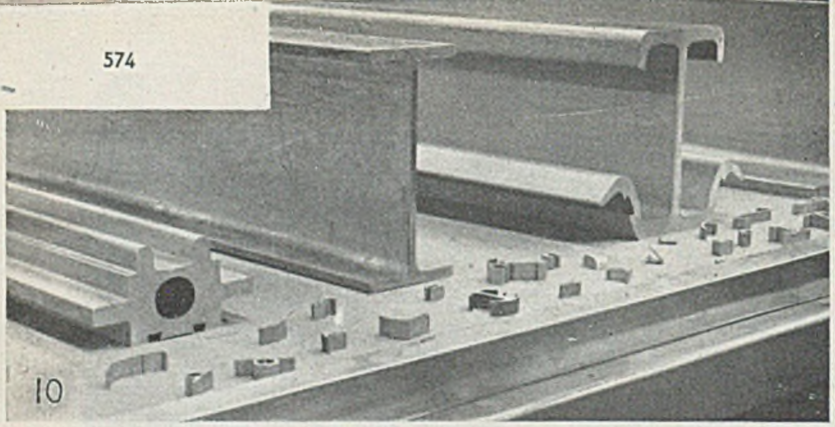
At the head of this page is illustrated the Brabazon I as it was to be seen at the ceremony, whilst in the background, like a giant screen, is the door, built by Esavian Ltd., of the great hangar which will house the aircraft. A general outline and some constructional details of this folding and sliding door were given in "Light Metals," October 1947 under the title "World's Largest Door."

This door was developed and produced in close technical collaboration with the Northern Aluminium Co., Ltd. and on this and two following pages are shown some of the castings and extruded sections which were specially produced for the job. Below are shown three hinge castings in Noral 350, a high-strength alloy which possesses great resistance to weathering. The alloy is of the binary type containing between 9.5 per cent and 11.0 per cent magnesium and is subjected to heat-treatment to develop the desired mechanical properties.



LIGHT METALS




10

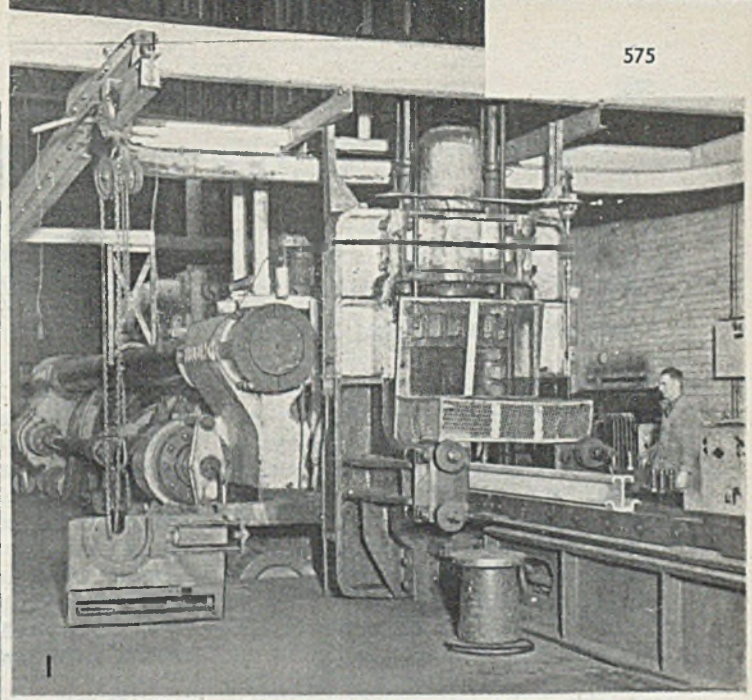
*(Continued from previous page)*

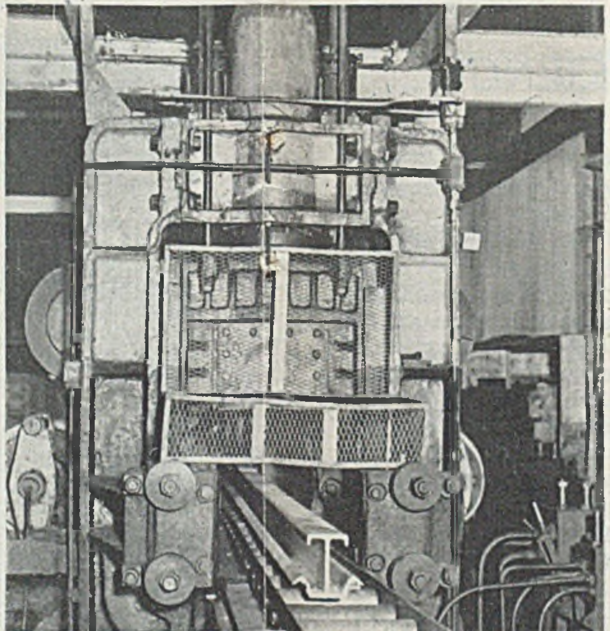
A number of other cast parts are included in the structural make-up of the door, but the main supporting members are extruded sections of special design. Shown at the right are views of the factories of the Northern Aluminium Company, where these sections were produced.

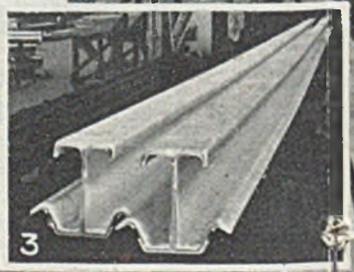
The largest sections were extruded from a 7,000-ton press, pictured here (1 and 2) producing anchor sections in Noral 51S (0.75 per cent. Mg., 1.0 per cent. Si), which are taken from the press and allowed to cool (3); they are then stacked (4, 5 and 6) awaiting shipment to the heat-treatment shop. In this instance a horizontal, electric heat-treatment furnace is employed, and shown here (7) are two sections on the carriage waiting to be charged into the furnace.

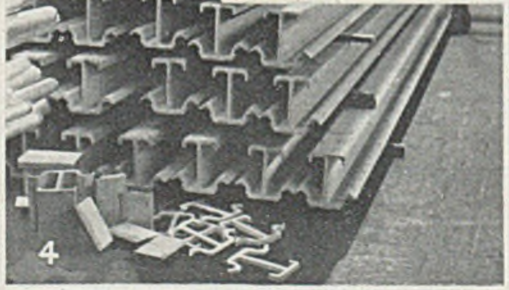
After heat-treatment the parts are rectified. This operation is carried out on the stretching and de-twisting machine illustrated (8). A final check assures dimensional accuracy (9).

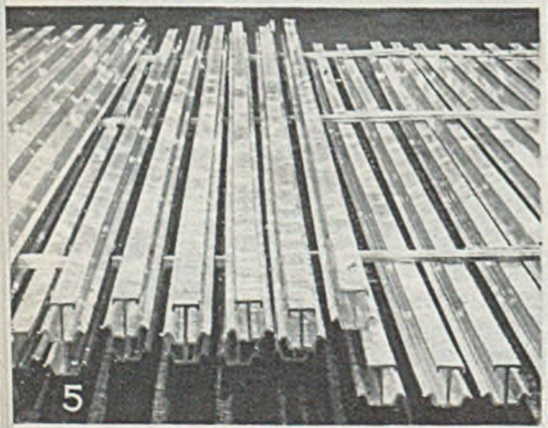
Several of the large and small extruded sections incorporated in the door are also shown (10).

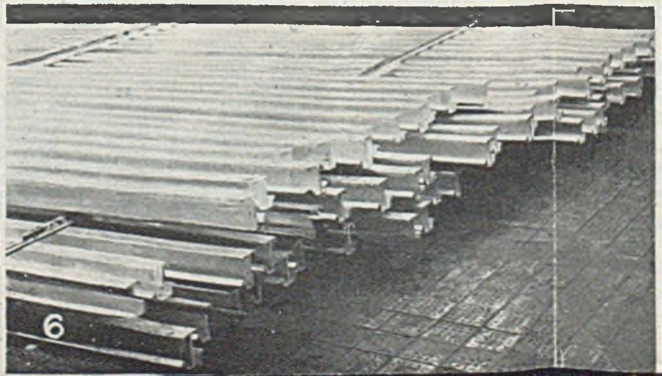

1


2


3


4


5


6


7


8


9

# In the Service of Science

## *Concluded from "Light Metals," 1947/10/539, the Final Section of this Account Considers Some Further Applications of Aluminium and Reviews the Possibilities of Magnesium*

PREVIOUS sections of this account have considered the valuable applications of aluminium and its alloys to scientific work by virtue of its various physical and chemical properties. Important amongst these, and not previously mentioned, is that of thermal conductivity. The good heat conductivity of the metal has been turned to advantage in the use of blocks of aluminium heated, either electrically or from below, by means of a gas burner, and containing holes into which small test tubes may be inserted. These miniature hot plates are quite commonly employed in micro-analytical work, and the use of aluminium gives them a greater efficiency than iron, and a better corrosion resistance than either iron or copper. A possibility is that of replacing sand in sand baths by granulated aluminium to allow a greater transference of heat.

Other apparatus can be made lighter in weight and more convenient to handle by the judicious use of light metals. Thus the Precision Scientific Co. of America has produced an aluminium desiccator finished by the anodizing process for greater resistance to corrosion and wear. The "Precision" desiccator has space for four crucibles and weighs approximately 12 oz., compared with more than 3 lb. for a similar unit in glass.

Owing to its high heat reflectivity and low emissivity, aluminium is of interest for thermal insulation. Polished aluminium calorimeters have a lower thermal capacity than similar instruments in polished copper, and heat losses may be reduced to an appreciable extent by using aluminium containers or aluminium-painted outer casings.

The Fisher Scientific Co. in America have utilized aluminium in two items of equipment, each of which is a boon to the chemist. One of them, known as the "Flexaframe," comprises a number of light-alloy rods and couplings, by means of which a sort of scaffolding may be readily built up and on which laboratory set-ups may be supported. Its use obviates the need for individual retort stands and supports, and precludes the possibility of breakage at joints due to the relative movements of components. The other gadget is a time-saving burette support. Fabricated from "Castaloy," which is described as a strong, corrosion-resistant light alloy, this burette support is so designed as to facilitate ease of operation and to eliminate the necessity for manipulating thumb screws, etc.

In the laboratory itself, on the structural and decorative side, aluminium finds use in skirtings and kick-plates, door furniture, bench tops, sliding doors, chairs, tables, cupboards, lighting fittings, and racks of all descriptions. Aluminium glazing is also beginning to find extensive application. Both English and American firms have placed on the market a semi-flexible aluminium tubing (with special connectors), which can be used to conduct gas, water, compressed air, etc., to non-portable apparatus.

Among more miscellaneous uses of aluminium in scientific apparatus and testing equipment may be mentioned a Geiger-Muller tube* which was described by Allen and Alvaret in the Review of Scientific Instruments.[23] This counter consisted of a tube made of aluminium foil 0.002 cm. thick which was filled with helium under atmospheric pressure. Also may be mentioned the Duret scouring machine which is used for testing the

* See illustration, "Light Metals," 1947/10/447.

fastness of colours to rubbing. Considerable use is made of aluminium in this appliance.[24]

A rather amusing, but nevertheless valuable, use of aluminium was in the manufacture of guinea pig collars for identification purposes. The U.S. Treasury Branch of Supply bought 20,000 for the Rocky Mountain Laboratory.

At the Royal Aircraft Establishment, Farnborough, is a seaplane testing tank over which a carriage of girder construction runs on wheels to tow the models under test and to carry observers and instruments. Duralumin was used for the construction of this carrier to avoid corrosion troubles and to reduce starting and stopping inertia. It is believed that light metals have been employed in similar structures in other research establishments.

Modern scientific research often involves long and tedious calculations. Here again light metals come into the picture. Calculating machines require less effort for working and can be lifted more easily when they incorporate aluminium. In a well-known French model, for example, all the small, precision-made moving parts are aluminium die castings, the base plate being also constructed of a suitably strong and rigid light alloy.

An announcement of fairly recent date observes that the uranium slugs required for atomic piles are held in aluminium containers to protect them from corrosion and to transmit the heat evolved to water.[25] For pest control, D.D.T. and pyrethrum have been used in solution in Freon contained under pressure in a container consisting of an aluminium tap and syphon assembly.

**Light Metals as Sources of Illumination**

Both the light and ultra-light metals play important parts in the production of the high-intensity illumination required for the high-speed cinematographic examination of the behaviour of objects in rapid motion, and for other purposes. Magnesium powder is, of course, a well-known constituent of flashlight equipment. Mixtures of magnesium powder and an inorganic oxidizing agent are easily ignited and burn explosively in a fraction of a second, producing a brilliant light of very short duration. Being rich in blue and ultra-violet radiation, the light possesses high actinic power towards photographic materials, and provides a controllable illumination without expensive apparatus.

Another method of producing a flashlight is to burn magnesium powder in a blowlamp. The powder is fed into the flame by blowing. Although this form of lighting is safer and much more efficient than flashlight, producing about twice as much useful light for the same consumption of metal powder, it is the less popular type because it produces more smoke and is limited in the amount of magnesium powder which can be burnt at one time.

**Filament-type Flashlights**

Both methods, however, show promise of being rendered obsolete by developments in the electric filament-type flashlamp. Like an ordinary electric lamp in appearance, these flashlamps contain a " filament " of aluminium wire or foil and are filled with oxygen. Switching on the current through the filament causes it to ignite and to burn explosively in the oxygen with the emission of high intensity illumination over a period of very short duration. The advantages of the flashlamp over flashlight powder lie in the convenience and safety of the former (no glass is scattered, as the burning of the filament creates a partial vacuum inside the lamp and the glass simply collapses inwards) and its amenability to control of the short-duration illumination.

In order that the filament may ignite without difficulty, its thickness must not be too great: foil must usually be maintained below 0.00004-in. in thickness and wire must not be more than a few 10,000ths-of-an-inch in diameter. This is a disadvantage, partly because it is not easy to produce or handle such fine materials, and partly because the rate of combustion is then too great, the duration of maximum light emission being about 15 milliseconds. This short exposure makes shutter synchronization difficult and photographers prefer a fairly uniform high intensity over a period of about 30 milliseconds for most work.

