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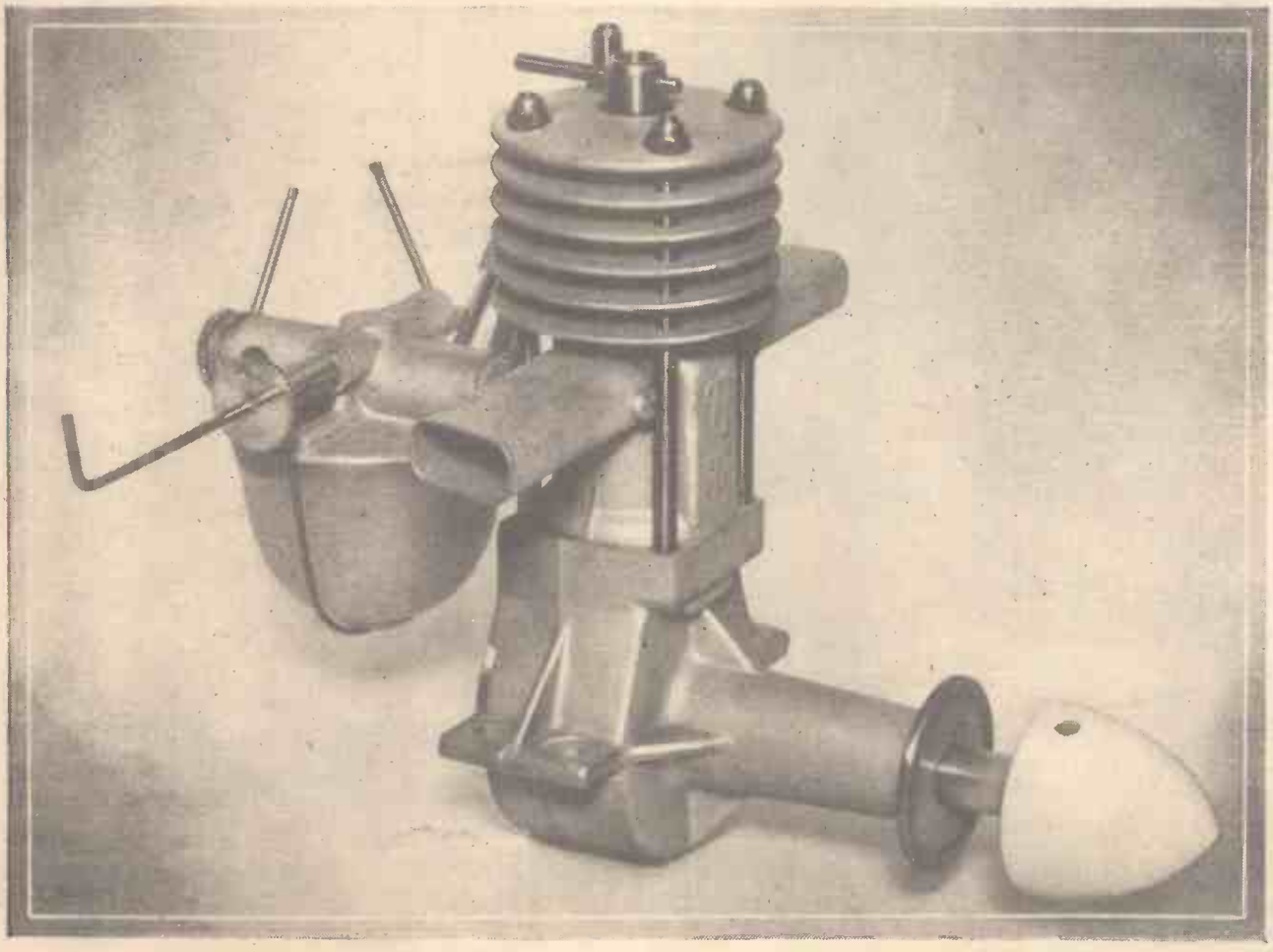
PRACTICAL MECHANICS

9D.

EDITOR: F. J. CAMM

AUGUST 1947



THE NEW 5 C.C. BRITISH-BUILT "ETA" MODEL DIESEL ENGINE (*See page 332*)

PRINCIPAL CONTENTS

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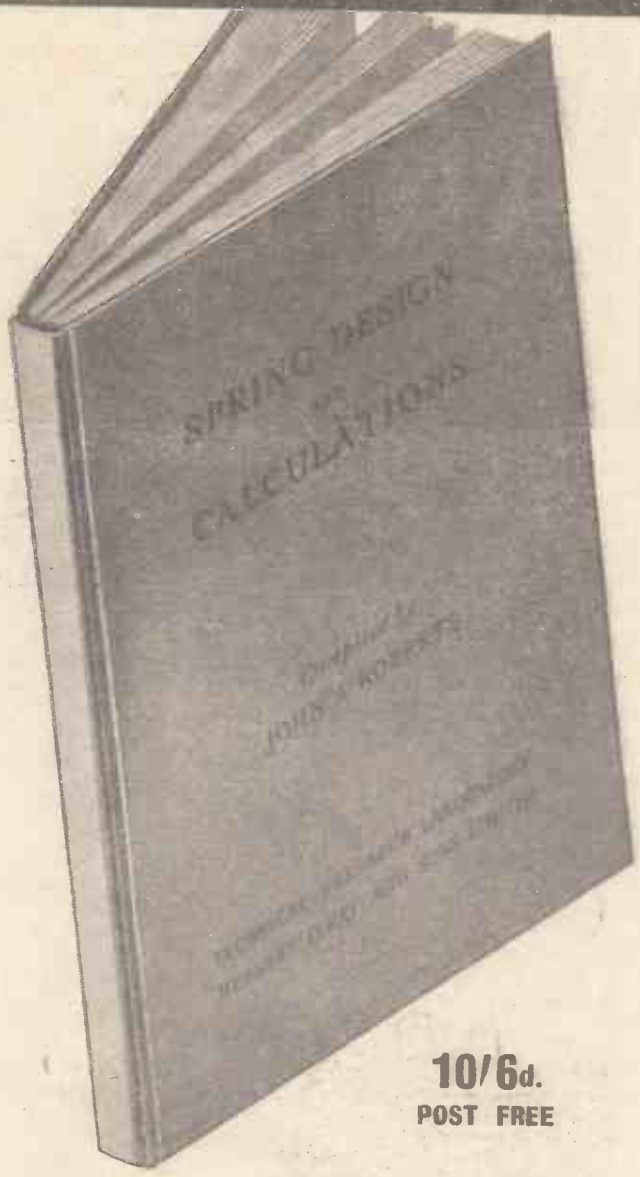

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Owing to the paper shortage "The Cyclist," "Practical Motorist," and "Home Movies" are temporarily incorporated.

Editor: F. J. CAMM

VOL. XIV AUGUST, 1947 No. 166

FAIR COMMENT — BY THE EDITOR

New Metals for Old

SO many new metallic alloys are now in use that it is interesting to look back during the past 50 years and trace the progress of these new alloys, which have been developed as a result of our increase in knowledge of metallurgy and the need for metals of different physical characteristics to those which were formerly available. According to Mendeleef's Periodic Law, there are found in nature 92 elements, 68 of which may be classed as metals. Many of these, which were only chemical curiosities less than 100 years ago, are now regularly used in science and industry, the most noteworthy being aluminium and magnesium.

The transmutation of one known element into another can now be brought about by using atomic projectiles which penetrate to the heart of an atom and alter the structure of the nucleus. The quantities involved, however, are so infinitesimal that these transformations are not of practical consequence at present.

Scientific investigation, however, is still going on, and we may expect within the next 10 years some startling discoveries as a result of investigations into nuclear energy. The physicist has in recent years succeeded in producing two entirely new metals, neptunium and plutonium, the latter, of course, being one of the elements constituting the fissile material used in one of the bombs dropped on Japan. These two metals are the heaviest known to man, and they are produced in uranium rods which form part of an atomic pile. Neptunium is formed as the result of the entry of a neutron into a uranium nucleus. It is radio-active but of short life, but it spontaneously turns into plutonium which must be extracted from the uranium rods before it can be used in an atomic bomb.

The Earth's Crust

Although there are 92 elements it is interesting and certainly remarkable to note that very few of them exist in the earth's crust, down to 20 miles below the surface. Oxygen, silicon, aluminium, iron and calcium form over 90 per cent. of the earth's crust, whilst potassium, magnesium, titanium, hydrogen, phosphorus, carbon and manganese bring the total to 96 per cent. Aluminium and magnesium, which play such an important part in engineering to-day and are likely to play an even more important part in the near future, constitute as much as 10 per cent. by weight of the earth's crust. Thus, only 4 per cent. of the earth's crust is left to contain as many as 80 elements.

Although scarce, over 40 of these elements are metals which are useful to industry. Scientists have provided the metallurgists with methods of accurate measurement for the testing of metals and alloys. So that if we know the qualities we require in a particular metal, we may by measurement from specimens determine whether those requirements are fulfilled. Requirements cover hardness, durability, strength, workability, and resistance to corrosion in air, water, or in the ground, thermal capacity and expansion, electrical conductivity, magnetic permeability, and retentivity.

Less than a century ago we were limited in our use of metals (excluding the precious metals) to wrought and cast iron, steel, copper, lead, tin, zinc, antimony and bismuth, and such alloys as bronze, brass and solders. To-day there are several thousand alloys in everyday industrial use, as our "Dictionary of Metals and Alloys" clearly shows.

The properties of alloys are not entirely determined by their chemical composition but by their interior structure, which can only be inspected through a microscope because they are invisible to the naked eye. In some cases, apart from the optical microscope the X-ray diffraction apparatus and the electron microscope are used. The latter is one of the latest instruments made available to the metallurgist.

High-speed Electrons

Its principle is based on the fact that electric and magnetic fields can be made to act on an electron beam in somewhat the same way as glass lenses do on a light beam. It is well known that visual microscopes cannot be effectively used at magnifications over 3,000, nor can they give any detail about structures less than the wavelength of light inside. By using high-speed electrons, however, which behave as if they were waves of extremely small wavelength and suitable electric and magnetic lenses the electrons can be focused through any object on to a photographic plate. It is worth while mentioning here that metals are opaque to electrons except as very thin films, and so the structure of metals is investigated by making a replica of the etched surface of a metal by means of a thin film of formvar, or silica, obtained by evaporation. The film is then stripped off and examined in the electron microscope.

When conditions are favourable, objects one hundred millionth of an inch in size can be observed in this way. It is a physical law that matter returns to its most stable form if nothing is done to prevent it. For example, roses return to briars if they are not pruned. Other things return to dust unless they are preserved. This certainly applies to metals, the most stable form of which are the ores in which they occur in the earth's crust.

Corrosion is the attempt of the metal to return to this most stable state. It is the action of oxygen which is the cause of corrosion. The prevention of corrosion is one of the major problems of to-day.

Stainless Steel

One of the most important discoveries in the search for corrosion-free metals is stainless steel, the discovery of which was quite unexpected. Brearley, in 1908, was experimenting with an improved steel for gun barrels, and in the course of his work he tried the effect of the addition of chromium. Some of the metal made in this way was thrown on to the scrap-heap, and he was surprised to notice some weeks later that they remained bright and untarnished. That was how stainless steel was discovered. Later the 18 per cent. chromium and 8 per cent. nickel type and other austenitic high chromium steels were produced. These also formed the basis of many non-oxidising steels which have been produced in recent years. Their application to-day is somewhat limited by the high cost of the alloying element, as well as the high cost of manufacture.

Chromium oxidises rapidly. A film of chromic oxide is thus formed which is tenacious and continuous, and it is this film which effectively stops further oxidation. If the surface of the steel is scratched, the protecting film is immediately renewed from below. The film is therefore self-repairing.

Corrosion

The cause of corrosion is the chemical attraction between metals and the oxygen in the air. Aluminium very rapidly corrodes. Aluminium is not very strong, so aluminium alloys have come into existence, but they are not so resistant to corrosion as pure aluminium. The anodising process has, however, come to the rescue. It was developed at the Chemical Research Laboratory, and is an electrolytic process in which the article to be anodised forms one of the electrodes in a solution through which an electric current is passed. Oxygen is liberated from the solution and builds up a very tenacious film of aluminium oxide of great hardness. The surface film can be coloured by means of dyes, and so the anodising process can be used for decorative as well as protective purposes.

Model Diesel Engine Developments

Details of the Latest Type of Power Unit for Model Aeroplanes and Racing Cars

By C. E. BOWDEN, A.I.Mech.E.

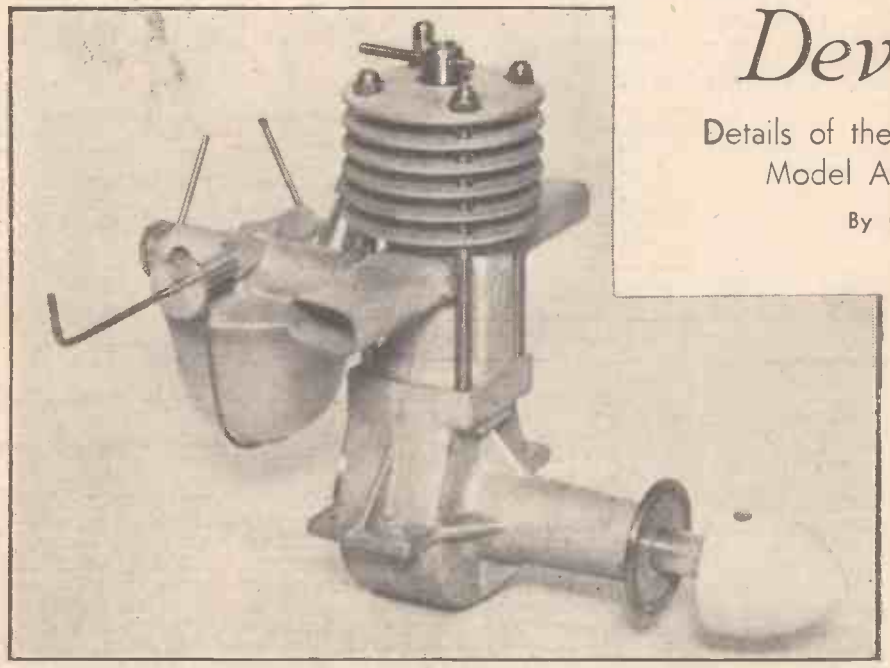


Fig. 4.—The new British "Eta" is 5 c.c. and weighs 9½oz. Height 4½in., bore .6781in., stroke .8593in. It has a speed range under load of 2,500-7,000 r.p.m. The static thrust claimed is 32oz.

NOT many years ago prominent people in the internal combustion engine world predicted that the model diesel engine would not be a commercial success because of the difficulty of making a sufficiently small and accurate fuel injector gear. These pundits have now been confounded, like many prophets of the past, for the model diesel engine is rapidly becoming all the rage to power model aeroplanes, boats and racing cars. In one sense the prophets may be said to have been correct.

Principle of Working

The new little model diesels are not strictly diesels, because they have a simplified method of firing the diesel fuel oil. They have done away with *the injector gear for the fuel*! They have therefore gone one better than Dr. Diesel thought possible. However, this is really splitting hairs, for these little compression ignition engines are simplified diesels, and they operate on the basic and fundamental principle of what has been popularly known as the diesel, namely, the fuel is fired by the heat of high compression. I mention the above because one sometimes hears statements by the pedantic on those lines. Some readers may wonder how the model diesel engine does work. Most people know that, broadly speaking, the full-sized compression ignition or diesel engine draws in a charge of air just like its petrol engine brother, but that there is no fuel mixed with that air. When the piston is at the top of the stroke, and the compression is around its highest point, a small, carefully metered charge of fuel is squirted into the very hot air. The heat of the air fires the mixture of fuel and air, thus causing an "explosion" which drives the piston down in the normal petrol engine manner. Now why does compressing air fire a charge of fuel and air? When you have pumped up your bicycle tyre you will have noticed that the pump and connector becomes hot, and the harder you pump the hotter it becomes. This is because you are squeezing or compressing the molecules of the air very rapidly into a confined space and the resultant friction creates heat just like any other form of rapid friction production will do. If one arranges a cylinder on an engine so that there is very little space left between the top of the piston and the cylinder head in relation to the amount of air taken in by suction, and then pushes the piston rapidly towards the cylinder head, you squeeze or compress the air very rapidly (anything from 16 to 20 times its original volume). This action generates great heat. That is what the diesel does.

The fuel shot into that highly compressed air under pressure immediately burns or detonates, thus giving energy for the engine's power stroke. Now the petrol engine only compresses its charge (in this case a ready mixed gas mixture of petrol and air) into a ratio of about 5 to 7 to 1 for average engines. But an electrical spark has to be used to ignite the compressed gas, because the gas is not sufficiently hot to ignite itself at the top of the piston's stroke. The fuel injection pump gear on the diesel has to be very accurately made, and costs a lot of money as well as being too heavy and complicated for fitting to tiny model diesel engines.

Therefore some clever people on the Continent of Europe thought of the idea of entirely eliminating the fuel injector gear that everyone thought was an essential to diesel success in order to ignite the low-grade fuel employed. These people used a perfectly normal two-stroke engine, but with a much higher compresson ratio of approximately 16 to 1 instead of 6 to 1. They suitably stiffened up this engine to withstand the higher stresses of the raised compression, and instead of using a fuel injector they mixed ether with the diesel oil fuel. Ether has a low flash point, but its chief virtue lies in its remarkable degree of ignitability. Petrol would also lower the flash point of diesel oil, but would decrease ignitability. All this happened during the war, and the first reaction in this country of many of the "clever armchair critics" was that such a fuel would "explode" either prematurely or late and therefore cause uneven firing. Like so many of the theory-mongers, these people were proved to be wrong in practice! In actual fact, the little model diesel engine fires with perfect regularity when compression and fuel mixture strength is correct.

Accuracy of Firing

To give the reader some idea of the extreme accuracy of firing, baby diesels of a little over only one half a c.c. have been carefully checked by instruments to turn round at 6,000 to 8,000 revolutions per minute under the load of an air-screw or water propeller, whilst, when running light, these minute engines have gone up to around the 12,000 r.p.m. mark! These figures are not imaginary, but are absolutely authentic.

I have a midget British diesel engine, weighing only 1½oz. complete, that flies a tiny model aeroplane of 23in. wingspan, weighing less than 8oz. Fig. 1 shows another of my little aeroplanes fitted with one of these midget engines. This small model has the remarkable wingspan of 34in. It is very stable and flies in high winds without any damage. Its weight is so light that even if it flies into a tree or bush little damage can happen, because I cover its wings with nylon, and its fuselage is made up from 1/16in. sheet balsa wood. This model can be slung into the boot of a car and produced during a ramble in the country when

Fig. 1.—The author's little 34in.-span model aeroplane fitted with a 1½oz. diesel engine of only 0.7 c.c. capacity. It is very portable and flies in high winds.

the spirit moves, or it can be carried in a small attaché case on a bicycle or bus.

Another of these tiny 1½oz. diesels is fitted to a small speed-boat I designed especially for it, with a length of only 19in. This miniature boat travels at great speed across a pond and can be seen in action in Fig. 3. Its tiny propeller is only ⅜in. diameter and revolves at over 8,000 r.p.m.

The little engine of only 0.7 c.c. mentioned above is to be manufactured shortly by Mr. Colyer, its designer and owner of the well-known model engine firm of Majesco, who also market a 2 c.c. diesel engine, already well established.

Readers who have not handled one of these new little wonder diesel engines will want to know the exact fuel they run on, how they work, whether they start easily, whether they wear well, if they run with reliability and what sizes they are made in.

Well, let us answer these questions, giving a few photographs of typical examples that I happen to have at hand. I have played hard with most of the British diesels and many of the Continental diesels during the past 18 months because it is a hobby of mine.

Fuel

Many types of fuel have been used, and new ones are constantly being concocted. But to date all fuels must have a large proportion of ether added. I personally think that in the future we shall find something less volatile, more easily used and cheaper than ether. But for the moment we all use ether. It is important to buy only "anæsthetic ether" or "ether meth" from the chemist. Both these are free from acid impurities that might damage the engine's innards. Approximately half the mixture should be ether, although engines have been run on less, and if easy starting and power can be sacrificed, the larger model engines of around 4 to 6 c.c. have been run on as little as 2 per cent. ether. This is not, however, generally suitable for model work.

All sorts of ingredients have been used to mix with the ether, ranging from castor oil to turpentine, petrol, paraffin, and diesel oil fuel. I have tried them all, but find I can run most model diesels on a simple mixture of one measure of diesel oil fuel, one measure ether, and half measure of heavy lubricating oil, such as Castrol XXL. Fuel has to be kept well corked up in its bottle, because the ether is very volatile and evaporates rapidly, leaving too much of the other ingredients. Another excellent fuel mixture is one measure each of castor oil, ether, paraffin (commercial), being careful to mix the castor oil with the ether first, then adding the paraffin or diesel oil.

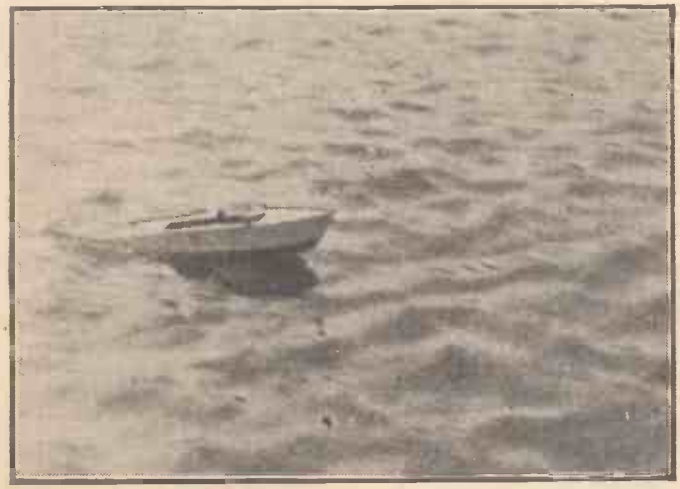


Fig. 3.—C. E. Bowden's 19in.-long speed-boat is here seen travelling fast across a pond. This boat, like the aeroplane in Fig. 1, is powered by a "Majesco Mite" diesel of only 0.7 c.c.

A very well-known and effective specially-made commercial fuel for model diesels has already appeared on the market known as "Mills" fuel. This only requires mixing with equal parts of ether. There is an excellent little British diesel, called the Mills, of 1¼ c.c.

How the Model Diesel Works

We have not the space to go into the full working of an ordinary three-port two-stroke engine, for that is what the average model diesel is, except for one change. Most have a variable compression adjustment that the owner can operate by hand. The compression can be slightly raised to start, and then reduced again when the engine warms up and when the gases expand due to engine heat, which automatically raises the compression. What is termed a "contra-piston" is fitted to the engine. This is a small sliding piston fitted inside the cylinder at the top and above the piston.

An external screwed tommy bar hand adjuster forces the contra-piston down when the tommy bar is turned in a clockwise direction. When turned anti-clockwise, the adjuster relieves pressure on the contra-piston and the weight of compression forces the contra-piston upwards. In practice, when the contra-piston is forced nearer the piston top at the top of its stroke the space between contra-piston and piston is obviously reduced. The "mixture" is therefore squeezed into a smaller space, which raises the compression.

Starting

To start the average engine the normal procedure is to screw down the contra-piston quarter to half turn, suck in fuel by choking the induction orifice with the finger for a few turns, then turn the engine very smartly to create the greatest possible "squeeze" and its resultant heat. The engine should start and warm up very quickly, when the contra-piston should be returned to its normal "best run position," i.e., quarter to half turn back of the hand adjuster.

Any slight adjustment to the carburetter needle valve is now made to obtain maximum revs. Diesels are not normally as critical to carburetter fuel adjustment as their model petrol brothers. But there is a definite relation between adjustment of fuel strength and compression ratio that the owner quickly senses.

Some model diesels have fixed compression. In this case there is no contra-piston and the fuel has to be very accurately mixed. The disadvantage is that the owner cannot test for maximum performance when the engine becomes hot. The advantage of such engines is simplicity of manufacture and operation.

Starting is more simple on a good model diesel than in the case of a good petrol engine. Good diesels are very good starters, contrary to popular belief of the uninitiated. Some of the early efforts of engine constructors have unfortunately created this false impression. The secret of a good diesel is lack of friction, i.e., an easy turner, and yet a perfect fit is essential between piston and cylinder. The piston must fit into a perfectly round and parallel cylinder bore. These attributes sound fairly easy of attainment, but, in practice, it has often been found that the prototype engine has been produced on these lines, but that when production of a number of engines takes place there are some bad slip-ups! It is only those firms who can attain the points I have mentioned that succeed. It should be evident that as a diesel depends upon the constancy of its high compression, the piston seal must remain good at different temperatures. Also, because the engine has to bounce over against a very high compression (over twice as high as its petrol competitor), if there is any undue friction to contend with, the engine cannot carry on over the initial strokes when starting. The British B.M.P. diesel is made in two sizes, a 0.9 c.c. (seen flying my little model in Fig. 2) and a 3.5 c.c. engine, which I also use a lot in flying-boats. Both these engines are at present unique in this country, in that they have ball races fitted for the mainshaft bearing, which certainly is an aid to friction-free running. Many model petrol engines in America are now fitted with ball-thrust races in the quest for friction-free performance where high revs. are required. There are, however, some very outstandingly good starters amongst plain bearing British and Continental engines. I cannot give a long list of these, because of space considerations, but two very good engines come to my mind—the 2 c.c. Majesco and the new 5 c.c. ETA engine, both British.

In Fig. 4 is seen a photograph of the ETA, and this will clearly show the compression hand adjustment lever situated on top of the cylinder that I have mentioned as a feature of most model diesels. It will also be observed that there are three other

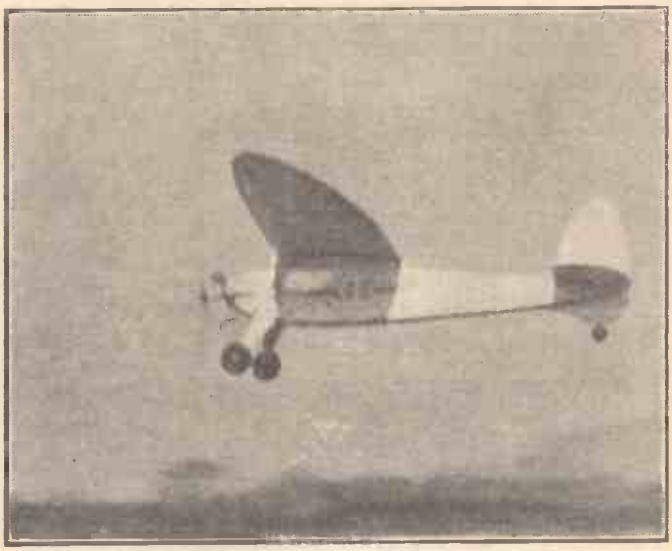


Fig. 2.—The author's slightly larger model, called the Meteorite, plans of which are available commercially. This little model can be seen in the air, flying by the power of a British 0.9 c.c. B.M.P. diesel. It is also suitable for 1 c.c. to 2 c.c. diesels and has a wingspan of 45in.

adjustments on this engine if the "carburetter" is examined. The lever facing the reader is the fuel needle valve that passes more or less fuel as desired to make the correct mixture of air and fuel. At the rear there is a lever that chokes the air intake for starting, instead of using the more common method of temporarily blocking the induction pipe with the finger, and on the far side of the carburetter there can be seen another lever. This, when pulled back by a time switch, shuts off the fuel supply completely. The engine can, therefore, be stopped in the air or on the water by a time switch at a predetermined time.

Reliable Running

Again there are a lot of gloomy remarks current about the bad wearing properties of a model diesel engine. In actual fact, good diesels wear extremely well *provided they are not run at too high a compression ratio*, which some people are inclined to do in the belief that the higher the compression the greater the power. Actually, too high a compression reduces speed and power, gives a muffled note and *makes starting very difficult*. I could quote a number of examples, but three will suffice to give a picture of good wear. In my somewhat large stable of diesels I have a German 6 c.c. "Eisfeldt" that has run countless hours in German hands to make Nazi youth air-minded during the war. It has since run a great deal for the benefit of certain British manufacturers interested in the early diesel days over here. I have used and demonstrated it a great deal, and it still powers a flying-boat of mine over Poole water on occasions.

I have one of the British "Frog" 1 c.c. diesels, weighing about 4½oz., which did over 30 recorded hours' running before I had it. It has since done a great deal more in my hands. Thirty hours is a long time for a model engine that normally only flies a model aeroplane or drives a boat for a few minutes at a time.

Two "Majesco" British engines, one of 2 c.c. and the other of only 0.7 c.c., have now run very long periods in all kinds of my experimental models, aeroplanes and boats. Both are still running beautifully. And so I could go on, although I could also record some bad examples. The fact is the diesel must be a good one, properly designed and made of the right material, and *then not run on too high a compression*. It then wears very well.

Types of Models that Suit Diesels

I have shown examples of the tiny models powered by 0.7 c.c. diesels to 1 c.c. diesels in the early photographs. The tiny diesel is particularly suitable for baby models because it eliminates the weight of electrical ignition gear, which in the past has been a limiting factor in size reduction of the working model. Electrical gear for the ignition has been out of all proprotion to the weight of the baby petrol engine.

The 2 c.c. size of engine is an extraordinary useful type. Fig. 5 shows a low wing model of mine being flown by a 2 c.c. diesel. The wingspan is 4ft. 6in., and this model takes off under its own power after a short but realistic run. I have also run a model speed-boat (vee bottomed hull) a great deal, powered by a 2 c.c. diesel, the hull being 38in. long.

