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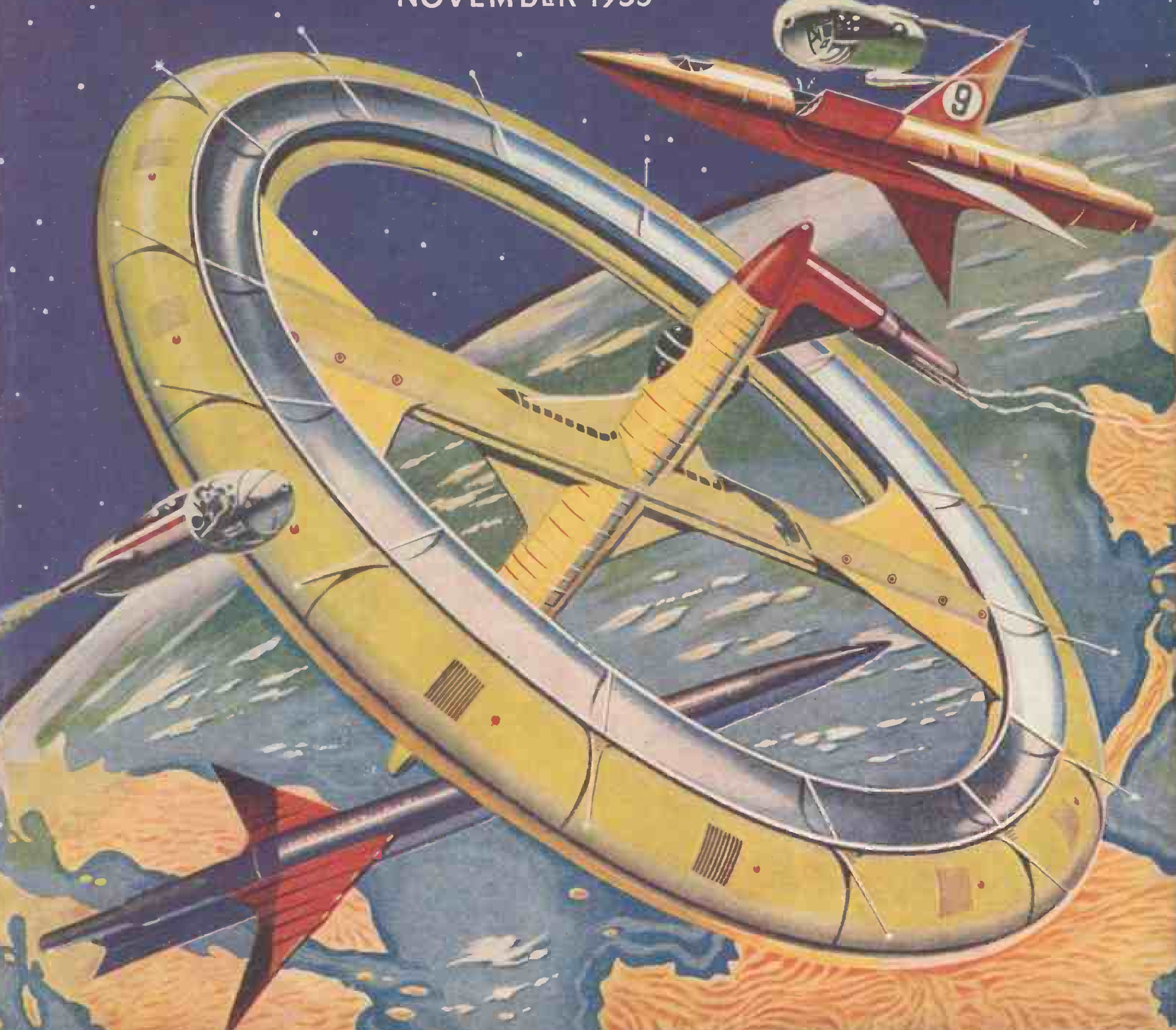
EDITOR: F. J. CAMM
NOVEMBER 1955