This is achieved by using an alloy instead of pure aluminium for the filament. Alloys containing 0.5-15 per cent. zirconium, barium, strontium or cerium, the balance being aluminium, are readily worked into foil of the required thinness, and are more easily ignited and give a flash of more uniform intensity than the pure metal. For wire filaments, up to 2 per cent. of a hardener may also be added.* Zirconium-aluminium alloys are already available commercially; the others can be made without much difficulty. The aluminium is melted and superheated to 800 degrees C. The alloying metal (barium or strontium) is then added as the pure metal, and plunged below the surface in a perforated iron cup.

Flares for observation and reconnaissance purposes make use of aluminium in the form of flakes, granules or powder and milder oxidizing agents. Light metals frequently enter into the construction of the flare as well as its filling. Thus an aircraft flare specified by the U.S.A. in 1939 contained a 14-ft. parachute carried in an aluminium tube. Shortly after release from the aircraft, the parachute opened out from the tube and the flare was ignited, its rate of fall being so lessened by the parachute that the pilot was allowed a considerable time for observation purposes. The candle of the flare contained powdered light metals as a combustible element. The energy content of the flare, the total weight of which was 19 lb., was equivalent to over 5,000,000 candle-power seconds, maintaining 300,000 candle-power for three minutes.

This flare, in its construction and operation, was similar to some which had already been in use in this country for military reconnaissance purposes, and in principle can hardly be improved upon.

Bally[26] speaks of a flare containing 3.3 lb. aluminium and 7.7 lb. barium nitrate which could burn from six to seven minutes with a luminosity of 350,000 candle-power, or, by shortening the time of burning, the candle-power could be raised to 500,000. In other instances, where high-power tungsten filament lamps have been employed in casings of restricted size for purposes of high-intensity illumination, aluminium has been used for the casing in order that the metal with its high coefficient of thermal conductivity might assist in the dissipation of heat.

In the realms of pure chemistry, aluminium foil amalgamated with mercury is a useful reducing agent in neutral solutions.

### Aluminium Bases for Detached Coatings

In the study of coating compositions it is frequently desired to examine a dried film of coating composition away from its support; such properties as tensile strength and elongation, which have an important bearing on the life of the coating, cannot be determined in any other way, due to the restraint imposed by the backing material.

It is possible to obtain a detached film from a rigid support without in any way damaging the delicate film by making use of the fact that aluminium is rapidly corroded by mercury. The coating is applied to a thin sheet of aluminium, and when it is dry it is floated on a bath of mercury, with the bare metal surface downwards. It may be necessary to sandpaper the metal while immersed in the mercury to remove the oxide film and initiate the reaction, or to coat the metal surface with mercuric chloride (which achieves the same object) before placing it on the mercury. The metal is then rapidly corroded by the mercury with the formation of considerable quantities of voluminous aluminium oxide, until only the paint film is left floating on the mer-

* According to Smith Hopkins, "Chapters in the Chemistry of the Less Familiar Elements" (Stipes Publishing Co., Illinois, 1940, cap. 12, p. 10), a zirconium-bearing "smokeless" flash powder containing 13.5% Mg, 58% $Ba(NO_3)_2$, 28.5% Zr, was placed on the market in 1930. This powder gave a quick-settling smoke.

cury surface. A caustic material such as caustic soda cannot be used to remove the metal in this case, because it would also attack the paint film. The mercury-attack method does possess the disadvantage of causing fairly strong local heating, which may alter the paint film if not controlled.

Finely powdered aluminium functions as a catalyst for increasing the velocity of reaction between percolating poison gas and anti-gas reactive materials, and it has been employed for this purpose in plastic anti-gas sealing materials, anti-gas sealing strips and other devices used both in warfare and in investigational work on poison gases.

### The Position of Magnesium

And what of magnesium and its alloys? So far, in this account, they seem to have entered very little into the picture. In the realms of organic chemistry, magnesium possesses a very special application which is due to its considerable chemical reactivity under certain conditions. This is in the preparation of Grignard reagents. Structural applications in the realms of science, however, are few. Binocular parts, optical instrument eyepieces and microphone cases have been made in the metal in order to achieve maximum reduction in weight. The ultra-light alloys are, however, worthy of more important roles in the field of science. Their density is less even than that of the aluminium-base alloys, whilst their mechanical properties are not greatly inferior; some of the magnesium-base alloys are superior in this respect to certain of the cheaper aluminium-base alloys which have been employed in components of instruments and equipment where the duties are not too onerous in character. Like the aluminium-base alloys they are available in a fairly wide range of forms including extruded sections; they may be sand- or die-cast, formed, and machined without undue difficulty, whilst assembly by means of welding and riveting is as attractive an operation as it is with aluminium-base alloys.

It is perhaps on the score of reduced corrosion resistance and the absence of any surface treatment corresponding to anodizing that the ultra-light alloys fall short of aluminium.* Nevertheless, in comparison with iron and steel and, in certain chemical environments, with brass and nickel silver, too, their resistance to corrosive attack is certainly no worse than these metals, and the application of protective organic coatings confers at least as much protection as on heavy metals.

A great many of the uses which have been found for aluminium and its alloys, as detailed above, would be served equally well or better by magnesium-base alloys. The fact that these materials are capable of performing the most onerous duties is evidenced by the use of cast and wrought magnesium alloy control levers and main undercarriage parts in aircraft during the war, or to give an example closer to the requirements of the laboratory, by the use of cast magnesium alloy eccentric cams in vacuum pumps and of cast ultra-light alloy heads for high-speed laboratory centrifuges. There is

* Since these words were written the American Magnesium Corporation have described a process which they have recently developed for producing a hard corrosion-resisting anodic coating on magnesium and magnesium-base alloys which corresponds in characteristics to the film produced on aluminium by the anodizing process. Treatment is carried out in three stages, namely, cleaning, electrolytic treatment in caustic soda solution, and subsequent sealing in a solution of sodium chromate.

In cleaning, the metal is first degreased in a nearly boiling solution of 5-10% caustic soda or in a solution containing sodium carbonate and trisodium phosphate. The oxide film formed by this process is removed by treatment in a chromic acid solution. If the metal is to be dyed the chromic acid treatment is omitted and the alloy is etched in a 20% solution of ammonium chloride.

The electrolytic treatment in itself is not new. The magnesium is made the anode in a bath of 5% caustic soda maintained at between 140° and 160°F. for about 30 mins. at a current density of 12-18 amps per sq. ft. No addition agents are recommended as it is doubtful whether these are of any real benefit. The film produced consists essentially of magnesium oxide which is probably hydrated to some extent. The same operating conditions are suitable for most of the commercial alloys of magnesium, whether wrought or cast, but a slight modification with each alloy is recommended to obtain optimum results.

After removal from the electrolyte the magnesium is washed in water and then immersed for 30 mins. in a solution of sodium chromate. A dichromate solution must not be used. After the sealing treatment the coat is slightly yellow in colour, hard and smooth. Most of the films produced in this way vary in thickness between 0.0005 in. and 0.0006 in. They will take organic dyestuffs in much the same way as the aluminium film produced by the anodic oxidation process, and they also provide a good base for paints. The Dow Chemical Co. has also developed an anodic treatment for magnesium.

no doubt that at the moment magnesium alloys are the Cinderella of the light metal family. Their value to the scientist is potential rather than real, and we look to the future for a proper assessment of their merits, and their demerits, too, and to their utilization in functions for which they are particularly fitted to perform. Then, as the light alloys are doing now, magnesium and its alloys will be making their proper contribution to science.

## *REFERENCES*

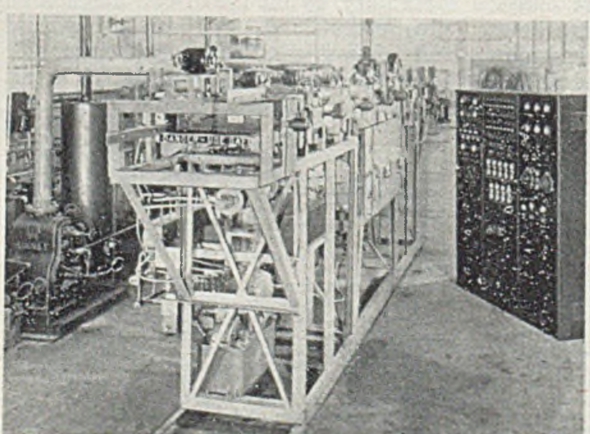

**(17)** *Brit. Pat.* 433,484, *Aluminum Co. of America.* **(18)** *Brit. Pat.* 436,154, *Aluminum Co. of America.* **(19)** *Brit. Pat.* 436,481, *Aluminum Co. of America.* **(20)** *Brit. Pat.* 489,169, *Aluminum Co. of America.* **(21)** *Brit. Pat.* 449,162, *British Aluminium Co., Ltd.* **(22)** *Brit. Pat.* 513,530, *British Aluminium Co., Ltd.* **(23)** *J. S. Allen and L. W. Alvaret, "Review of Scientific Instruments," October,* 1935. **(24)** *Dyer,* 1935/73/499. **(25)** *Institute of Metals, May Lecture,* 1947. **(26)** *"Rev. de l'Aluminium,"* 1929/6/781.


# In the Service of Science—Addendum

Further to the discussion on front-surfaced mirrors on page 413 of our August issue, National Research Corporation, Cambridge 42, Massachusetts, announces the completion of a unique high-vacuum machine for the automatic production of such mirrors for use in the television industry. Also the formation of British American Research Limited, has been announced which company has been incorporated in Scotland as a joint venture with Daniel Varney Limited, who were during the war engaged in the manufacture of scientific research instruments and laboratory apparatus. British American Research Limited, will undertake the manufacture and sale of the industrial high-vacuum equipment which has been developed by the National Research Corporation.

During the war, tremendous impetus was given to the development and use of high-vacuum technology in many fields. One of the most important developments was that of coating lenses and prisms for use in binoculars, range-finders and bomb sights. By thermal evaporation of metallic salts on to these optical elements under high vacuum greatly improved transmission of light resulted. Similar techniques have been developed for producing front-surface mirrors and decorative novelties by evaporating aluminium, gold, silver and other metals on to glass, plastics, paper or cloth. The efficiency of these operations had been impaired because they have heretofore run on a batch basis with a consequent loss of time while the operator placed each group of objects in the vacuum chamber, pumped it down and performed the coating operation.

This is the first automatic type of machine in which materials can be continually processed at high-vacuum pressures ranging below $10^{3}$ mm. or 1/100 millionth of an atmosphere. With this novel coating machine shown in the accompanying illustration, a 2-ft. square aluminized front-surface mirror can be produced in one minute, compared with 15 mins. to an hour previously required. The unit is approximately 40 ft. long and weighs 10 tons.



The glass to be coated is held in a tray which is placed in a conveyor. It then proceeds automatically through a series of cells or locks until it emerges at the opposite end of the conveyor as a finished mirror. The first cell is evacuated to about .3 mm. Hg absolute. By means of very high-speed diffusion pumps the pressure in the second cell is reduced to approximately .0001 mm. (about one ten-millionth of atmospheric pressure). The processing takes place in the next chamber, after which the completed mirror proceeds out to the atmosphere through a lock system reversing the entrance sequence. The air lock doors are operated hydraulically, and the sequence of operations is controlled through electrical interlocks and relays. Motion is imparted to the trays from an intermittently-operating chain in each cell that engages the trays.

There are a number of technical features that make this automatic type of machine particularly interesting. The processing chamber is under vacuum continuously, and the high-vacuum pump-down cells do not go to a high pressure that will produce subsequent evolution of gas from the metal walls. The total quantity of air that must be pumped per piece is greatly reduced by making the cells just large enough to hold the desired objects. There is the further advantage that the flow of materials through the system becomes nearly continuous by using a fast cycle.

Successful application of this type of automatic machine requires that production demands must be relatively high in terms of total units, a high use factor must be assured, and the objects for any one machine must be nearly identical. It is furthermore desirable that the processing under high vacuum can be made to take place within the time of a few cycles so that the middle-chamber cycle does not become excessively long. Once the requirements are satisfied very large savings may be made in unit cost and high-vacuum processing may be said to be truly out of the laboratory. While the progress of only one unit through the machine is described, in actual operation the pieces follow each other so that a maximum number of the cells are loaded all the time consistent with smooth operation.

National Research Corporation has made other notable contributions to the development of high-vacuum technique, particularly in the dehydration of penicillin, blood plasma and other pharmaceuticals. A similar high-vacuum diffusion process is now in use by Vacuum Foods Corporation for the production of orange juice concentrate and powder. The Corporation is also continuing its metallurgical activities developing the vacuum processes for the production of gas-free metals.

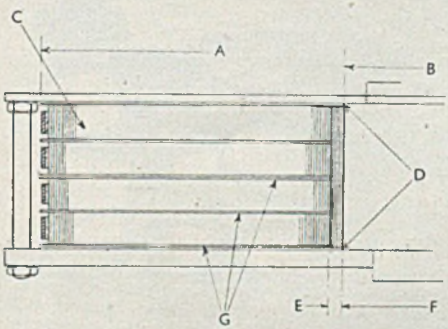
# Letters to the Editor

*Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired.*

## Anodic Films for Electrical Insulation

"We are interested in the application of insulated aluminium strip for use in lifting-magnet coils. This practice of replacing copper strip with aluminium was developed to quite a large extent in Germany during the War owing to the short supply of copper. It also has the advantage, however, of reducing the overall weight of a magnet which is a big asset when crane loading is a vital factor.

"Appended is a drawing showing a section of a typical magnet. The aluminium, which takes the place of the copper varies in the width from ¾-in. to 1¼-ins., thickness .010-in. to .030-in. and in length from 600 ft. to 1,000 ft. Four coils are usually required to complete a coil winding.




SECTIONAL diagram of conventional lifting-magnet coil: A, mica washers 32½ in. diam.; B, internal diam. of top and bottom mica washers; C, coil made up of four layers, each wound with copper strip 0.9375 in. wide, interleaved with asbestos tape 0.007 in. thick; D, mica washers (2), 0.30 in. thick; E, mica ⅜ in. thick; F, core, 5 in. diam.; G, mica washers (6), outside diam. 32½ in., internal diam. 15[illegible] in., thickness, 0.030 in.

"In place of the asbestos insulating tape inserted between each turn of copper, the aluminium strip is insulated by either a chemical process such as anodizing or by painting to form an electrical insulation between turns. The depth of insulation varies with the size of magnet, but a general breakdown voltage figure would be 5 to 15 volts between each turn, although for a commercial proposition the thickness would have to be kept constant. The insulation would have to withstand a temperature of 150 degrees C.