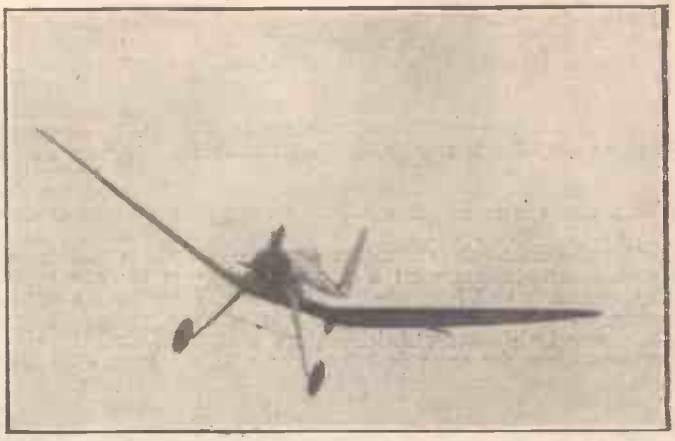


Fig. 5.—The author's low wing monoplane flown by a 2 c.c. diesel engine. The wingspan is 4ft. 6in., which gives an excellent idea of the size of model that this engine can deal with.

Fig. 6.—A scale model "Tiger Moth" flown by Dr. Thomas around himself by the American method of "U" control, which controls the elevators and the engine speed. The wingspan of the model is 40in.

Now look at Fig. 6. This will interest the scale model fans. This model has a 2 c.c. diesel and is a scale "Tiger Moth" which flies around its designer and operator, Dr. Thomas, a friend of mine, who controls it by "U" control. The elevators are controlled by two fishing cord lines, and there is a third line that opens up or throttles down the engine in the air. I have a similar type of model, but in my case a monocoque low wing that I also fly by "U" control.

Diesels of 5 c.c. to 6 c.c. are considerably more powerful and, incidentally, can give one a hefty kick through a back-fire, when starting, due to over-compression. A stout glove on the starting hand is advisable on these larger diesels. They are particularly useful for flying-boats, seaplanes and model cars. I use them a great deal for model flying-boats and seaplanes because I fortunately live near that wonderful sheet of sailing water at Poole. The diesel eliminates all troublesome electrical ignition gear that so much dislikes damp water!

A number of fellow model enthusiasts I know are just taking to the diesel for model car racing. I have recently seen two 4 c.c. diesel-engined cars in action by Mr. Bagent, of Bournemouth, also a tiny 8in. long 0.9 c.c. car, and the redoubtable Mr. Curwen, of model car fame in England, has produced a most interesting and very hot 4 c.c. diesel car. There are also some notable foreign diesel model cars in existence, and there is no doubt that the diesel will become immensely popular in the near future for small model aeroplanes, boats and cars. I also predict that when the fuel has been slightly altered to eliminate the expensive ether, that the model diesel will develop into the baby internal combustion engine of the future auto-cycle, lawn mower and outboard motor.

A New Magnet Material

INCREASED use of small magnets in radio and electrical equipment has called for a suitable magnet material which can be formed into any shape with the minimum, or if possible total, elimination of expensive machining operations.

The Plessey Company, of Ilford, who have been investigating these problems in their laboratories, have now introduced a suitable material known as Caslox.

This is a pressed powder permanent magnet material consisting of a mixture of iron cobalt oxides and a small quantity of plastic binder.

The chief advantage of this new material is that it can be moulded into any shape, and since this technique eliminates machining operations, the way is opened up for much wider application of small magnets, irrespective of their shape. Once the necessary tools are made, as with plastics or similar mouldings, the magnets can be pressed out rapidly in any quantity.

Caslox is particularly suitable for use in small motors and generators. The rotor of a synchronous clock motor is a typical example of a small moulded magnet having a metal insert which can be quickly and easily produced from this material.

The small magnet of a magnetic gramophone pick-up head, telephone and hearing-aid ear pieces are further examples. This material has also been successfully applied in the manufacture of children's toys and similar novelties which incorporate lightweight magnets as functional components.

The density of the material is 3.2 grams per c.c., it is a reasonably good insulator and has a specific resistance of 0.5×10^6 ohms per c.m. cube.

British Cycle Manufacturing Methods

Some Reasons for Low Production Costs

THE evidence at the recent hearings of the U.S. Committee of Enquiry on Tariffs to the effect that American manufacturers of cycles cannot compete with the British either on the score of price, workmanship, or mass-production methods, lends particular interest to the methods employed by leading British makers. Especial importance attaches to the finishing operations on parts upon which the precision and easy running of the finished product largely depends, such as the bottom bracket axle shown in Figs. 1 and 2. The actual finish of this part presents certain problems which only become apparent when carefully studied, and which can be readily overlooked by a production or methods engineer who may not have had considerable previous experience in the trade. It will be seen that this piece has to be finish-ground on four diameters and two radii, and it is obviously desirable from the point of view of costs, no less than accuracy, for this to be done in one operation if possible. While a centreless grinding machine would apparently

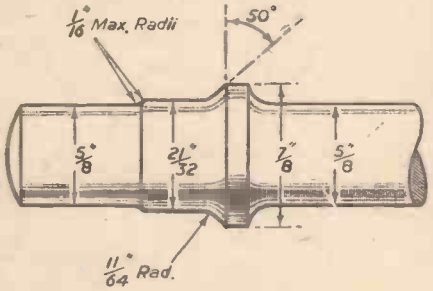


Fig. 1.—Bottom bracket axle, with modification.

furnish the obvious set-up for this, there are difficulties both in connection with loading and ejection, as well as forming the wheels. In connection with the first problem, the average centreless grinder, when equipped for plunge or in-feed grinding, has a wheel advance of only some 1/16in., the effect of which (as will be seen from Fig. 2) is that a piece with two large intermediate shoulders such as this is extremely difficult to load on to the workplate, and once it is ground it is impossible to eject it by the usual mechani-

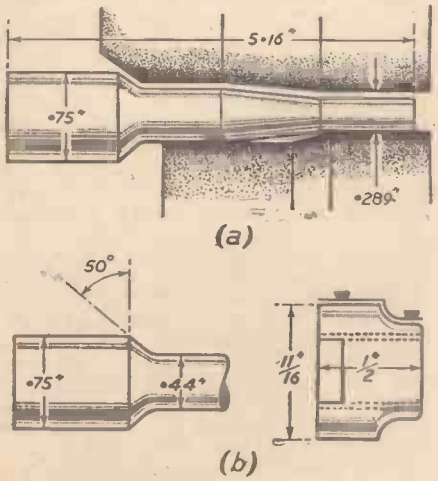


Fig. 4.—Pedal spindle (a) and modification usually adopted (b).

Fig. 5.—Cone and ball race.

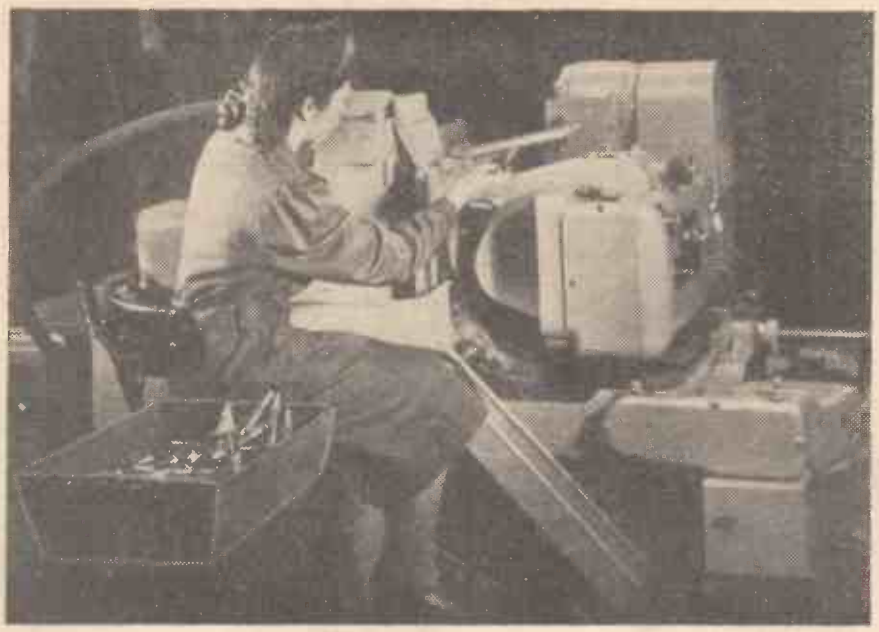
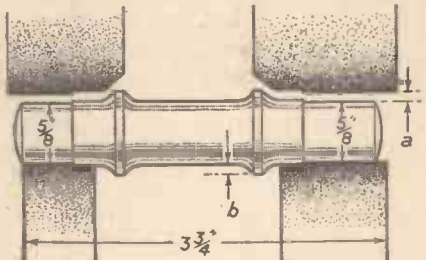


Fig. 3.—Photograph of Scrivener automatic controlled-cycle machine grinding entirely automatically the four diameters and two radii of bottom bracket axles.

cal means of knocking out into the front tray of the machine, as it is enmeshed between the wheels and can only be lifted out slowly and with extreme precaution.

The Controlled-Cycle Solution

The introduction of the Scrivener controlled-cycle for plunge-grinding overcomes the triple problems of loading, ejection, accuracy and finish. In this machine, the loading of the piece is effected automatically



If wheel advance "a" is less than depth of profile "b", the piece cannot be ejected in the usual way.

Fig. 2.—The depth of form presents difficulties of ejection with the older type of centreless grinding machine.

by a magazine on the principle shown in Fig. 3. Ejection of this deeply profiled piece is effected by dropping it alongside the workplate at the conclusion of the grinding operation, which latter can be prolonged as much as may be desired. The dropping of the piece is rendered possible by the fact that the controlled-cycle mechanism permits of a maximum withdrawal of one inch for the control wheel in place of the mere 1/16in. which is all that is possible with the older type of machine actuated by hand lever.

The Difficulty of Form

A further difficulty is frequently encountered in ensuring a perfect blend between the various diameters and the ball-race radius when this is attempted by the combined method of wheel-crushing for the radii and diamond-truing for the diameters. With the Scrivener method a slight modification is made to the axle as shown by Fig. 1, which permits of truing the complete wheel profile by means of a diamond mounted on a slide which is hydraulically traversed across the profile of a suitable former. This ensures that the operation of truing the wheels is virtually fool-proof instead of involving the difficult operation of blending two different units.

Production

A Scrivener controlled-cycle machine, when working upon axles with a stock removal of .006in. to .008in. will grind the four diameters and two radii entirely automatically at rates up to about 720 finished axles per hour.

Pedal Spindle

The pedal spindle illustrated by Fig. 4 is ground along the whole length under the head on the same type of controlled-cycle machine equipped with a suitable magazine-feeding device at the rate of 600 per hour in the case of work involving a stock removal of .006in. to .008in. In this case, in addition to a special magazine, the wheels em-

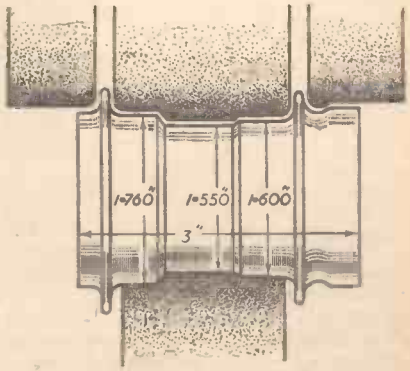


Fig. 6.—Hub completely ground over the whole profile.

ployed would consist of one 5½in. wide for grinding and a 4in. wide control wheel.

Cones

The cones shown by Fig. 5 are usually only specified to be ground on the radius forming the ball-race, but on the Scrivener controlled-cycle machine they are ground all over for convenience in controlling the piece during the grinding operation. The operation necessitates grinding and control wheels 1in. wide, a special workplate, and a magazine of the combination type for selecting and loading. On work with a stock removal of .005in. to .008in. ground all over, the production is 600 per hour.

Hubs

The hubs shown by Fig. 6 require grinding upon the two end diameters, the three inner diameters and the rims, in fact the complete profile is ground (with the exception of the outer diameter of the rims) on a controlled-cycle machine equipped with a special wheel cluster and special workplate. The feeding device in this case is of the semi-automatic (not the full automatic) type, and the production on this account is proportionately lower, being about 180 per hour removing up to .025in. stock.

These and other achievements of machine-tool manufacturers help to explain why (according to admissions made by the American cycle manufacturers at the recent official inquiry) the production of the British industry is larger and the finished product more accurately built than those of the United States. The same developments also show some of the reasons for the success which the British cycle is enjoying in some of the most competitive export markets of the world.

Observations—3

Interesting Scientific Facts About Everyday Topics

By Prof. A. M. LOW

(*Continued from page 206, April issue.*)

Thought and Energy

IT is extraordinary how the small amount of technical learning available to anyone seems to become more linked up in its various branches every day. We now know that the class of traffic passing over a bridge varies the amount of wear that takes place. It has even been found that certain shapes of girders may produce windage in such a fashion as to cause these parts to tremble sympathetically until the tiny particles in the metal re-arrange themselves into a less strong physical formation.

Science tells us that we cannot destroy anything, and that if you burn a match and could destroy that match the whole balance of the world might be upset. For myself, I do not credit that it is possible to think without our thoughts having some effect, because energy cannot be destroyed and therefore the energy of thought *must* go somewhere and do something.

It is only our own ignorance that does not let us know what happens when we consign our friends to perdition. It is only prejudice that prevents us from teaching and publishing that a good thought has a definite effect. Yet it is a scientific argument which can be supported by normal logic.

There are many strange fancies which have now become partly true, and perhaps one of the most famous examples is that when we shout with rage the surrounding air is appreciably warmed. No one would have believed this a few years ago, yet it is capable of establishment by the use of definite electrical measuring instruments.

Thin wires stretched across a trumpet have their temperature raised by noise; the principle has been used in warfare for examining the noise of distant gunfire. What *I* want to know is what happens to this heat. It intrigues me also to think that the voice, ethereal emanations, and heat effects belonging to people who apparently died centuries ago are still wandering round the universe and contacting in some fashion with our own earth.

I am far too modest to believe that any thought of mine, or apparatus I might design, can be collected in the form of rappings upon the tables or jazzings on a tambourine.

Birds and Buildings

I HAVE been told that there is a building in a certain Southern State that is gradually crumbling to pieces from the attacks of birds upon its mortar. Birds can see very well, and I do not find it hard to believe that something in the mortar encourages the presence of insects which the birds try hard to dislodge in moments of before-dinner temper!

The real fact of the case is that if we knew the consequence and scientific details of each and every action or thought of which we seem to be capable, we might be so frightened of these consequences that we would never dare to think at all. But whether it is best to forget what might happen, by light, love, laughter and song, I will leave you to decide. A blackguardly thrush is pecking at my wall at the moment. Shall I save the building from physical destruction, or shall I think that the bird is beautiful and clever and lay up a little store of happiness by relying upon the everlasting value of mental effort?

Round and Round

WHEN you snip off a piece of paper about 1in. long and ¼in. wide, or, indeed, any shape of this kind, it twirls rapidly as it falls. Surely you must have wondered why? You would not take a queer thing like that for granted?

If that slip of paper be examined under a microscope it is never the same on both sides, nor is it ever quite straight. Nor, once again, is the air in a room ever quite stationary.

Due to any of these causes, the paper, as it drops, has an initial jerk of some kind, and this allows the air to slip more easily over one surface and one edge than those which are opposite. The effect mounts up and away goes the paper, twiddling for all it is worth. Little things are not useless. Many observations of this kind were made by the early aeronautical designers, whose observations are embodied in every 'plane that breaks the record to-day.

Crockery that Sings

IF ever you are staying at a nice, old-fashioned hotel and in your room is a china hand basin, fill it with hot water and listen. It is very likely that you will hear a gentle singing sound like radio that has gone wrong.

Do not write to the Society for Psychical Research, but examine the surface of the old basin closely and you will see that it contains a large number of hair-like cracks in the glaze. Water seeps slightly through the first layer of glaze, causes these little pattern pieces to rub together as they expand and drive out the air which is contained beneath. Hence the singing.

It is a queer thing that air sticks quite hard to solid surfaces. You will remember the example I gave of the cigarette thrown out of the car window? The match or cigarette seems to stand still for a moment because the air sticks to the surface of the car. When electric light bulbs are evacuated quite a lot of air sticks, and if one has a few lead shot inside the bulb and twirls it round and round, air is actually released from the microscopic irregularities in what to our eyes is a perfectly smooth surface.

A new British aircraft, the Percival "Merganser," a twin-engined 5-6 seater high-wing monoplane, designed for air taxi and air freight work, which was demonstrated at Luton airport recently.

The Design and Operation of D.C. Machines

Further Notes on Their Principles and Design

By W. H. SUTHERLAND, B.Sc.

(*Continued from page 309, July issue.*)

WHEN a D.C. dynamo is put on load (that is, commences to supply a current to some external circuit), the iron core of the armature is magnetised by the passage of the current through the armature winding. It must be emphasised that such magnetisation is quite independent of the presence of the main poles, and would take place just as readily if a current of the same magnitude and direction were passed through a stationary armature removed entirely from the effect of the field system. The form of the magnetic field produced in the armature can be deduced easily by considering the fields of the individual conductors. The lines of force due to a straight conductor are circles, of increasing radius, surrounding the wire, and the direction of the magnetic force around the circles can be found by applying Maxwell's Corkscrew Rule :

> Imagine a corkscrew (or any right-handed screw) to be rotated so as to move along the wire in the direction of the current. The direction of rotation of the screw gives the direction of the magnetic force around the circles.

In Fig. 8, these lines of force are drawn for the two conductors directly under the field poles. By Fleming's Right-hand Rule (Fig. 2, previous article), it was deduced that a clockwise rotation of the armature will drive current upwards from the plane of the paper in conductors passing beneath south field poles, and downwards in those passing beneath north poles. Applying the corkscrew rule, the magnetic force is seen to be clockwise beneath a north pole and anti-clock beneath a south main pole, as indicated by the arrow heads in Fig. 8. The effect of the armature current in the complete armature winding is, therefore, to produce armature poles in the positions shown.

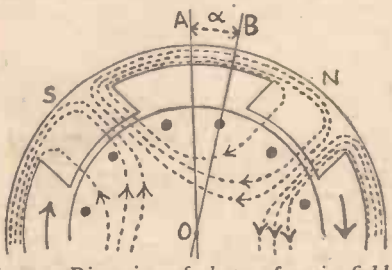


Fig. 9.—Distortion of shape of main field by interaction with armature field, causing increased flux density at the front portions of the poles.

Armature Reaction

It might be thought at first sight that such poles would have little effect on the operation of the machine, since they occur exactly midway between the main field poles. Unfortunately, that is not the case. A closer examination of Fig. 8 will reveal that the direction of the armature flux is directly opposite to that of the field pole flux in the region where the two fluxes mix over the back half of each field pole, whereas both fluxes pass in the same direction across the air-gap over the front half of each pole. Lines of force in opposite directions are mutually destructive, so that the effect of armature reaction is *to weaken the field over the back half of a field pole and strengthen it over the front half (in the direction of rotation)*. This is illustrated in Fig. 9, by the concentration of the lines of main flux at the front edges of the poles, little, if any, flux passing across the gaps at the back edges. It is almost as if the armature exerted a frictional " drag " on the field flux, tending to pull the lines with it in the direction of rotation.

The immediate effect of this distortion of the shape of the main field is a displacement of the region of zero flux from the geometrical centre of the interpole gap (OA) to a new position (OB), displaced *in the direction of rotation by an* angle alpha from the original position. OB is, of course, approximately midway between the two *front regions* of the poles, while OA is midway between the *centres* of the poles.

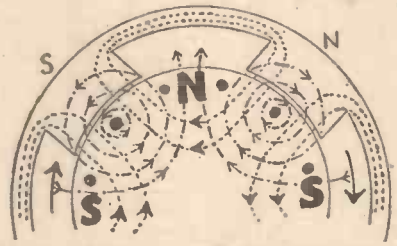


Fig. 8.—Interaction of the armature flux and the field flux, and production of armature poles.

Commutation by Brush Shifting

In resistance commutation, it is necessary that each loop of the winding shall be short-circuited by a brush while passing through the region of zero flux, in order to avoid circulating currents in the shorted loop with consequent sparking at the brushes. This is achieved if the conductor drawn crossing the line OB in Fig. 9 forms one side of the loop which is shorted at the instant of the diagram. In all the diagrams of dynamo windings shown so far, the brushes have been placed so as to short-circuit conductors while crossing the line OA, the region of theoretical zero flux. Such machines would run without sparking only on no-load, when the position of zero flux would actually lie in the region OA. As soon as armature current commences to flow, the position of zero flux moves forward to OB, and the machine commences to spark at the brushes, *unless the brushes are also advanced by an angle alpha in the direction of rotation.* This advance of the brushes is shown in Fig. 10, where commutation is occurring in those loops (drawn dotted), which are passing through the regions of actual zero flux.

This system works well so long as the load on the machine remains reasonably constant, but any large variation in armature current (either increase or decrease) will cause a corresponding shift of the line OB, and sparking will commence again. Brush advancing is, therefore, a solution of the problem of sparkless commutation only in the case of constant load machines (e.g., for accumulator charging, or industrial processes requiring steady D.C. current). For large, variable load machines, an attendant would be required to adjust the position of the brushes with every major variation in load. In very small machines, where the problem of sparking is not very serious (on account of the smaller E.M.F.'s involved), it is usual to fix the brushes with a permanent small shift in the direction of rotation, sufficient to compensate for an average amount of armature reaction.

E.M.F. Commutation

For large machines, a much more satisfactory procedure is shown in Fig. 11. Small auxiliary poles—called " commutating poles " or " interpoles "—are fitted at the geometrical centres of the interpole gaps, and are arranged to have *the same polarity as the following main field pole.* A comparison of Fig. 8 with Fig. 11 will render the method of operation immediately apparent. Due to armature reaction, the iron of the armature is magnetised with poles, as in Fig. 8, and these occur exactly opposite to the small interpoles. In Fig. 8 the north pole of the armature is sending flux *out* of the armature ; in Fig. 11 the north interpole is sending flux lines *into* the armature in the same region, and the two fluxes are therefore mutually destructive. *If the magnetic strength of the interpoles can be maintained equal to the magnetic strength of the armature poles for all values of the load, then the two fields cancel, and armature reaction has been prevented.* The position of the zero flux now remains at the geometrical centre of the interpole gaps, and sparkless working is assured at all loads with the brushes fixed permanently opposite to the centres of the main poles.

An alternative explanation of the action of the interpoles is as follows : With no-load, zero flux occurs midway between the main poles. As load is applied, the zero flux position moves forward, and a conductor passing the centre of the interpole gap is still virtually under the influence of the field of the preceding pole, and will therefore have an induced E.M.F. which will cause sparking if the brushes are left in the no-load position. Since the interpole is opposite in sign to the preceding pole, it will induce an E.M.F. in the commutated loop opposite to that induced by the field of the preceding pole, and, if these opposing E.M.F.'s can be kept equal in magnitude, there will be no resultant E.M.F. tending to drive circulating currents around

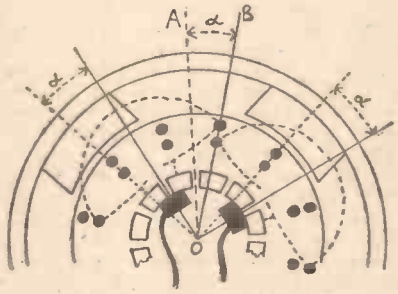


Fig. 10.—Shift of the brushes through an angle alpha in the direction of rotation to keep short-circuited loops in the region of zero flux on load.

the loop undergoing commutation. Hence the derivation of the term "E.M.F. Commutation."

Fortunately, it is easy to arrange that the interpoles shall exactly balance the armature poles at all loads by connecting the magnetising coils of the interpoles in series with the external circuit, as shown in Fig. 11. As the load increases, the effect of armature reaction and the compensating effect of the interpoles increase exactly in step. On no-load, armature reaction is absent, and the interpoles remain unmagnetised, since there is no current flowing through the magnetising coils.

Effect of Armature Inductance

The armature winding forms a highly inductive circuit, and this tends to slow down the rate at which current reverses in a loop

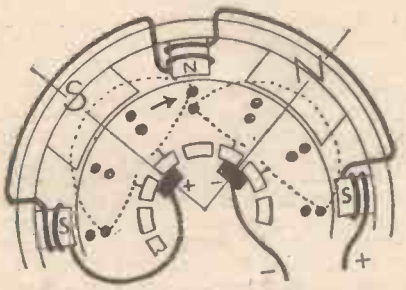


Fig. 11.—Use of interpoles to produce an E.M.F. in shorted coils equal and opposite to that produced by armature reaction.

undergoing commutation. Two simple methods are available to "speed up" the reversal of current. In the first, the brushes are advanced in the direction of rotation *by an angle greater than is required to counteract armature reaction*. This procedure brings the shorted loop slightly under the influence of the next following pole, and the small E.M.F. thus induced in the loop is in the correct direction to help in the rapid reversal of current. Like armature reaction, the effect of armature inductance varies with the load, so once again this method is most effective in constant load machines.

When interpoles are employed, these may be magnetised to an extent greater than is necessary merely to balance the armature reaction. Since the interpole has the same sign as the following main pole, this is exactly equivalent to bringing the shorted loop slightly under the influence of the following pole, and the small E.M.F. needed to reverse the current is thus obtained. In this case, the extent of the over-excitation of the interpole increases with load, so that armature inductance is balanced for all operating conditions without the need for variable brush shifting.

Calculation of Dynamo Voltage

The E.M.F. generated by a dynamo may be calculated from the formula

$$E = \frac{p}{a} \cdot \frac{\theta Z n}{10^8} \text{ volts}$$

E = terminal E.M.F.
p = number of field poles.
a = number of parallel paths in armature.
θ = flux through *each* field pole.
Z = *total* number of armature conductors.
n = speed in revs. per *second* (not r.p.m.).

Strictly speaking, E is the terminal voltage on no-load. When the machine is loaded, some of the available induced E.M.F. is used in driving the load current through the armature resistance. The terminal voltage (call it V) is then less than the induced E.M.F. by this amount, so that—

$$V = \frac{p}{a} \cdot \frac{\theta Z n}{10^8} - RI$$

I = current delivered to external circuit.
R = brush-to-brush resistance of armature.

As a rule, the value of R is small, and the copper loss in the armature may be neglected in practical calculations. It should be noted that (a) has the value 2 for *all* wave windings, but has the same value as (p) (therefore making the factor p/a equal to unity) for lap-wound machines.

The only factor which may cause difficulty in the practical application of this formula is θ, the flux per pole. This may be calculated from the formula—

$$\theta = \frac{4\pi NI}{10 \times S} \text{ lines.}$$

N = number of magnetising turns.
I = current (amps.) through field coils.
S = reluctance of complete magnetic path.

For each pole, the reluctance may be taken as half that of any one of the four magnetic paths, since each pole has two flux paths virtually in "parallel." The factor S requires some explanation. The reluctance of a magnetic circuit is almost exactly analogous to the resistance of an electrical circuit. In the magnetic paths through a dynamo, the reluctances of the separate sections (i.e., pole pieces, air gap, etc.), may, therefore, be added together numerically to give the value of the total reluctance for the path (like resistances in series). The reluctance of any section of a magnetic path may be found from:

$S_1 = \frac{L_1}{p_1 a_1}$ L_1 = length (cms.) of that section of path.
p_1 = permeability of material of section.
a_1 = cross section (sq. cms.) of section.

The value of p, the permeability, is usually of the order of 1,000 for iron, and is, of course, unity for air. Finally:

$S = S_1 + S_2 + S_3 + \ldots\ldots$

Characteristics of D.C. Machines

The operating characteristics of a D.C. dynamo may be deduced from the formula for the terminal voltage on load. Combining terms which remain constant for a particular machine, this may be rewritten:

$V = k\theta - RI$

For a shunt connected dynamo, the value of θ is independent of the load current for normal loads, so that the terminal voltage should also be independent of load conditions. However, as the load increases, the value of the product RI becomes appreciable, causing a drop in the value of the expression for V. This is clearly to be seen in the falling slope of the line (b) in Fig. 12. The terminal voltage drops as the load is increased, slowly at first, but then rapidly. To explain the dotted portion of the curve, remember that the increase of load current must be obtained by decreasing the resistance of the external circuit. Beyond a certain point (known as the "critical resistance"), the machine refuses to generate, since the terminal voltage has dropped below the value needed to maintain a working flux through the field poles. The machine will, therefore, not operate inside the dotted region.

For a series connected dynamo, θ is directly proportional to the load current (assuming that the machine is operated below magnetic saturation). The relation between V and I is, therefore, approximately a straight line through the origin, as at (a) in Fig. 12. However, for large values of load, the product RI begins to take effect, and the magnetic circuit begins to approach saturation, so that the curve becomes parallel to the current axis. When magnetic saturation has been reached, any further increase in the current will cause an increase in the various losses without a corresponding increase in the

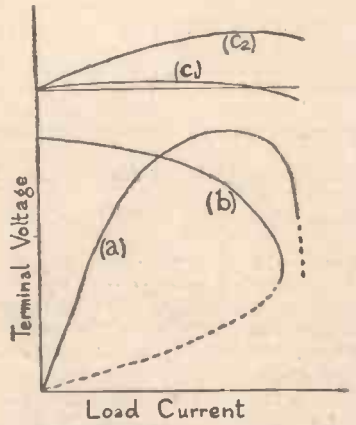


Fig. 12.—Characteristics of D.C. machines.
(a) = series fields.
(b) = shunt fields.
(c_1) = normal compounding.
(c_2) = over-compounding.

generated E.M.F., and the terminal voltage drops.