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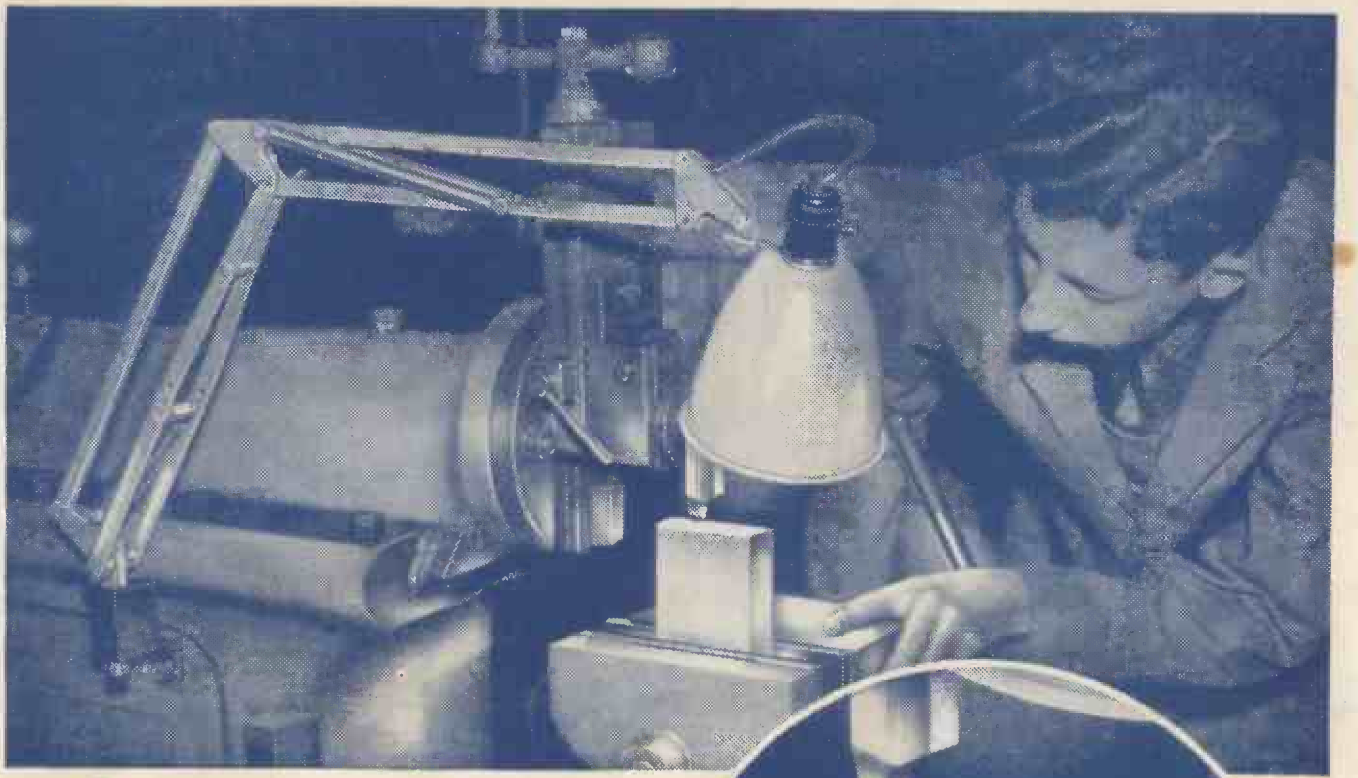