"We trust the above gives an outline of the use of insulated aluminium strip and look forward to hearing from you regarding its possible manufacture in this country."—(By request, the inquirer's name has been withheld.)

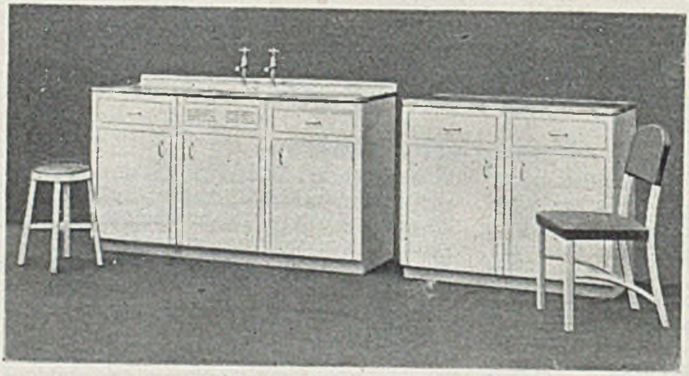
Although the anodic film possesses excellent insulating qualities, it is as a rule necessary, when using aluminium strip or the wire for coil winding, to provide an oxide layer with special mechanical properties in order that it may withstand the winding process, particularly if this be carried out on automatic machines. Several processes exist for producing such special films, although, so far, little use has been made of them here in the electrical industries. Because of the long length of material required, such anodizing processes are of a continuous nature.

Some general idea of the value and limitations of the anodic film for purposes of this type may be found in "Light Metals," 1945/8/384. It is suggested that inquiries be directed to the British Aluminium Co., Ltd., Salisbury House, London Wall, London, E.C.2 (Phone, Clerkenwell 3434); United Anodizing, Ltd., 40, Brook Street, London, W.1. (Phone, Mayfair 4541); and The Rushton Organization, 38-41, Woburn Place, London, W.C.1.

## Light Alloy Dinghies

"Could you please give me any information of the producers of the light-alloy dinghy as illustrated in your article 'Aluminium from War to Peace,' 'Light Metals,' July 1945, page 339."—C. J. Farman.

Inquiries regarding smaller types of light-metal boat may with advantage be directed to Warwick Aviation Co., Ltd., Saltisford, Warwick; Reynolds Light Alloys, Ltd., 10, Buckingham Place, London, S.W.1 (Phone, Victoria 0902); and G. Johnson Bros., 103-149, Cornwall Road, London, N.15 (Phone, Stamford Hill 6601).



ILLUSTRATED on this page are various examples of all-light-metal domestic and kitchen furniture by Marston Excelsior, Ltd. They include sink unit, cupboard and chairs (left), dining - room table and chairs (immediately below), sideboard (bottom left), and kitchen dressers (bottom right).


DOMAL
MAGNESIUM
IT COSTS NO MORE TO USE THE BEST
-use Domal High Purity Magnesium
PRODUCERS OF HIGH PURITY MAGNESIUM ·
MAGNESIUM ALLOYS · CALCIUM · BARIUM
DOMINION MAGNESIUM LIMITED · 67 YONGE STREET · TORONTO · CANADA
2107

## Light-alloy Furniture

"We read in the October issue of "Light Metals" that you have an inquiry concerning wrought aluminium furniture, and have pleasure in attaching hereto brochure illustrating the range of light-alloy metal chairs which we are manufacturing, together with a brochure illustrating kitchen equipment, which we are also manufacturing.

"Having regard to the pleasing design of furniture manufactured from aluminium alloy, we feel sure that our products will prove of interest."—S. A. HACKLEY, Marston Excelsior, Ltd.

We feel sure that the statements made in this letter will be amply borne out by an accompanying series of illustrations showing various types of chair manufactured by Marston Excelsior, Ltd., together with items of kitchen furniture executed in light alloy to most remarkably pleasing designs.

---

## Hardness Test for Aluminium Sheet

"As manufacturers of aluminium articles and ware, we are interested in a simple method of testing aluminium sheet. We have heard that there is a simple 3-pronged device which gives a comparative hardness reading by the number of indentations made (either 1, 2 or 3), and we would ask you if you can possibly tell us the name of this device and where it can be obtained."—A. G. THOBURN, for Albion Metal Products, Ltd.

The device referred to is, we believe, the "Webster Pliers," of American origin, and not marketed in Great Britain.

There is, however, another American machine sold in this country by Barber, Coleman and Co., Brookland, Lancs. The apparatus is called the "Barcol" Impressor, and uses a spring-loaded point, measuring hardness by the depth of the impression as indicated on the dial gauge. It is satisfactory for hardness up to approximately 160 V.P.N. Hardness is not measured by any standard scale, and therefore, unless conversion curves are prepared, the instrument can be used only for comparative purposes. Whilst such an instrument measuring up to 160 hardness V.P.N. would be suitable for all aluminium alloys, it should be noted that it cannot be used for testing "alclad," due to the composite nature of this material.

---

## Anodizing Pressure Die-castings

"I have been reading a very interesting article entitled "Sand, Gravity or Pressure?" in the October issue of "Light Metals," and note that the author says "Pressure casting cannot be anodized satisfactorily." He does not give an explanation for this particular characteristic, and I should be very glad if he could find time to amplify the point."—M. D. DAY, Chief Engineer, Airways Training, Ltd.

Controversy is apt to arise when engaging in discussions on the possibility of anodizing aluminium-alloy pressure die castings. It is certainly not correct to say that these cannot be anodized at all; it is possible so to treat them, and a fair amount of quite successful work has been done in this direction. The high-silicon alloy, however, commonly used for pressure die castings tends to give a film of rather unprepossessing appearance, even though highly artistic effects may be obtained. These, may, at the same time, be of a somewhat unexpected and uncontrollable nature and, in any case, treatment may prove abortive due to the exposure of sub-surface porosity as a result of the removal of metal from the surface of the casting.

The position is probably best summed up in this way: there is no inherent reason why pressure die castings cannot be anodized, but, due to their rather unpredictable nature, the treatment cannot be recommended for large-scale production finishing.

## Meker Burner in Aluminium and Steatite

"I have read with some considerable interest the article 'In the Service of Science,' appearing on page 443 of your September 1947 issue in which is demonstrated the value and some uses of aluminium and light alloys in the construction of laboratory


equipment. I wish to advise you of another application which we were forced to adopt due to restrictions, and which proved to be entirely efficient and even more preferable.

"About 1940 this Institute, obliged to equip the chemical laboratories where about 40 analysts were employed, was faced with the problem of procuring a quantity of Meker burners. The normal type of this burner is made with a brass body and a nickel-sheet top. The material costs being too high and also very difficult to buy, we decided to study a particular type of Meker burner made in aluminium with the nickel burner element substituted by another less expensive and somewhat more readily available material.

"After some experiments, which were exceedingly successful, burner elements manufactured in compressed steatite were used. The different parts of the Meker burner are die-cast in anticorodal alloy. After mechanical treatment some of the parts were anodized, some left as they were, and some chromium-plated. Best results were obtained by anodizing, but also parts which did not receive a superficial treatment gave better results than the old brass types which were subject to a rapid corrosion and blacking.

"For more than six years these Meker burners have been in use in our Institute under very drastic conditions, but nevertheless they are still working excellently."—PROF. DR. ING. CARLO PANSERI, Director, Instituto Sperimentale dei Metalli Leggeri, Milan.

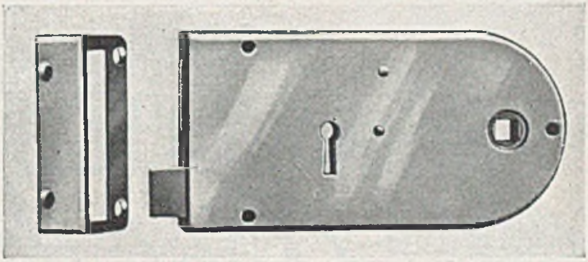
We take this opportunity of thanking Dr. Panseri for drawing our attention to a novel development in the use of aluminium and steatite for laboratory apparatus.

---

## Metal Envelopes for Sheet Transport

"In 'Light Metals,' July 1947, page 345, you make reference to a new method of packing sheet metal products in containers other than wooden cases. Could you advise us the manufacturers of such metal cases."—H. ROBINSON, Thomas Bolton and Sons, Ltd.

We have reason to believe that numerous experiments have been carried out regarding the transport of sheet metal in metallic "envelopes," in place of the usual wooden cases, and it is suggested that inquiries be directed to the Northern Aluminium Co., Ltd., Banbury, Oxfordshire, for further details. Sheet steel as well as aluminium has been so packed for transport.



RIM type aluminium lock supplied with either bright finish or japanned black. Dimensions $5\frac{3}{8}$ ins. × $2\frac{3}{4}$ ins. × $\frac{5}{8}$ ins. (Courtesy Golmet Ltd.)

# LOCKS Old and New

LOCKS, like the milk on the doorstep in the morning, are commonly taken for granted. At frequent intervals burglars attempt to pick them; the wise householder, after he has put the cat out at night, turns the key in them. Their long and ancient history, however, is rarely considered.

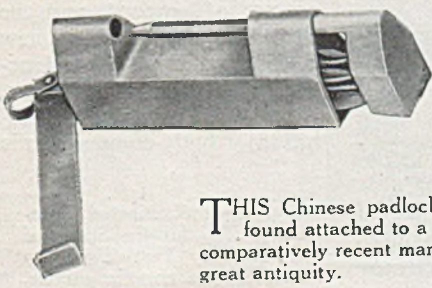
The earliest locks were made of wood which, during the later Middle Ages, gave way to cumbersome ornamental creations in iron. The middle of the 19th century saw the development of the lock as we know it to-day—an intricate example of precision machinery ranging in size from the minute mechanism (made in gold, silver or platinum) attached to lockets and other trinkets to the giant masses responsible for safeguarding the contents of strong-rooms. Brass became accepted as the standard material for smaller locks and showed itself admirably suited both with respect to wear in service and to the neglect which is the common lot, especially, of household locks.

As an alternative material of construction, aluminium has only recently made its appearance in this field. Tests to date indicate that mechanically it may satisfactorily replace brass or light steel fabrications, whilst over both of these materials it possesses the advantage of ready availability.

In "Light Metals," 1947/10/76, was illustrated a $2\frac{3}{4}$-in. mortice lock constructed substantially in light metal with the interior parts anodically treated. Some of these locks have now been in use for about 12 months, and reports have shown them to be entirely satisfactory.

To test serviceability under strenuous conditions one lock was set in a steel door and subjected to prolonged slamming and heavy usage. The only detectable result was a slight marking of the face of the latch bolt due to the contacting of the hard surface of the steel door frame.

The locks referred to are manufactured by Golmet, Ltd., Central Road, Caerphilly, Glam, who have demonstrated their confidence in aluminium construction by introducing the rim type illustrated here. One advantage of light metal over steel sheet in this connection is that the aluminium lock is weather and rust proof and, therefore, ideal for outside use even in hot and humid climates. The weight factor is of importance in that bulk transport charges (especially where the locks are exported) are reduced.



THIS Chinese padlock (shown here opened, with key in position) was found attached to a large camphor-wood chest. It is of brass and of comparatively recent manufacture, but the design of the mechanism is of great antiquity.

# PREFABRICATED *Light Metal* COACHWORK *in France*

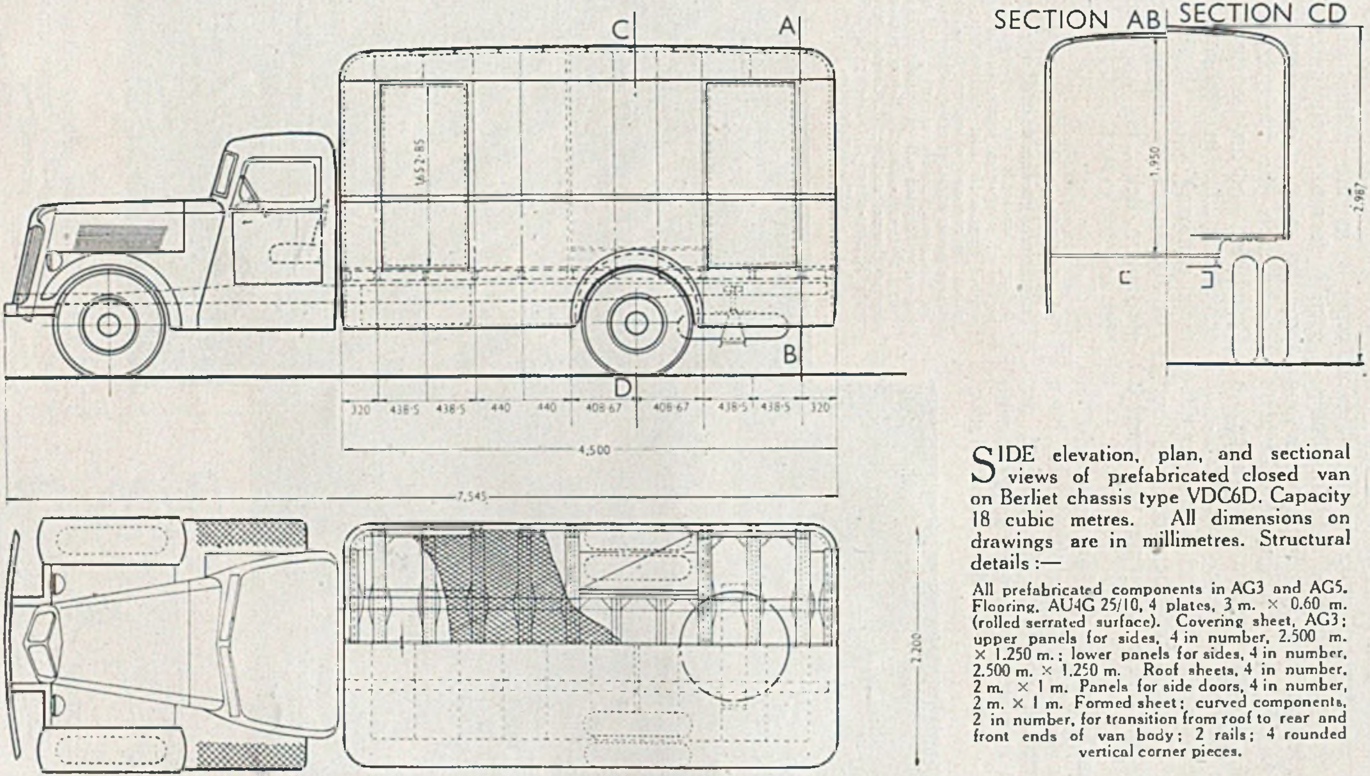
*Sponsored by the Société des Prototypes de Carrosseries Légères, Full-scale Production of Light-metal Coach Bodies is in Progress in France. This Article by Graham Davies Describes the Scope of the Undertaking and the Methods of Production*

THE construction of light-alloy commercial vehicle bodies has been developed to a considerably greater extent in France than in this country. There are several reasons for this; in the first place, France is an important aluminium-producing country and the metal is actually easier to obtain, at the moment, than steel. It must be remembered, moreover, that the technique of light-alloy coachbuilding had become well established across the Channel before the war, and many vehicles had successfully undergone the test of regular road use, some for a period of 10 years.