In compound machines (i.e., field coils partly shunt connected and partly series connected), the rising series characteristic can be made to compensate for the falling shunt characteristic, causing the terminal voltage to remain constant over large ranges of current, as shown by line (c_1). When current has to be transmitted over large distances to the consumer (e.g., for tramcars or trolley-buses) a slightly rising characteristic is an advantage, to compensate for the increasing loss of voltage in the cables when greater currents are consumed. In this case the dynamo is generally "over-compounded" that is to say, the field is obtained more from the series sections of the field coils than from the shunt sections, and the rising nature of the series characteristic predominates, giving a result such as line (c_2) in Fig. 12.

NOTES ON CEMENTS

GLYCERINE and red lead mixtures are very good for cementing metal objects into their sockets, and suchlike jobs. Raw linseed oil with resin, boiled up and added to red lead, makes another cement for similar purposes. Ordinary putty is whiting and linseed oil. This tends to dry up and come away, and a better mixture is to admix litharge (or red lead) to linseed oil with some lime. The lead decomposes the oil which combines with the lead to form a lime soap which is insoluble in water, therefore providing a waterproof mixture. When used, it is best to paint the surfaces of the crevice or fillet to be puttied up with linseed oil.

Waterglass Cement

A mixture of glass powder and pulverized fluorspar with waterglass (silicate of soda), in the proportion of 1, 2 and 6, is made up and used at once. It sets very hard in a few moments. Lime and waterglass form very durable cements.

Heat-resisting Cements

Mix up quite quickly 8 parts of pyrolusite crystals (manganese dioxide) with 10 parts of zinc oxide and 2 parts of waterglass (silicate of soda, egg preservative). It is very rapid setting, and when once fused forms a glass-like mass of great adhesive power

Switzerland Can Make It

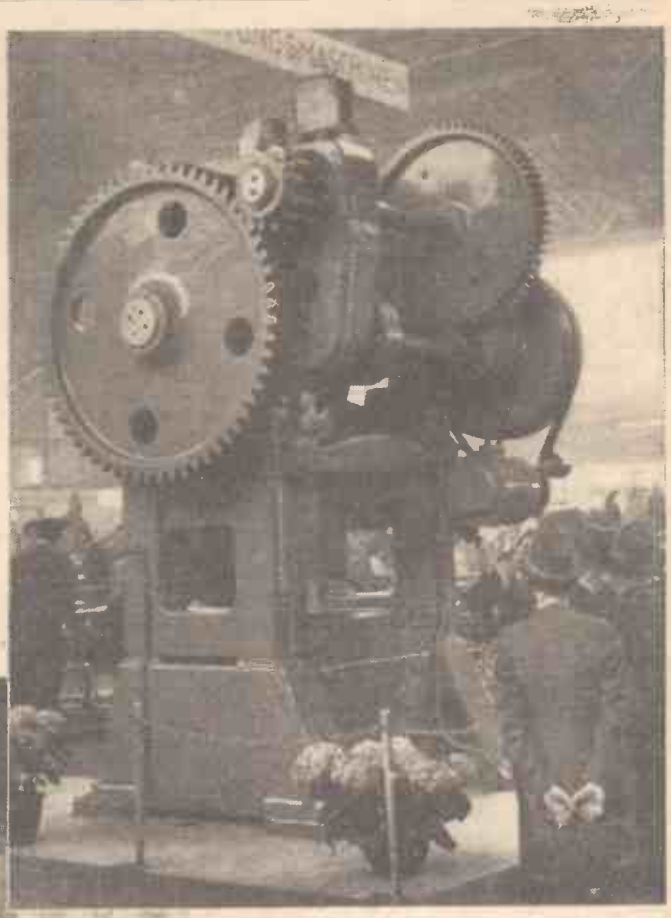
Afterthoughts on the Swiss Industries Fair at Basle

By the MARQUIS of DONEGALL

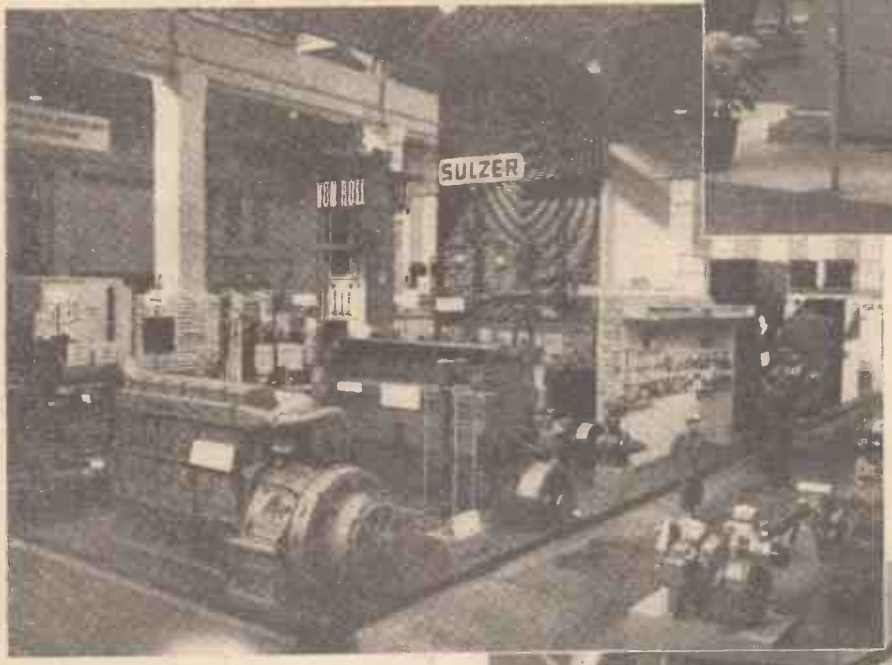
THE above headline is not news. Everybody knows that Switzerland Can Make It. The question that is disturbing the Swiss—and, incidentally, most of the rest of the world—is: Can Switzerland Sell It?

The Swiss, with their thoroughly practical nature, are much perturbed at having the most valuable currency in the world. They are as loathe to undervalue the golden eggs that their goose of two wars' neutrality has laid for them as they are to starve. It sounds silly, but starvation is the alternative. A knowledgeable Swiss with whom I got into conversation in a second-class railway compartment (only Germans, Japanese, Hungarians, Roumanians and Finns have enough money to travel first), put it more clearly than I have heard since I was at school in Switzerland.

He said: "You see, broadly speaking, we have nothing but salt, stone and water-power. It is not sufficient, that we may live, to import a raw material, double its value by processing and re-export it. For us to live, Swiss skill must export it at ten times its original value." Hence all the precision stuff, from watch springs to fancy-dress motor-bicycles.



A Swiss-made power press in the heavy industry section.



Heavy industry exhibits at the Basle Exhibition.

Watchmaking and Jewellery

It is going to be very difficult to give you a run around the Basle exhibition in one short article. Let me explain first that the Hall of Watchmaking and Jewellery alone occupied an area equal to the whole of the "Britain Can Make It" Exhibition. I spent two whole days and still did not cover quite everything.

Before I start on the few items that I shall select, a word about the general set-up. Apart from the fact that any starving person could have eaten his way round the exhibition for ten days, for nothing, it did transpire that the Swiss are a very artistic nation. I think that "artistic" is the right word—even if it is applied to essentially modern presentation. It takes imagination to have tropical birds so invisibly controlled in the Hall of Fashion, that they looked as though they were flying at liberty. It takes imagination to reconstruct a schoolroom full of male and female "Charlie Macarthys" at their desks. The schoolmistress puts a piece of paper under each "pupil's" right hand. At the press of a button they all write out a message advertising a pencil called "Caran d'Arche." The messages are distributed to the interested spectators.

This view of a corner of the Exhibition gives a good idea of the good lighting and lack of crowding.

Cycles and Motor-cycles

When you feel strong enough you walk the quarter-mile to the Hall of Bicycles. The bicycles and motor-cycles were, from our standards, "fancy." Very lovely to look at in their chromium and with all their gadgets from speedometers to picnic holsters. One enterprising firm had "Big Bear, Middle Bear and Little Bear" riding cycles down a synthetic snow slope. A large prize was offered for the nearest computation of the Big Bear's mileage during the exhibition.

Although it may be old to my expert readers, I was very interested in the new-style dictaphone. This machine is called a "Textophone." Obviously, it records dictation, but it does it on everlasting steel wire, as opposed to the old wax cylinder. It has remote control, volume control for loudspeaker, can record a whole conference of two hours, is noiseless and plugs into the electric light. Apart from this, if you ring up your house, it will take a message over the telephone. No! Not quite as good as the "Ipsophone"! I'm coming to that.

The "Textophone" is purely a dictating machine which, if so arranged, will record a telephonic conversation or message.

The "Ipsophone"

I had the opportunity of testing the "Ipsophone" at the exhibition. Apparently, even in Switzerland, you cannot buy it. It's like my house-and-office "inter-com"—you hire it (five Swiss francs per day). Taking it at the most official rate of exchange, it would cost you over £100 a year to hire.

The "Ipsophone" is, I am sure, well known to you. So I will be brief. I went into a telephone booth and rang up my "home." My wife was at "home"—another kiosk—but did not answer my call. As I rang, the Voice (had I been in England) would have said: "Lord Donegall is not at home. Will you please dictate a message." As it was, the Voice said the equivalent in German, and I dictated my message. My wife then picked up the receiver and got the "play-back," which, of course, she could have done, in real life, hours later.

My good friends of the G.P.O. told me months ago that they know all about the "Ipsophone"—and, indeed, have an improvement on it.

A view of the recreation ground attached to the Exhibition.

It was nice to see just one disguised British product. There may have been others that I did not notice or were too disguised to be recognisable. The one to which I am referring is the Standard Jaguar cycle—manufactured in Switzerland and, anyway, a nice British name.

Domestic Novelties

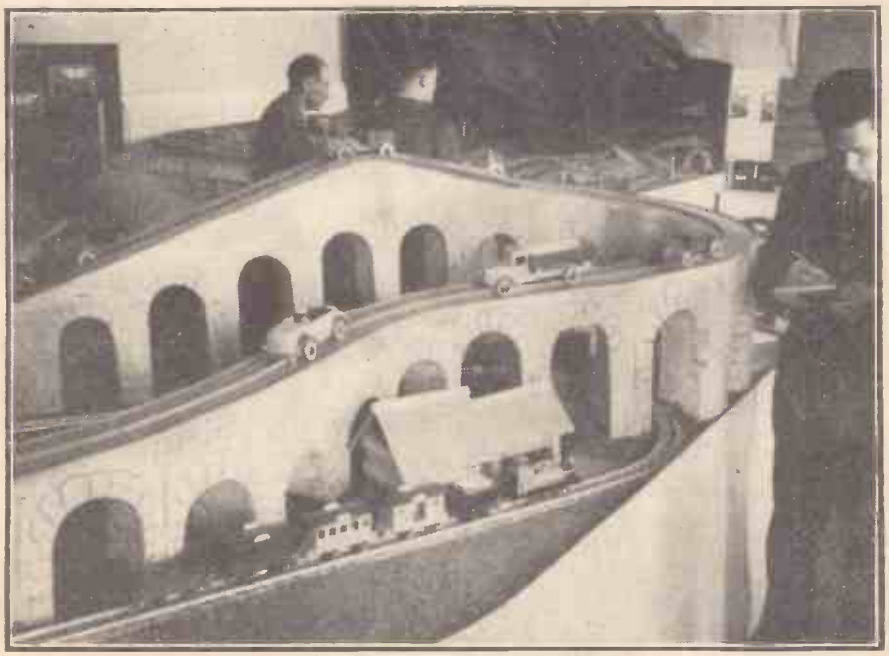
The "Chest-that-Furnishes-Your-House" has not yet been seen in this country. Out of the "chest" you build up two spring single beds, a wardrobe, a table, four chairs, and cooking utensils. This utility furnishing was devised by "Aermo," of Zurich, in conjunction with the Swiss Red Cross, for the help of the displaced and homeless masses of Europe. It is a gem of neatness. "Could you put it back into the chest?" I asked the demonstrator. "I think *I* could!" he replied, somewhat non-committally.

On the "put-together-yourself" principle one of the best things was the tubular set that makes anything from a wheelbarrow to a scooter. Incidentally, it also makes 97 known things, from dumb-waiters to cots.

Cots bring me to perambulators. The pneumatic tyred, streamlined, convertible for fine or wet weather.

The exhibition was wonderful in presentation, initiative, lavishness, artistic conception and practical common sense, and the Swiss courtesy-cum-efficiency that their old yearly immigrants have come to take for granted was also there.

But Can Switzerland Sell It? I hope so. The world would indeed be in a bad way without that sensible little country.



This scenic layout with road transport dashing around mountain passes proved a great attraction.

"Bristol" Engines in the Antarctic

FIRST news of the performance of "Bristol" Pegasus engines powering the two spotter aircraft with the British whaling fleet in the Antarctic was recently received in a cable from Mr. John Grierson, in charge of the unit. Confirming the arrival of a B.A.C. engineer, he reports that 80 hours' flying have been completed in the Antarctic and the Pegasus engines are "as good as ever."

Operating from the 20,000-ton factory ship s.s. *Balaena*, the two Supermarine Walrus spotters are the first aircraft to be used on a whaling expedition. Manned by former Naval Air Service personnel under the command of Mr. John Grierson, well-known Transatlantic flyer and test pilot, who organised the scheme for United Whalers, Ltd., the amphibians are catapulted from the *Balaena* to search for schools of whales. Once the quarry is sighted, radio replaces the traditional masthead shout of "There she blows," and the aircraft remain above the whales to guide the boats.

The present whaling campaign is designed to augment Britain's slender stocks of fats and oils. Great success has already attended the efforts of the fleet, and the catch is expected to exceed £17,000,000 in value.

Memoirs of the Metals

Sidelights of Interest on the Metallic Elements, Their Properties and Characteristics

2—Mercury. The Metal which Fascinated the Alchemists

MORE, perhaps, than any other metal, apart from gold, mercury or quicksilver has intrigued mankind ever since it was first discovered and made use of at some now long-forgotten era of the ancient Chinese civilisations.

Such a fact can well be understood and appreciated, for mercury, the nimble, brilliant, shining liquid metal which is so difficult to handle by ordinary means and which runs away from one's grasp whenever it is able to do so is, from outward appearances, so different from the ordinary stable and stolid metals that its remarkable features attracted the attentions of the magicians, the alchemists, and other chemical dabblers from very early ages.

No wonder, indeed, that this silvery-white, evasive metal was named after Mercury, the winged messenger of the gods, who is usually depicted as a youth wearing a winged hat and "talaria" or winged sandals, and whose mythological characteristic was speed, nimbleness and celerity.

The metal was named also in association with the planet Mercury, the nearest planet to the sun, whose hard, brilliant lustre is to be observed at certain times of the year under favourable conditions shortly before sunrise or after sunset.

Mercury is not one of the metals mentioned in the Bible, but it must have been well-known during the Biblical era. It has been found in Egyptian tombs and it was known to the old Greeks, who called it "chutos argyros" or *quick-silver*. Later on it was dubbed by the Greeks "hydor argyros," *fluid* or *liquid silver*, from whence was derived its Latin name, *hydrargyrum*, by which term the metal to this day is known in pharmaceutical chemistry.

Alchemical Conception

The metal, indeed, fascinated the alchemists. They attributed all sorts of magical properties to it. "Nimble, volatile mercury" they believed to be a constituent of all metals. Indeed, to the ancient chemical magicians all true metals contained gold and mercury.

Curiously enough, mercury itself was always denied recognition as a true metal. It was so different from all ordinary metals, thought these early experimenters, that it could not possibly be a real metal itself. It was, rather, an essential ingredient of metals, yet not essentially a metal itself.

This belief held sway up to the middle of the 18th century, until 1759, in which year mercury was first frozen and shown in that condition to possess every possible metallic characteristic.

The melting-point of mercury is minus

A hook made of frozen mercury supporting a 7lb. weight (the hook is covered with frost, hence its whiteness).

38.9° Centigrade. Solid mercury resembles something between lead and silver in its general appearance. Provided that its temperature is not too low, it can be beaten out like lead whilst preserving something of the whiteness and lustre of polished silver. At the temperature of liquid air (about minus 190° C.) frozen mercury has considerable tensile strength, as is witnessed by the accompanying photograph depicting a hook made of mercury frozen in liquid air supporting a 7lb. weight.

It is recorded that the explorer Ross, when travelling across Greenland in 1849, shot at and actually pierced a plank of wood with a bullet of frozen mercury by way of illustrating the extreme coldness of the region he was traversing.

A curious thing about mercury is that when it is progressively cooled it contracts at a uniform rate, but as soon as its freezing-point is reached it undergoes a large and a sudden contraction. Hence, solid mercury is denser (and heavier) than liquid mercury, the liquid mercury having a specific gravity of 13.59 and the frozen metal having a specific gravity of 14.19.

Another strange thing, too, is that when mercury boils its vapour is quite colourless. You can see through it just as if it were steam, the boiling-point of mercury being 357° C., which is only 30 degrees above the melting-point of lead.

Even at normal room temperatures mercury gives off a vapour. Some people claim to be able to smell it. Certainly the presence of the vapour is easily proved by suspending a fragment of gold leaf within a corked bottle containing a little mercury. Within a day or two the gold leaf will become whitened owing to the formation of an amalgam of gold and mercury.

In very thin films liquid mercury transmits violet light, but is opaque to all other forms of light.

A Poison Metal

Mercury is one of our poison metals. Strangely enough, you could probably drink liquid mercury without being poisoned—provided that you drank enough of it!—the reason for this being that mercury in the mass is not readily digested by the body. But when you grind up mercury with such things as chalk, sugar, lard or olive oil, the mercury is broken up permanently into very fine globules, so fine, indeed, that it is easily assimilated by the body in this state and thus acts as a violent poison.

Some of these finely-divided mercury preparations, such as "grey powder" (mercury ground up with chalk) and "grey ointment" (mercury ground with lard or Vaseline), are

Pure mercury when spilled on to a smooth surface, breaks up into spherical or button-shaped globules which readily coalesce together.

When mercury is only slightly contaminated it forms "tails" which do not easily run together and coalesce.

used medicinally, but always, of course, in sparing amounts.

When we come to mercury vapour we find that this is excessively poisonous, so much so that, until very recent times, the lives of workers at the mercury mines usually ended around the age of 40.

In connection with this toxic effect of mercury vapour, the *Philosophical Transactions* records a striking instance. A Spanish vessel containing mercury in bags experienced rough seas during its voyage to Britain. The bags were badly stacked in the hold of the vessel. They ruptured, and the mercury escaped and ran hither and thither along the bottom of the ship. As a result the whole of the ship's company became violently ill, and it was only with the greatest difficulty that a few of them managed to steer the vessel into port.

Another instance of the very poisonous nature of mercury vapour is recorded. In this case an entire family moving into an old house became ill in varying degrees of severity. Mercury poisoning was diagnosed, but where was the mercury? It was eventually located—a few pounds of it—under the floorboards of the dining-room, having been spilled by a former tenant and found its way there through a crack in the boards.

All the soluble salts of mercury are extremely poisonous, particularly mercuric chloride ("corrosive sublimate"), a white salt, merely two or three grains of which may be expected to terminate the earthly existence of any person swallowing it unless prompt attention is given.

Convict Labour

So dangerous, indeed, are the hazards incurred in the handling of large amounts of mercury that the Spanish Government at one time employed the forced labour of convicts in the quicksilver mines at Almaden, the most valuable mines known and those which normally give rise to nearly half the world's annual supply of mercury. At an earlier date the labour was assigned to slaves, and, at another period, the Spanish Government granted a lifelong exemption from military conscription to all volunteers who had put in a couple of years at the Almaden mines.

To-day, fortunately, at these mines and at others technological improvements have contrived very greatly to lower the mercury hazards, so that mercury winning is now a much safer trade than ever it was before.

The main mercury ore is *cinnabar*, which is a sulphide of mercury. The crushed ore is put into furnaces, carefully roasted, and the mercury vapour which is driven off is collected in receivers and subsequently purified by redistillation. It is transported either in strong leather bags or in iron bottles—usually the latter, which hold about 75lb. of mercury apiece.

Cinnabar has a brilliant scarlet colour. It was beloved by the old painters of the classical schools who used it in their colours on account of its brilliancy and its fullness of shade.

Other mercury mines are located in Bavaria, California, Peru, Japan, China, and Russia, but as regards size and output the mines at Almaden in Spain (covering an area of about 12 square miles), still hold their own, although they have been worked more or less continuously since at least 500 years before the Christian era.

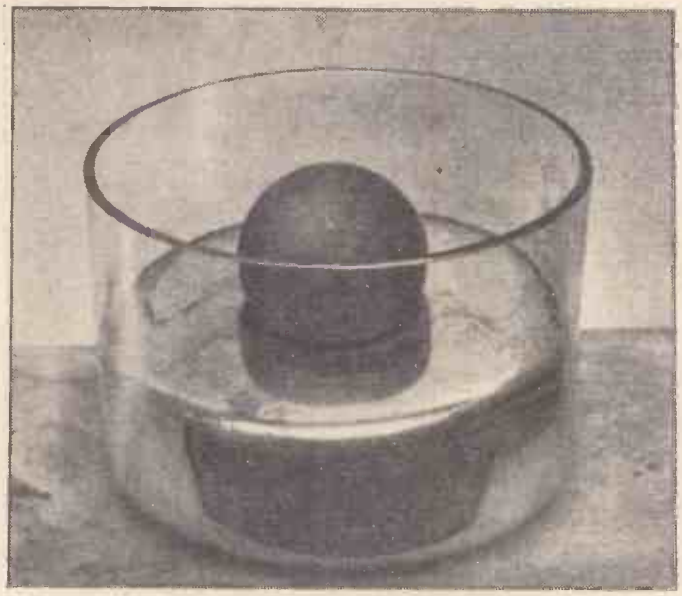
Mercury is the only metal which is liquid at ordinary temperatures, but there is another metal which comes very near to it in this respect. This is Gallium, a metal discovered in 1875, which melts at 30° C. and which runs to a liquid when held in the palm of the hand. Were it only commoner it would replace mercury in many directions.

The properties of mercury, its electrical conductivity, its employment in thermometers, barometers and a host of other scientific measuring instruments are well-known and need not be laboured in this article, neither need we dwell on the modern use of mercury vapour in electric discharge lighting installations, a development which seems likely to increase in extent as the years go by.

Amalgams

It is worth while, however, to consider for a moment the great readiness which mercury possesses of combining with other metals to form metallic mixtures or alloys. Mixtures or alloys of mercury with other metals are termed "amalgams." Such amalgams have many uses from filling teeth to the refining of gold; from the making of low-temperature thermometers to the manufacture of metallic sodium and other materials.

Mercury will form an amalgam with most metals provided that the right conditions are given. With some metals it unites with the evolution of a considerable amount of heat. For instance, grind a small lump of metallic sodium with an equal quantity of mercury. Suddenly, the mercury will amalgamate with the sodium with a miniature explosion and a momentary flash. The resulting amalgam will be quite warm and sometimes even decidedly hot.



Most metals will float in mercury. The illustration shows a heavy iron ball floating in a bath of quicksilver.

On the other hand if we grind mercury with metallic tin we get almost a sort of freezing mixture, the union of the mercury with the tin being attended by a strong absorption of heat.

Perhaps the most industrially important amalgam of mercury is the gold amalgam. On the South African Rand the gold-bearing ore is crushed and ground up with mercury, whereby the metallic gold (and some silver) enters into union with the mercury forming a liquid or pasty amalgam. The amalgam is then heated to drive off the mercury, leaving the impure gold behind. This is a process which is known to have been worked by the Romans.

One of the most curious of the mercury amalgams is a certain crystalline potassium amalgam which is made by heating ordinary potassium amalgam to a temperature of 440° C. The amalgam has the composition K_2Hg. It is, therefore, a definite compound of potassium and mercury, and is not merely a solution of potassium *in* mercury. But the interesting thing about this particular compound or amalgam is that it is spontaneously inflammable in contact with air. A similar amalgam with sodium, Na_3Hg, has the same property.

Mercury is one of the purest of the commercial metals. If it is appreciably below 100 per cent. purity it will not break up into clean, silvery and nimble globules or "buttons" when spilled on to a smooth surface. Even if only slightly contaminated with other metals it breaks up into "tails," as shown in the illustrations on the previous page.

Mercury Turbines

One of the latest of the industrial uses of mercury is that in which it is made to replace steam in high-pressure turbines. Boiling mercury has a greater thrusting force than steam. It is also more readily condensed. Hence, what would be simpler than to boil mercury and to use its high pressure, invisible vapour to drive heavy turbines at high speeds?

The project has been tried out with some success, particularly in America. Yet, apart from the ever-present danger of mercury vapour escaping from the turbine system, the snag is that the vapour of boiling mercury, particularly when it is super-heated, attacks even the most enduring and the toughest of steels. Last year's metallurgical reports from America indicated that experiments were proceeding with a mercury-titanium amalgam which was stated to be non-corroding to steel, but confirmation of these results is still awaited.

A Remarkable Result!

Lastly, one of the strangest of uses to which mercury has ever been put is worth detailing.

The old alchemists had a fixed belief in the mystic powers of mercury. Among other things, they supposed that bread weighted with mercury and thrown on to a stretch of water such as a pond or a lake would float and eventually come to rest over a spot where a dead body lay.

This ancient belief was actually tried out in recent years, the precise date being October 13th, 1932.

On that date a modern loaf of bread was loaded with mercury so as to make it floatable and it was cast into the Coventry Canal at Bedworth, near Warwick, in which it was believed a missing girl lay drowned.

The weighted loaf, after careering about for some time, eventually came to rest over a certain spot in the canal. Excitement ran high when drag-nets were thrown into the water at that area and the body of the girl was at once recovered!

It is possible that coincidence may have had something to do with this event. But, apart from that, science has no explanation for this strange behaviour of mercury, the messenger metal.

Electrical Engineering Developments–2

A Short Account of the Electrical Progress Made by the General Electric Company in 1946

THE progress and development achieved in any one year must bear some close relation to the field in which work has been done. The manifold activities of the G.E.C. are such that a review of progress would cover the whole content of electrical engineering. This review of achievement in 1946 is, therefore, extremely condensed and much has, inevitably, been omitted altogether.

POWER PLANT AND INDUSTRIAL APPLICATIONS

Turbo-alternator Ventilation

Investigation of the problems of hydrogen cooling of alternator windings has been actively continued. The maximum output may be raised by its adoption, and several other advantages also accrue. The design of the seal and casing has received particular attention, as well as such ancillary equipment as apparatus to indicate the purity of the hydrogen and oil purification equipment.

Loom Motors

Largely redesigned, the range comprises seven ratings from ½ h.p. to 3 h.p., the five sizes from ½ h.p. to 1½ h.p. being mechanically interchangeable at same centre height, as are the two larger sizes. This is of considerable convenience to the user, as operating power required varies with the material being handled.

In the smaller sizes the rotor bars are bent over and fused together by carbon arc, a successful method which is being extended to the larger sizes.

Mining Gear

A salient pole synchronous motor rated at 1,500 h.p. has been supplied to the Government Gold Mining Areas (Modderfontein) Consolidated. Operating at unity power factor it drives a 30ft. diameter ventilating fan at 120 r.p.m. The original drive was steam.

A D.C. winder motor with a peak rating of over 4,000 h.p. has been completed for the Crown Mines, Johannesburg. The drive for the associated Ward-Leonard set is a slipring induction motor rated at 1,800 h.p., 2,200 volt, 500 r.p.m.

Synchronous Condenser for Palestine

A 10,000 kVA condenser was supplied for power factor correction at the Reading Power Station of the Palestine Electric Corporation. The load consists mainly of a large number of irrigation pump motors and the condenser is designed primarily for operation at zero leading power factor. Under certain light load conditions, however, the condenser is required to provide 4,000 kVA at zero *lagging* power factor. Remote control equipment and all ancillary plant and switchgear were supplied (see Fig. 1).

Ship Propulsion

Electrical propulsion equipment, including auxiliaries and switch and control gear, is in hand for a new single screw tanker. The salient pole motor is rated at 9,000 s.h.p. at 124 r.p.m. and is supplied by a turbo-alternator giving an output of 6,940 kW. at 3,220 r.p.m., 53.8 cycles.

Power Generation

An order has been received from the North of Scotland Hydro-electric Board for three vertical shaft direct coupled water wheel alternators for the Errochty Power Station in the Tummel Garry Scheme. Each alternator is rated at 27,800 kVA, 4,000 volts, 50 cycles, 3 phase, .9 power factor, but is to be capable of operating at any voltage between −15 and +10 per cent. of normal rating.

Among turbo-alternators on hand for the equipment of central stations at home and abroad, a notable export example is a further order for two 37,500 kVA sets for the Orlando Power Station, Johannesburg, making a total of five machines in all. For Haifa Power Station a 40,000 kVA unit is at present being built.

Of the four 35,300 kVA sets on order for the new Meaford Power Station, two are in course of erection at the site. A 37,500 kVA unit has been installed at the Sculcoates Station, Hull, and another of the same capacity is being installed at Woolwich. For Newport Corporation, a further set rated at 37,800 kVA is in course of construction.