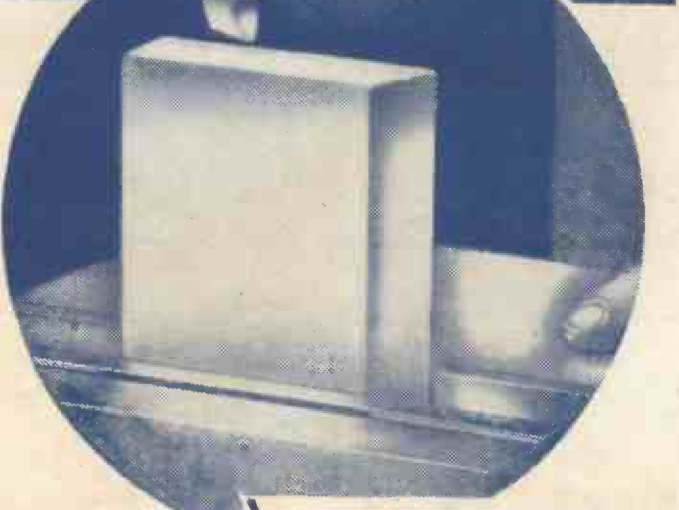

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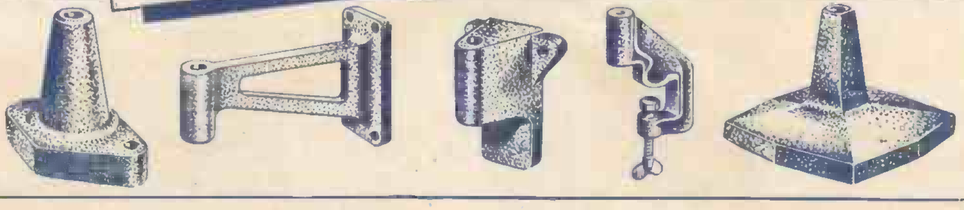

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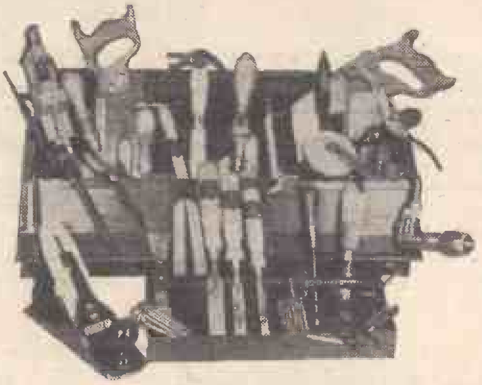

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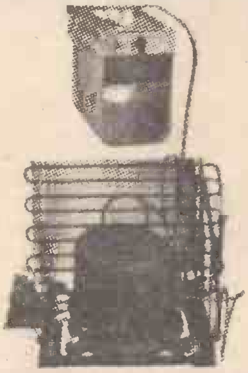

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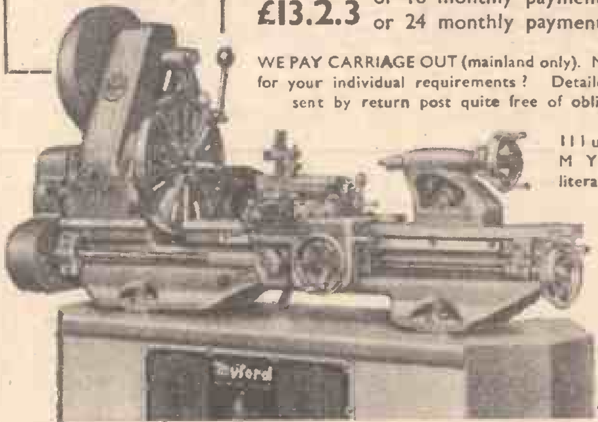

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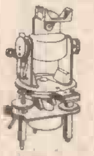

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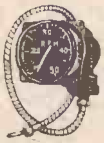

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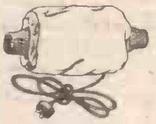

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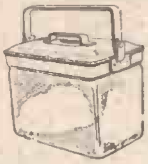

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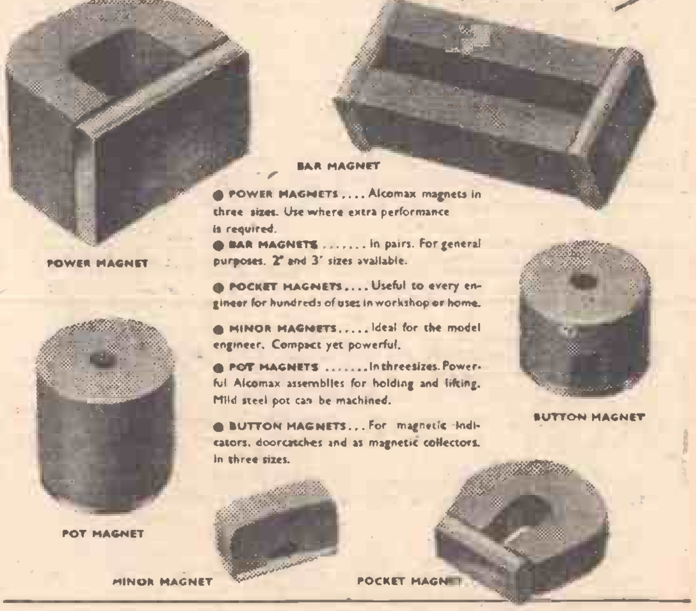