At the present time the entire industrial vehicle fleet of France is in process of renewal, and the necessity for using new methods of body construction has become obvious. Above all, a certain standardization of body components is

Fig. 1.—Prefabricated light-alloy body for the Shanghai Tramway Co. Twenty vehicles are now in service.

PLATE 1.



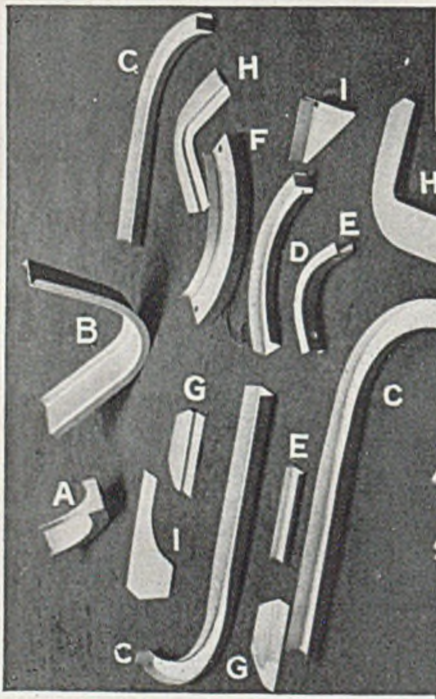

SIDE elevation, plan, and sectional views of prefabricated closed van on Berliet chassis type VDC6D. Capacity 18 cubic metres. All dimensions on drawings are in millimetres. Structural details :—

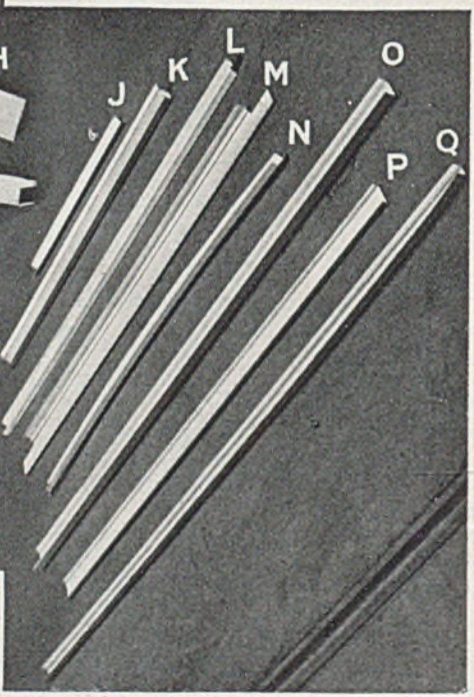
All prefabricated components in AG3 and AG5. Flooring, AU4G 25/10, 4 plates, 3 m. × 0.60 m. (rolled serrated surface). Covering sheet, AG3; upper panels for sides, 4 in number, 2.500 m. × 1.250 m.; lower panels for sides, 4 in number, 2.500 m. × 1.250 m. Roof sheets, 4 in number, 2 m. × 1 m. Panels for side doors, 4 in number, 2 m. × 1 m. Formed sheet; curved components, 2 in number, for transition from roof to rear and front ends of van body; 2 rails; 4 rounded vertical corner pieces.

required, so that operations in the final stage of erection at a body-builder's works may be reduced to a minimum. This idea was already thought out as long ago as 1942 by certain coachbuilders under German occupation. Even in those dark days there were plenty of Frenchmen who still had faith in the ultimate liberation of their country, and much quiet research work was carried out.

The fruits of this are now visible. Some 60 French coachbuilders have co-operated to form the Société des Prototypes de Carrosseries Légères, with head offices at 189, Boulevard Bineau, Neuilly-sur-Seine. Although this concern is in the nature of a research society, formed to study and bring to a practical stage a new method of body construction, the managing director, M. Colombier, and his associates, who conceived the idea in war-time, have put their company on a business footing. The Société des Prototypes is now in full production, delivering bodies to its members and for export.

Fig. 2 (below).—Various standard curves, lengths and gussets as used in prefabrication. A, Curved bracket for near cross-member; B, Curved section of windscreen frame; C, Curved pieces of various lengths for roof construction; D, Curved pieces for rear-end assembly; E, Channel section closing gusset at end of cross-member (see Figs. 4 and 5); F, Curved piece for roof edge; G, H, and I, Pieces cut out and formed with or without pressing or bending; J, Body side-pillar; K, Bearer reinforcement; L, Bearer channel section; M, Curved component for roof; N, Step-edge; O, Stringer; P, Component for step; Q, Component for door.



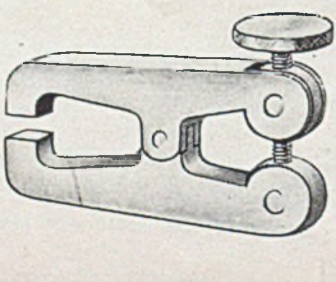
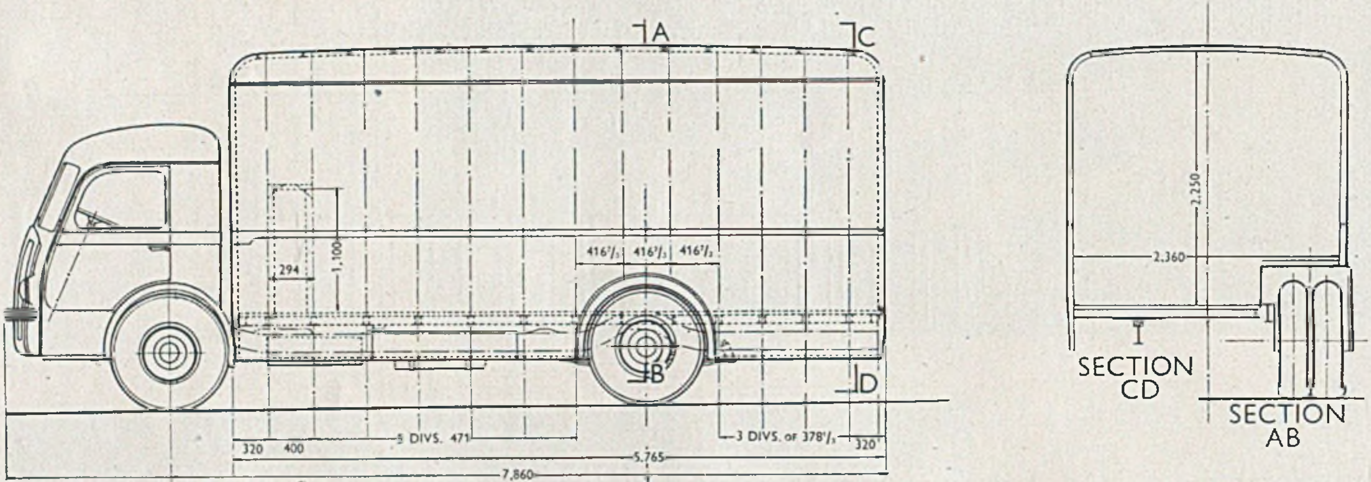
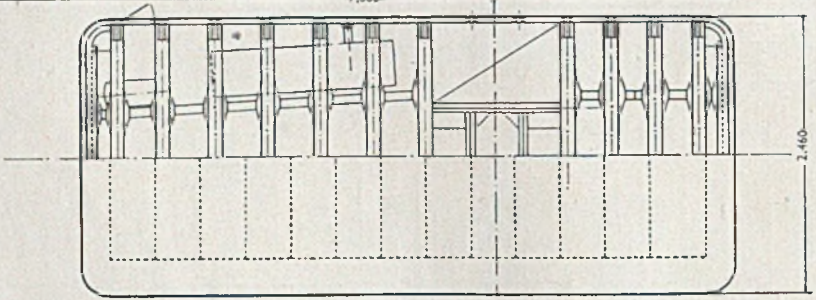



Fig. 3 (Left).—Clamp for securing various parts during welding, made up in the factory with pieces cut from extruded section.

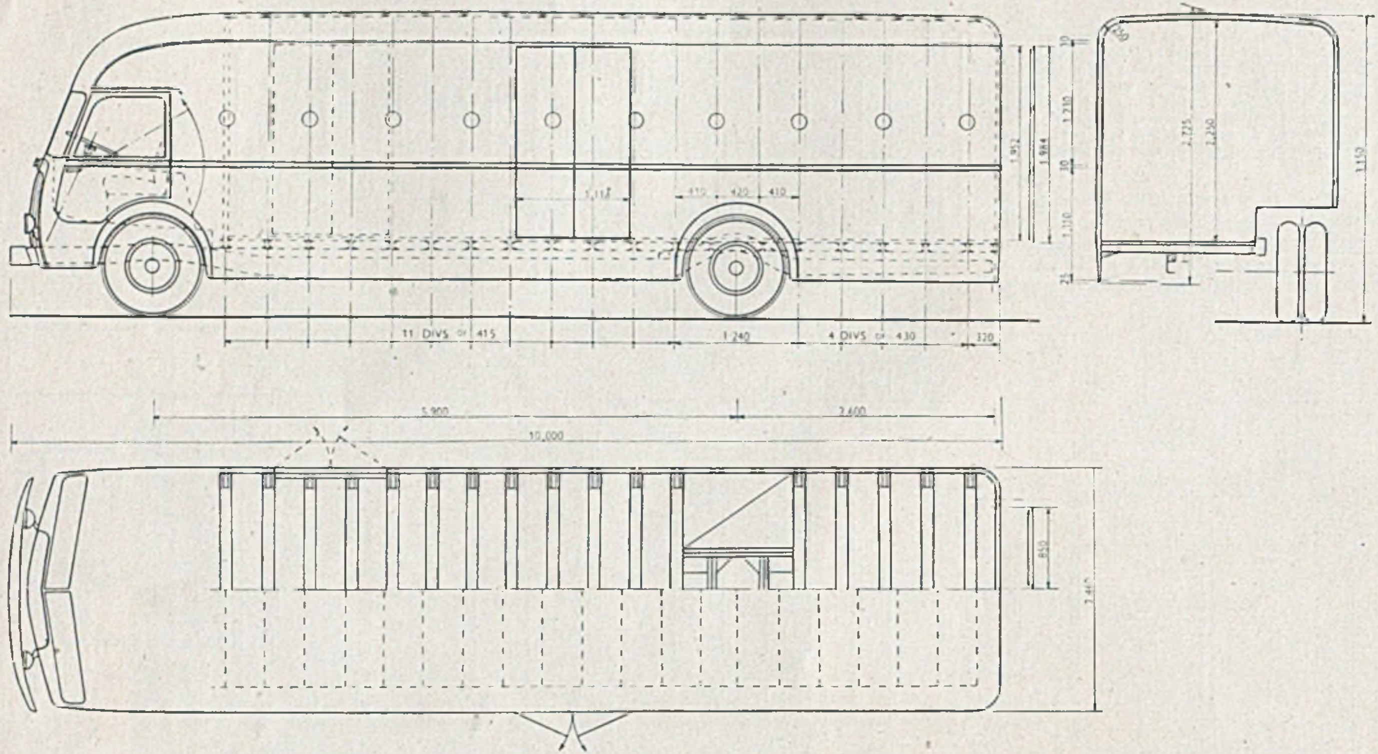
PLATE 2.



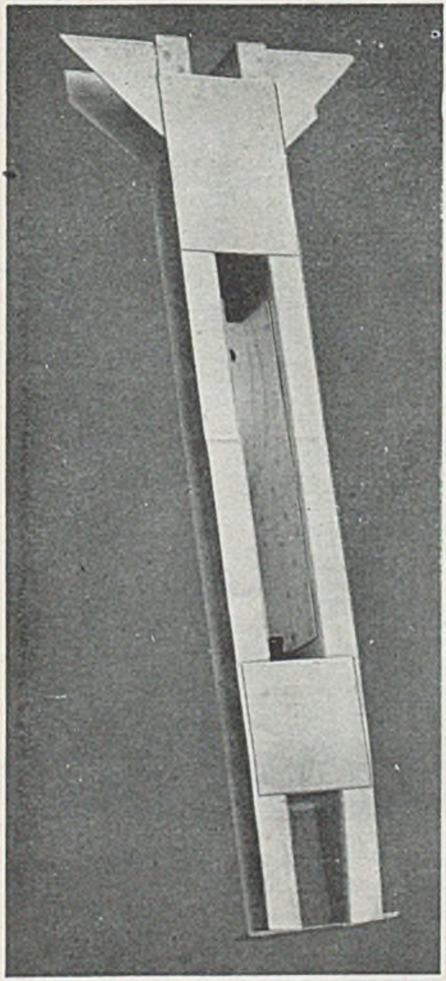

SIDE elevation, part plan and sectional views of prefabricated closed van on Panhard chassis type 5T5-IE. 2IE. Capacity 30 cubic metres. All dimensions on drawings in millimetres. Structural details :—

All prefabricated components in AG3 and AG5. Sheeting in AG3 ; bodywork panels, 9 in number, 3 m. × 1.300 m. ; rear-door panels, 2 in number, 2.500 m. × 1.100 m. ; roof sheets, 5 in number, 2.500 m. × 1.100 m. Formed sheet (AG3) : curved components for transition from roof to front and rear ends of body, 2 in number ; 2 rails ; rounded vertical corner pieces, 4 in number.