Fig. 2.—The "Mutac" switch.

Smoke Detection Equipment

Combustion control in the interest of fuel economy is of national importance and this adds interest to the photo-cell smoke detection installation designed for marine use with oil fired boilers. Equipment has been installed on the aircraft carrier *Warrior* and on the battleship H.M.S. *Vanguard*, which took their Majesties to South Africa, and on both vessels successful tests have been carried out.

Equipment of Cement Works

The company is responsible for the entire electrical equipment of the new Shimshon Portland Cement Works to be erected in Palestine. Apart from the generating plant, cables, transformers, switchgear, lighting and telephone exchange, there will be slipring and squirrel cage drive motors alone aggregating some 9,000 h.p.

Electronic Control Gear

Grid controlled hot cathode rectifying valves are employed to supply voltage to armature and controlled excitation for D.C. motors. Run-up to predetermined speed and close speed control over a wide range of load is effected. These equipments have been supplied to B.S.A. Tools and a number are on order for other industrial applications.

The "Mutac" Switch

This microgap switch (shown in Fig. 2) is suitable for breaking A.C. up to five amperes and is typical of the peacetime applications of moulded insulation technique. Useful life has been shown to be upwards of 100,000 operations, whereas British Standard requirements call for no more than 12,000 operations. Automatic testing is employed. Demand is

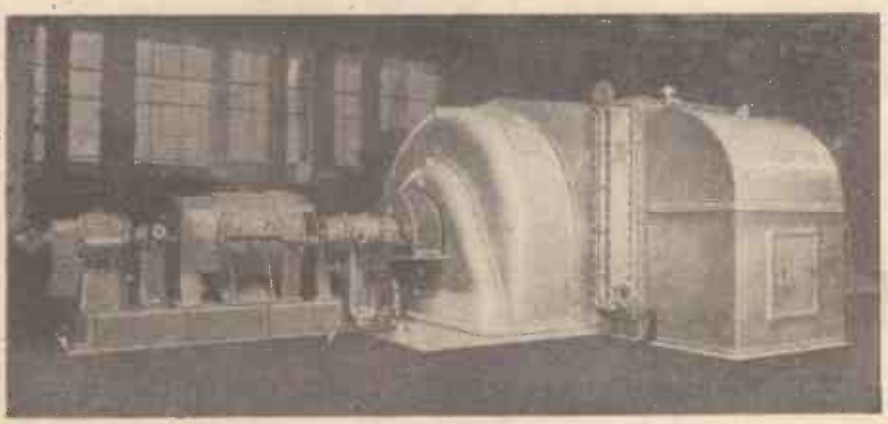


Fig. 1.—A synchronous condenser for the Palestine Electric Corporation.

Fig. 3.—G.E.C. fluorescent lighting in a West End store.

enormous for housing and export purposes, and production already exceeds 400 gross weekly. Models rated up to 10 amperes are projected.

Traction

Several new features developed during the war have been incorporated in trolley bus equipments, 65 of which were ordered for Cardiff City Transport Department. Rheostatic braking with limited regeneration is employed for these. On the completion of the orders for the Belfast City Transport Department there will be 182 electrical equipments operating there—the largest fleet of trolley buses equipped by one manufacturer anywhere outside the London Passenger Transport Board's system.

Fractional Horsepower Motors

A new range of single phase F.H.P. motors of ½ h.p., ¾ h.p. and .9 h.p. has been introduced. These are suitable for capacitor starting, the ½ h.p. motor being also arranged for split-phase starting.

A number of innovations has been introduced both in the types of apparatus employing small motors and in the design of the motors themselves.

Ore Bedding and Blending Plant

A comprehensive plant employing the Robins-Messiter system, which will probably be the largest of its kind in the country, is in course of installation at the Corby Works of Stewarts and Lloyds, Northamptonshire. The maximum rate of handling is 600 tons per conveyor per hour, two conveyors operating in parallel. The mechanical equipment is supplied by Fraser and Chalmers Engineering Works, while Witton Works are responsible for the electrical gear. About 80 motors will be employed, and the control panels aggregate a total length of 250ft. Intricate sequence control is essential, and an illuminated mimic diagram is being provided.

Equipment for Rubber Mills

A.C. motors from 75 to 600 h.p. have been manufactured for the Dunlop Rubber Company. Voltage ratings vary from 400 to 5,000 volts and the drives are for rubber calenders, mixers and the like. The larger machines have the primary circuit connected to the sliprings and starting gear to the stator. In the majority of the machines, arrangements for extremely efficient quick stopping are provided.

Planer and Lathe Drive Controls

These are examples of typical industrial applications in which electronic apparatus and standard electrical gear, limit switches, for instance, are combined to provide specialised control.

The lathe control is particularly interesting as, in turning a log 4ft. to 5ft. in length into a continuous sheet of veneer, the rotational speed must increase as the diameter decreases, so as to keep the peripheral speed constant.

Electrical Dynamic Balancing Machines

Some 50,000 F.H.P. rotors were balanced by such machines during the war, with greatly accelerated production and accuracies of .001 oz.-ins. A large machine is now being built for the dynamic balance of turbo rotors up to 40 tons in weight. Spring movements are translated into electrical effects which, suitably amplified, give an indication of the balance weight required and the position of application. On the prototype, handling a 4 ton rotor, this apparatus reduces balancing operation time from several days to one hour.

LAMPS AND LIGHTING

Fluorescent Lamps

Excellent results have been obtained in transport vehicle installations, hospital operating theatres, industrial and business house applications (Fig. 3).

High Pressure Mercury Vapour Lamps

Improved colour rendering and easier operation have been attained, and experimental lamps up to 25 kW. produced. Such lamps, colour modified, have been tested in collaboration with Messrs. Technicolour, with promising results. Efficiencies of some 70 L/W seem within reach.

A circuit providing the requisite high voltage for a few microseconds only enables an H.P. M.V. lamp to be switched on and off as required without danger.

Cinema Studio Lighting

Apart from the lamps just described, the new design of 150 ampere double negative arc is of notable interest, particularly as arc noise is considerably reduced with lower current density in the negative.

Extended tests continue on the high intensity flash discharge lamp for colour photography; good results are obtained with a 1/5,000th second flash, the spectral distribution being suitable and many thousands of flashes obtainable from the lamp. A filament lamp, mounted integrally, allows the photographer to get the right angle for lighting before operating the flash.

Airfield Lighting

High intensity beam contact lighting and projector lamp floods have been designed. A single 2 kW. floodlight unit provides peak intensity of about 2.5 million candles and a bank of three units mounted side by side will illuminate 2,000 yards of runway.

Measuring Instruments

Pulse technique has many applications in testing, examples being the matching of cables by measurement of transient response, and stability tests on feedback amplifiers. Two transient test sets employ impulses of

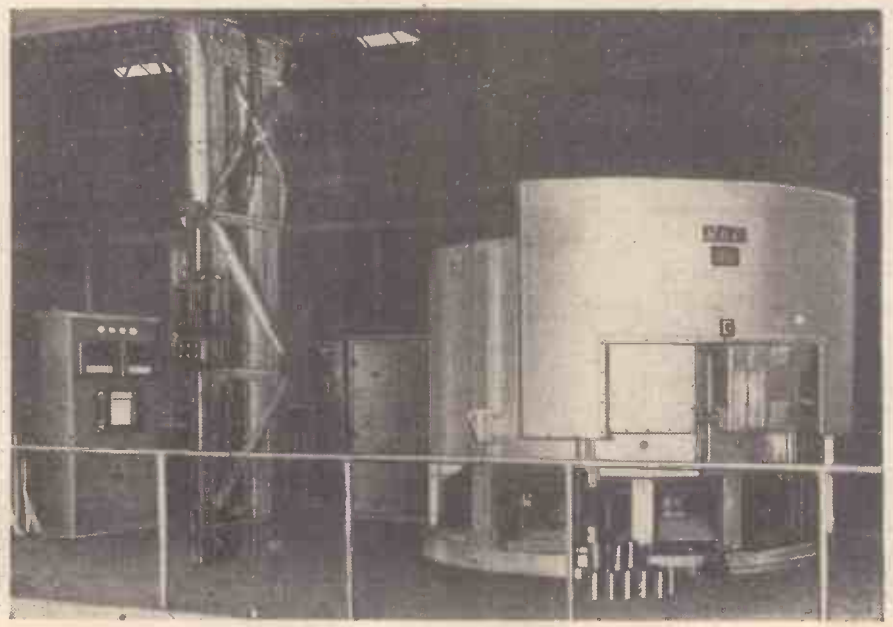


Fig. 4.—A G.E.C. electric furnace for process heating.

0.01 microsecond in one case and, continuously variable, from 0.1 to 50 microseconds in the other.

Copper Oxide Rectifiers

In the new technique evolved, the plates are cemented together with a silver adhesive and sealed in a polythene case by injection moulding. For high frequencies the plates are mounted in ceramic tubes and again hermetically sealed.

H.F. Current Transformers

An air-cooled copper strip toroidal transformer measures current up to 30 amperes at frequencies up to 50 Mc., far beyond previous limits, which were of the order of 2 Mc.

Impedance Measurement

A capacitor, retaining its calibration to higher frequencies, replaces the calibrated resistor. Instruments calibrated directly in Q values, on approximately linear scales, read up to 500 in two ranges. One covers 25 kcs. to 50 Mc., and the other 15 to 150 Mc.

PROCESS HEATING

Electric Furnaces

A rotary hearth for brass billets (850 deg. C.) and a continuous flow batch furnace for annealing thin aluminium sheet, coiled on steel spools, are examples of new types produced for industry. Much progress has been made in controlled atmosphere technique, particularly for carburising and such processes. (Fig. 4.)

Radiant Heating

The range of applications has been developed and a medium intensity oven has been introduced to fill the gap between lamp equipment and high intensity ovens developed during the war for stoving artillery shells. For the car industry a plant simultaneously stoves primer-surfacer and stopper on a well-known coupé body, taking 20 minutes for the complete operation. Softening of plastic sheet before shaping has proved an important application.

High Frequency Heating

One of many interesting problems was the heating of a non-metallic material to a temperature of over 2,000 degs. C. In the laboratory a temperature of over 2,500 degs. C. was reached, the material being heated by eddy currents induced in a lagged graphite crucible, neutral atmosphere being provided. For copper and glass seals for radio valves, eddy currents induced in the copper disc heat it sufficiently to cause local melting of the glass tube. This flows and becomes sealed to the disc.

Dielectric applications have included, among others, drying of sponges, thread on spools, sterilisation of lint after packing, heat treatment of tobacco and rubber, and pasteurisation of beer after bottling.

TELECOMMUNICATION

V.H.F. Point to Point

Interesting experiments were carried out involving the use of two transmitters operating on the same frequency and carrying the same modulation, the object being to increase the service area of F.M. transmission to mobile cars. Of several methods, the following was considered to be technically the most promising.

At the main station normal circular coverage was obtained working on 100 Mc. A second transmitter at the same site, carrying identical modulation, had the carrier frequency raised by multiplier circuits to 250 Mc., and this transmission was beamed on to a relay station outside the main service area. Here the signal was frequency-divided, amplified, and retransmitted from an aerial with circular coverage. There were only small areas where interaction was detected and the effect was not sufficient to reduce the combined service areas of the two stations.

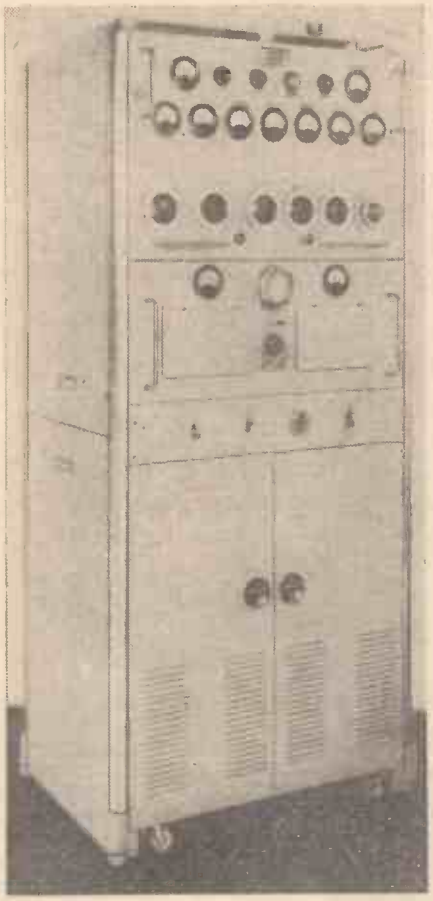


Fig. 5.—An F.M. broadcast transmitter, as supplied to All India Radio by the G.E.C.

Work was carried out on V.H.F. intercom. between all parties engaged on railway transport and maintenance work, and a study of propagation through tunnels, including "S" bends, was made.

Standard G.E.C. frequency modulated equipment fitted to the Royal train and the pilot train enabled constant telephonic communication to be maintained between the trains on their Majesties' South African tour.

V.H.F. F.M. Broadcast Transmitters

A complete 1 kW F.M. broadcast transmitter, as illustrated (Fig. 5), has been designed and one has been supplied to All India Radio.

Two amplifiers and their power supplies, similar to the output stages of the 1 kW transmitter, have been supplied to the B.B.C.

Telephone Equipment

Multi-channel carrier sets have been redesigned and are more compact, flexible, and easy to install. Facilities afforded are typified by an interesting service provided over an oil company's open wire line. Nine facilities—telephone (including automatic), telegraph, and teleprinter—are provided.

Increase in signalling speeds, reduction in size of control panels and the development of the "Six Pulse" system have been major advances in supervisory control gear. In one control equipment, supplied to the London Passenger Transport Board, any one of 70 circuit breakers can be selected in one second.

Valves

Several transmitting and receiving valves for use at very high frequencies are under test and some will figure in future manufacturing programmes.

The E. 1769 is a small disc seal triode with an anode dissipation of 20 watts, and operates as amplifier or oscillator at up to 1,500 Mc. The CAT 21 (water-cooled) is, as a result of new constructional technique, much smaller than earlier types of similar rating. The anode can handle 20 kW dissipation, maximum D.C. voltage of 10 kV, the pure tungsten filament providing 25 amperes emission at 90 per cent. saturation. In air-cooled form the valve will have a 10 kW rating (E 1845). Both are robust and suitable for use in industrial equipment; they also operate with high efficiency in wide band amplifiers.

A magnetron developed for Merchant Navy radar operates at about 3.2 cms and gives a pulse power output of 45 kW with an efficiency of 30 per cent.

Gas Discharge Devices

In such transmit-receive switches for common aerial work on radar systems, the characteristic of the gas filling is most important. Investigations that have been made promise notable improvements in performance in saturation of walls and replenishment of water vapour.

Cathode-ray Tubes

Technical improvements in the design of standard tubes and general improvements in manufacturing technique and fluorescent powder applications have resulted in higher efficiencies and more convenient physical dimensions.

Working in Tinplate

A Supplementary Material Supply and its Utilisation

By H. D. E. GOODALL

MATERIAL supply is, in these days, a problem of considerable difficulty, and the small quantity available is expensive. There is one source which does not appear to have been drawn on to any extent, and which can provide a fairly generous supply of material, suitable for quite a wide range of uses, at little or no cost.

The material in question is tin sheet salvaged from food containers. This does not, on first thoughts, appear a very promising material, but further consideration shows that it can fill many gaps left by the short supply of other materials, and can be used in the construction of a surprisingly large range of articles; the only other material required being tinman's solder.

The first reaction to the use of this salvaged material is that the sheets available will be small in area. This is true in some measure, but the sheets obtained are larger than is often supposed (a good average size being 9in. by 4in. to 5in.) and can be joined to form larger sheets as required.

The metal is easily worked, and the tools required are those usually found in any mechanic's workshop, namely, engineer's hammer, drill brace and drills, centre punch, small sharp chisel, tinman's snips, soldering iron, solder and flux, iron block, flat nose and cutting pliers, fine-tooth saw, clips for soldering, steel rule, engineer's square, scriber and fine files.

It is proposed to give details of the methods for working this material and to describe some representative articles made with it.

Materials

The containers will be found to be (a) plain tin, (b) tin coated with varnish or lacquer, (c) untinned steel, or (d) tin coated with heavy paint on one side. Of these, (a) is to be preferred, but (b) and (c) are quite satisfactory if cleaned locally and tinned. Those in category (d) should be discarded as not being worth salvage.

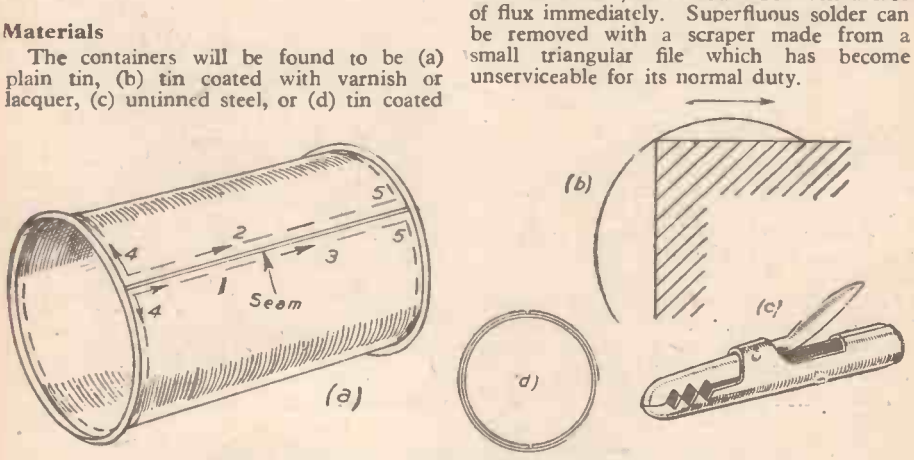


Fig. 1. Method of cutting a tin container and flattening the tinplate.

The first step in the preparation of the material is to thoroughly clean the containers; this should be done immediately the contents are removed. The containers are then cut to obtain the largest sheet possible. A convenient method to do this is shown in Fig. 1 (a). First make a cut 1 to the right hand of the seam for half the depth of the container. Next make cut 2 to left of the seam for full depth, and cut 3 to the right, completing cut 1 to full depth. Bend seam right back over bottom of container. Make cut 4, removing beading at the mouth, and complete by circumferential cut 5.

To flatten the sheet so obtained, place on the edge of the bench (see Fig. 1 (b)) and with the flat face of the hammer make strokes forwards and backwards; the initial pressure should be light, but gradually increased as the sheet flattens. Move sheet forward and repeat. When half of the sheet has been treated, reverse and repeat the process. This should provide a sheet flat enough for ordinary purposes.

Soldering

Ordinary tinman's solder should be used, for preference that supplied in sticks of about ⅛in. by ¼in. The flux should be one of the liquid varieties, such as "killed spirit" or one of the many liquid fluxes obtainable ready for use. A paste flux is not so easy to clean off after soldering.

Cleanliness is essential for successful results, and all surfaces, before soldering, should be cleaned and "tinned."

All parts to be soldered should be assembled and secured in their correct relative positions. For this purpose spring clips are very useful; a variety of which is sold as a high-tension battery wander-lead clip (Fig. 1 (c)) is very convenient.

After assembling, the joint is spot soldered at two or more places, the clips removed and the soldering completed, making sure that the surfaces are in close contact until the solder has set.

All soldered joints should be washed free of flux immediately. Superfluous solder can be removed with a scraper made from a small triangular file which has become unserviceable for its normal duty.

Manipulation of Material

The working of the material consists almost entirely of straight bending and flanging. Owing to its thin gauge, the amount of actual "working" of the metal itself is limited, although a certain amount of "beating" can be carried out.

An iron or steel block, or alternatively a flat or square bar, is required for flanging, and it will be convenient if the angle between one side and the face of the block is rather less than 90 deg. (say, 85 deg.), to allow for the springing of the material.

To flange the material, mark off the width of the flange, line up the scriber mark with the edge of the block and knock over the flange, starting from one end and working as long a length as possible, bearing in mind that any one part must not be forced too far at one time, so as to avoid stretching the metal. Having partially completed the flange, start again from the other end and work along to meet that already flanged. The flange will now have been turned over but is still somewhat uneven, so the sheet is repositioned on the block (85 deg. angle) and these inequalities beaten out with light taps of the hammer. This material must not be subjected to heavy blows at any time as it is comparatively soft and easily "drawn" out, resulting in distorted work.

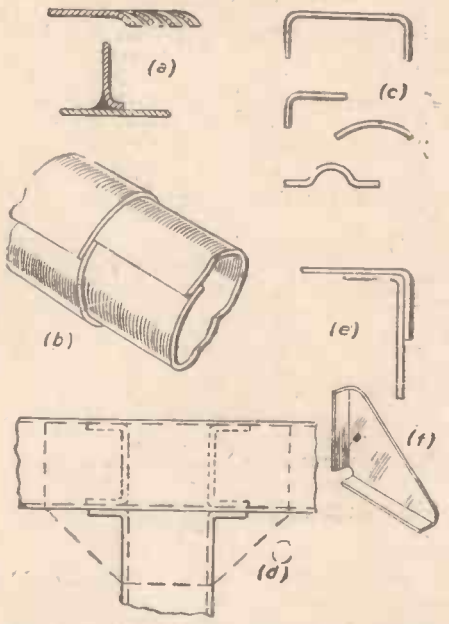


Fig. 2. Various joints, bends and stiffeners.

If it is required to form a groove, as at a, Fig. 5, proceed as above, place a flat strip of metal of the required thickness in the angle, hold firmly in a clamp or vice and work the metal over.

To bend the material at other than 90 deg., set the scriber line to the edge of the block, bend the sheet over to the angle required and finish with light taps with the hammer along the edge of the block.

It is sometimes desired to cut a fairly large hole in the material. This can be done with a cold chisel, but this method may be found to cause a certain amount of local distortion, particularly if the chisel is not so sharp as it might be. An alternative, and in some cases a better method, is to drill a series of holes close to the scriber line and cut through the pieces between the holes with the snips. If a clean edge is required, trim off to the scriber mark with a sharp cold chisel and finish with a smooth file.

If, however, a tubular section has to be fitted and soldered in this hole, it is advisable to leave the ragged edges and flange them over as in Fig. 2 (a), so as to provide a larger surface for the solder and consequently a better and more rigid joint.

Use of Formers

Tubes of various sizes can be made up on suitable formers, the latter being made to the inside dimensions of the tube. The former can be of wood or metal, but for sizes less than about ⅛in. a metal former is preferable.

To illustrate the procedure, the construction of a tube of circular section will be

described, other shapes being made in exactly the same manner, using the appropriate former. In this way, tubes of about ¼in. diameter upwards can be made.

Mark off and cut a piece of material as long as possible or as required, having a width equal to the circumference plus the overlap, which should be ¼in. for tubes about 1in. diameter, reducing this proportionately for the smaller sizes to about ⅛in. for the ¼in. diameter.

Line up and tap over both long edges to the contour of the former, then line up carefully and work the material round the former by hand. Having shaped the tube, secure it tightly to the former by means of pipe clips or cord (half hitch) at two places, making sure that the ends are lined up. Gently tap the overlap down and spot solder in two places to fix alignment. Remove clips or cord and finish soldering along the joint, pressing the surfaces into contact until the solder is set.

Longer lengths of tube can be made up by joining the shorter lengths as described below, but in this case the last inch length of the joint is left unsoldered until the two lengths are joined.

To join up, place two lengths on the former and pass one over the other for a distance of about ½in. to form an overlap, the under edge of the outer tube butting against the upper edge of the inner tube, as indicated in Fig. 2 (b). The overlap is then gently tapped into close contact and soldered. Further lengths can be added as desired. By assembling on the former in this manner, no difficulty is experienced in lining up and a straight tube is assured.

Telescopic Tubes

Short lengths of tube sliding one inside the other can be easily made up. The walls of such tubes should be reasonably stiff and two thicknesses of sheet should be used. The procedure is to form two sheets for the inner tube, such that the butt edges are just clear of each other when the two sheets are clamped tightly together one over the other on the former. These edges are positioned 180 deg. apart, as shown in Fig. 1 (d), the whole tightly clamped on the former and soldered along the butt edges and ends. This tube is cleaned up, the surface finished, and the second tube made up in the same way, using the first tube (in place on the former) as the former for the second.

If it is found necessary later to cut either of these tubes, the edges should be soldered before finishing.

Design and Construction

In designing articles from tinplate of such a thin gauge, consideration must be given to the rigidity of each individual part. Sufficient rigidity can usually be obtained by using a formed section as at Fig. 2 (c), the angle and channel sections being the stiffer and most useful shapes. Closed sections, such as circular or box sections, are inherently rigid, but if of relatively large sections, stiffening diaphragms may be necessary. Another point to consider is the attachment of one section to the next, so that any reasonable load from one part can be transferred to the next without fear of breakage or distortion. No hard and fast rules can be laid down to cover this, but where transverse loads occur, diaphragms, ribs or plates (see Fig. 2 (d) and (f)) will usually be required. Where a tube or similar part projects through the wall of a section, either a second support inside or ribs or plates on the outside should be fitted.

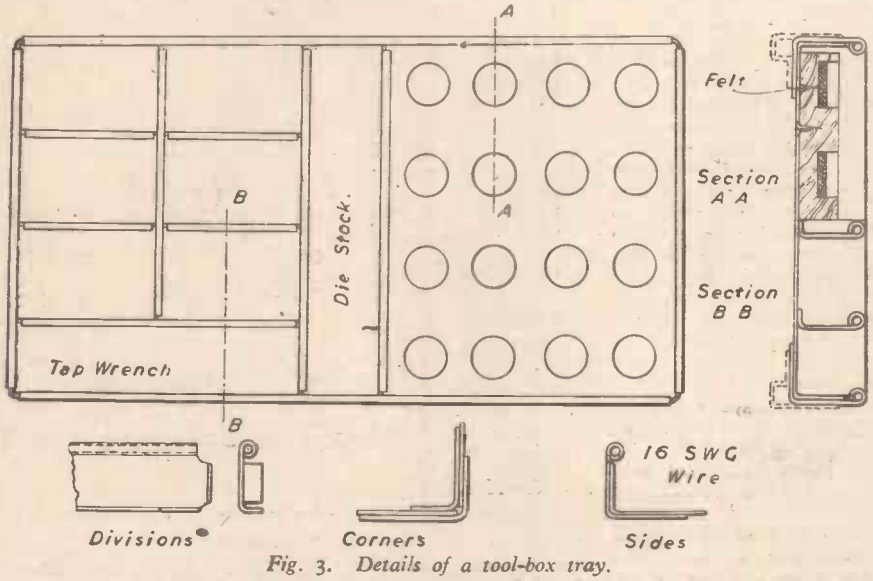


Fig. 3. Details of a tool-box tray.

Should it be desired to obtain stiffness by the use of a double thickness of sheet, it will be found that to sweat all over often results in distortion of the sheet. This can generally be overcome by drilling a number of holes in one of the sheets, clipping them together, spot soldering at a few places along the edges, and then spot soldering through the holes and finally soldering round the edges. This method will be found useful in many cases and, if desired, the holes can be filled with solder and finished flush.

Owing to the thinness of the sheet it is difficult to drill clean holes larger than ⅛in. or 3/16in. diameter. When larger holes are required (a) a small hole should first be drilled, followed by progressively larger sizes (1/64in. steps are advisable) until the required size is obtained, (b) clamp the sheet between two pieces of fairly hard wood and drill right through, or (c) use a trepanning cutter. In all cases it is essential that only light pressure be applied to the drill.

Rivets can be used for joints in suitable cases, but, in general, it will be found that soldering is to be preferred.

Box shapes are the simplest form of construction, and rigidity is obtained by providing what is, in effect, an angle section framework, by flanging the edges of the sheets so that the corners of the box consist of an angle having a thickness of twice that of the sheet (see Fig 2 (e)).

If one side of the box is open or apertures are to be left in the side, these edges can be stiffened by (a) turning the metal over on itself, (b) turning the metal over a wire, (c) sweating a wire along the edges or (d) sweating on a doubling sheet

If the sides are of appreciable size, it may be desirable to stiffen them to prevent "panting." This can be done by sweating small angles, channel sections or wires diagonally on the inside, or fitting diaphragms.

Cylindrical shapes are made on a former as already described. Where the size is such that the length of one sheet is less than the circumference, the cylinder can be built up on the former, care being taken that each sheet is carefully positioned before soldering. Cylinders of relatively large size will require stiffening by means of internal diaphragms sweated in. If desired, the centres of the diaphragms may be cut out, leaving an angle ring.

Tool-box Trays

Sliding trays can be made for tool boxes, which will be found to be little, if any, heavier than wooden ones, considerably more economical as regards space and remarkably rigid. The design of the tray will depend on the purpose for which it is intended, that shown in Fig. 3 being for dies and taps.

Rigidity is obtained by double angles along the sides, formed by flanging up the bottom sheet and sweating on a second angle having the top edge turned over a wire. Additional stiffness is obtained from the division plates. If desired, further stiffening can be provided by means of the section (shown in dotted lines) along the longitudinal edges.

The wooden carrier for the dies should be of fairly hard wood, held in position by a few wood screws. The compartments for the die-stock and tap wrenches should be lined with felt secured by means of an adhesive. A pad of felt should also be glued in the bottom of each die housing. This felt should, after fixing, be moistened with oil to prevent water being absorbed to the detriment of the tools.