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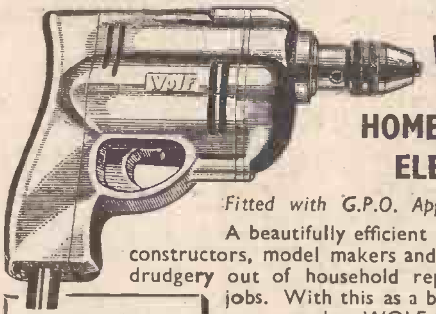

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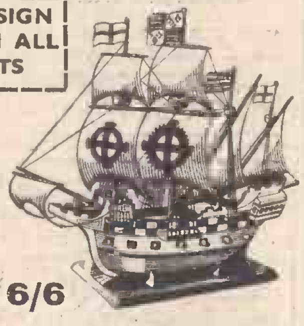

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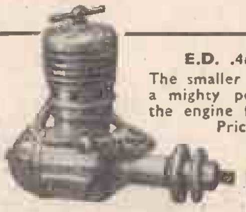

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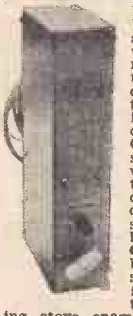

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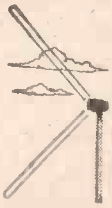

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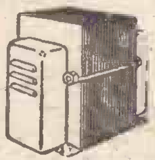

Fully shrouded—standard 200-250 v. primary. 280-0-280 at 80 m/a. 6.3 v. at 3 amp., 5 v. at 2 amp.

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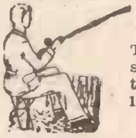

Tubular aluminium not separate sections, extends like telescope from 15ins. to 9ft. 3/6 + 1/- p.p.

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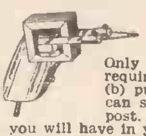

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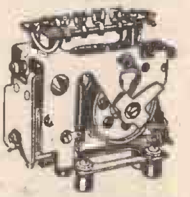

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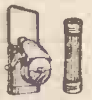

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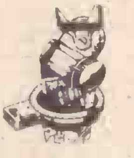

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Constructional Data	1/6

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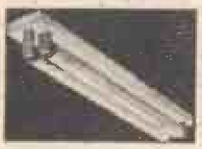

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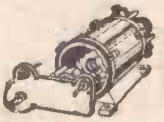