SIDE elevation, plan and sectional view of the large prefabricated closed van on Scania-Vabis chassis type B.22. Capacity 42 cubic metres. All dimensions on drawings in millimetres. Structural details :

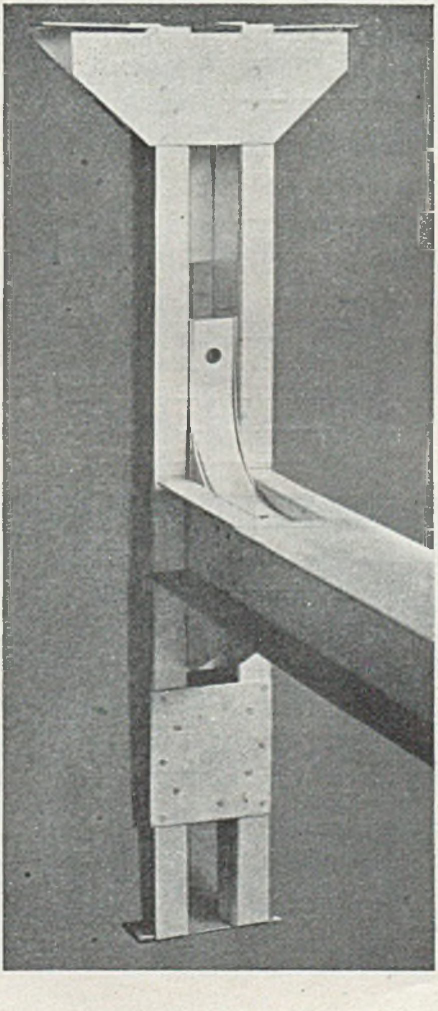
All prefabricated components in AG3 and AG5. Upper and lower side panels, 10/10, 9 in number, 3 m. × 1.30 m. ; panels for driver's cabin, 10/10, 2 in number, 3 m. × 1.30 m. ; roof sheets, 10/10, 9 in number, 2.500 m. × 1.100 m. or 8 in number, 2.500 m. × 1.250 m.; panels for side and rear doors, 10/10, 4 in number, 2.500 m. × 1.250 m. Formed sheet; curved component for transition from roof to end of body, 1 only; rounded vertical corner pieces, 2 in number; 2 rails.



the reception of raw materials are expedited by the fact that a shunt line from the goods yard at Amboise station runs right into the factory.

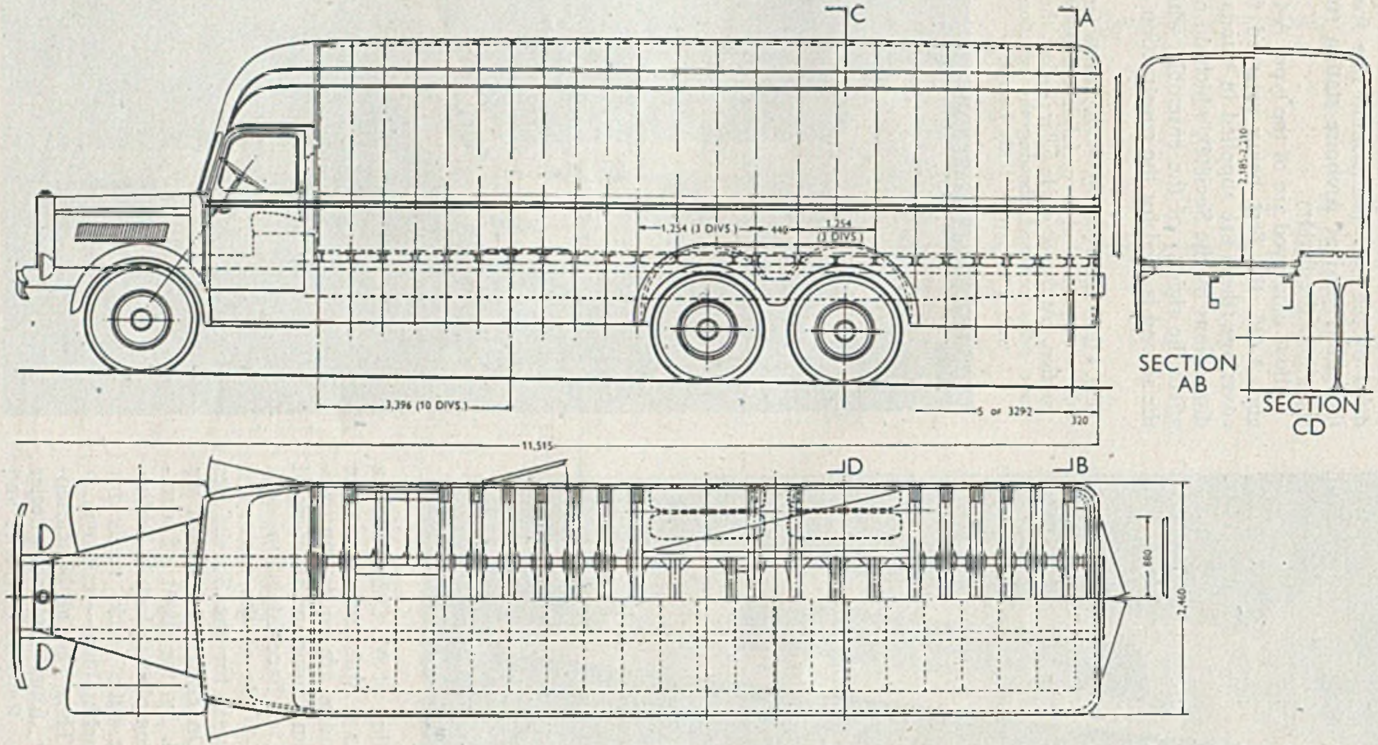
Alloys employed are of the types A-G3 and A-G5, the first being reserved for coverings (these are supplied in standard dimensions by the Société), which do not affect the rigidity of the ensemble, while the second is used for the construction of

Fig. 4 (left) and 5 (below).—Components for the construction of a prefabricated body section. At the left a side pillar; below, the side pillar reversed showing the junction with a transverse body bearer.



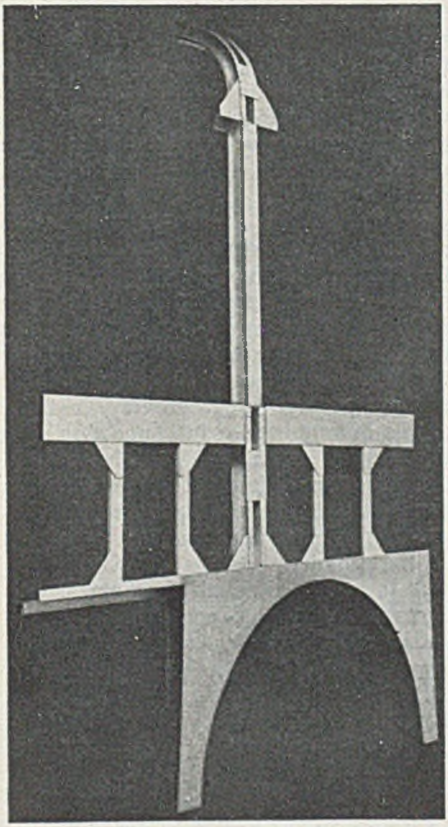
At the invitation of M. Colombier we visited the works at Amboise, where these prefabricated bodies are under construction. This is an important sheet-metal concern, the Cie. Facel-Metallon, and more than two-thirds of the factory is employed on work for the Société des Prototypes. On entering the yard we were impressed by the sight of components for 10 complete industrial bodies, each in a neat little stack, ready for delivery to coachbuilders—just over a week's output. They were all big closed-van bodies for four- and six-wheeler Willeme chassis. Railway deliveries and

PLATE 4.




SIDE elevation, plan, and sectional views of prefabricated closed van on Willeme chassis type R15 (long). Capacity 43 cubic metres. All dimensions on drawings in millimetres. Structural details :—

All prefabricated components in AG3 and AG5. Sheet work : centre portion of roof, sheets 8 in number, 10/10, 2.50 m. × 1.10 m.; upper side band sheets, 4 in number, 10/10, 2 m. × 1 m.; upper panels, 6 in number, 10/10, 3 m. × 1.30 m.; lower panels, 6 in number, 10/10, 3 m. × 1.30 m.; rear door sheets, 2 in number, 10/10 2 m. × 1 m. Formed sheet: top rails, 2 in number; curved component for transition from roof to end of van, 1 only; rear vertical rounded corner pieces, 2 in number; prefabricated doors for driver's cabin, 2 in number; prefabricated windscreen, 1 only.



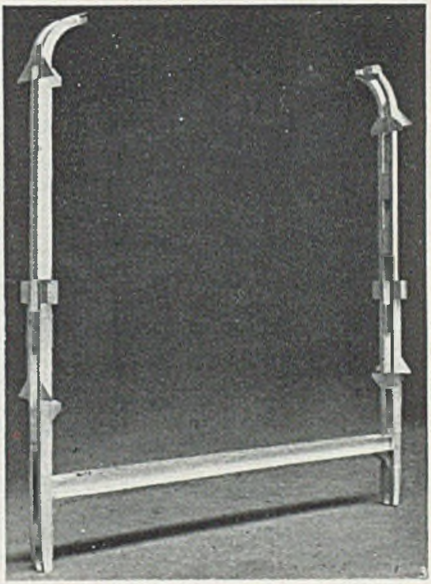
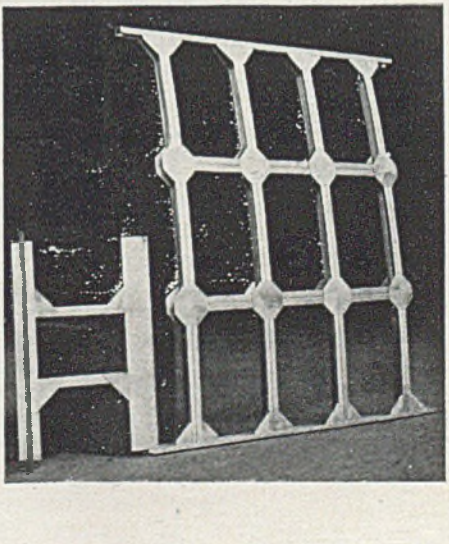


Fig. 6 (adjacent, left).—Forward wheelarch component, showing pillar, panel and roll-over to roof rib.

Fig. 7 (above).—Masterly example of prefabrication design. Side pillars and body bearer in one standard unit.

Fig. 8 (below).—Build-up of roof panel element.



a rigid framework in built-up components. In certain cases, alloys A-U4G are employed for components of large section, which do not need either heat treatment or bending for their construction.

In going through the works we were struck by the immense amount of careful thought given to standardization and reduction in the number of parts for building up the prefabricated body-frame sections. It should be borne in mind, however, that the engineers of the Société have been studying this particular matter for years past, although the factory did not get into full production until January last.

The prefabricated bodies are strongly reminiscent of one's boyhood days, when parts to make all sorts of things could be purchased, stuck on a card, with full

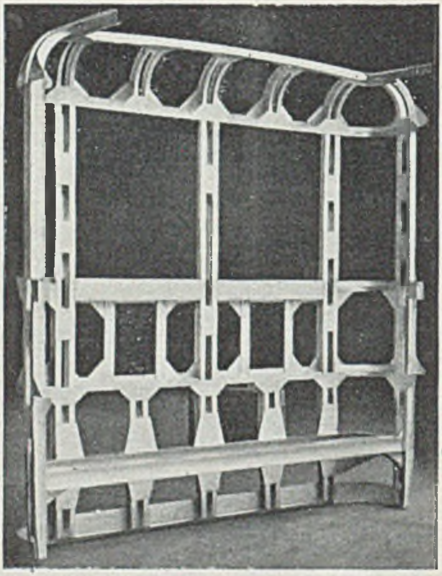


Fig. 9 (Above).—Complete standard rear-end structure, as delivered to the coachbuilder.

instructions as to how they might be put together. The number of partial assemblies, or sections, required for a bus, coach or lorry body is quite astonishingly small. In this, buyers have co-operated with the Société by agreeing to a certain range of standard dimensions—roof curvatures, window sizes and so forth—whilst on the works side, the number of smaller items making up these prefabricated components has also been reduced to an extent which may seem almost incredible.

In view of the economic significance of this development, some small digression may be permitted. Simplification by standardization is no new thing; it still meets with opposition, however, and one is tempted to wonder what progress engineering science would have made, for example, had not some measure of sanity been introduced by the codifying of screw threads, a movement which initially met with much antagonism and is still not entirely completed. In the case of commercial motor bodies, the existence of a strong element of personal predilection for this or that design must still be recognized, irrespective of any consideration of utility or logic. The position is not so desperate as in the case of private motorcars, however. Little success has attended any current attempts to effect reforms in this latter instance, but, definitely, in the former case, common sense has shown a greater tendency to prevail. Attainment of successful prefabrication, whether it be of houses or motor bodies, depends on this factor of standardization being satisfied to the maximum extent, first in major forms (that is, those directly of interest to the customer), and secondly, in those details of importance in connection with production organization. The Société des Prototypes de Corrossevies Lègères has accomplished an important step forward in gaining wide general agreement on these issues.

As a result, although the Société produces and sells all kinds of commercial bodies, these bodies are supplied *by length*. As M. Colombier explained to us, the first information required from a prospective client is, " What *length* of body do you want? " Actually, the

Fig. 10 (Below). — Exterior view of the complete rear end shown in Fig. 9.