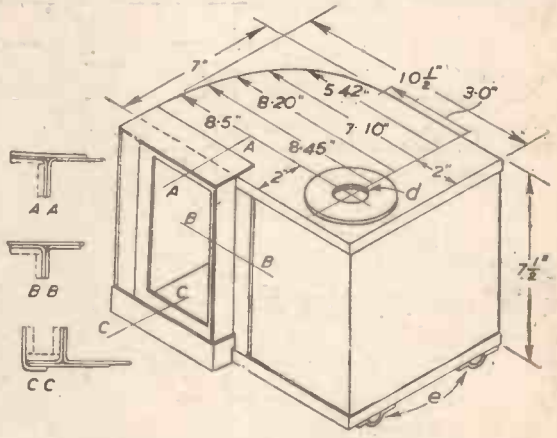


Fig. 4. General view and details of a dark-room safety lamp.

Dark Room Safety Lamp

This is shown in Fig. 4, and is designed to emit reflected light only.

The construction is straightforward, but in this case it is advisable to use the rolled seam joint for joining the sheet sections to provide a certain amount of rigidity.

The opening for the lamp holder is reinforced by a doubling plate (a tin lid sweated on the inside forms a very stiff reinforcement). It will be found desirable to tighten the holder nut on to a felt washer.

The safety screen opening is made to suit the size of the screen to be employed, and is lined with felt (shown by the dotted lines) to obtain a light-tight joint. The upper part of the screen is pressed against the felt by a simple design of spring catch.

The curved portion is intended as a reflector, but near accuracy cannot be expected with this thin material; the ordinates for such a reflector are, however, given in Fig. 4.

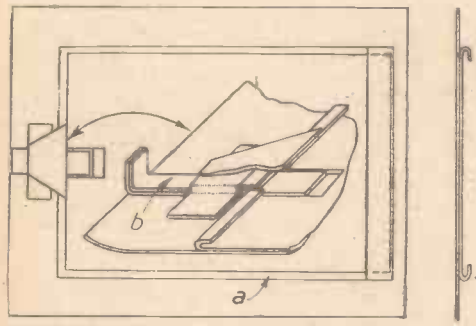


Fig. 5.—Details of a bromide paper carrier for enlarging.

Bromide Paper Carrier for Enlarging

This is intended for use in place of the usual board on which the bromide paper is attached by means of pins. It consists of a grooved frame on a baseboard, together with an ejector, to facilitate the removal of the exposed bromide paper.

A sheet $\frac{1}{8}$in wider and $\frac{1}{8}$in. longer than the paper size has three sides turned over as at a, in Fig. 5, to form the grooves. The fourth side has a flanged strip sweated at the ends to the top of the grooves, with clearance underneath to permit the passage of the paper. An enlarged view of the ejector is shown, and a detail of the slide at b. The whole is mounted on a suitable baseboard.

Reading Lamp

A design for a reading lamp is shown in Fig. 6. The stem is made up of two flanged plates and two unflanged plates. The base is stiffened by two channels, which also serve the purpose of supporting the stem. The top is made from one piece as shown, having at each inclined joint one flange turned under for soldering, and a doubling plate sweated on the underside of the upper surface. A $1\frac{1}{8}$in. hole is shown in this plate, but this will have to be adapted to suit the lampholder used. All joints should be well soldered, superfluous solder removed and the edges slightly rounded and smoothed off.

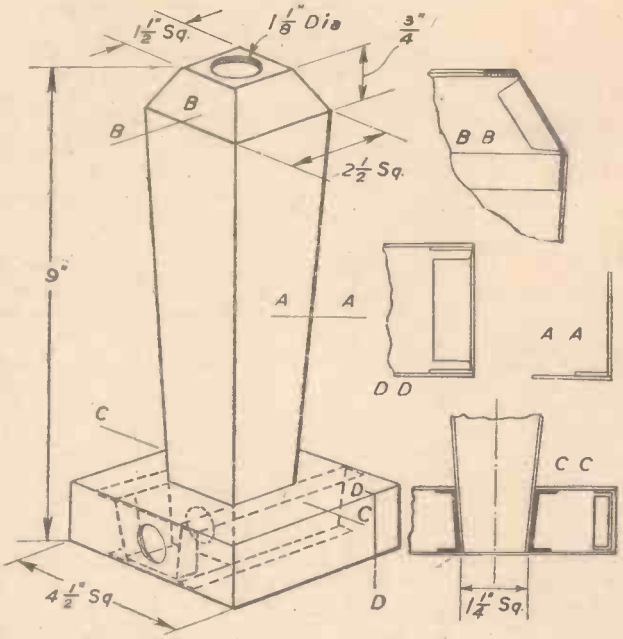


Fig. 6.—A design for a reading lamp in tinplate, and details of construction.

Holes are required to lead in the electric cable, and provision must be made to prevent damage to the cable insulation by any sharp edges of the holes. Hard rubber or bakelite tube could be used for this purpose. If desired, a two-point plug fitting could be incorporated in the base, in which case the chafing trouble could be avoided by the use of a short length of lead-covered cable.

Further holes must be left in the bottom plate to allow the base to be filled with sand or shot (the latter for preference), to give stability to the lamp. These holes are covered, after ballasting, with sweated-on patches.

Finally, after cleaning and enamelling, a pad of felt is secured by means of a suitable adhesive to the underside of the base.

The foregoing gives some idea of what can be done with an apparently unpromising material, and a little thought will suggest many other applications.

Camera that Delivers Finished Prints

An Important Development in the Photographic Field

By "TECHNICUS"

A SPECIAL camera has been invented by Edwin H. Land, originator of Polaroid glass, which takes a normal photograph, develops the negative and delivers a finished print in one minute. The developing process is "dry," the print emerging from the camera body only slightly damp, to dry quickly in air. The arrangement of this interesting camera is shown in the accompanying illustration, from which it will be seen that it employs a lens, shutter and roll-film, being much the same as the ordinary camera. After exposure the negative is wound down to a pair of rollers, shown in the illustration, where it is brought into contact with the positive paper from which the print is made.

Developing Capsules

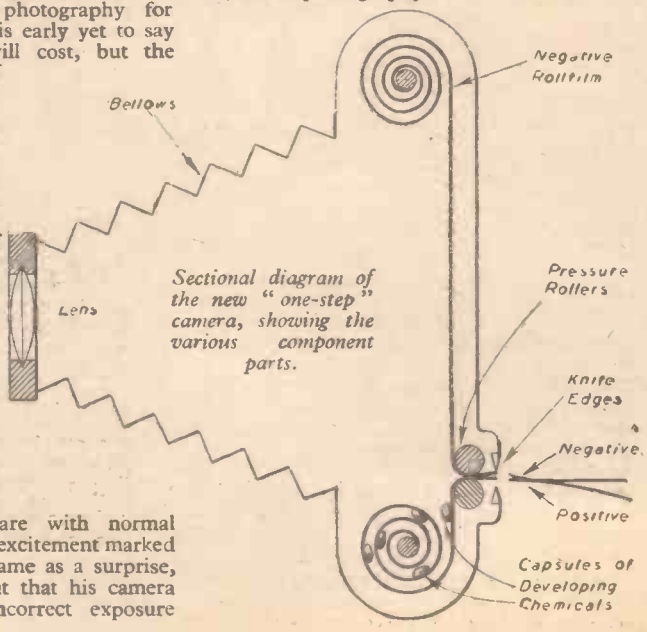
At the edges of the positive paper, which is wound in a roll form, there are small capsules or "pods" arranged at intervals. These "pods" contain the developing chemicals, made up of hydroquinone, sodium hydroxide, hypo and sodium sulphite. When the positive is pressed into contact with the exposed negative the "pods" are burst, and the developing chemicals spread over the interfaces of the two, forming, as it were, a sandwich. A thickening agent is added to the developing chemicals to give them tackiness and adhesion.

This camera, which was recently announced to the Optical Society of America, constitutes in effect a one-step photographic process and promises to revolutionise photography for the man in the street. It is early yet to say how much the camera will cost, but the Polaroid Corporation of America hope to announce this during the year when, presumably, plans for production will be completed. A feature of the process is that, whereas the present method of developing a film involves solution of some of the silver salts in the emulsion and their discarding, this new idea utilises those salts to produce the image on the positive paper.

Normal Photographs

There is nothing experimental in the "one-step" camera, for examples of its work were exhibited at the Optical Society's meeting and were seen to compare with normal photographs. Considerable excitement marked its announcement, which came as a surprise, but the inventor points out that his camera cannot compensate for incorrect exposure on the part of the operator, this being possible with existing conventional developing methods.

It is significant that there is nothing unusual in either the design or the chemicals used in the "pods," which suggests that the idea might take on with the public, offering as it does a considerable saving of time and trouble in photography.



Sectional diagram of the new "one-step" camera, showing the various component parts.

Rocket Propulsion

The Northrop "Rocket-wing"

By K. W. GATLAND

(*Continued from page 268, May-June issue*)

THE most outstanding contributions to aeronautical science since 1903—actual turning points in development—may be summarised as the following: the true cantilever monoplane, the helicopter, jet-propulsion, rocket-propulsion and the *flying-wing*.

It would be difficult, indeed impossible, to name a *single* person as being responsible for any one of the above achievements. As in all branches of technology, it is seldom that one man, or even one group, is responsible for perfecting an original scheme; rather is it in the work of many, each making some small contribution over a period of years, that an idea is eventually brought to practical fruition.

Some inventions that are generally considered to be the work of modern technicians have, in fact, been in the "melting-pot" for centuries. Take, for example, jet propulsion. This source of power began to appear in practical form during the late war, but its actual inception was in Hero's æopile at the commencement of the Christian era. Similarly, rockets were known to the Chinese of the thirteenth century; and, as any student of aeronautics knows, Sir George Caley proved the feasibility of vertical flight with his model steam-driven helicopter, which flew in 1893.

The Northrop MX-324 "Rocket-wing" was the forerunner of the XP-79 "aerial-rammer" and research machine for the B-35 and YB-49. It is seen here at speed during the first test-flight under power.

A self-combusting mixture of monoethylaniline and red fuming nitric acid powered the Northrop "Rocket-wing" which first flew in 1944.

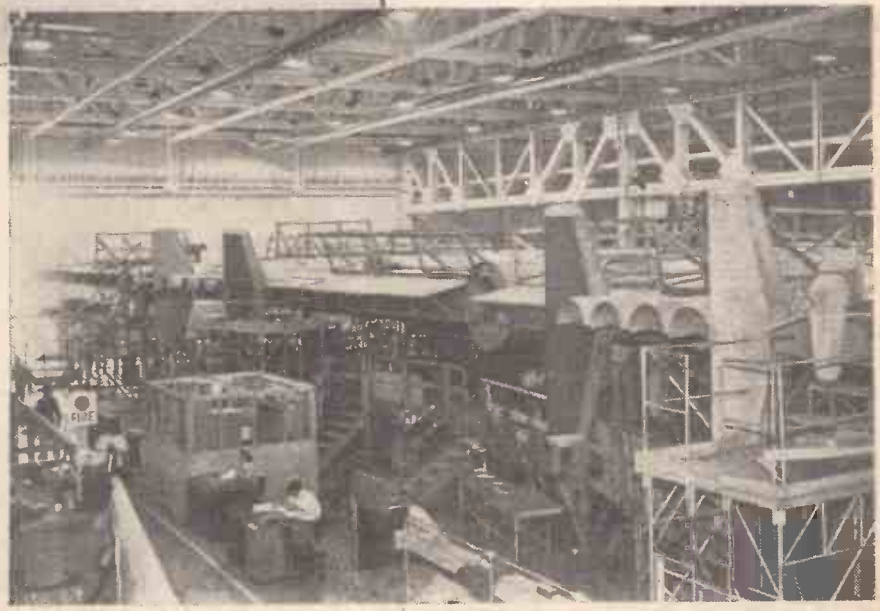
The Flying-wing

The flying-wing does not appear to have so long-established a history, although it is true that some of the earliest gliders were "all-wing." Such names as Professor Hugo Junkers, Col. J. W. Dunne, Capt. G. Hill (now Professor Hill), and Professor Lippisch are outstanding among those who pioneered the flying-wing aeroplane, but credit for its final perfection is due almost exclusively to the work of John K. Northrop and engineers of Northrop Aircraft Incorporated.

"Aviation Advanced Ten Years"

What this firm has achieved in recent years must have advanced aviation by at least a decade. Solution has been found to all control and stability problems related to the type, and progress has been so rapid as a result that already a jet-powered all-wing fighter and a giant all-wing bomber are flying and in service with the U.S.A.A.F. It is an acknowledged fact that by eliminating the fuselage and tail surfaces the overall drag is diminished by anything from 33⅓ per cent. to 50 per cent., and this implies considerably less power expended in obtaining a given speed, and hence less fuel consumed, permitting greater range or increased payload. Just how effectively this has been done can be gauged from the accompanying pictures.

The Northrop experimental programme could not have reached its climax at a more convenient time. It was apparent from the first that the new era of turbo-jets and rocket units meant power in excess of what the normal airframe and its cantilever arrangement of wing and tail could withstand, but now the flying-wing is established, power and structure are much more evenly matched. This, no doubt, will be seen when



The prototype YB-49 takes shape in one of the big workshop hangers at Northrop Field, Hawthorne, California. When completed, it will have a span of 172 feet, 31 feet greater than that of the B-29 "Super-Fortress."

the Northrop XS-3 transonic research aircraft is rolled out on the tarmac at Murac Flight Test Base, California.

The Northrop "Rocket-Wing" MX-324

It is perhaps not generally known that it was a rocket-powered flying-wing, less than 30ft. in span and weighing 4,480lb., that gave Northrop some of his initial data. It was built during 1943, and successful flight trials were made under the control of test-pilots John Myers (who is now the firm's vice-president in charge of sales) and Harry Crosby, the former flying the 'plane in glide tests and the latter demonstrating it under power.

This "Rocket-Wing" followed the same general layout as the earlier "Baby-Northrop" N1M (which was actually the first of the "all-wing" series and flew in 1940), though it did not embody down-turned tips and the composite rudder/elevator controls which these permitted, as did its predecessor. In the rocket 'plane, a reversion was made to the vertical type fin and rudder and normal wing-tips.

The pilot was accommodated *prone*—an achievement of merit in itself—in a trim cockpit which projected slightly beyond the wing leading-edge. In one of the photographs, Crosby is seen lying in the cabin, his head rested in a sling to permit easy forward vision through the large moulded Plexiglas nosing. The prone cockpit was adopted for two good reasons: one, to allow the incorporation of a special thin aerofoil without spoiling the shape with a big cabin, and, two, to give the pilot a better chance of withstanding high "g" pressures in violent manœuvres. The arrangement worked out well, but not without some early difficulty in design. A completely different control system was required, with a short servo-assisted control column which worked elevons on the wings, and rear foot operated rudder pedals, in addition to the novel pilot's *couch*.

The tricycle undercarriage was non-retracting and large fairings shrouded the wheels, keeping resistance down to a minimum. Small streamlined skids protected the wing-tips in the event of an uneven landing.

Rocket Engine Designed by Aerojet

Power for the MX-324 was obtained from a small bi-fuel rocket engine, the XCAL-200, designed and built by the Aerojet Engineering Corporation of Azusa, California. It had a single combustion chamber operating on a self-combusting mixture of monoethyl-aniline and red fuming nitric acid—a full complement of 31 gallons.

The propellant system was gas charged from four pressure tanks which fitted neatly in the wings alongside the fuel and oxydiser tanks, hydraulic and electric control equipment. The combustion chamber took up a position in the centre of the wing, its nozzle protruding from the trailing edge.

Early Tests

Flown first as a glider in October, 1943, the machine was taken to Harper Dry Lake, near Batstow, California, for ground and flight trials on June 20 of the year following. A team made up from engineers of Northrop and Aerojet was responsible for the tests which followed: first, static trials of the power plant; then, taxying trials and, lastly, flight trials under power.

The motor was first fired separate from the airframe to ensure its correct function, particular attention being given to the "cut-out" gear. A few minor adjustments and it was ready for bolting down in the wing.

The unit was then operated for duration of run, while the machine strained at heavy stakes used to secure it to the ground.

This stage satisfactorily concluded, it was time for Crosby to start taxying trials. He climbed in the cockpit and, having settled himself down on his couch, pressed the ignition trigger on the control column, turning the rocket on and off as he manœuvred about the desert. That was on June 23! Slight re-work was needed on the 'plane after this, and nearly two weeks elapsed before the tests could continue.

The first actual flight under power took place on the morning of July 5, a Lockheed "Lightning" having been flown out to act as tow 'plane, with Capt. J. Sherman as pilot. The two aircraft were linked by a long cable which splayed out into two just ahead of the MX-324, the ends attaching to lugs, one on either side of the cabin.

Everything ready, Capt. Sherman inched his twin throttles forward. The cable came taut and the two machines gathered speed, lifted gently and began to climb in a long curve.

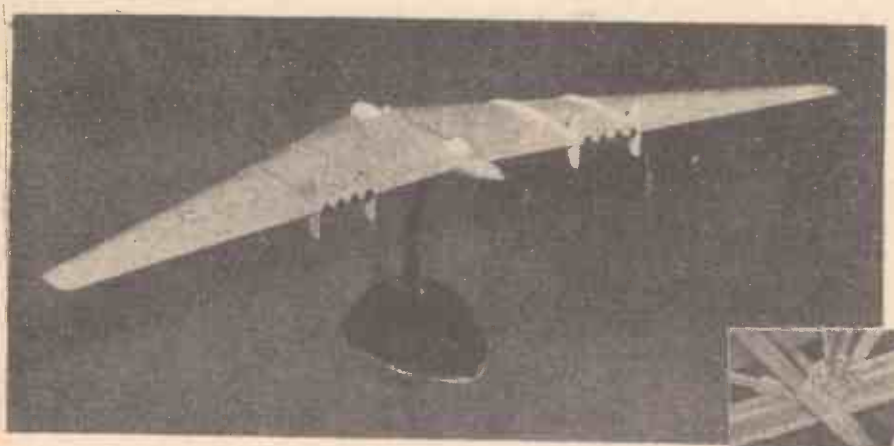
They came back over the take-off point at about 8,000 feet, and when directly above the observers, Crosby tripped the release, dropping the tow-line. The "Lightning" drew away rapidly, and before the speed of the tiny "Rocket-wing" had time to fall off too sharply, its pilot pressed the ignition trigger and the 'plane shot forward under the impulse of its motor. It cut a swift streak across the sky, the jet billowing out in a long plume and lasting about five minutes.

All fuel gone, Crosby glided down in front of his elated audience to a perfect landing.

A second test-flight was made six days later, in which the 'plane was dived under full throttle from several thousand feet. Crosby came down fast and low, skimming the lake bed, then pulled up almost vertical until he had levelled out again 6,000 feet high.

Following these tests at Harper Lake, the "Rocket-wing" was brought to Murac Base where, with Crosby again at the controls, it flew several times more. The Aerojet engine functioned perfectly at all times, though it lacked ample power for the MX-324.

As more powerful rocket-engines were not then available, Northrop carried out a redesign on the machine, and a development appeared later as the XP-79, a *twin-jet fighter* in the 500 m.p.h.-plus class. It was intended to operate as an aerial rammer for tearing the wings from enemy bombers, but came too late for use in the war. The all-wing leading edge was heavily armoured and



The completed YB-49, as shown by this model, will embody eight General Electric TG-180 turbo-jet engines rated at 4,000lb. thrust apiece. Features of interest are the grouped tail pipes leading from the submerged engines, the four stabilisers, and the central crew nacelle. Also apparent are the pilot's canopy and astrodome.

The four engines in each wing of the YB-49 are flanked by stabilisers. These supply the necessary stability and their absence in the earlier B-35 is accountable to the steadying influence of contra-rotating air-screws.

permitted the pilot to direct his machine straight into the wing of an opposing aircraft and fly away safely.

Big Brothers of the "Rocket-Wing"

Not only did the tiny "Rocket-Wing" supply invaluable data for building the XP-79, but it also contributed to the design of Northrop's latest masterpiece, the giant B-35 flying-wing bomber which, in general outline, is an enlargement of the tested wing pattern.

This 172ft. span "Wing" is powered by four 3,000 plus-horsepower engines with co-axial pusher airscrews and, being able to carry a load of 10,000lb. a distance of 10,000 miles, it must be classed as one of the world's longest ranging bombers. Although it is entirely all-wing in conception, normal fins and rudders are not fitted as stability arises from the contra-rotating airscrews. There are eleven controls operating as elevons (aerofoils which work either as elevators or ailerons), with rudder assemblies at the tips.

The recent disclosure that two *jet-drive* versions of this design are under construction and will be flying by mid-summer marks yet another triumph for Northrop. They are under contract to the Army Air Forces and have been given the designation YB-49.

"The Most Efficient Aircraft"

This latest development represents the most efficient combination of structure and power-plant that has yet appeared, and the design is so advanced aerodynamically that Northrop is likely to retain his lead for some time to come. Power hitherto undreamed of will be supplied by *eight* General Electric TG-180 turbo-jets. The engines are rated at 4,000lb. thrust apiece, and flying at sea-level and at most efficient speed (which is not yet revealed), each pound of thrust will equal one horsepower, making the total output of the YB-49's power-plant 32,000 h.p., *nearly three times that of the B.35.*

In addition to its engines, the B.49 differs from the B-35 in having four vertical stabilising surfaces, though these do not mount rudders. They are fitted to make up for the loss of stability originally obtained from contra-rotating airscrews in the B-35 and, as will be seen from the photographs, two are rooted in each wing on either side of the engine groups. Long, slit-like intakes are placed in the leading edge between each pair of stabilisers.

Identical in Size

The YB-49 is being built to the same specification as the earlier propeller driven bomber, both types having the same dimensions: a span of 172 feet, a root chord of 37½ feet, a root thickness of 7 feet, and a tip chord of 9ft. 4in. The length of each elevon is 34ft. 6in.

Landing flaps occupy the centre section of the span, and slots in the wing-tips are aids to control at low speeds. The landing gear is tricycle and, of course, fully retracting, with 5ft. 6in. diameter double-wheels on the main legs and a smaller wheel assembly at the nose.

In order that all excessive control forces should be prevented, the flying-controls are worked through a full-boost hydraulic system co-ordinated with special Northrop-designed pneumatic loading devices. This arrangement gives artificial "feel" to the controls, similar to that obtained naturally in smaller aircraft.

A special electrically-driven throttle, also designed by Northrop, ensures that the pilot does not "over-ride" his engines. The throttle opens slowly and is designed to extend engine life by holding down tail-pipe temperatures.

Performance Not Revealed

Speed, ceiling, range and bomb-load are not yet revealed, but it can be said that the ratio of load to weight is far greater than would be possible with a conventional aircraft of comparative size, and again this mirrors better economy and efficiency of operation.

The machine will house a crew of 13 within the 37½ft.-long pressurised centre portion, the pilot enclosed beneath a clear-view canopy in the extreme nose, with the co-pilot seated below him and to the right and having his view through a "glass" panel in the leading-edge. Just outboard to starboard and slightly behind the pilot is an astrodome, and immediately to his rear—within the same canopy—is seating for one of two gun-controllers, who faces aft.

Remotely Controlled Barbettes

Multiple guns (presumably 0.5in.) are mounted in five barbettes, two above the wing and two below with the other behind the pilot's enclosure; and these will be operated remotely by the controllers, the second "gunner" having his position in the central nacelle over the trailing edge. Also aboard will be a navigator, radio-operator and bomb-aimer, with space for six men "off-duty."

This all too brief resumé of Northrop research must serve for the present writing, but it is hoped to be able to return after the "security veil" has been lifted from the XS-3.

(To be continued)

Notes and News

Johnson's Photographic Competition

MESSRS. JOHNSON & SONS, of Hendon, have recently issued a list of prizewinners in their December Photographic Competition, which closed on December 31st, 1946.

Two first prizes of £5 each are awarded to: Mr. Vernon Shaw, 29, Park Road, Timperley, Cheshire, and Mr. A. Ruddle, 1, Westbourne Avenue, Worthing, Sussex.

Three second prizes of £2 each are awarded to: Mr. H. S. Bower, 113, South End Close, Hampstead, N.W.3; Miss B. Wagstaff, 1-21, Northwood Hall, Hornsey Lane, N.6; and Mr. I. W. Lightbody, 20, Allanshaw Street, Hamilton, Lanarkshire.

In addition, there are awards of 10 third prizes of £1 each, 20 fourth prizes of 10s. each, and 25 consolation prizes.

New Folding Canoe

IDEAL for export to all countries, including the tropics, and already shipped to Denmark, Sweden, Turkey, Middle East, India, Canada and Latin America, the first light alloy folding canoe ever marketed in Britain was given all-day-long demonstrations at the British Industries Fair held last May.

It was shown at the London (Sports Goods) Section, and visitors were able to study for themselves the method of assembling from the "flat."

Devised by an R.A.F. squadron leader who was responsible for designing and producing the folding dinghy supplied to the British Admiralty and Ministry of Aircraft Production during the war, this peacetime version, suitable for two people and their camping equipment, weighs only 38lb. (17 kilos), and can be carried on the roof of a small car, yet it is 12ft. (3½ metres) long when assembled. Assembly takes only about two and a half minutes. The method of construction combines a light alloy skin with silver spruce gunwales and keels. The whole of the shell or skin is in one piece, folded to half its open length. When open, sliding tubes link the gunwales into a rigid frame. Telescopic struts lock the shell in the arched canoe-shaped position, and stainless steel catches bring the ends together. Soft rubber in compression seals the centre hinge joint and two ends, and the canoe is ready for use. All the fitments are built into the canoe, and nothing is carried loose to get lost.

Each canoe is tested to hold at least 400lb. before leaving the factory, and the corrosion resistant light alloy skin not only gives a stiff shell, but one which is impervious to fungus and insect attack. It is shipped in lots of 10 in specially built wooden crates.

The makers are Grimston Astor, Ltd., Bideford, N. Devon.

The Ediswan direct recording Electro-encophalograph (which has become known as the "Lie-detector"), in use at the Imperial College of Science Exhibition, South Kensington.

A Fixed-focus Daylight Enlarger

Constructional Details of an Inexpensive but Efficient Apparatus for the Amateur Photographer.

By H. A. ROBINSON

FOR the beginner a fixed-focus daylight enlarger has several advantages over the artificial light focusing type. Enlarging is automatic, one size of negative giving uniformly one size of enlargement without further adjustment. Construction is easy, and as a very small stop is always employed an inexpensive lens can be used. Also, there is no condenser, nor is an elaborate dark room required.

Fig. 1 gives a good idea of the finished apparatus. The side has been cut away for clarity.

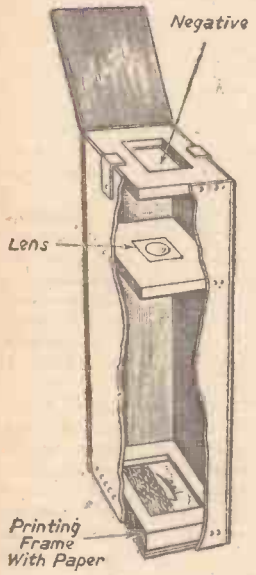
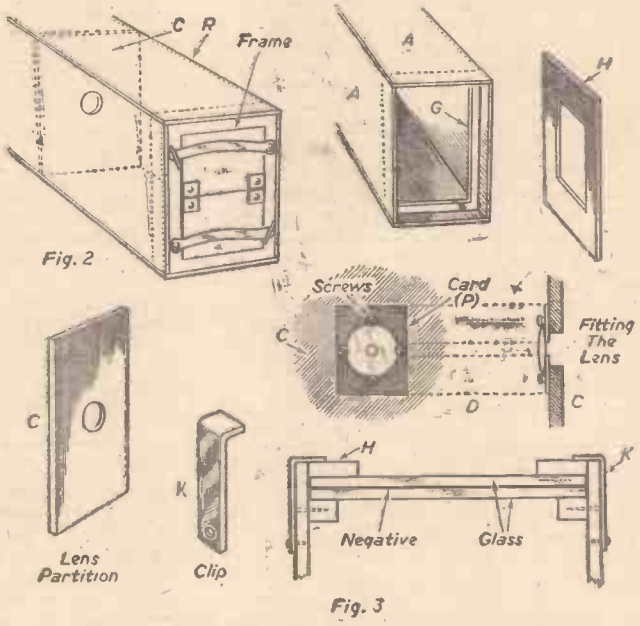


Fig. 1.—Sectional view of the complete enlarger.



Figs. 2 and 3.—Details of rear end of casing, lens fitting, and negative holder.

Items required, other than wood, are an ordinary p.c. printing frame, a simple lens, two sheets of plain glass the same size as the external dimensions of the frame (about 7in. by 5in.) and a tin of matt black paint.

The Lens

The lens can be any simple double-convex and need not be of a high order. Focus should be about 3in. Such lenses are found in box cameras or can be bought for about 3s. 6d. from any secondhand camera shop.

Having procured the lens, make a few experiments with a candle and sheet of paper to find the position of the lens which gives a sharp image of the flame on the paper, when flame and paper are about 2ft. apart. Make a note of the distances.

Now measure the width and length of the printing frame and cut the sides (A) (Fig. 4) —two with a width equal to the side of the frame and two with a width equal to the end of the frame, plus two thicknesses of the side wood. Make all the pieces 1in. more in length than the paper-to-flame distance and use ¼in. or 3/16in. plywood for all four sides.

Cut partition (C) from ¼in. wood to the same size as the frame and make a ¾in. circular hole from its centre. Over this place a sheet of thin, well-blackened card (P) with a ¾in. diameter round opening in the middle, and over this lay the lens, securing with four screws round the outside as indicated in sketch D, the screw heads just catching over the glass. Paint all these parts and the printing frame with the matt black.