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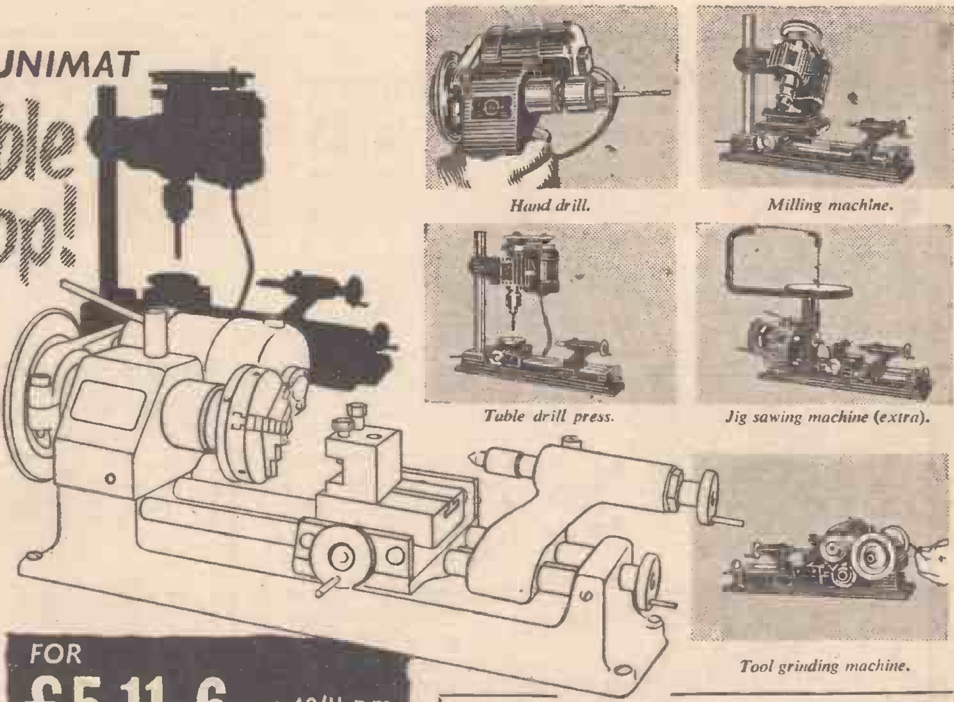
THE AMAZING EMCO-UNIMAT
Complete portable power workshop!



The Emco-Unimat, a miniature ball-bearing machine tool is the perfect equipment for model makers and amateur craftsmen. The standard motorised lathe, as illustrated, can be used as a pillar drill, milling machine, grinding machine, or hand-drill—*and no extras are needed*—though much additional equipment is available for its more extended use. We emphasise the fact that the Emco-Unimat is a *precision* tool, capable of a variety of machine shop operations on a miniature scale.

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Hand drill.

Milling machine.

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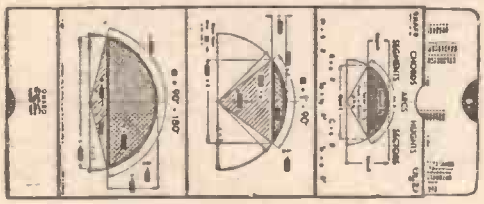

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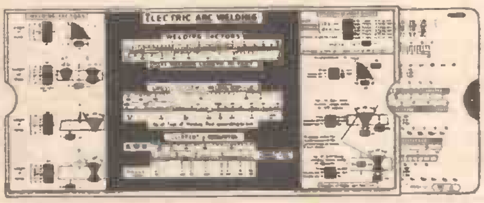

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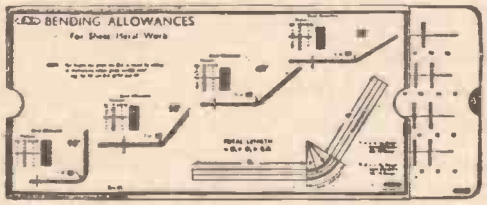