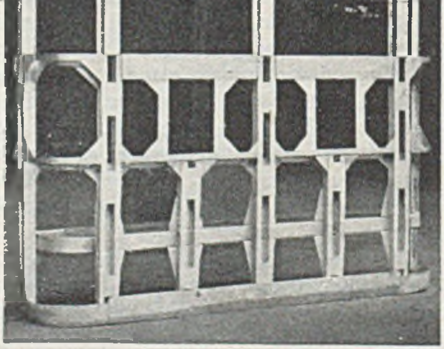
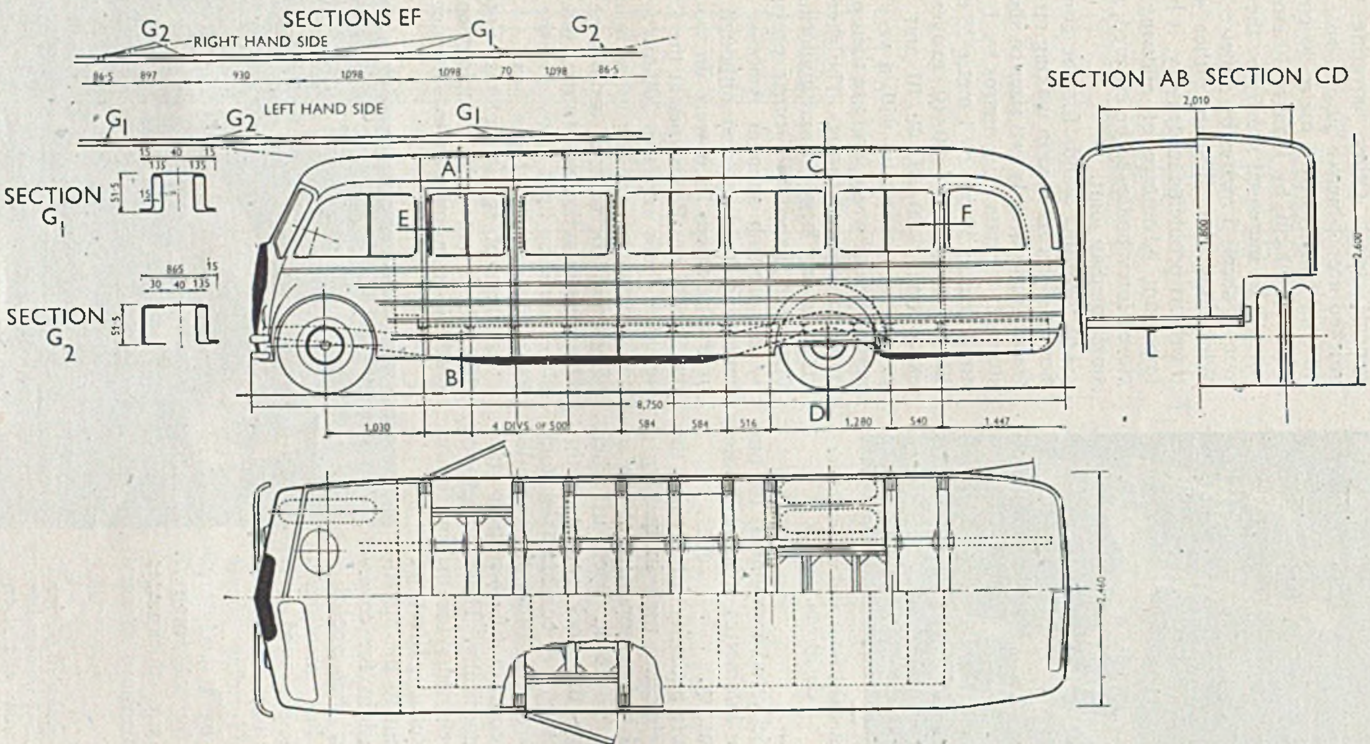


PLATE 5.




SIDE elevation, plan and various sectional views of a motor-coach body on a Leyland Tiger chassis. All dimensions on drawings in millimetres. Structural details: All prefabricated components in AG3 and AG5. Side and end panels, 9 in number, 2.500 m. × 1.250 m. Formed sheet: 1 driver's cabin; 1 sheet for front; 2 rails.

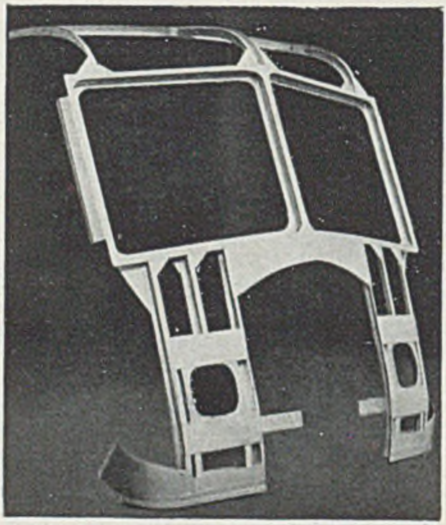


Fig. 11.—Standard front end assembly for closed van.

Société has delivered components for one and a quarter kilometres of motor bodies since last January.

The absolute necessity for keeping the number of elements used in making a prefabricated body component as low as possible was borne in upon us when going through the stock rooms at this Amboise factory. A considerable stock has to be carried in order that a series production concern of this kind shall function economically. The stock includes, apart from elements for making body-frame components, sheets of light alloy, cut to the appropriate dimensions for covering the frames when erected.

For the last mentioned, sheet thicknesses used are: 1 mm., 1.2 mm., 1.5 mm., occasionally forming sheets of 2 metres by 1 metre and 2.5 metres by 1.25 metres. That is to say, thicknesses and area dimensions in very general use. Other covering sheets stocked are: 2 metres 50 cm. by 1 metre 10 cm., 3 metres by 1 metre 30 cm., and 3 metres 50 cm. by 1 metre 30 cm. The list will be increased shortly by the inclusion of sheets 5 metres by 1 metre 25 cm. While this size presents rather serious transport problems in delivery, it has the important advantage of allowing long, closed lorry bodies to be covered, with a single median joint.

On the other hand, for the construction of elements used in making up body-frame sections, only two sizes of sheet are stocked: formats of 2 metres by 1 metre and 2 metres 50 cm. by 1 metre 25 cm., in 12/10, 15/10 and 20/10 gauges, and exceptionally 30/10, 40/10 and 50/10 gauges. These cut up with a very small percentage of waste, and are then pressed into the required forms. The sheets are cut on a very large Grimar guillotine, and thereafter shaped in Grimar presses.

The pressing shop at Amboise is an enormous building, and although most of the machines in it were on work for the Société des Prototypes at the time of our visit, there were two 700-ton presses, one functioning and the other in course of erection, for work of a different kind. The press in action was turning out complete roofs in light alloy for the little Panhard-Levassor " Dyna " car.

An item of special interest noted in this shop was the employment of synthetic-resin-impregnated wooden dies

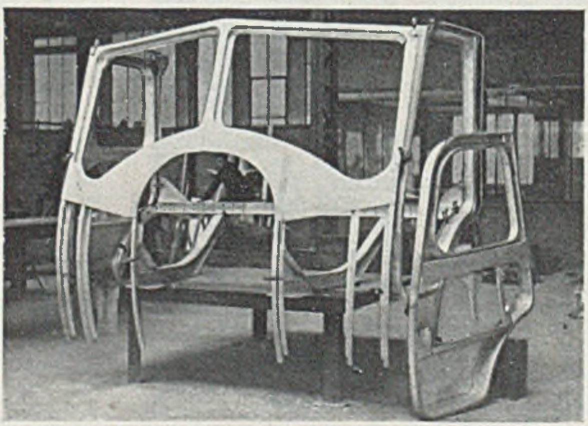
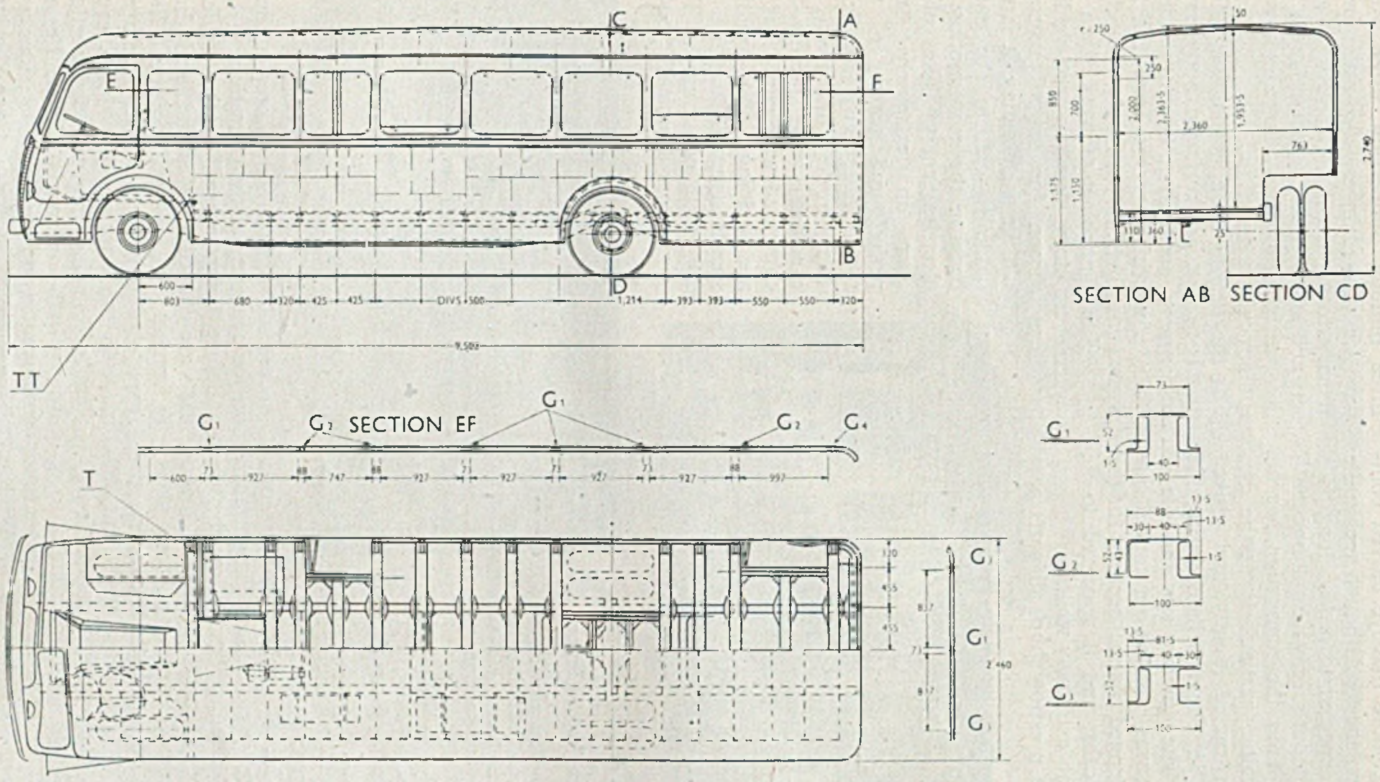


Fig. 12.—Prefabricated driving cab for a coach, complete with door-frames and door.

PLATE 6.






SIDE elevation, plan, and various sectiona views of an omnibus for 55 passengers on Scania-Vabis chassis, type B21. All dimensions on drawings are in millimetres. Structural details : All prefabricated components in AG3 and AG5. Side panels, 7 in number, 2.500 m. × 1.250 m. ; roofing sheets, 7 in number, 2.500 m. × 1.250 m. ; panels for driver's cabin, 2 in number, 2.500 m. × 1.250 m. Formed sheet : rounded component for transition from roof to rear end, 1 only ; rounded vertical corner pieces, 2 in number; 2 rails; 1 driver's cabin; 1 sheet for front.

for pressing more massive curved components from sheet. Although such a die cannot be expected to last so long as a steel one, it costs only about one-tenth as much. Thus the innovation has an economic value, particularly as the dies can be constructed rapidly, and proved their value in Great Britain during the late war. The time we saw this die in operation it was pressing out curved side members, flanged channel section, for the frames of cabs, and it appeared to be doing the job extremely well.

From the pressing shop, all parts pass into the store and thence to the chemical cleaning department before they reach the welding and riveting shop, which is another big building nearly as large as the pressing shop. M. Colombier insists upon the absolutely paramount importance of properly cleaning light alloys before any attempt is made to weld them. In the chemical cleansing process, parts are first pickled in a bath of caustic-soda solutions (10 per cent. w/W) at 70 degrees C. They remain in this for 10 minutes and are then transferred to a cold-water bath. From this they pass to a nitric-acid bath (10 per cent. w/W) for three minutes' immersion, after which they are washed in a warm-water bath. When treating small parts, such as gussets and angle plates, ingenious racks are used, designed to carry a large number of components at one time.

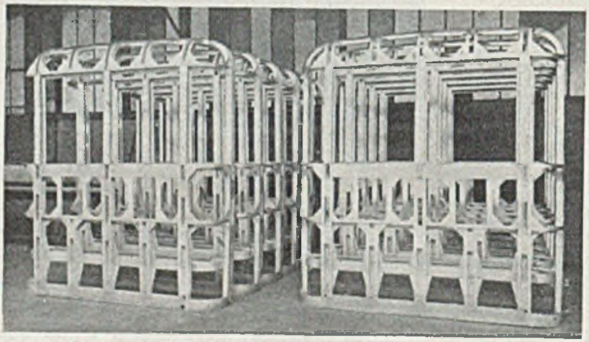


Fig. 13.—Standard rear-end body units stocked in stores section of the Amboise factory.

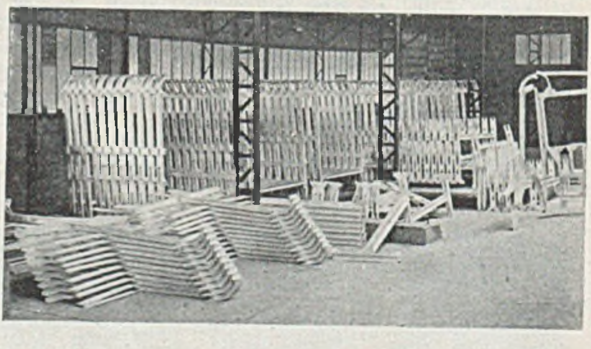


Fig. 14.—Another view of the stores section, showing the side pillar and bearer units together with other components.

In the welding shop, partial assemblies, that is to say, prefabricated body-frame components, are built up by spot welding, while power riveters are used for the riveted members. There were nine electric welding machines at work when we visited the factory. Electric spot welding has been chosen for several reasons. Unlike gas welding, it is not liable to deform the parts, because the consumption of electrical energy takes place over an extremely brief period, and heating of the metal is strictly localized. The work, moreover, is executed very rapidly as compared with either gas or arc welding. Spot-welding speeds average from six to 20 points per minute. Test pieces are frequently tested to destruction, in order to keep a check on the efficiency of the operation.