The Casing

Assemble the walls, two overlapping, tightly round the frame as in Fig. 2, with the frame sufficiently far in that the cover which is later fitted will lie flatly over the ends. Secure the frame with a series of ⅜in. screws at 1in. intervals all round. For the moment hold the partition (C) with a sprig, roughly at the place where it has to go. Run also a series of ½in. fine sprigs (R) down the whole length of the seams at about 1in. intervals.

For the further end cut four pieces of ¼in. stripwood to make the collar (G), and to lie over this shape the piece (H) from ¼in. plywood, the centre opening being 3½in. by 2½in.

Finally, two spring clips (K) can be made and attached as shown.

Lengths of clock spring bent after the temper has been taken out by local heating will do admirably. The end assembles, as in Fig. 3, with two sheets of glass (film (negative between) resting on the collar (G) and the rectangle (H) on top, all being held by the clips, and, as the aim is to get the ends of the walls and part (H) flush with each other, the collar (G) is fitted at such a distance in as to bring about this condition. Tests are made of measurements taken from the glasses and part (H) to get the right position.

Test must now be made to get the partition (C) with lens in exactly the right position. To do this place a thin negative in between the glasses and taking the back from the printing frame lay a piece of ground glass or not too grainy tissue paper on the frame glass just where the sensitive paper will go. Place the negative end before a very bright light and an image will appear on the glass. This, probably, will not be quite sharp, but by easing the partition a little forward or backward (removing the ground glass and frame glass to do so) the exact position of sharp focus can be found. It is worth spending some little time in getting this position accurately.

Once found, secure the partition with a series of ⅜in. screws from the outside, and fill in the little hole left by the temporary sprig with a touch of putty.

Making the Box Light-tight

Now comes the task of making the box absolutely light-tight. If well made it should be quite tight as it is, but no chances can be taken, as all light other than that coming through the negative must be kept out, so strips of black linen tape (or adhesive linen tape blackened) are run along the seams. Tape should also be run round the corners where the inside partitions connect with sides, these being reached through the opening in the back and front. If neatly put on the tape will not spoil the appearance.

To complete the enlarger, all that is necessary now is to fit the two flaps as in Fig. 4. These are rectangles of 3/16in. plywood held by light hinges. The flap that goes over the printing frame end is to keep any back light from getting through the folding back of the printing frame to the paper, and it is held with another spring clip at the opposite end to the hinges. The flap at the negative end is for keeping out the light till it is time for the exposure, and really acts as a shutter. It is not clipped down and a small knob is fitted to help in quick manipulation. Both flaps are well blackened and are covered on the inside with rectangles of thin black velvet, glued securely down. As a final refinement a handle of leather, as used for carrying rugs, etc., would be very convenient.

(*Continued on page 355*)

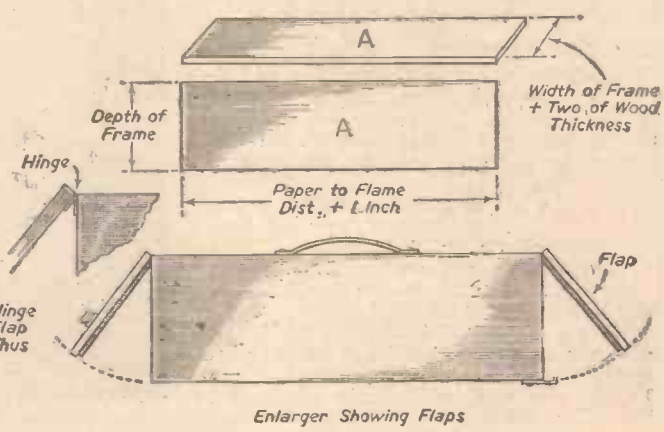


Fig. 4.—Casing construction, and details of hinged flaps.

THE WORLD OF MODELS

A Cornishman's Collection of Models : The Home of Model Making : Model Turbo-electric Tug

By "MOTILUS"

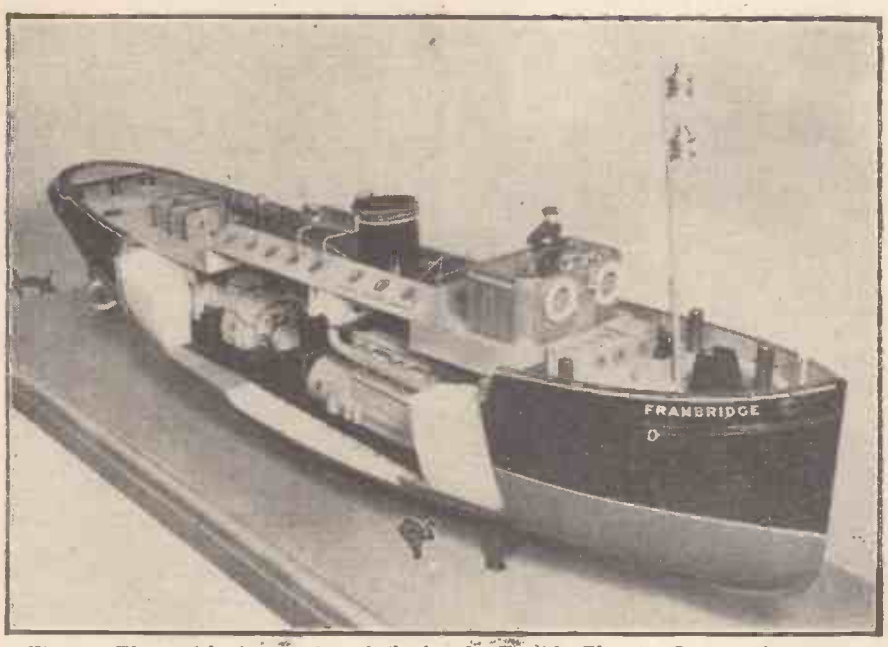


Fig. 4. The model of a tug-boat built for the English Electric Co., to demonstrate Turbo-electric drive. The larger scale steering wheel which operates the model can be seen on the left of the photograph.

SPENDING a short vacation in Cornwall, I was very interested to visit that picturesque and attractive miniature port, St. Ives—once the home of smugglers and now the rendezvous of artists and people of leisure—and to find much to interest me. Apart from the old buildings and charming narrow ways in this once-famous fishing town, I found many inhabitants interested in models. In the issue of August, 1946, I referred to Mr. A. Hope, the chef of the Tregenna Castle Hotel, and, when calling on him again, I found him engaged on two more ancient ships, which I hope to feature at a later date.

An Interesting Collection

On meeting Mr. James Laity, who owns a provision store on the Wharf in St. Ives, I was told of his collection of relics of all kinds, and his many models. He was most anxious to show me his treasures, some of which were outstanding. One was a huge model of the *Bellerophon*, made in 1795, probably in Jersey, since she was originally a French man-o'-war. This model was shown at the Great Exhibition held in Hyde Park in 1852 and sold to a private owner. It was subsequently bought by Mr. Laity at a curio shop in Bath. The hull measures 9ft. 6in., and the model is nearly 17ft. from figurehead to stern. The model is not in excellent condition, and I hope someone will be found who could fully and accurately repair it, then it would certainly make a very valuable addition to a museum, especially one where ship models are collected. Among other interesting relics were antiques from the Far East—Japan, China and Burma—and I was particularly struck with the varied collection of ship models from China and Japan, ranging from ancient Chinese junks to models of the *Cutty Sark* period.

Mr. Laity had a special treasure in his drawing-room in the form of a beautiful model in ivory of a three-masted ship, 12in. long from figurehead to stern (Fig. 1), made by the French prisoners of war on Dartmoor between 1780-1815, which he also purchased from a curio shop in Bath. This model is in excellent condition and is one of the finest pieces of work of this type which I have seen outside the South Kensington Museum.

A Novel Gate

Walking in the suburbs of Carbis Bay, Cornwall, I noticed many of the householders had adopted a rather unique type of garden or entrance gate in the form of a steering wheel of a ship. I understand that these are either relics from old ships or wheels which have been given to the owners by friends who were replacing the steering wheel on their yacht. As you will see from the photograph (Fig. 2), they make quite an attractive gate with a definite "shipping" atmosphere, most appropriate in such a place.

To the engineer, perhaps the most interesting sight in Cornwall is the old Cornish pumping engines, and while in the district I took the opportunity of making contact with Mr. J. H. Trounson, the hon. curator of the Cornish Engines Preservation Society, a man whom I found to have great pride in his county and in the famous men who have been born and associated with it. As a result of the unveiling of the statue of Richard Trevithick in Cambourne in 1932, interest in the old Cornish pumping engine, perhaps the greatest achievement of the engineers of that county, was stimulated. In 1935 the Cornish Engines Preservation Society was formed, with the object of preserving some of the relics and evidence of the ability of the forefathers of this old

Fig. 1. Mr. James Laity's ivory model of a three-masted ship.

Fig. 2. The unusual entrance gate used by some of the residents of Carbis Bay, Cornwall

Fig. 3. The Engine House of the East Pool Mine, Pool, Nr. Redruth.

mining county. To Richard Trevithick, famous as the inventor and engineer who built the first steam locomotive to travel on rails (hauling 70 people at the rate of five miles an hour in 1804), can also be attributed much of the credit for the development of the single-action beam engine. This type of engine, first used by Thomas Newcomen for pumping water from the Cornish mines, although greatly improved by James Watt 167 years ago, is still in use to-day.

An Old Beam Winding Engine

Shown in the photograph (Fig. 3) is the East Pool Mine, Pool, near Redruth, which contains a 30in. rotative beam winding engine. This engine and its house have been given to the Cornish Engines Preservation Society by Messrs. East Pool and Agar, Ltd., with the agreement of the Ministry of Supply. Urgently needed repairs to the roof and walls have been carried out, and this is now to be used as an industrial museum. It is significant that this is the last Cornish rotative beam engine to be made in Cornwall. It is double acting, has a stroke of 9ft., with slot link reversing gear, and the valves are of the double-beat Cornish type. Designed by F. W. Mitchell, it was built in 1887 by Messrs. Holman Bros., of Camborne.

I spent some time in Redruth and visited the house where William Murdock lived from 1782-1792, which has now been converted into a small museum. William Murdock was the inventor of the steam locomotive, and the first one, a model, was made in this house. Local tradition tells that it was first tested one evening on the path of the churchyard, giving the vicar the fright of his life! It must have been regarded as a very strange phenomenon at that time. Gas lighting, first used in this house, was another invention to the credit of William Murdoch.

"Where the Models are Made"

The town of Northampton was recently favoured with a visit from John Clark and Jacqueline Boyer when they were appearing in a stage version of the show *Just William*. I am sure that readers will be interested to know that the first thing that John Clark wanted to see in the town was where the models were made, despite the fact that he was informed that Northampton was the home of the boot and shoe industry. However, the two youngsters were taken on a tour of inspection round the works of Bassett-Lowke, Ltd., where they found many things to delight them. Jacqueline was most impressed with a model railway built on an estate. "What an idea for our Japanese garden at home," was her remark. Trains, of course, gave the greatest pleasure to John, and he gave full marks to the "Flying Scotsman" model, which, although only a yard long, can easily pull an adult in a miniature carriage. In the waterline ship model department they watched with bated breath while the small pieces of wood, bristol board and metal were fixed into position on the minute ships. After remarking on the number of drawings used to make a single component (there were about 35 sheets of blueprints on the bench of the machine shop at the time), they saw metal parts being made on an automatic lathe. A few yards away they saw a craftsman turning up parts by hand straight from a drawing and were amazed at the correct detail which he was able to attain. In the paint shop, John and Jacqueline could hardly believe their eyes when they watched some very fine lettering and lining being done by hand with extreme precision.

Model Turbo-electric Tug

One of the latest models built for the English Electric Co. is a tug, made to demonstrate the principles of turbo-electric drive, which means direct control to the propeller through the motors, from the captain through the telegraph on the bridge. By this means, although the signals from the bridge are registered in the engine room, no action is necessary by the engineer. This drive is particularly useful for small vessels, such as tugs, where a fraction of a minute in transmitting commands from bridge to engine room is of such importance. The model (Fig. 4) is made to a scale of ½in. to 1ft., and a replica of the bridge, mounted outside the showcase for demonstration purposes, is to the scale of 1½in.-1ft. By operating the telegraph on the large-scale bridge, the propeller revolves at various speeds forward and reverse, the rudder is moved, the signal is transmitted to the engine room, and at the same time the figure of the pilot on the bridge of the model itself operates the small telegraph. Truly a remarkable model.

A FINE DISPLAY OF MODEL POWER BOATS

A fine group of model power boats entered for the Coupe de Paris, on June 8th, at the Bassin Destuileries, Paris.

Letters from Readers

Trisection of an Angle

SIR,—With reference to the note on this subject by K. R. Saillard, in the May-June issue, I suggest that the method described is false, and liable to mislead. Students of pure mathematics should be aware that it can be proved that θ cannot be trisected by any method using compass and rulers only.

The method described is only true for one particular value of θ, that obtained from the equation

$$\sin\frac{\theta}{3} = \frac{\sin\theta}{1+2\sin\left(\frac{\pi}{2}-\frac{2}{3}\theta\right)},$$

if my calculation is correct.—G. H. CHILD (Hove).

Modifying a Three-phase Motor

SIR,—The accompanying circuit for operating a three-phase motor from a single-phase supply might be of interest to W. M. Smith (Derby), whose query I noticed in the "Enquiries" section of the July issue of PRACTICAL MECHANICS. I have used the circuit successfully with a ⅛ h.p. motor. The condenser should be fairly large, say, 8 to 16 mfd., while the choke should be fairly small. I used an electromagnet with a piece of iron across the poles quite successfully. The optimum values can best be found by experiment.

I hope the circuit will be of some assistance. —H. C. BURFORD (Raynes Park).

The Ferguson Paradox

SIR,—I believe I have discovered the explanation to your epicyclic gear paradox, published in the May-June issue.

For argument's sake, first suppose the line of centres to be stationary, and all three gears to rotate. This is permissible as it is true relative to the line of centres.

In actual fact this is the equivalent of a rotation of the line of centre in an anti-clockwise direction when the left-hand gear (A) is fixed.

If the right-hand gear (B) has the same number of teeth as A, it will rotate with equal velocity to A relative to the line of centres; that is, it remains fixed relative to A.

If B has less teeth, it will rotate slower than A relative to line of centre; it rotates anti-clockwise relative to A (i.e., in direction of line of centre).

Vice versa, if B has more teeth the idler in all cases has no effect on the speed of the gears, it serving only to change the direction of the driven wheel.—D. P. BROWN (Brighton).

SIR,—In reference to your article, "A Mechanical Paradox" in the May-June issue, this does not appear so paradoxical after a few minutes' thought.

The 60-tooth gear wheel mounted on the arm of the model will appear stationary when the arm is turned about the fixed gear wheel, due to the reversing influence of the intermediate or idler pinion which neutralises axial movement of the free 60-tooth gear.

Therefore, however far the arm is turned about the fixed gear wheel, the free gear wheel is turned (in theory) an equal amount in an opposite direction in relation to the arm. Thus, the free gear wheel does not move axially.

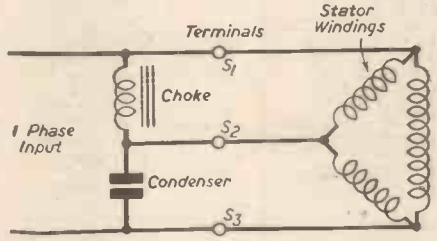
Actually, the arm from one point turns axially about the free gear, while from another it turns about the fixed gear; and the free gear with no axial movement turns bodily about the fixed gear.

The difference in speed of the 59- and 61-tooth gears is accounted for by their number of teeth being other than 60, that of the fixed gear.

The 59-tooth gear in a normal gear train would turn slightly faster than the 60-tooth gear, and as (in theory) the fixed gear moves in an opposite direction to the arm, so the movement of the 59-tooth gear tends to become over-neutralised and so lags behind, or moves opposite to the arm.

The reverse applies to the 61-tooth gear which gains slightly on the 60-tooth free gear.—C. LEVERETT (Great Yarmouth).

SIR,—I was very interested in the article on Ferguson's "Mechanical Paradox"



Circuit diagram for operating a three-phase motor from a single-phase supply. (H. C. Burford.)

in the May-June issue of PRACTICAL MECHANICS.

As my mathematical knowledge is limited, my attempt at explaining how it works must be non-mathematical and non-technical.

Assuming the reader has the model before him and turns the handle in a clockwise direction to operate the mechanism. If he now holds the handle still and rotates the base in an anti-clockwise direction, this will give the same direction of rotation relative to the handle.

Now, taking one of the cluster of gears at a time, mark one of the teeth on each of the large gears (A and C) and rotate the base through one complete revolution. Note the positions of the marked teeth.

In the case of the 60-teeth gear (C), it will be found that it has stopped in the same position relative to the fixed gear (A) in which it was originally. There is no mystery in that, obviously.

Taking the 61-teeth gear, we repeat the process and find that the gear C has not quite completed one full revolution, but is one tooth "short" of the mark. Relative to A, it has made $\frac{1}{61}$ of a revolution in a clockwise direction.

Repeat with the 59-teeth gear. It will be found that it has moved a little more than one revolution—$\frac{1}{59}$ in fact. Here we find that the marked tooth has moved one tooth forward, i.e., in an anti-clockwise direction.

The next step is to suppose that the cluster of gears meshed directly with the fixed gear A. Obviously, then, the cluster of gears will rotate in an opposite direction to A, though at slightly different speeds: 61 T slower, 60 T the same, 59 T faster than A.

It follows that the "trick" lies in the innocent-looking idler B. Placed between the two, it causes A and C to rotate in the same direction when the base is turned.

As we have seen, the middle gear of the cluster takes up the same relative position as A, no matter what position the latter takes up. Therefore, when the handle is turned, A being fixed, the middle gear is stationary.

As we have also seen in our second demonstration, which omitted the idler B, the topmost gear rotated more slowly than A, while the bottom gear travelled a little faster than A. To satisfy these conditions when A is stationary, then obviously they must rotate in opposite directions when the handle is turned.—J. R. DORRITT (Smethwick).

SIR,—The simplest way I can think of explaining how the Ferguson Paradox Machine works is, for explanation's sake, taking the idler pinion as having 15 teeth. When it is carried round the fixed sun wheel of 60 teeth it must revolve four times on its axle in the same direction as the arm travels. As it gears with the 60-tooth middle wheel of the cluster, it will propel its 60 teeth in the reverse direction to which the arm is revolving. As this cluster wheel has 60 teeth it obviously will not revolve in space.

When the cluster wheel has 59 teeth, it is carried 60 teeth in the reverse direction to the direction in which the arm is travelling, so it moves one tooth per revolution of the arm in a reverse direction. Conversely, when the cluster wheel has 61 teeth, it is moved 60 teeth in the reverse direction, so it moves one tooth in the same direction as the arm. The well-known differential chain-hoist works on the same principle.—R. F. HEWSON (Rathkeale).

Waterproofing Roughcast

SIR,—With reference to the reply to J. N. Manchipp (Bristol) in the May-June issue of PRACTICAL MECHANICS, I think the best solution to his problem would be the use of "Snowcem," easily obtained, durable, and besides being waterproof itself, it seals and so renders waterproof the surface to which it is applied.—H. A. PHILLIPS (Winton).

A FIXED-FOCUS DAYLIGHT ENLARGER

(Continued from page 352)

Operation

To use the enlarger, the negative is put in position in daylight (emulsion side down) and the apparatus taken to the dark room, where a sheet of bromide paper is fitted in the printing frame, back and flap being closed. Out in the open again, the negative end is pointed towards any area of *clear sky*, the flap raised and a pre-determined exposure given. When finished, the flap is closed and in the dark room development carried out in the usual way.

Club Note

Andover and District Model Engineering Society

THE Society's exhibition, held a short time ago, was in every way a huge success. This was partly due to the support of the other members of the Southern Federation of Model Engineering Societies, who loaned models. The Andover Society was responsible for the formation of the Southern Federation, which includes nearly all the societies in Hampshire and some in neighbouring counties. We extend a hearty welcome at our meetings to all interested persons in the neighbourhood, especially model engineers now serving in H.M. Forces. Our summer programme includes visits to the Chapel River Press, McDougall's Mills and the local gas works. For particulars apply to: R. Pemble, Hon. Sec., 14, Weyhill Road, Andover.

QUERIES and ENQUIRIES

A stamped addressed envelope, three penny stamps, and the query coupon from the current issue, which appears on back of cover, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

Barium Sulphate : Baumé Hydrometer

WILL you kindly give me the following information ?

(1) Where can I obtain "commercial" grades of heavy spar (barium sulphate), alum and silica in quantities of 14 to 28lb. ?

(2) What is a Baumé hydrometer, and how does it differ from an ordinary hydrometer ?—A. Southwood (Southall).

(1) THE commodities which you require may be obtained from the following sources :

Barytes (barium sulphate)

Varcoes Sales Co., Ltd., 13, Worsley Street, Salford, 3, Lancs ; Messrs. James Miller, Sons and Co., Ltd., 90, Mitchell Street, Glasgow, C.1 ; Malehurst Barytes Co., Ltd., Minsterley, Shrewsbury.

Alum

Messrs. Peter Spence and Sons, Ltd., National Buildings, St. Mary's Parsonage, Manchester.

Silica (ground)

Messrs. Colin Stewart, Ltd., Wharton Lodge Works, Winsford, Cheshire ; The Welsh Silica Co., Ltd., Connah's Quay, Flintshire.

For very small quantities of these materials apply to any firm of laboratory suppliers, such as Messrs. W. & J. George and Becker, Ltd., 17-29, Hatton Wall, London, E.C.1.

(2) A Baumé hydrometer is simply a hydrometer which is marked in degrees Baumé. Except for determining sugar contents, it is not greatly in use in this country. Baumé readings are complicated by the fact that there are two Baumé scales, a "Heavy Baumé" for liquids heavier than water and a "Light Baumé" for liquids lighter than water. Furthermore, the Baumé scale used in Europe is slightly different from that used in America.

On the "Heavy Baumé" scale, 0 deg. corresponds to a specific gravity of 1.00, and 66 deg. Bé corresponds to an s.g. of 1.842.

On the "Light Baumé" scale, 0 deg. is equivalent to the s.g. of a 10 per cent. solution of pure sodium chloride, whilst 60 deg. Bé is the equivalent of 0.745 s.g.

For Baumé degrees which are greater than unity, the following equation gives the means of conversion :

$$\text{s.g.} = \frac{m}{m - d}$$ where m = 145 (144 in America), d = Baumé reading

Imitation Sea for Model Ships

CAN you inform me of the best way of making the imitation sea for model ships in bottles, and the best formula for the mixture ?—Lewis Burton (Bramley).

THE imitation sea to which you refer is usually based on gelatine.

Dissolve about 20 parts of gelatine (not glue) in 80 parts of water, and add sufficient dye to the mixture to colour it a pale greenish-blue. It is *essential*, also, to add several drops of carbolic acid to the mixture to prevent the gelatine from turning mouldy.

The above mixture sets solid when cold. It is, therefore, advisable to pour warm into the bottle and allow to set. If shaken vigorously, it will create foam, and some of this will remain on setting, thereby giving a realistic effect. A little common alum may be added to the liquid to aid its hardening (when set) and its freedom from mould.

Another liquid which may be used for the same purpose is sodium silicate (waterglass). This remains as a very viscid liquid, but in contact with air it very slowly becomes more or less opaque. However, for temporary use over a period of months, it may, perhaps, suit your purpose very well.

Liquid for Petrol-level Indicator

I AM unable to obtain the special liquid for replenishing the gauge of the hydrostatic petrol-level indicator on my car. Can you please let me know of a suitable substitute ?—A. Pritchard-Williams (Penygroes).

VARIOUS designs of petrol-level indicators employ various fluids. For example, the Ford hydrostatic fuel gauge uses as an indicating liquid acetylene tetrabromide, a clear liquid of specific gravity of 2.9—3.0 which is coloured by alcohol-soluble dyes.

As an alternative, you can use, also, a mixture of 3 parts (by volume) of ethyl acetate and 2 parts of castor oil. A still better mixture comprises equal parts of castor oil and ethyl lactate. In either case, the liquid is coloured by alcohol-soluble dyes.

The latter mixture in particular has a high boiling-point and a low freezing-point. It is very staple and it has no effect on metals. It is advisable to use the purest form of castor oil (medicinal) for this purpose, since some of the cruder castor oils tend to be acid.

Another gauge fluid comprises a 50 : 50 mixture of pure glycerine and diacetone erythritol.

Unfortunately, nearly all the above substances are difficult to obtain by private individuals at the present time.

Metallic Seal in Quartz

WHAT is the best way of attaching a metal electrode to a piece of quartz glass tubing so as to make it vacuum-tight and heat-proof ? Also, what is the metal alloy used for the electrode. —N. Cooper (Birmingham).

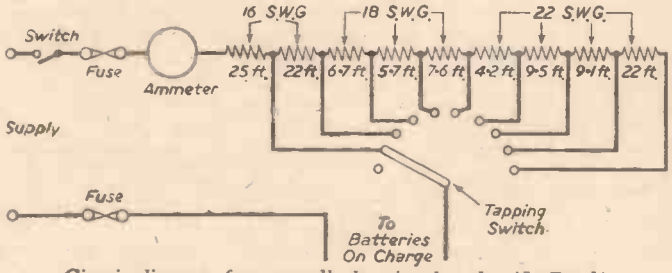
BY far the best way to get a vacuum-tight metallic seal in glass or quartz is to use a platinum wire. This has nearly the same coefficient of expansion as glass or quartz and no difficulty will be experienced in making a good and permanent seal. About an inch of platinum wire costing about three shillings would suffice. This material may be obtained from Messrs. Johnson, Matthey & Co., Ltd., Hatton Garden, London, E.C.1.

Alternatively, there is a nickel alloy which will suit the same purpose. It is usually coppered. Particulars of it can be obtained from the Mond Nickel Co., Ltd., London, S.W.1. The metal of electrode construction varies a great deal. It is frequently pure nickel or nickel alloy, but in other instances it may consist of platinum, iridio-platinum or molybdenum. The three latter metals are naturally expensive, but they can be obtained from Messrs. Johnson, Matthey & Co., Ltd., address as above.

It is possible, too, that you may be able to get some of this material from Messrs. Philip Harris & Co., Ltd., Laboratory Furnishers, of Birmingham, or from Messrs. W. & J. George & Becker, Ltd., 157, Great Charles Street, Birmingham, 3.

Small Charging Board

CAN you oblige me with particulars of a small charging board suitable for the following purpose ? I have a small electric charging plant of 50 volts with 26 large-capacity storage cells, and I should like to charge four or six small 2-volt wireless accumulators and at odd times a 12-volt car battery from the 50-volt storage which I always keep fully charged.—Ian Boyd (Kinbrace).



Circuit diagram for a small charging board.—(I. Boyd.)

YOUR charging board could consist simply of a single-pole switch in series with an ammeter reading up to at least 10 amps. and a variable resistance as shown in the diagram, the charging circuit being fed through two 10-amp. fuses.

The variable resistance could consist of lengths of 16, 18 and 22 s.w.g. Glowray resistance wire, as supplied by Messrs. Henry Wiggin & Co., Ltd., of Grosvenor House, Park Lane, London, W.1. These wires could be wound in coils of small diameter and connected up to the back of brass contact studs fitted in an asbestos or slate panel, with a phosphor bronze or brass moving contact.

Jelly Moulds for Plaster Casting

I AM thinking of making ornamental plaster figures, cast in jelly moulds and sprayed with cellulose. Can you give me the following information ?

(1) Where can I get the kind of jelly required, or, if it is unobtainable, how can I make my own jelly ? I have heard that it is now possible to buy a kind of rubber jelly that will last indefinitely. Can you give me particulars of this ?

(2) Does plaster need priming or treating in any other way before being sprayed with cellulose ?—B. Webster (Trentham).

FOR your jelly moulds you should use a strong glue solution, making the solution as thick as possible. This will set dead hard. Alternatively, you could use a solution containing about 30 parts (by weight) of gelatine dissolved in 70 parts of water.

We have been unable to trace the suppliers of the rubber jelly which you mention, and we doubt whether it is obtainable in this country. However, you might get more information on this point by referring to Russell Handicrafts, Ltd., Hitchin, Herts.

Strictly speaking, a plaster cast can be painted or enamelled without any surface treatment other than ordinary smoothing, but in order to save paint it is best to brush over the surface of the plaster a pore-filling material. For this purpose, use a weak solution of gelatine, say 5 parts of gelatine (not more) in 95 parts of water. Brush this hot over the plaster surface and allow it to dry in. Then proceed with the painting in the usual manner.

Do not forget that all gelatine and glue solutions and mixtures need preserving if they are to be kept for any length of time, for without a preserving agent a glue or a gelatine solution will rapidly become mouldy. The best preservative agent is ordinary carbolic acid or lysol, five or six drops to every pint of the solution.

Removing Varnish from Metal : Ethyl Silicate

I SHOULD be grateful if you could supply me with the following information :

(1) The easiest way of completely removing old varnish from metal without scratching the metal.

(2) Details of a substance known as ethyl silicate, i.e., its preparation, uses, etc.—A. F. Stallwood (Stroud Green).