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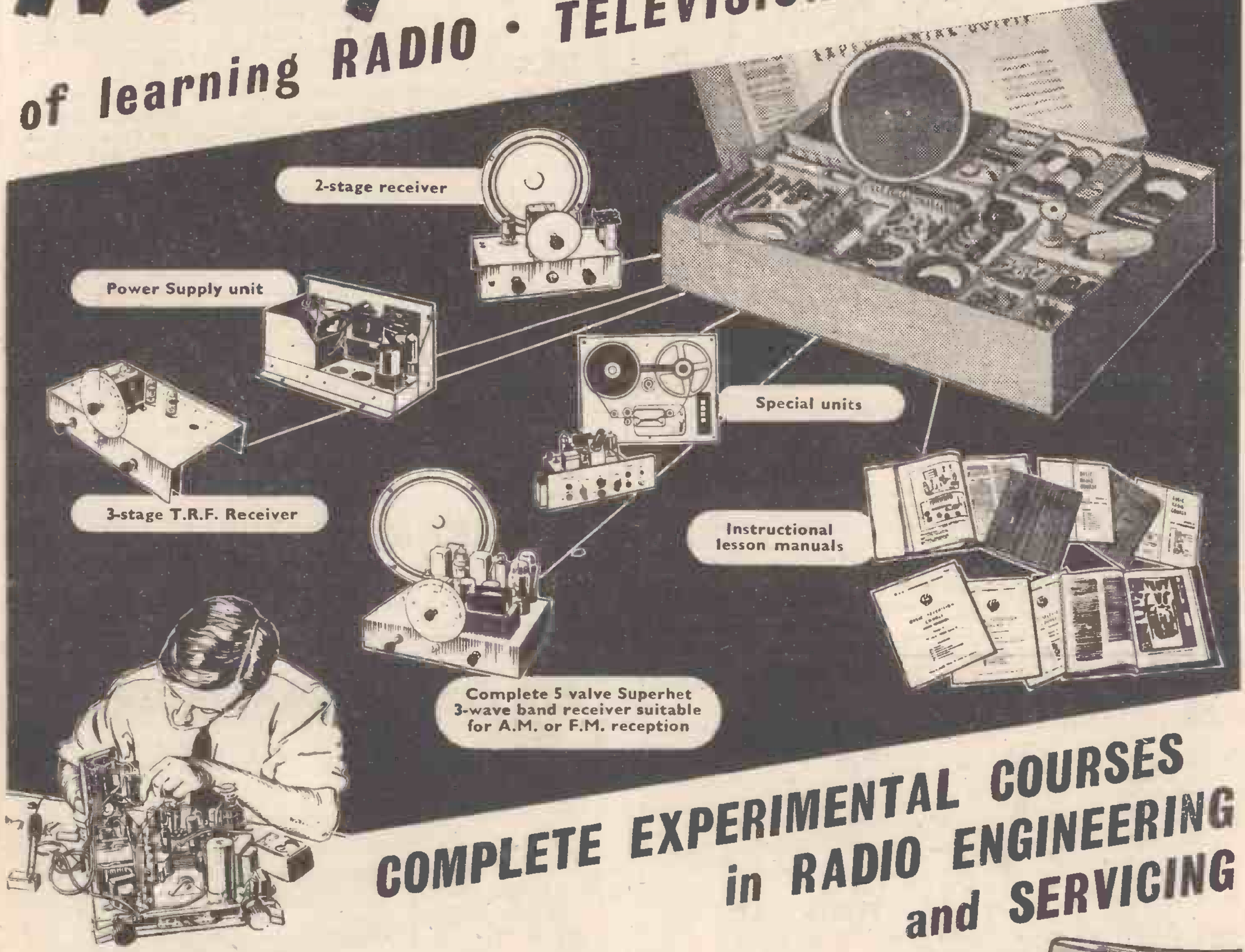

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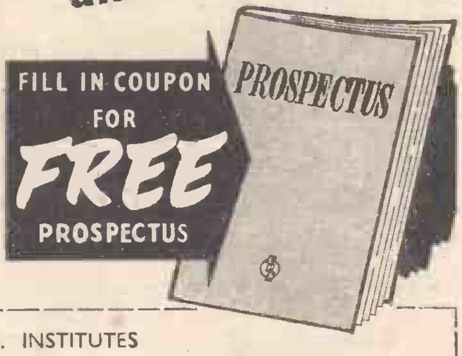

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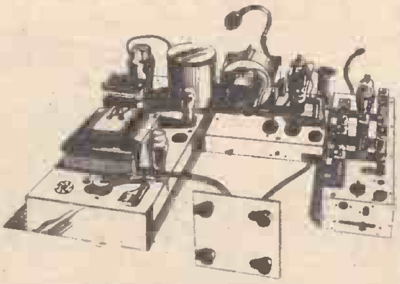

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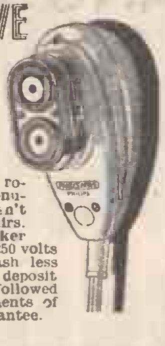