Before being passed to the welders, parts are clipped together and firmly held in contact by a number of neat little screw clamps in light alloy. These are made in the works by the simple expedient of sawing up extruded section, ordered in the appropriate form. Jigs are employed in the erection of various partial assemblies; as, for instance, the joint

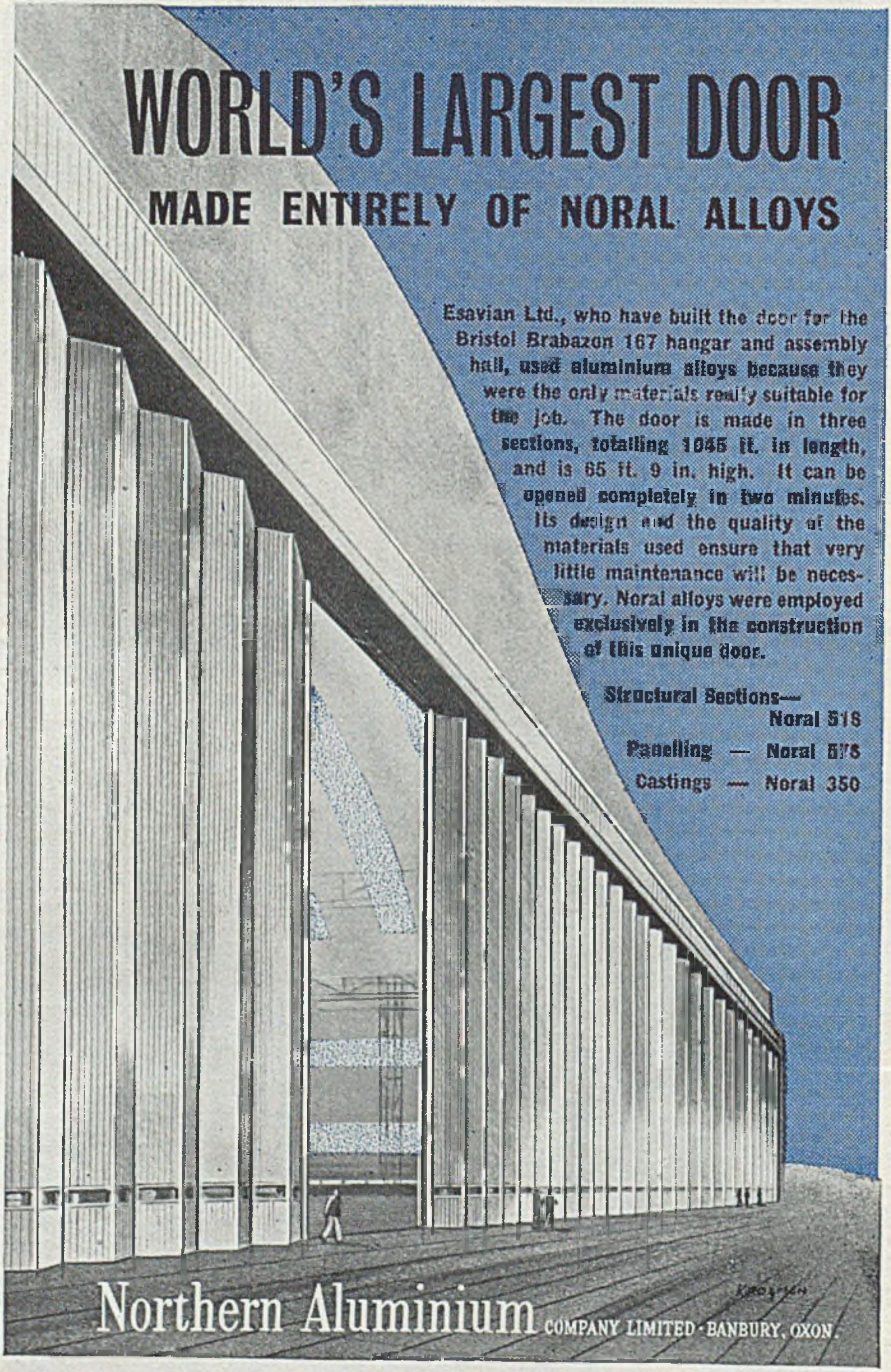
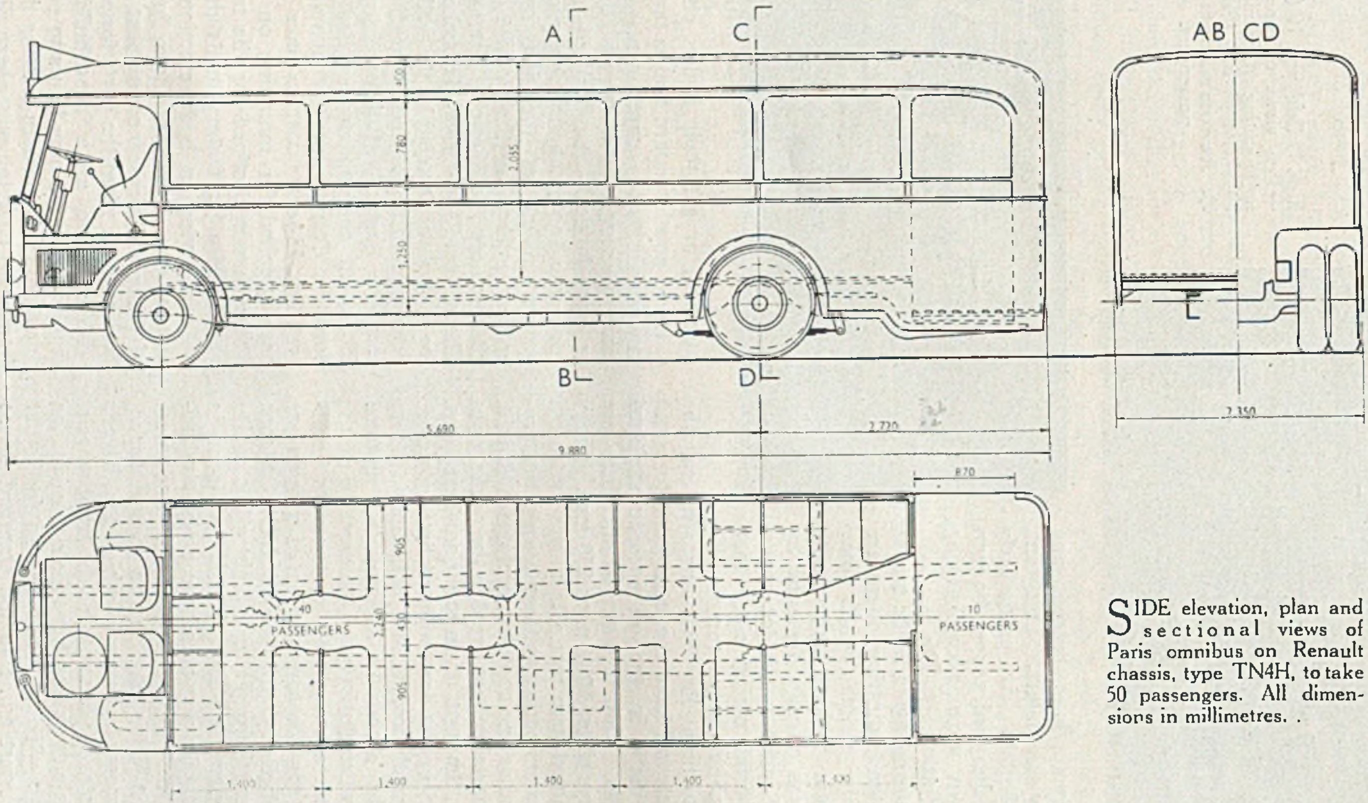
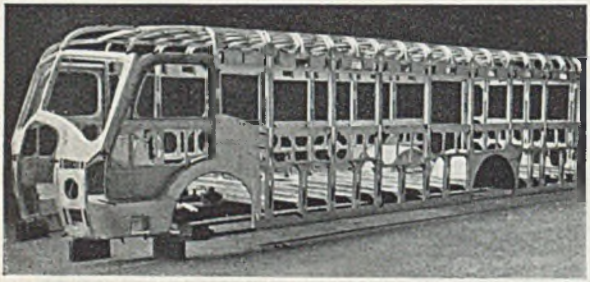

WORLD'S LARGEST DOOR
MADE ENTIRELY OF NORAL ALLOYS
Esavian Ltd., who have built the door for the Bristol Brabazon 167 hangar and assembly hall, used aluminium alloys because they were the only materials really suitable for the job. The door is made in three sections, totalling 1045 ft. in length, and is 65 ft. 9 in. high. It can be opened completely in two minutes. Its design and the quality of the materials used ensure that very little maintenance will be necessary. Noral alloys were employed exclusively in the construction of this unique door.
Structural Sections—Noral 51S
Panelling — Noral 57S
Castings — Noral 350
Northern Aluminium COMPANY LIMITED · BANBURY, OXON.

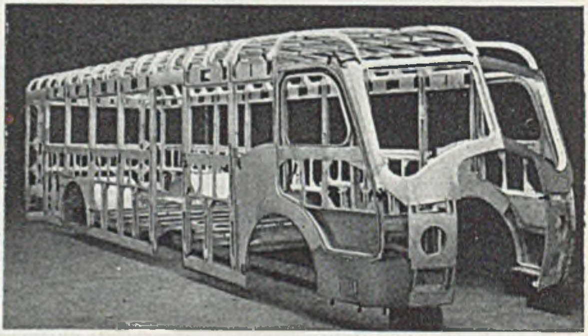
PLATE 7.




SIDE elevation, plan and sectional views of Paris omnibus on Renault chassis, type TN4H, to take 50 passengers. All dimensions in millimetres.



Figs. 15 (left) and 16 (below).—Two views of coach body for mounting on Scania-Vabis chassis, type B21 (See plate 7). Accommodation—55 passengers.



between floor bearers and body side pillars. This joint, incidentally, is particularly well designed, as may be seen from the accompanying illustration.

Turning again to the matter of standardization, there are certain points which may explain the remarkable success already achieved by the Société des Prototypes in the brief period since that company started commercial production. Roof sections, whatever the vehicle, all have the same curvature and are made in the same three standard widths. Radii on curved members are always either 80 mm. or 250 mm. It may be noted here that side pillars and cross members acting as floor bearers are produced as one complete prefabricated unit. All parts are numbered in the works, right from the start, down to the smallest items.

All bodies are mounted first on wood, by coach screws, and then bolted down to the chassis. Riveting is employed almost exclusively in the erection of the complete body. All components necessary for the construction of a body are supplied by the Société to its clients. Ribbed floor plates in light alloy, cut to the necessary dimensions, are kept in stock. Driving cabs have been standardized for Panhard-Levassor, Latil, Somua, Scania-Vabis, etc., and, in general, for all commercial chassis in which the driver's doors are in advance of the front wheels. Vehicle users may have their own ideas as to cab window forms and so forth, but they must agree to the standard forms supplied, or get their bodies elsewhere.

Up to now, standard bodies turned out in prefabricated components include buses, passenger coaches, vans and closed or open lorries. Standardized roof luggage grids for coaches are supplied when ordered. One of the first important orders received by the Société was for 20 buses for the Shanghai Tramway Co. These are 50-seater single-deckers, and the bodies were erected by the well-known French commercial coachbuilding concern, Le Bastard, of Rouen, from prefabricated components supplied by the Société. Components for a number of very fine 55-seater coaches have recently been supplied for mounting on Scania-Vabis chassis, destined for the transport of staff of a big factory in Belgium.

Time saving in body erection represents a most important factor in favour of this prefabricated component system. For instance, when the parts for an 18-ft. vehicle arrive at a coachbuilder's, it requires only 170 man-hours to put them together. This includes erecting the body frame and covering with sheet alloy, and

M. Colombier explained that this means an average of about 33 man-hours per metre of body length, but, as already mentioned, he always thinks of motor bodies in terms of length.

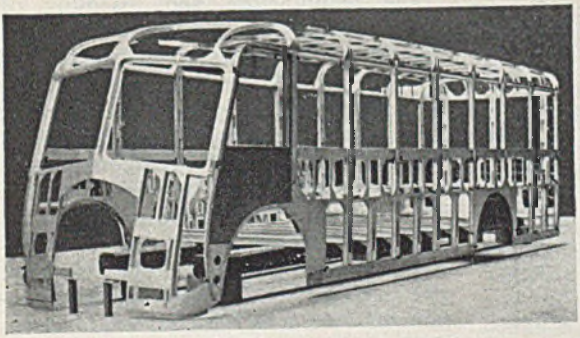
Although the Société des Prototypes is at present engaged on normal types of bodywork for passenger or goods transport, standardized bodies for special purposes will undoubtedly follow.

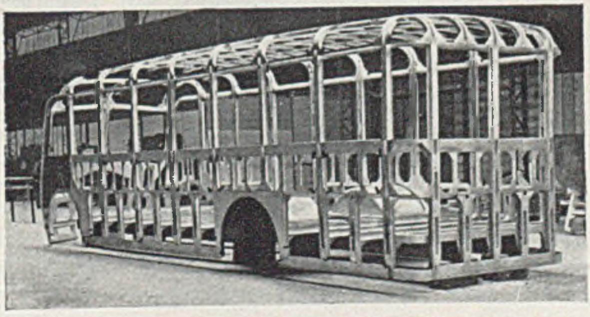
In building these prefabricated light-metal bodies, a fair amount has been borrowed from the technique of aircraft constructional practice, with necessary modifications to a very different purpose. One good point which struck us in examining some of the sectional components was their great rigidity. Body floor bearers, for instance, are made from two large-section channels boxed in top and bottom with strip.

On the purely commercial side, M. Colombier pointed out that as a light-metal body costs, in France, about one and a half times as much as one in steel, and as half of the erection work is already performed when the prefabricated units are delivered, the financial turnover of any given coachbuilding shop producing alloy bodies is automatically multiplied by the coefficient 3.

From the vehicle user's standpoint there is the one outstanding advantage of weight reduction. In estimating this for any particular vehicle, the Société des Prototypes again uses length as a measurement form. They estimate that weight economy obtained is in the nature of 80 kg. to 150 kg. per running metre of body length. The figure 80 applies to ordinary closed lorry bodies up to 15.3 cubic metres capacity, that of 150 to special bodies for special purposes, such as meat transport. An average weight saving over steel of 100 to 110 kg. per running metre is estimated for coach and bus bodies, or for closed lorries up to 30.3 cubic metres capacity.

Apart from its more obvious advantages, this system of building bodies from prefabricated parts allows the cutting of a good deal of red tape. French industry in general is, like our own, severely restricted at the moment, and it is afflicted with the same form-filling mania which we are obliged to endure. Prefabricated components such as these are regarded by French officialdom as finished products, and they do not require transfer licences or raw material permits when delivered to coachbuilders. This fact simplifies the supply problem for French coachbuilders very considerably.





Figs. 17 (above) and 18 (right).—Front and rear views of a special coach body built for staff transport of a large Belgian concern.

# Commutators

## *with Anodized Aluminium Insulation**

### *H. Blaess, Leipzig, Describes a Novel Light-metal Application and Indicates How, by a Suitable Modification of the Commutator Assembly Process, Mica May Successfully be Replaced by an Alumina Film*

UNSATISFACTORY supply of both mica and mica substitutes has led German electrical firms to suspend the regular production of commutator machines, and, so far as possible, to replace direct-current motors by others running on a.c. This, however, is not possible in the case of battery-driven vehicles and tramways.