(1) USE the upturned edge of a copper coin and gently scrape the varnished surface in one direction only. If the varnish is old and has become brittle, it will come away completely and the underlying metal surface will, contrary to being scratched, actually be burnished. If the varnish is new and still pliable, you will have to use a paint-removing preparation and mop it on with a soft rag, subsequently rubbing the softened varnish away. The precise composition of the paint remover will depend on the nature of the varnish to be removed. Most of the paint removers contain acetone, paraffin wax and a softening liquid such as ethyl acetate. Others contain benzol. Any of these liquids will soften paint and varnish, but, unfortunately, they are all most difficult to obtain at the present time.

(2) Ethyl silicate (silicon ester) is a colourless liquid which is rapidly increasing in commercial importance. In the presence of moisture it slowly breaks down, releasing silica (silicon dioxide), which is a most stable and resistant inert material. Hence, ethyl silicate is used increasingly as a stone preservative and a stone binder. It is used for restoring the stones of ancient buildings, as a surface treatment for concrete, and as a moulding material for the production of delicate and complicated engineering castings.

In the laboratory it is prepared by the action of ethyl alcohol on silicofluoroform, $SiHF_3$. On this small scale it is difficult to prepare, but other methods have been worked out for its industrial manufacture, so that it can now be obtained at a relatively low cost. It is manufactured by Messrs. Albright & Wilson, Ltd., 49, Park Lane, London, W.1, who, no doubt, would be willing to let you have copies of any available literature concerning it.

Softening Spring Water

I REQUIRE to soften about 250 gallons of hard water daily, taken from a spring. Could you advise on the best method of softening ?—A. S. Heywood (Stoke Hill).

BY far your best and most efficient method of water-softening is to use one of the well-known "base-exchange" processes by means of which the water is simply trickled through a bed of special filtering medium, emerging almost totally free from permanent hardness. After a time, the filtering medium becomes "spent." It is then regenerated by filtering a solution of common salt through it and, after a subsequent rinsing, it is again fit for use.

Apparatus and plant for these processes is supplied by The Permutit Co., Ltd., Gunnersbury Avenue, London, W.4. We are not, however, aware whether outfits are yet being supplied to private users. Sofnel, Ltd., Greenwich, London, S.E., may also be able to help you in the matter with descriptive and explanatory booklets.

Moulding Perspex : Varnish Thinners

WOULD you kindly answer the following queries ?

(1) Is there a chemical which will dissolve Perspex so that it could be poured into a mould to set ?

(2) If above is possible, could you suggest a solution which could be painted on the plaster-mould to protect it from injury by the chemical incorporated with the Perspex ?

(3) Where can I obtain aluminium rivets in small quantities ?

(4) I have some paper varnish which needs thinning to be usable again. What would you suggest I use for the purpose ?—F. Metcalf (Portsmouth).

(1) Perspex resin can be dissolved by chloroform, trichlorethylene, or by a mixture of equal parts of acetone and amyl acetate. The solution takes about three days to do this, but a thick, varnish-like liquid is obtained. This slowly sets on drying, but, of course, there is a good deal of shrinkage as the solvent evaporates.

(2) To protect a plaster mould, dissolve 10 parts of gelatine in 90 parts of water. This will set to a jelly. It should be used warm, brushed over the mould and allowed to dry. It can be washed off with water when necessary. As a matter of fact, however, none of the above Perspex solvents will injure plaster, so we do not see any necessity of your going to the trouble of gelatining the plaster.

(3) Aluminium rivets can be obtained from the following firms: Messrs. Thos. Bradley, 72, Great Hampton Street, Birmingham, 18; Messrs. David Powis & Sons, Ltd., Golden Hillock Road, Sparkbrook, Birmingham, 11.

(4) Since we have no idea of the composition of your particular varnish, we are rather at a loss to suggest a suitable thinner. It is very possible that yours is a shellac varnish, in which case methylated spirit can be used as a thinner. If it is an oil varnish, you will need linseed oil for this purpose.

We do not know where you can obtain a *small* quantity of this specialised varnish since most manufacturers nowadays are not disposed to trouble with small orders. However, you can readily make a good shellac varnish for this use by dissolving shellac in about an equal bulk of methylated spirits. Shellac is obtainable at most paint and decorators' shops.

Treating Inside Surface of Aluminium Bottle

CAN you suggest a method whereby I can coat the inside of an aluminium bottle with a substance that will not taint the contents, usually water, as the aluminium does at present ?

I have tried celluloid dissolved in acetone, but was unsuccessful ; a form of plating seems to be indicated.—M. Miller (Kingston).

A CLEAN aluminium vessel is not usually considered to have the property of tainting fresh water. We should have been interested to know in what way the water is tainted by the aluminium, since aluminium kettles and kitchenware are quite common nowadays, and are regularly used without complaint.

However, if you are satisfied in your own instance that the water is, in fact, tainted by the aluminium bottle, your best plan is to paint the inside of the bottle with a clear cellulose lacquer. Such lacquer can nowadays usually be obtained at a local paint shop.

Alternatively, you can make it up yourself from the following formula, but we fear that you will have difficulty in getting hold of the necessary materials :

Film scrap	15 grams	(or parts by weight)
Ethyl acetate	17	"
Amyl acetate	25	"
Xylene	60	"
Benzene	40	"
Boiled linseed oil	8	"
Tricresyl phosphate	3	"
Ethyl alcohol (industrial spirit)	26	"

Electro-plating is impracticable in your instance, but you might try anodising the inner metal surface, whereby you would produce a film of aluminium oxide thereon. Fill the vessel to the brim with a 3 per cent. solution of chromic acid. In the centre of the vessel suspend a carbon rod. The carbon is made the negative pole and the vessel itself the positive electrode (anode). Pass an E.M.F. of about 30 volts D.C. for half-hour, the temperature of the liquid in the vessel being about 40 deg. C. Finally, well rinse the interior of the vessel in hot water and allow to dry.

Potential Divider for Transformer

I WOULD be much obliged if you could supply information on the following points :

(1) I have a transformer, output 8 volts 10 amps., and wish to limit the output to 6 volts. I think a potential divider would be needed. Could you give me particulars of the resistance required ?

(2) Is it possible to obtain outputs of 2, 4, 6 and 12 volts at 1 amp. by using a potential divider either on the A.C. or D.C. side of a Westinghouse full-wave rectifier, with following equipment ?

(a) Transformer, output 22 volt 2 amp.

(b) Full wave rectifier, input 22 volt A.C., output 12 volt 1 amp D.C.—J. D. Bird (London, W.C.2).

THE output of the 8-volt transformer could be limited to 6 volts by means of a resistance in series between the transformer and the load circuit. If the load current is C amps. the ohmic resistance of the series resistance required would be $\frac{8-6 \text{ volts}}{C \text{ amps.}} = \frac{2}{C}$ ohms.

A potential divider could be used for the same purpose, but this method is rather uneconomical of power. With either a series resistance or a potential divider the voltage at the load will depend on the load current, or the resistance of the load circuit. This could be compensated for by making the series resistance or the potential divider adjustable.

The advantage of a potential divider is that the load voltage could be kept more nearly constant than would be the case with a simple series resistance. The nearest approach to a constant load voltage on a varying load current would obtain in the case of a potential divider supplying a small load current with a large waste of power at the divider. The simplest way of controlling the output voltage of the rectifier is by means of a resistance connected between the transformer and rectifier.

Treating a Red-tiled Floor

I HAVE a floor consisting of red quarries. When I took over my present house, the people before me had left the floor covered with old lino. It has been taken up for quite a while, but every time it is cleaned with soap and water, it dries in white patches. Could you advise me how to remedy this ?—Mrs. A. Bradburn (Fenton).

WE are sorry to say that there is very little you can do about your red floor. If you scraped the entire surface so as to remove the white patches we fear that they would return again. Your best plan, we think, is to scrub the floor with plenty of hot soapy water and a little washing soda. Let the floor dry out thoroughly and then go over it with a cloth charged with one of the proprietary red floor polishes which are obtainable nowadays. "Red Cardinal" polish would, we think, give you the results you want. It would give the floor a semi-gloss appearance and we think that you would only have to re-apply it at monthly intervals.

Metal Filling

WOULD you give me the formula for a good metal stopper, which I understand I must have before re-painting my car.—A. Lowe (Southampton).

IT is not necessary to fill up dents in metalwork before it is re-painted. However, if the cracks and dents are bad you can use the following metal filling :

Gum arabic (powder)	12	parts (by weight)
Plaster of paris	12	" "
Iron filings (fine)	12	" "
Silica powder (or whiting)	64	" "

Dissolve the gum arabic in a small quantity of water and with this solution make a thick paste with the other ingredients. This hardens within a few days to a water-and fire-resisting coating which may, of course, be painted or varnished over after a preliminary smoothing down with fine glasspaper.

Pressure Adhesives

WILL you please answer the following query : What is the composition of the pressure-sensitive adhesive which is applied to some types of envelope ? This substance will only adhere to itself, and does not feel sticky to the touch.

I believe that one composition has a rubber latex base, but there is also a composition which contains no rubber.—W. E. Polson (Edinburgh).

THE best pressure-adhesives are formulated on a rubber latex basis—usually a mixture of rubber latex and a resin plastic. These, as you point out, will only adhere to a similarly treated surface.

Another type of non-latex pressure adhesive contains 12-25 per cent. of a film-forming ingredient, such as ethyl cellulose or vinyl chloride acetate combined with 65-35 per cent. of a transparent synthetic resin, such as an acrylic resin. A little fine silica flour is sometimes added to give the adhesive an extra "bite."

Unfortunately all the above materials are very difficult to obtain at the present time, and we know of no firm which would be willing to supply you as a private individual.

Bleaching Shellac

I SHOULD be grateful for the following information : I have some orange shellac flakes and I wish to bleach them to make a clear french polish. Could you please tell me what process to use ?—J. Mace (Blackheath).

SHELLAC is bleached by the action of chlorine on it in the presence of air and sunlight. You can bleach your shellac material in the following way :

Crush the shellac up into the form of fine flakes or powder and spread it in a large dish or shallow tray. Cover the shellac with water and bubble chlorine gas into the water. The shellac will slowly bleach, and the bleaching action will proceed more rapidly if sunshine is allowed to fall on to the tray.

If you are unable to obtain or to make chlorine gas, you may use a solution of chloride of lime. Grind up chloride of lime with cold water to form a paste. Then add about three times as much water and stir the liquid well. Filter it and use the clear filtered solution as the bleaching agent. Stir the shellac into it in jars, and then acidify the solution by adding a small amount of hydrochloric acid. Chlorine will be generated and this will dissolve in the water.

After the bleaching has been effected by either of the above processes, the shellac must be most thoroughly washed in cold water in order to get rid of every trace of chlorine and/or chloride of lime, and finally allowed to dry slowly in the air.

Plaster Material : Rubber Moulds

WOULD you please inform me where I can obtain moulage, the material used for taking casts of faces, statues, etc ?! I think it is also known as Egocoll and Hominit.

Could you also let me know how rubber moulds are made ?—A. M. McCoid. (Hull).

ALL the materials which you mention have a plaster-of-paris basis, many of this class of material consisting of nothing else than plaster of paris. We think you will be able to obtain good, fine plaster material of the type you need from either Messrs. Peter Ford and Sons, Ltd., Uttoxeter, Staffs, or from Messrs. Cafferata and Co., Beacon Hill, Newark-on-Trent. It is always well to remember that a mere trace of glue in the water used for slaking these materials is capable of slowing up considerably the setting time of the plaster.

Rubber moulds are made by a process of curing para rubber or, more usually, "composition" rubber containing a proportion of para rubber. The composition formulæ are all secret ones and so, also, are the practical details of the curing process. We think, therefore, that the only practical method of getting rubber moulds is to have them made for you, but whether you will be able to persuade firms to do this at the present moment is rather doubtful. Nevertheless, for your information, we are appending addresses of rubber firms who might be willing to undertake this work : Messrs. F. Reddaway and Co., Ltd., Pendleton, Salford 6, Lancs ; Schubert Moulding Co., Treaty Works, Hounslow, Middx ; The British Ebonite Co., Ltd., Nightingale Road, Hanwell, London, W.7 ; The India Rubber, Gutta Percha and Telegraph Works Co., Ltd., Silvertown, London, E.

Crackle Enamel

I AM desirous of finishing some articles in crackle finish. Would you kindly inform me whether crackle enamel is to be obtained and the methods of using, or, if not now easily obtained, can you supply a formula ?—E. W. L. White (Castleford).

CRACKLE enamel is not a commercial commodity in the ordinary sense of retail trade. The crackle finish is formed on a metal surface by means of heat-treatment, the enamel being mixed with a material which, under heat influence, destroys the continuity of the enamel film. For this reason it is very difficult to produce the crackle finish on a small scale, since the precise conditions are usually maintained secret.

The incorporation of a metallic soap with the enamel will produce a crackle finish when the enamel film is suitably heat treated. About 5 per cent. of aluminim stearate incorporated with the enamel will provide an effective "crackle agent." The same amount of ordinary sodium stearate will also sometimes suffice.

After enamelling, the object is immediately baked in an oven at 110-115 deg. C. until the wrinkles are formed. Thereafter, the baking is continued at 300 deg. F. for three hours in order to harden the film and to augment and extend the wrinkles.

Silver Selenide

WOULD you please tell me how to make silver selenide ? I have silver nitrate and also selenium (metal).—C. Watson (Bolton).

THE best way to make silver selenide from selenium and silver nitrate is as follows :

Generate *pure* hydrogen gas by the action of pure diluted sulphuric or hydrochloric acid on pure zinc. Lead the gas over a gently heated bulb tube containing molten selenide. This will produce hydrogen selenide, H_2Se. The gas is then led into a solution of silver nitrate, whereby silver selenide will be precipitated therein.

Another way is to boil fragments of selenium in a solution of silver nitrate, but this method is not very efficient.

You should bear in mind the fact that hydrogen selenide, besides being bad-smelling, is rather seriously poisonous, and even traces of the gas will often produce a very bad headache when breathed.

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Editor: F. J. CAMM

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Comments of the Month

By F. J. C.

New Secretary for the R.T.T.C.

THE resignation of Mr. S. Amey as General Secretary of the R.T.T.C. since 1944, raises the question of whether, when the new appointment is made, efforts should not be made to place this body, at present lacking international recognition, on a businesslike basis, with a full-time paid secretary and London offices.

Mr. Amey has filled the post of general secretary with enthusiasm, energy and distinction and we are not surprised to learn that for business reasons he finds it necessary to terminate his engagement. Whilst his resignation has been accepted with regret, which will be all the more keenly felt because he was an extremely able secretary, we wonder whether those who partake in time trials fully appreciate the vast amount of work which goes on behind the scenes in organising even the comparatively small pastime of time trials.

At present most of the officers have to work from their homes and the whole organisation is run in an amateurish way. If it is to be considered as a national sport it must have a full-time secretary who can give his entire energy to the organisation, and prompt attendance to the mass of correspondence which must descend upon him.

Committee meetings are infrequent and delays are therefore inevitable under the present scheme. Other bodies have offices and full-time secretaries and we see no reason why those who wish to indulge in time trials should not pay for such services. They are getting a good deal too much for nothing. They expect men to give up almost entirely their leisure hours in their interests, but the time comes when these voluntary or part paid services interfere with the livelihood of the officials concerned. Under the present method it is likely that every two or three years the R.T.T.C. will be looking round for a fresh secretary, and frequent changes in this important post are bound to lead to confusion and inefficiency.

The Committee is advertising the vacancy and is prepared to hear from interested persons. Here again, however, they are expected to write to another official at a private address. Surely the correspondence of a body which claims to be national should have a centralised address to which all correspondence should be sent for redistribution to the respective officials. We hear complaints that whilst one officer of this club attends to correspondence promptly another may hang on to it for weeks before it receives attention.

The prompt answering of letters is an ordinary business procedure. Cycling clubs are all run by honorary officials who are not always too businesslike in answering letters. They should not be encouraged into the belief that they are no worse than their controlling body.

The time has come, therefore, when the R.T.T.C. should set its house in order. Its experimental period is over, and it hopes to stay. Like the N.C.U., however, it may find itself in a moribund condition in a few years, when massed start racing has entirely established itself as the chief road sport. Certainly it has exhibited greater enterprise, greater energy, and greater business acumen than all of the other bodies put together—even to starting its own journal. The methods of other bodies at present have been to endeavour not to improve their own particular sports to make membership more attractive, but by devious means, not always in accord with the spirit of true sportsmanship, to get massed start racing suppressed.

Unsuccessfully, however, for if massed start racing is suppressed time trials will go too, and they will be hoist with their own petard.

Massed Start Racing

TIME trials have a place, albeit a small one, in the pastime of cycling. The part, however, can never be greater than the whole; the minority will never be able to govern the majority. Massed start racing is here as a modern development, required and wanted by the mass of cyclists, and it attracts larger crowds and greater publicity than the hole and corner time trials which those old men who regard themselves as the proprietors of cycling sport would like to see continued in perpetuity on the lines laid down when a cyclist cowered at the very sight of a policeman.

Of course, things will change as these old men in the course of time pass away and younger men with a more modern outlook fill their places. But that time is not yet.

Had the N.C.U. not thrown road sport overboard in its trembling and aspenlike fear of the police many years ago, there would be no need to-day for men to have to undertake honorary work for a national body. Look at the R.T.T.C. Handbook and the large number of addresses to which a club secretary has to write. There is a chairman, a hon. auditor, a hon. treasurer, a secretary, and an assistant secretary, all operating from different addresses. Some are not on the telephone. In fact, it is not possible during normal business hours to get into telephonic communication with any member of the R.T.T.C. Usually one has to ring them at their business premises, which is not only unbusinesslike but unfair to the employers. It must interfere with the official's work for which he is paid.

Small Clubs

THE industry owes a lot to cycle sport, and it should contribute to a fund to enable the R.T.T.C. to function properly and to have such money available as will enable them to develop the branch of road sport they represent. Small clubs with membership of under 20 have not the funds available to contribute much to the central office. As a result the work is thrown back on honorary officials who have to make disbursements and then draw their expenses This is an equally unsatisfactory arrangement. We also think that the R.T.T.C. should publish its own house journal as by this means it would save itself a considerable amount of money on postage and duplicating, because member clubs would receive their official announcements by this means and have a permanent record of club news and national committee decisions.

The Annual Handbook issued by the R.T.T.C. is badly produced. It lacks vital information. Any amendments, changes of address, etc., have to be notified to club secretaries through the post, and this throws an added burden upon the secretary. The club journal would relieve him of a great deal of this work. However, those interested in the post now advertised and who feel they have the necessary qualifications should write to Mr. W. H. Townsend, 100, Betham Road, Greenford, Middlesex.

In selecting the new secretary we hope that the R.T.T.C. committee will insist upon a telephone being installed, that correspondence is promptly attended to, that committee meetings are regularly called, and that the successful applicant is on probation for a trial period. If after that lapse of time he is found to be satisfactory, he should be prepared to take the job full time for a salary for a period of years. Muddle must result from the frequent handing over of club documents from one secretary to another. It is time there was stability about this organisation.

Perhaps in due time the B.L.R.C. will take over the R.T.T.C., the N.C.U., and the R.R.A. Our criticisms of the R.T.T.C. equally apply to the R.R.A. and its multifarious counterparts throughout the country. If a Records Association is necessary, one only should suffice. You do not need a Scottish R.R.A., a Northern R.R.A., a Southern Counties R.R.A., nor any of the other bodies which exist at present to homologate records over local areas. One national body only, controlled on businesslike lines, is all that is required.

Track Racing

TRACK racing, as we see it, will die a natural death within the next few years. It is unprofitable, nearly always runs at a loss because of the poor gate, is badly managed and badly promoted. The two rival forms of sport left, time trialling and massed start, now compete as to which will be the final form of road sport.

Attempts at road records we all know leave little opportunity for the amateur plowing his lonely furrow. It is only the professional man backed by a large manufacturer who can afford to train and to wait for the favourable opportunity and to have available a plenitude of spares, helpers, and cars. The expenses of breaking records are fairly heavy, and few amateurs can afford it.

Paragrams

Bridge Plan Abandoned

AFTER various changes of mind, Bedford Town Council have decided not to proceed with the erection of a light cycle and foot bridge over the river between Queen's Park and Kempston. It was suggested that a Bailey bridge would suit the purpose but during the recent floods the water reached a foot above the level of the roadway of the proposed bridge and it would probably have been swept away. It is now proposed that an all-purpose bridge to carry all normal traffic shall be built.

Job for Cycle Dealers?

CLEETHORPES Road Safety Committee members have become concerned at the number of local schoolchildren who rattle to school on cycles which appear to be in danger of an early collapse and they propose that no child should be allowed on the road without a certificate issued by the committee to say that his or her cycle is in a roadworthy condition. The committee have approached the police and local cycle dealers on the matter of these inspections. The police are willing to make the inspections at intervals but could not do so regularly and they suggest that the cycle dealers would be far more competent at the work.

On the Move Again

THE ancient market cross at Epworth, well known to riders through this small North Lincolnshire town, is probably going for a little journey in the interests of road safety. It is suggested that the cross, reputed to be one of the crosses from the base of which John Wesley preached, should be moved towards the centre of the market-place and put on an island, in order to give a freer traffic flow.

Improved Facilities at Stations

APPROVAL has now been given by the Ministry of Transport to the provision of better accommodation for cycles which are temporarily left at railway stations, and over five hundred stations are affected. All that remains now is for porters to be given a lesson or two in cycle handling, as it does not make for pleasant feelings when a rider returns to collect his machine and finds lumps of enamel have been chipped from the frame.

Have You Seen a Buglet?

MR. J. B. GOODWIN, of Stamford, Lincs, is the proud possessor of that unusual "musical" instrument, a buglet. This instrument was used by the leader of cycling clubs, after the manner of the coach horn, and warned pedestrians and riders of nervous horses when the club riders were about to enter a town or village. This particular buglet which Mr. Goodwin owns was presented to the now defunct Stamford Cycling Club, in 1890, by Mr. J. L. Rollings, of Stamford, who was for many years a prominent cyclist and cycle dealer in the town and died about three months ago.

Too Hot to Handle

SHORTLY after a Coalville (Leics) police constable had missed his cycle from where it had been left outside a house at which he had been making inquiries, the machine was found abandoned on the other side of the town. The thief, no doubt, had suddenly realised that he was riding a policeman's bicycle and that the results might be very serious for him if he got caught.

Death by Four Inches

CYCLING along a 16in. gap between the railway track and the edge of a viaduct, Frederick William Longstaffe, of Radwell, Bedfordshire, overlooked the fact that the width of his handlebars was 20ins. A train came along, caught the handlebars and swept the rider to his death before he could do anything to save himself. A verdict of accidental death was recorded at the inquest at Sharnbrook.

Teaching the Children

AS part of a special Road Safety Week, held at Kempston, Bedfordshire, a number of children were given rides in police patrol cars to improve their road sense and to let them see some of the dangerous antics which children are liable to get up to when cycling. These free rides are very popular with the children, but it is to be hoped that they will not be lured away from their cycles when they grow up to ride about the countryside at speed seeing nothing, enclosed in airless mobile greenhouses.

Cycle Pioneer

A LAST connection with Thomas Humber, pioneer cycle manufacturer, has been broken by the death of his only daughter, Miss Emma Humber, of Hampton.

Humber began the manufacture of cycles in his backyard at Nottingham, after seeing a French model at the Paris Exposition in 1867. In twenty years the number of people employed in his business grew from 80 to 2,000, and a limited liability company was formed.

Less of a Surprise

CYCLISTS riding near the well-known Surprise View in Derbyshire, just outside Sheffield, have often received an unpleasant surprise owing to the selfishness of motorists who have parked their cars in all kinds of crazy positions and then suddenly draw into the roadway when they want to move off again. Now, however, it is proposed that the piece of moorland near the Surprise Rocks shall be banked off and all parking there prohibited. Motorists will have to park nearer to the 'Toad's Mouth, and in this way it is hoped to reduce the number of accidents there this summer.

Short Memories

ALTHOUGH he considers the schools do very good work in training the children in road safety precautions when cycling or walking, Sir William Brockington, Director of Education for Leicestershire, thinks that when the children are away from school they are apt to forget their training a little. "While going to and from school they are in the atmosphere of school influence," he said, "but during holidays and when not going to and from school they forget all those excellent lessons which I have seen them observe most meticulously when 'on parade'."

Efficiency!

A SHORT time ago the railway authorities refused to consider a suggestion that hooks for holding cycles in luggage vans and preventing them from getting damaged should be fitted on the grounds that insufficient cycles were carried to make the suggestion worth while. Now, according to the Minister of Transport, the railways can produce no figures showing the number of cycles carried by rail last year, which makes their argument against cycle hooks rather fatuous.

No Comparison

"A GOOD cycle is worth nowadays as much as a secondhand car at prewar prices," said a speaker during an address to Bedford Chamber of Trade. And, he might have mentioned, far healthier and much less of a drain on the pocket.

Miles and Miles

MISS MARY LAW, of Newborough, near Peterborough, who has just retired after 24 years as a teacher at Thorney School, seven miles away, estimates that during this period she has cycled over 112,000 miles to and from school. She has never once failed to get through, even during the worst weather, and when she could not ride all the way she would ride a little and walk a little, but she got to school in the end.

His Handicap

A BAD attack of sciatica on the eve of the Amateur Championship of the Northamptonshire Golf Union nearly proved the undoing of one of the competitors, Mr. C. S. Catlow, but he refused to be beaten and cycled round the course at Church Brampton, Northants, to draw his match. When the replay comes off he hopes to be able to go round in the normal way.

Delayed Action Conscience

THREE years after he had stolen a cycle lamp from a machine left standing outside a public house at Armthorpe, Yorkshire, a colliery worker went to the local police station and said, producing the lamp: "I want to admit stealing this lamp." He was subsequently fined at Doncaster West Riding Police Court for this and another theft.

Bargain Day

OVER 500 cycles, formerly used by the Army and R.A.F., were included in the sale of surplus Government transport held at Kirmington, Lincs. The machines were sold either singly or in batches and the average price realised by each machine worked out at £2 5s.

Pneumatic Tyres Handicap

SPEAKING at the dinner of the Old Wyggestonian Association of Wyggeston School, Leicester, Mr. T. Kingdom, a former headmaster, mentioned some cycle races which were held at the School in 1893. Some of the machines had solid or cushion tyres, while one or two, right up to date, had pneumatic tyres, but the riders of cycles with pneumatic tyres had to pay for their foresight by being handicapped 40 yards in the various events. But even then they were well in front.

Matron Worse than Fine!

"I THOUGHT it was better to be caught by the police than by the matron," said a Loughborough (Leics) College student who was caught by the police for riding without lights. He told Loughborough magistrates, who fined him 10s. for the offence: "If I had been late, it would have meant a most unpleasant few minutes in the matron's inner sanctum, so I took the risk and cycled without a light."

Australian ex-Flight Lieut. Roy Walters, of Melbourne, who lost the sight of both eyes and had his left arm shattered in New Guinea, and his wife out on their novel bicycle made for two. The bicycle was designed by Walters to enable himself to enjoy cycling trips with his wife and three daughters.

Around the Wheelworld

By ICARUS

The Veterans' Ride

THE 100 in 12 hours promoted by the C.T.C. in June was the seventh of the series, and I cannot help feeling that these rides are a great mistake. It is no achievement to be able to ride 100 miles in 12 hours—an average of 8½ miles an hour. On the other hand the vanity of many of these old cyclists is appealed to. They like to feel, or at least to give the impression to younger riders, that they are still able to do at 60 or more what they did at 20. Why is it that so many of these veteran cyclists are so inordinately conceited because they ride a bicycle? Have they not yet learned that children of five are now doing it, and that the period when it was considered skilful to ride a bicycle is long past?

The C.T.C. seems inordinately proud of the fact that one of its councillors was seventh in the event. Surely nothing very much to be proud of in that, is there? I should have thought that any "veteran" over the age of 50 years (one of the qualifications for the event is that entrants must be over 50 years of age) would have been capable of being in the lead, and that there would be a massed finish of veterans.

The condition of some of them at the end of the race was not a good advertisement for these veteran riders. There were 92 starters and five failed to complete the course, which took them through Buckinghamshire and the Thames Valley, starting and finishing at Paddington.

There were two men of 80 in the ride, and seven were over 70. We think that if they must run these silly events the C.T.C. should make a rule that the riders should be over 50 but not older than 60. I refuse to believe that a rider of 80 is either safe on the road in an emergency, that he is in full possession of the faculty of road sense, or that his physical condition is such that he is able to ride 100 miles within 12 hours with safety.

Let us have a little less of this vanity from the veterans who want the sport to continue on the lines upon which it was run in the eighties, and who have endeavoured to mismanage the sport for so many years, regarding themselves somewhat as the proprietors of it. Some of them, I am glad to note, have had the wisdom to retire from the sport. Clubs should make it a condition that they compulsorily retire from active participation. You will gather from this that I am awarding marks of no credit to the C.T.C. for running such an event.

Rule 9 of the Highway Code

IN the June issue I quoted George Bernard Shaw, who himself had questioned the wording of Rule 9 in the Highway Code. This states "Where there is a footpath, use it. If there is no footpath it is generally better to walk on the right so as to face oncoming traffic." Mr. B. Redfern, of Sheffield, thinks that it is no more trouble to walk on the right of the highway than it is to walk on the left.

Of course not; and it is idle to deny that the risk is greater when walking on the left than the right. When facing oncoming traffic one can take steps to avoid it if necessary, even if there is a pavement. Mr. Redfern thinks that in any case, if a person is walking down a highway and a large vehicle is approaching, there may not be enough room to allow both to pass, in which case it is more logical for the pedestrian to move off the highway than the vehicle. If the pedestrian in question had his back towards the vehicle he would not see it, and this would necessitate much braking and hooting, especially if the pedestrian was inclined towards deafness. In other words, it is quicker for a man to avoid a car than vice versa.