The author investigated the possibility of readily providing aluminium sheet with a good insulating oxide film in order to use such treated sheet in place of mica in the construction of commutators. Aluminium, if exposed for some time to air, becomes protected by a strong oxide layer exhibiting very high contact resistance. Such a film is, however, not satisfactory for the purpose in mind. Anodic films of a thickness of about 0.05 mm. (0.002 in.) and of high insulating power can easily be produced, however, and the increase in thickness of the oxide does not hinder the practical use of the sheet. A special advantage is the relatively great resistance of alumina in this form to heat (say, up to 300 degrees C.), its high heat conductivity and its great hardness (stated to be equivalent to a Mohs's hardness of 9).

As electrolytes for the anodizing bath may be used chromic acid, oxalic acid, or sulphuric acid with various additions, such as nitric acid, potassium sulphate, etc. The author reports on a test bath using 10 per cent. oxalic acid with the addition of 0.2 per cent. chromic acid operated at a temperature of 30 degrees C. The film obtained from such a bath had a breakdown strength of 5,000 V. a.c.: for higher voltages the insulating lamellæ would thus have to be divided, but no tests at pressure above this value were undertaken.

Direct or alternating current can be used for the bath. When using direct current, a cathode material has to be selected which is not attacked by the electrolyte. In the case of alternating current, the " cathode " can be formed by another workpiece which it is desired also to anodize.

#### Assembly of Commutators with Anodized Insulation

The manufacture and assembly of commutators with this novel metallic insulation necessitates a new method of production. For comparison, operations necessary for assembling medium-size commutators with mica or other insulation will be described. The commutator lamellæ are built up together with the insulating slips in a clamping ring, after which an appropriate series of dove-tailed slots are provided at the periphery. The pack is then inserted into the commutator bush with the commutator press ring, together with inbuilt commutator collars; the clamping ring is now removed. The periphery of the commutator is next machined, the insulation being undercut to diminish brush friction.

Now, when insulating lamellæ of anodized aluminium are used, the order of operations has to be changed. The anodized light-metal slips are finished to final size in order that, during the machining of the commutator, no

* "Die Technik," 1947/2/247.

damage or removal of the oxide layer may occur. From the accompanying figure it will be seen that the treated edges of the anodized insulating slips must always lie below the conducting copper faces. This is achieved during assembly by pushing the anodized slips up against fixed pins in such a way that those edges which must not be touched during machining are positively located in position from the outset. The machining of the copper lamella thus becomes possible without in any way entailing harm to the anodized film. Any burred edges which remain on the copper in the groove between the conducting lamellæ are removed by means of a small triangular file, taking care that no scoring of the surface of the anodized slips occurs.

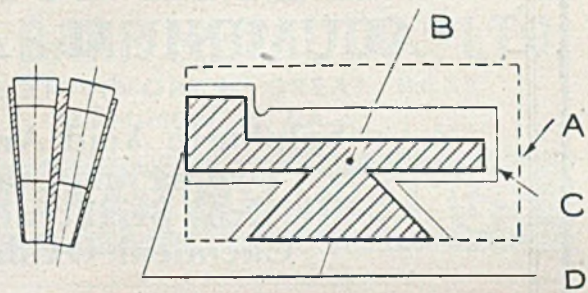
Users of machines employing commutators of this type must be instructed to take care when reconditioning commutators as, naturally, the same precautions hold good regarding avoidance of damage to the anodic film. Again, when cleaning the grooves, the insulating film must not be roughly treated; in fact, maintenance of this sort is best carried out by means of flat wooden slips or small pieces of soft copper strip.

With rotors operating at high speed, centrifugal forces at the commutator attain a high value. Now, in the case of normal insulating lamellæ, say, of mica, frictional effects are sufficiently great to obviate any danger of displacement; anodized aluminium insulators, however, must be very securely located, otherwise, due to the smooth surface of the oxide film, slipping may occur.

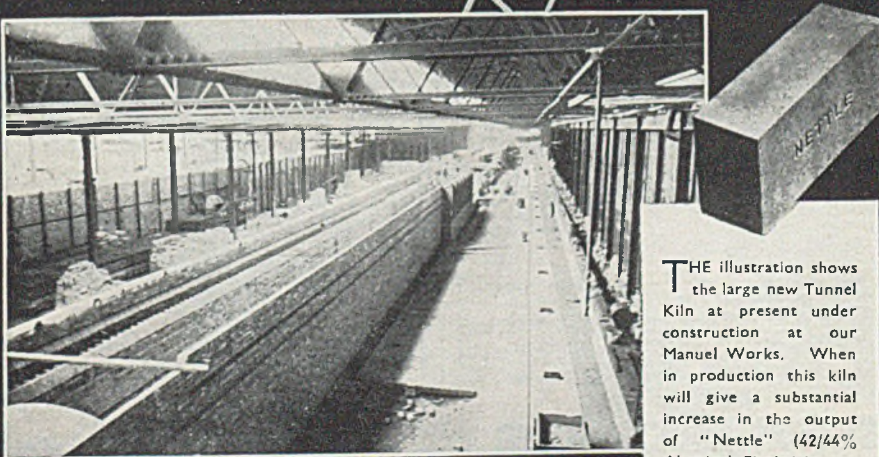
A further development in the construction of the commutator consists in the use of anodized aluminium collars which, in conjunction with the anodized insulating slips, give a unit offering minimum resistance to heat transfer and, hence, capable of increased electrical loading.

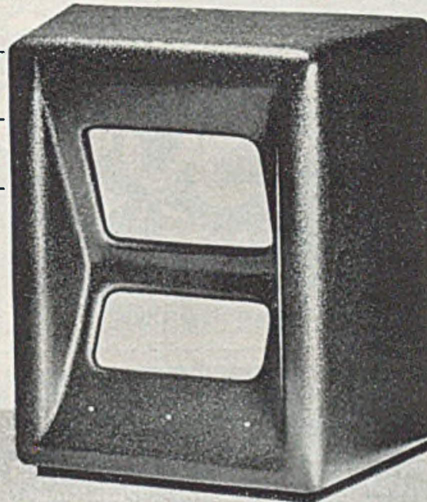
The author has indicated further changes in the design of commutator motors. It has been proposed to construct such a unit devoid of the usual insulation on the armature and field windings, which, in place of the normal copper wire, would be constructed of aluminium-sheathed copper (i.e., the converse of practice established for Cupal), the aluminium coating being anodized to give the requisite insulation. Those parts of the winding likely to be subject to mechanical stress due to thermal or centrifugal effects would, in practice, be additionally protected by a suitable "armouring" of anodized foil.

Electrical connections would entail no difficulty with a material of this sort, as the aluminium could be scraped off and joining effected on the copper by soldering in the usual way. Joining of the armature winding to the commutator lamellæ by means of studs in place of the usual soldering might prove advantageous in certain circumstances, particularly as a motor of this type, being devoid of organic insulating agents, could be operated at a higher permissible temperature rating than a motor of normal construction.




ASSEMBLY of a commutator with anodized aluminium insulating slips: A, size of the unmachined commutator lamellæ; B, finished machined and anodized insulating lamellæ; C, thin drawn out lines indicate the machined edges of lamellæ (B); D, fixing edges remain unmachined.


NETTLE





# CLASSIFIED ADVERTISEMENTS

LIGHT METALS

Rate 4d. per word, minimum 4/-. Box Number Fee 1/-.
Press date for December issue - - November 25, 1947.

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

## AGENCIES

**American Technical Industrial Research Organization** offers its services (through British office) to British manufacturers and others interested in all American technical and scientific progress; in acquiring American goods; or in selling to the American market.
Before you write note that we charge an annual fee for our services; that we are down-to-earth technicians with a sound proposition and no time to waste; and that what we offer is something you won't find anywhere else.
To reach us, put your address and name on a post-card and send it to BCM/UNDEB, London, W.C.1. 118-2

**Large Australian distributors and manufacturers** wish to contact United Kingdom counterparts regarding export as well as part or total manufacture of products in Australasia. Box 1630, care of "Light Metals." 118-x1630

## BUSINESSES, PREMISES, OFFICES, ETC.

**Established manufacturers' agents** offer warehouse space up to 1,200 sq. ft. with comprehensive sales services among builders' merchants, ironmongers, oil and colour merchants in London and Home Counties. Apply Howard and Wright (Sales), Ltd., 222 Union Street, London, S.E.1. 118-3

**Specialist business** manufacturing containers with free-hold property having 10,000 sq. ft. floor space about 30 miles from London for sale, £16,000. Full details, Henry Butcher and Co., 73 Chancery Lane, London, W.C.2. 118-1

## 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. 119-396

**Aluminium castings,** all alloys. 35 years' experience your guarantee. W. Barnet, Casson Place, Elland. 123-325

**The Aluminium Castings Co., Ltd.,** Ingleston Foundry, Greenock. Solar ware and medium engineering sand or gravity die castings. zzz-412

**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-414

**Edwards 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-415

**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-416

**Non-corrosive high-strength castings** in aluminium alloys for marine and general engineers. Moyle, Kingston-on-Thames. zzz-417

**Sand castings** in aluminium or other non-ferrous metals. David Pickett and Sons (Engineers), Ltd., Elm Street, Cardiff. zzz-419

**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-420

**For all kinds of sand cast work.** Patterns made. Work delivered ready for your machines. Established January, 1921. G. F. Whitmarsh, 8a Great Francis Street, Vauxhall, Birmingham. zzz-450

**Lavender, J. H. and Co., Ltd.,** Hall Green Works, Crankhall Lane, West Bromwich. Phone, Stone Cross 2273. Sand and gravity diecastings in aluminium alloys. zzz-418

## SITUATIONS VACANT

**Designer required,** must be capable of initiating design and taking executive control of pilot manufacture of household and industrial articles, including folding tables, chairs, occasional furniture, office fittings, kitchen equipment, etc., from aluminium, plastics, wood substitutes and similar materials, first-class facilities and opportunities in large modern factory, North London. Send full particulars to Box 1267, care of "Light Metals." 120-3685

## CELLULOSE

**Cellulose materials** for car and industrial spraying, also synthetics. New edition "Paint Spraying," price 3s. 6d. Comprehensive catalogue, 2½d. Leonard Brooks, Iona Terrace, Romford. zzz-431

**Cellulosing and spray painting.**
All types of cellulosing and spray painting of manufactured components, toys, furniture, etc., can now be undertaken in our modern and well-equipped spray shop. Non-corrosive, preservative and wood cellulosing a speciality, all work dealt with under expert supervision, special terms for quantities and contract work. Inquiries to:—
C.I.G. Sprayers, Portsmouth Road, Milford, Surrey. 118-4

## MACHINERY, TOOLS AND PLANT

**About 4,000 pneumatic hand tools,** comprising drills, hammers and riveters (3/16-in.-¼-in.) by most of the best makers; they show big savings on current prices. Write for illustrated list to Box 2197, G.T.C., Ltd., 82-94 Seymour Place, London, W.1. 118-8

### Machinery, Tools and Plant Wanted

**Diecasting machine** wanted urgently, prefer E.M.B. No. 12, cash waiting, we will collect, distance no object. Write or phone, Roncraft, Ltd., Colwyn Bay. Phone 3191. 118-10

**Wanted,** second-hand horizontal two-ram type metal baling press and pump, 1-2-cwt., state price and where seen to Short and Harland, Ltd., Queen's Island, Belfast. 118-6

## MISCELLANEOUS

**Pulverizing and grading of raw materials.** Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-432

**Monomarks.** Permanent London address. Letters redirected, 5s. p.a. Write, Monomark, BCM/MONO92. 120-2170

PERSPEX.
Official stockist offer clear and pastel shades in standard sheets or cut to specific requirements.
ALSO MOULDINGS
of all types in Perspex.
SYNTHENA, LTD.,
AKED STREET, VICAR LANE,
BRADFORD. 120-3684

**Britain's best bargains** in electric cable, 8½ mill. yards available at big reductions covering auto, ignition, flexs, radio and starter cable, list free on application to Box 5004, Magna, Ltd., 82-94 Seymour Place, London, W.1. 118-7

**Aluminium sheet and strip** for sale, new, various gauges, 120 tons, part or whole, reasonable price. Box 989, care of "Light Metals." 118-x1165

**Electro plating,** nickel, gilt, etc., executed promptly by established firm. Write Box 908, Reynells, 44 Chancery Lane, W.C.2. 119-3683

## PRODUCTION CAPACITY AVAILABLE AND WANTED

**Lancashire firm** open for press work. Capacity to 120 tons. Box 6850, care of "Light Metals." zzz-403

**Metal powders and oxides.** Quotations and samples on application. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-433

**Capacity required.** Firms capable of bending and fabricating tubular parts and stamping sheet metal parts for incorporation in quantity assemblies should communicate with Box 1275, care of "Light Metals." 118-9

**Anodizing and colouring** of aluminium and alloys, large capacity available in new works, highest quality work, fast colouring a speciality. Metal Chemical Finishes (Liphook), Ltd., The Avenue, Liphook, Hants. Phone, Liphook 2283-4. 118-11

**Capacity available** in Continental factories for machine work, including turning, lathe work, drilling, bending of profile or channel iron, cold cutting, torch cutting, electro-welding, sheet and plate rolling, pressing, milling, planing. British Boiler Accessories, Ltd., 62-3 Fenchurch Street, E.C.3. Royal 4122. 118-5

## RAW MATERIALS AVAILABLE AND WANTED

**Asbestos.** Bentonite, Feldspar, Kyanite, Quartz, all minerals. Dohm, Ltd., 167 Victoria Street, S.W.1. zzz-451

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

Vol. X. No. 118.

LIGHT METALS



CREATIVE CONSTRUCTION

# LARGE? – NOT for RENFREW!

## and 500 off, too!

This *5 foot 140 pound casting** is made in one of Europe's largest mechanised aluminium foundries. We would welcome your enquiry to supply large and intricate aluminium alloy castings. The biggest we are handling at the moment weighs 1200 lbs. and the most complicated contains over 50 cores. We like this work — write to us today.

** Diesel Engine Scavenge Pipe for British Polar Engines Ltd.*

RF
ASSOCIATED WITH ALMIN LTD

# RENFREW FOUNDRIES LTD

HILLINGTON · GLASGOW · S·W·2