British League of Racing Cyclists

AT the meeting of the National Executive Committee, held in Birmingham, it was decided that the remaining B.L.R.C. Championships to be held during the coming year, that is to say, hill climbs and time trials, be open as special independent events. It was also decided to hold an independent road race championship at Wester-super-Mare on September 21st over the same course as was recently used for the Amateur Championship.

The Automatic Cycle Pump

I HAVE recently been testing a pair of pumps for automatically inflating the tyres as you pedal, and which were invented by the Editor of this journal. Readers may be interested in the results. I deliberately punctured the tyre with a pin and timed the deflation. The tyre was completely flat in seven minutes. I then fitted the pump, one to each wheel, an operation which took me one and a half minutes per wheel. My bicycle has a four-speed hub, but the design of the pump is such that it may be fitted to any hub. It is clamped to the spokes by two bolts; there is a connection to the valve, and it is only necessary to slacken the spindle nut to push the cam on. I then spun the wheel to get a little air into the tyre and rode off. The tyre was fully inflated at 170 yards and remained fully inflated for the duration of my ride, which was 45 miles. I checked the pressure at the finish and found that it was, as at the start, 30lb. per sq. in. When the right pressure is reached a release valve prevents further air going into the tyre.

The pump ensures correct inflation whether the tyre is inflated or not. Each pump weighs only 1¾oz., and is counterpoised to keep the wheel in balance by a small piece of lead weighing only ¼oz. and attached to the opposite side.

I found them extraordinarily efficient, and I envisage that in a few years they will be standard fitments on cars as well as cycles.

A Golden Book of Records?

WHY does not the Road Records Association do for the record breakers what the Golden Book of Cycling has done in the wider spheres of cycling? In other words why does it not produce the Golden Book of Records, and once a year have an annual function inviting record breakers of the year and past record breakers to sign it? Preferably the book should contain photographs. I am aware that many record breakers have signed the existing Golden Book, but I think that a national body should preserve its own records for future generations.

End of the N.C.U.?

IN my view the N.C.U. will go out of existence around the year 1960, having outgrown its usefulness. It will have no further aspects of cycling to control, and I think its end will take the form of absorption by the Road Times Trials Council or some other body such as the B.L.R.C., probably the latter, judging by the way it is going ahead and the growing strength of its adherence.

I do not envisage any legislation during the next 10 years prohibiting road sport. I do, however, see signs of a considerable change in the type of that sport. The Road Time Trial run under absurd conditions of secrecy for reasons which no longer apply will gradually die in favour of races to which the public have access. This change will come about as veterans at present in charge of cycling affairs die off. In other words, times are changing, and I think for the better.

The Scottish Cyclists' Union

I AM glad to know that the Scottish Cyclists' Union is expanding and that they now have approximately 1,000 members and 21 affiliated clubs. They are, of course, running on B.L.R.C. lines, although they are in no way subservient to it. They are not, of course, recognised by the E.C.I under the "one club one country rule." Full details of the club are available from David Findlay, 63, Gibraltar Gardens, Dalkeith.

Wayside Thoughts

By F. J. URRY

Bicester, Oxfordshire.

Picturesque cottages grouped around the old church.

The Good Journey

BEFORE the Roman came to Rye, or out of Severn strode,
The rolling English drunkard made the rolling English road ;
A reeling road, a rolling road, that rambled round the shire,
And after him the parson came, the sexton and the squire.

Those ringing lines by G. K. C. came into mind as I passed the time of day with a gentleman of the cloth in the rambling lanes 'twixt the Graftons and the shallow valley of the slow Avon, and spring had come to the land and spilled its lap of blooms among the hedgerows. He was a jolly fellow doing a round of duties per bicycle and, though he sat up straight to twirl a pedal, he had the right way of the game and the right spiritual outlook on the material beauty surrounding us. For indeed it was beautiful, this day of early May sunshine with great clouds sailing over the arch of the blue and enough warm wind to lift the feathers of your hair. And the bird song seemed to make the sunshine warmer, trilling among the young leaves dancing to the thousand tunes. As it happened I was on my own, for no one would join me on this early morning of Saturday, since I suppose gardens need attention, and the Saturday work to many of us means the Sunday release. Dozens of times have I been this way in all seasons of the year, have walked these great fields with a gun, but mainly they have revealed their beauty to me from the seat of a bicycle. This day the rich tilth took a purple tinge under the sun, with here and there the young green of the grain and the blooming orchards in between, a sight to rejoice the heart of man and wish all the growing things the luck of the season. Near Exall at the noon of the day I ate my alfresco lunch sitting beneath a sheltered bank gay with violet and primrose, and then I crossed the busy Evesham road to delve into the tumbled lanes of the Lenches, where our Midland country seems the same as it was in the days of my youth, for when a car does show up it is almost a surprise. Reaching the Ridgeway I came down the Slough from Crabbe's Cross, crossed the Alcester road and went under Spernal Woods to Moreton Bagot and Overton, by Barrells Hall to Ullenhall, and Ford Hall, into the tangle of lanes surrounding Earlswood ; over fifty miles of Warwick and Worcester byways when spring was in its first bloom and the glory of life in me. That was the best introduction to my homeland this year of grace, and talking the journey over with a farmer friend at tea time, we came to the easy conclusion that the world is a lovely place when it wears the jewel of an early May day.

From Here to There

MY leather saddles are polished beautifully brown by the friction of cloth, and I can slide along them into any position desirable, according to the effort needed, within the limit of their length. I noticed this the other day when I took a 1932 vintage machine out for an airing. The stamped name on either saddle flap has almost disappeared, yet the seat is as firm and comfortable as ever. Which is a measure of the long-term virtue of a really good seat, and goes to prove the economy of buying the best. Why, with so high a frictional polish on any saddle, does not the seat of my knickers wear out ? Candidly I don't know, but it is years since any essential darning was undertaken to that well-used portion of my attire. Like most people's, my cycling suits have been double seated for years, and I have found this reinforcement of special value during these days of restriction and the cunning acquisition of coupons, extremely useful—but not for the purpose intended. All my knickers wear out just above the knees, where the cloth of them slips up and down over those joints as my legs make the circuit of the pedals. So the old tailor, listening to my tale of woe and having little material to sell to a couponless customer, made the suggestion of using the seat patches for the repair of the knee caps ; and it worked. Since a neat patch is a badge of economy to-day and a fine example of "mend and make do," which seems the right way to use the war time slogan, —I don't mind, and if anyone else does, well they are quite welcome to air their opinions seeing that I possess the correct answers. I hand the tip on to you as a means of making a useful garment last a little longer, even though it may not do for state occasions.

Then and Now

IT is a long while since we were in the grip of the arctic winter and the common gulls were flying over Birmingham. During part of that period there were more] idle bicycles than automatics, notwithstanding the shut-down, and mine was one among the millions, for the icy roads scared me. I don't specially mind the sudden skid, but if I am unseated it is the fellow following me in the car who will skid also and probably mop me up in the process ; and he cannot help it. So I had a short period of public service travel, and looking back at that time am thankful our British weather does not often impose such a handicap on single-track travel. Now that I am free again to make my journeys when and where I will during leisure time and keep my daily appointment at work, I realise more than ever the values of a bicycle. For I'm alive, joyfully alive, sitting on a saddle and moving comfortably from place to place, serene, content and self-sufficient. This evening, for instance, I have just arrived home from the lanes, spring bowered, that run between Maxstoke, Fillongley and Meriden, the very heart of the old forestry of Arden, where some of its great oaks still stand like gnarled sages amid the modern hedgerows to remind the wanderer of a mediæval mid-England of great glades and a wilderness of woodland. What a change in joyful activity, parade of beauty, and the touch of historic romance pervades an evening journey when spring is here and the leaf is unfolding, as compared to the pinched weeks of a couple of months ago. The seasons would come in any case and their glory spread into summer days and the burning beauty of autumn ; but I often wonder if they would ever seem so good to me if I could not welcome them from the saddle of a bicycle where a man is so very much more alive to the spirit of the moment because his energy is complimentary to all the surrounding loveliness.

The Lure to Go On

MOST people ride bicycles for convenience, a jolly host for the pleasure of company and club life, and others—the lesser numbers maybe—for the sheer joy of this mode of travel. The former need teaching how to ride, what to ride, and where to ride—other than to work and home again—a whole bookful of teaching, not so much in the manner of what cycling can mean to life, as what they miss of life's real values by not making it a game and pastime. The very best of teachers would not capture half of them as converts to the pastime, because their hearts and desires are set elsewhere ; but I do think many thousands of our utility riders, because they remain utilitarians, miss a very enjoyable and simple chapter of life. The technical journals cannot hope to reach and teach them, but the lay press can and the trade can, but neither of these channels has the necessary enthusiasm, or at least it is not particularly discernible. The younger folk who make up the ranks of club life need little teaching on what to ride or where, but they do require the persuasion to remain in the game when their ardent days have ended and there are strands of grey among the gold or brown or black. They should know better than to allow a great game to run out of their existence when they can so easily turn it into a great pastime with which to go rolling down the years with the spice of youth still flowing through veins that refuse to grow old because of the exercise, the quiet, gentle exercise of cycling. Those of us who have grown old at the game know these things are true, and have gradually become aware how large a part cycling plays in our lives in the matter of health, variety of scene, and its splendours, and perhaps more than anything the complete individual freedom it presents to a man. If you were to ask me to define my cycling to-day in a couple of words, they would be "silent satisfaction," that sense of well-being which defies capture in a mesh of words. This sense of the abstract, this essence of vital feeling under the dome of heaven, is among my greatest pleasures ; it is worth striving for, and, having gained, preserving to the last kick of the pedal.

There are Difficulties

I WAS talking of holidays a few nights ago, always an anticipatory pleasure, but the prospects are not rosy by any manner of means. That compulsory stoppage of work in February has upset all the summer arrangements, and made many of us wonder how we shall manage to work in any free time in a year of depleted work time. While the wars were raging I promised myself many holidays when peace returned to the world, not realising, like many another, that peace in these times would present so many problems, holding an elderly individual more closely to the adventure of work than he desired. No doubt matters will straighten out in due course and some of the clouds disperse ; but by that time it may be the embryo arrangements will have been shattered, and the problems of accommodation increased. But I shall have the week-ends left, and when the chance occurs endeavour to lengthen them, so at the worst there will be compensations. The trouble to-day is that one has to book so far ahead in order to obtain a centre or centres from which to undertake daily explorations, and it is not easily possible to fix a holiday in these disturbed days. Often enough I envy the campers in their bivouac, yet even so recognise my time is past when half a hundredweight of luggage is a joyful burden, or the open meadow on a rainy night a comfortable couch. It isn't so much point of view as the arrival of the sixty-eighth summer.

Road and Tyres

THE severe winter has left our road surfaces badly scarified in many places. It seems to me to have done them greater damage than all the wartime traffic, and from all I hear we shall have to put up with the "make do and mend" principle for an indefinite period. The fast lads will naturally go on using their light narrow section tyres and dodging the pot-holes, but those of us who ride for joy and to whom speed is a past pleasure, would be wise to stick to our 1¾in. section tyres, if possible of the open-sided type, which to me are a happy compromise between the lightest possible and something a trifle sturdier and still resilient. Years ago I used to say that if I could afford it in my elder age I would use no other tyres than racing sprints, but that notion has faded out, partly due to the excellent open-sided covers we were offered before the war, and which I understand will soon be returning to the depots, and partly because so much of my cycling is over secondary roads, and rough lanes, and that little extra cushioning of the bigger section tyre is comforting. As a matter of fact it is true to-day to aver that many of our main roads are in a more ragged condition than the secondaries, undoubtedly due to the heavier burden of traffic borne by the big arteries. So my 1¾in. open-sided covers (and I still have a few left of pre-war make) will comfortably meet the rather rugged road conditions ; and if you are buying for other than speed work, this tip on section selection is quite good advice. Like most old riders I like my bicycles as lightly built and equipped as possible, always providing the comfort of the user is preserved, and that for me is mainly met by tyres as suggested, with enough saddle to make a real seat, and with a range of gears, several of which allow me to pedal rather than push when wind or grade suggests easier going.

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CYCLORAMA

By H. W. ELEY

A Note for Mr. Pickwick

THOSE who are privileged to know something of the Pickwick Bicycle Club (the oldest cycle club in the world) may be familiar with those truly Pickwickian dinners and other functions which are held all too infrequently. But bearing in mind that the original Pickwickians were essentially travellers, revelling in the joys of the open road, someone recently asked me why the old club did not have a summer outing or cycle run. I wonder why? I know that many of the distinguished members may have given up active riding, but maybe once in a year, on a bright summer's day, they could meet and ride out to some haunt of the original Pickwickians and recapture, even in a world of austerity, something of the joy and revelry of that first merry bunch of Dickens characters.

Dunlop Loses Two District Managers

TWO good Dunlop men, both well known to me, have passed over during recent weeks. Egbert Walters, for many years district manager at Newcastle, and Douglas Paterson, district manager at Edinburgh, were both fine fellows, with long and distinguished records of service in the Dunlop organisation. It is sad that both have passed away at comparatively early ages, and they will be greatly missed. When I think of them, I think of the Dunlop Company in earlier days, when motoring was but in its infancy and the cycle tyre, on which the fortunes of the great company were built, was supreme. Like many old Dunlop men, Walters and Paterson were, in days gone by, keen cyclists. Many dealers and clubmen in Newcastle and Edinburgh will mourn the loss of these two stalwarts.

Derbyshire Days

RECENTLY, I managed to snatch a few precious days from business and journey to Derbyshire, near to the Staffordshire border. And how good it was to again visit ancient Ashbourne and tour around the good villages between that town and Uttoxeter! A pleasing belt of country, with many unspoiled little villages; and when I left, to return to London, the first of the hay was being cut and the countryside was aromatic with the sweet scent of the new-mown hay—surely one of the most delectable scents the countryside can give us! In an old inn, I heard accounts of the rigours of the winter in the area—tales of villages being cut off for days on end and of gallant work in cutting tracks to the isolated and hungry villagers. But during my short stay the sun shone and all the land was smiling. . . .

I Meet the "Big Three"

FRED KELLER, of the Raleigh Company, Noel Brealey, of B.S.A., and D. D. MacLachlan, of Hercules—I met them, all together, at a meeting recently, and it was good to talk with these men who so vigorously advertise cycles and are so interested in everything connected with the cycling movement. All are firm believers in publicity, and all do a good job—not merely in selling bikes but in selling *cycling*. And that, to my mind, is a vital matter: we have to tell of the joys of cycling, of the manifold benefits of owning a bike and of getting out into the green lanes and broad highways.

Another Wise Schoolmaster

SOME time ago, in these columns, I mentioned the case of a schoolmaster I knew who regularly gave the scholars at his school lessons on road safety, and particularly on the correct way of riding a bike, its proper upkeep, and the way to get the utmost pleasure out of riding. Lately, I have met a second wise schoolmaster, who has prepared diagrams illustrating the Highway Code, and who gives short talks on road safety matters. This individual action, coupled with the campaign put out by the Government, is excellent, and I wish that more teachers felt that it was within their province to instruct the youngsters on these vital matters. There are far too many road accidents still and, in my view, the schoolmaster has a wonderful opportunity of assisting in their diminution.

Salute to Colour!

IN two senses—in the first place, I welcome the brightly-coloured bikes which one sees out on the roads at week-ends, and secondly, I am glad to see that dealers' shop windows are not quite so drab and uncolourful. Despite the fact that the paper situation is still serious and difficult, it would seem that cycle and tyre and accessory manufacturers are managing to get more showcards and window bills, and the display of these in dealers' windows is quite cheering. For too long these windows have been dull and lacking in colour. And, from the dealer's point of view, I know that colour is a valuable sales factor.

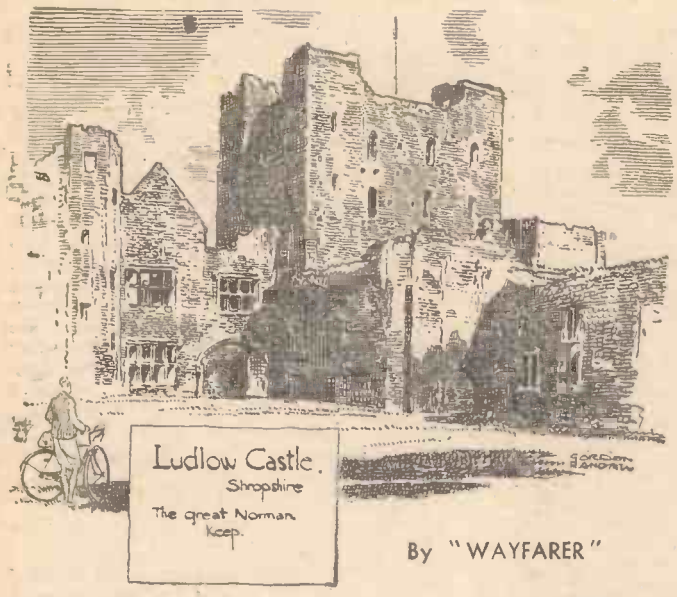
The Enchantment of Essex

I WAS once guilty of writing a book about the English counties and ever since I have received requests from time to time asking for advice about certain shires and information as to their scenic charms. And it has always surprised me that so few tourists think of riding in Essex—or, for that matter, in Suffolk or Northamptonshire! These counties, whilst possessing no rocky gorges or majestic scenic grandeur, are nevertheless full of a quiet charm, and the other day I wrote to a correspondent advising him to explore the heart of Essex: to forget the part of the county which is merely a dormitory for London, and to get out to the Hanningfields, to see High Roding, to potter around Dunmow and to delve into some of the ancient history of Colchester and Chelmsford. He took my advice, and has since written me quite enthusiastically about his tour. Little villages which have remained unspoiled over the centuries; inns which really do merit the epithet "quaint"; pastoral views as pleasing as any you will find in more widely-advertised counties; and old towns where tradition still lingers and the pace of life is still leisurely. Go to Essex—and you will find enchantment.

Angling and Cycling

AS ever, I hailed the opening of the coarse fishing season with delight, for I still cling to my love for rod and line. And how handy is the bike in getting to those quiet pools where the wily carp abide! Long ago I solved the problem of the handiest way of carrying rods, creel and other impedimenta on my machine, and from now onwards, through the summer and autumn, I promise myself some good days by river bank and peaceful pool. "The one that got away" will, of course, be described with all an angler's ecstasy over a pot of ale in some fishermen's inn, but there will be good days when I shall make a goodly catch of roach and, possibly, pull out some sizable bream from that noted bream-hole in Bittern Pool. Angling and cycling go well together, and both are antidotes for stress and strain and all the complexities of modern life.

My Point of View



By "WAYFARER"

Shift the Junk!

IS it nobody's business to see to the removal of the ancient motor-cars which were dumped down at the roadside in various places as a war measure, for the use of snipers, etc.? According to my calculation, the war has been over for about two years, but little has yet been done to get rid of these disfiguring features of the landscape. Further, is it really necessary for local authorities to litter our roadsides with defunct macadam and like material removed from other districts? Upon my word, if this is the way we are going to treat our countryside, we don't deserve to have won the war. Let our watchword be: "Shift the junk!"

Knowledgeable Folk

JUDGING by the number of times we cyclists are asked by motorists for road directions we must be looked upon as knowledgeable folk. It is always a pleasure to help, of course, but the thought occurs that some of these worthy people ought to buy maps, and indulge in a little study before venturing abroad. A few Sundays ago, just as I was starting off for my day's ride, a mapless motor-cyclist came up alongside and asked me to direct him to Lowestoft, nearly 200 miles away. I could not do the whole thing without a map, but I put him right for the first 50 miles of his journey, recommending him to make a further inquiry along the road. In any event, it is silly to tell a man too much, because he probably cannot memorise a long route. Few of us can, anyhow.

Resistance Movement

IT is a mistake for a cyclist to ask a head-wind whether it wants a fight, because the head-wind will accept the challenge, and the cyclist will get hurt. You may be able to triumph over a hostile breeze, but that result will not be achieved by brute force, but by "finesse." "Dogged does it," should be the motto. Get down to the job and tackle it steadily. If it is possible to take refuge in the lanes you will obtain a little "cover" there. If you are riding in company, proceed in single file, and tuck in behind your pal—taking your turn at riding in front, of course. Don't attempt to rush things; don't ride to anywhere near exhaustion point; don't forget the value of a change of exercise now and again. Time devoted to walking is not of necessity time lost.

The Distant Scene

I REALLY began to wonder whether good visibility would ever return to us, so that I could look over leagues of country at the distant scene, drawing joy and inspiration from the graceful hills which ring my home town. And then, on the last Saturday in May, visibility was put back on to the menu, and I found a new thrill in staring at some of the things which "I have loved long since and lost awhile." It was a great delight once more to let the eyes range from Edge Hill and the Cotswolds to the Clees and the Wrekin, and to look once more on Bredon and the Malverns, on May Hill (Monmouth) and the Black Mountains, the Forest of Arden and the Wyre Forest, with pieces of patchwork quilt in between. The bicycle is a grand thing to possess, and to use, from this one standpoint alone—in its capacity of (so to say) a "view-finder." And doesn't the distant scene make your mouth water?

To Attract Tourists

BY way of further comment on the plan which is being formulated to attract tourists from abroad, let me "put in," as the lawyers say, a recent experience in the matter of obtaining the eminently simple meal of tea. It was early closing day in the small country town at which two of us desired to purchase sustenance, and the cafés, in common with all the other shops, were shut. At 4.45 p.m.—note the time!—we boldly knocked at the locked door of the best hotel, only to learn that they had "finished serving teas for the day"! At a near-by hotel, which we noted was labelled "Residential and Commercial," we gleaned that they "didn't serve teas." A mile or so down the road we came upon a third hotel displaying a sign, "Lunches and Suppers," and we felt that fate was going to be kind to us after all. Chalked on the door was: "Open at 8.30." The inn-keeper pointed to this in reply to my request for tea, and my suggestion that the inscription related to beer only produced the intimation that "we don't serve teas." Half a mile farther on we came to an unlicensed establishment which was doing quite a good trade in the way of supplying teas, and there we fed satisfactorily.

Such an experience as this does not lead one to feel that there is much chance of attracting foreign visitors to these shores, nor does the suggestion of Sir William Wayland, in *The Daily Telegraph*, excite me to any great extent. He asks what about our thousands of small inns and taverns, and speaks of "the quietness, quaintness, and homeliness of the world-renowned English inn." The most suitable comment on this is: "Sez you!"

Expansive Mood

I AM to be found in my most expansive mood when a cyclist in distress stops me and inquires whether I can provide him with a spare chain link. For years I have made a practice of carrying one of these things in my tool-bag, and—touching wood!—I have never yet had to use it. It is evident that I provide it for the benefit of others, and I am quite happy to do so. It may act as a mascot—only I do not believe in mascots. Anyhow, so long as I have such a spare available—and I make a point of replacing it as soon as possible after giving it away—I am delighted to be of service to a brother cyclist. And hang the expense—2½d.!

Ultra-cautious

A LADY who came to visit my home the other day mentioned in the course of conversation that she makes a point of having her bicycle "vetted" by a cycle repairer once a month as a regular thing. I made no audible comment, but thought quite a lot. That bicycle is used solely for shopping purposes, and, as the owner lives near to the shops at which she deals, it is open to question whether the monthly distance travelled touches 50 miles. Expert attention after so small a mileage surely suggests an ultra-cautious mentality. In my own case, a "vetting" process after 5,000 miles is nearer the mark.

Not So Good

IN mid-May, when I was staying at Llangurig, the loftiest village in Wales, I was "taken for a ride" (in a motor-car) over that gorgeous itinerary which comprehends Aberystwyth, the Dovey Valley, Machynlleth, Llanbrynmair, Carno, Caersws, Llandinam, and Llanidloes—80 miles of the best, with a small detour up the Llyfnant Valley. It was pleasant to see all that countryside again after an absence of some months, but the experience did not provide me with any measure of satisfaction. It was not so good. Frankly, I have never been able to beat up much enthusiasm for motoring—indeed, I have never tried, possessing something so much better—and I must say that I prefer to earn my travel. I would gladly have "worked my passage" over that enthralling route, paying for my pleasure in the coin of energy, and I would have obtained a real "kick" from the experience. The round is one I know very well, and have known for a long term of years—since, indeed, the time when the road over the Plynlimon Pass was in the most reprehensible condition imaginable—and I find in it an enduring joy. It is not a journey to be taken at speed, except self-created speed, and is so very good that there should be time for the lingering process. It hardly seems reasonable to loiter when in a motor-car and to put a restraining influence on all those horses which live under the bonnet; and so, on the occasion referred to, the vehicle sped on, and the changing panorama was seen as a quick-running film. Actually, the high light of the day was the sojourn in the Llyfnant Valley, where we had dinner and tea to the accompaniment of the sweet music of the two rivers which meet outside the house called "Glanrafon," and the quiet hour devoted to idleness about a mile further up the valley—idleness interrupted by the process of throwing twigs and branches into the hurrying waters!

No: the sort of travel in which I indulged on that day was not the sort I like, nor the sort to which I am accustomed. I want to "paddle my own canoe": I want to earn my pleasures: I want to buy my joys: I want to be conscious of the self-satisfaction arising from achievement. If people could only understand this point of view, they would not continue to commit the folly of suggesting that "you ought to have a motor-car," or "you ought to have a motor-cycle"—a statement which always provokes me into the retort: "No! that's just what I ought *not* to have!" So long as I am able to "wind up" a bicycle, I desire no other method of wheeled travel, and I shall continue to believe that I have the best. The bicycle has given me so much that not willingly shall I discard it in favour of something which, in my judgment, is definitely inferior. There is no substitute for the bicycle.

Problem

A NEIGHBOUR submitted a little problem to me the other day, and, really, it was a difficult one. His small boy, age ten, had just been given a bicycle, and the problem was where this was going to be used, having regard to modern traffic conditions in the vicinity of great cities. Was the lad to be allowed to ride the bicycle, or not? Well, the problem was, fortunately, not one for me to settle, but I did express my views on the state of affairs now existing, with created dangers triumphing over common sense. I regard it as highly undesirable that any one class of the community should be restrained from using the public highway because of the callousness of a small proportion of drivers, and I remain convinced that there can be no amelioration of the position until the authorities "fit the punishment to the crime." If the people who deliberately manufacture the dangers of the road were awarded the medicine they deserve, I fancy that there would be an immediate improvement in the conditions of travel.

What is the Solution?

A PROBLEM has been nagging at my mind for many a long day, and I am not able to find the solution. Indeed, it is not clear to me whether there *is* a solution. Can any of my readers see daylight?

Without being too precise, it can be admitted that there are several million cyclists in this country—or, at least, several million people with bicycles. There are also several million folks, of eligible age for cycling, who are without bicycles. Is there any method by which a higher percentage of the first category, and a substantial proportion of the second category (without of necessity preaching or proselytising), can be fired with enthusiasm for the pastime? I know, of course, that participation in the activities of cycling sometimes involves facing discomforts and difficulties. I know that cycling is not always easy. I know that it looks like hard work—as, indeed, it is frequently characterised by those who possess a thin film of knowledge regarding the game. I know that cycling can punish its devotees. I know that hills can be wearisome and adverse winds heart-breaking. I know that extremes of climate are not everybody's "cup of tea." But I am not in the least bit afraid of laying a properly drawn-up balance-sheet in front of the public and asking for their unbiased consideration of the debits and credits.

At the moment it is not my purpose to specify all the debits, some of which have been named above. Nor shall I enumerate the whole of the credits. Let me put the thing briefly in this way: Last Saturday you had a wet and cold ride; next Saturday it will be just the reverse. To-day you have been hampered and obstructed by a head-wind; to-morrow the breeze will be your friend and ally. Last Saturday week you travelled through something akin to a fog; on the following day visibility was simply marvellous. If you felt a bit "under the weather" one day you must bear in mind all the other days when you were on top of your form. One item cancels out another, but at the end of the balance-sheet you come across a number of "hidden reserves." You have your memories; you know Devon and Cornwall, the Weald of Sussex, Broadland, the Yorkshire Dales and Moors, the Lake District, Cheshire and Shropshire, and the valleys of the Severn and the Wye; you have seen the Malvern Hills leaning against a perfect sunset sky; you have stood at the top of Fish Hill and looked at "all the kingdoms of the world and the glory thereof"; you know Snowdonia and the Conway Valley; Tal-y-Llyn and the Llyfnant Valley, Barmouth Estuary and the Pass of Aberglaslyn; you know the sublime view of the Hebrides from Morar and the vista of mountainous Scotland from Stirling Castle; you are familiar with Galloway and the Pass of Brander, with Glencoe and the Pass of Killiecrankie; you know Glendalough and Glenmalure, the Vale of Avoca and the Blackwater Valley, Killarney and the Dingle Peninsula, Connemara and Mount Errigal, Lough Swilly and Achill Island. You know all these places, and many more, because you are a cyclist. You have memories; you have experience; you have knowledge; you have abounding good health. These are your "hidden reserves"—and not all that hidden! I assert that the credit side of your balance-sheet is positively overloaded, and yet there are millions of nominal cyclists who are merely touching the fringe of the pastime, just as there are millions of non-cyclists who do not know what they are missing. Most of them might advantageously come in and obtain their share of the benefits and advantages which the pastime of cycling has waiting for them.

The problem which is set you here and now is: How can we get these folks well and truly into the cycling army? I see no solution. Can you?

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