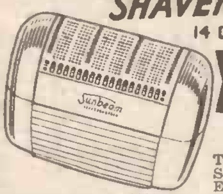

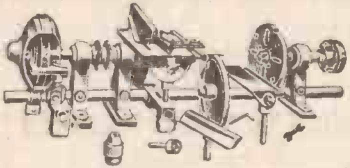

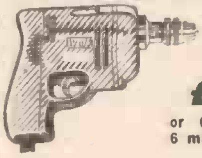


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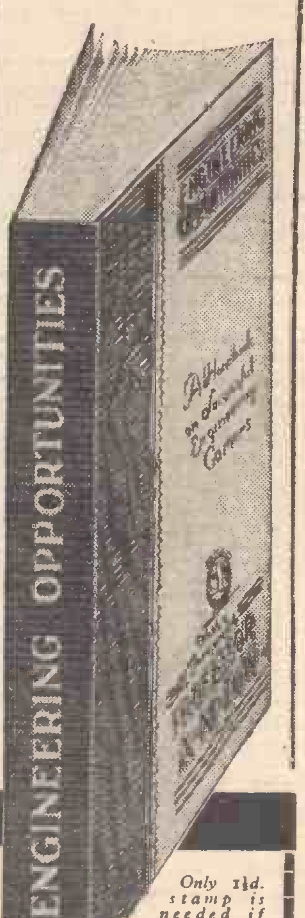

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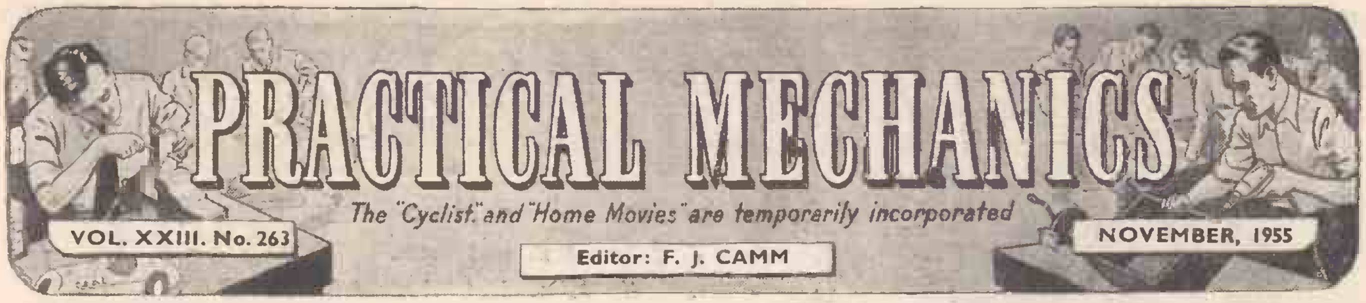

PRACTICAL MECHANICS
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VOL. XXIII. No. 263
Editor: F. J. CAMM
NOVEMBER, 1955

FAIR COMMENT

By

The Editor

Lord Dowding on Flying Saucers

LORD DOWDING in a recent speech said that evidence of flying saucers is overwhelming. If by this he means flying saucers from other planets, the exact reverse is the case. There is not a tittle of evidence of any sort that any craft from any planet has ever landed on any part of the earth. If he thinks otherwise he must be easily convinced. He went on to say visitors from outer space will not tell us their secrets because the first thing we would do would be to fit out an expedition with soldiers and then try to conquer them. "We must learn better manners before they will tell us of their scientific attainments." This, of course, is utter poppycock, and we challenge Lord Dowding to produce any acceptable evidence in support of his views. During his talk, he quoted from a number of well-known books on the subject, including Adamski's. I suggest therefore that he reads my comments in our issue dated January, 1954, on this contentious book. Mr. Adamski was to visit this country, and it had been agreed that I was to be present to cross-examine him. For health reasons, however, he has been unable to come, but it is a date which I hope will be kept for I am keenly looking forward to it. Lord Dowding entered the realm of vaticination when he went on to say that there were people from outer space who lived for 1,000 years, who could disappear at will and can speak any language. I shall soon begin to believe in leprechauns and that there are fairies at the bottom of my garden.

Saturnian flying saucers, we are told, have crews of 12 and an "endurance of one week," also that the Venusian saucers had crews of six and only 24 hours' flying time. We challenge Lord Dowding again to produce any evidence which would be acceptable to those having scientific knowledge and training. I issue a challenge to Lord Dowding to an open debate on the subject.

We are told that there are small reconnaissance discs, 2ft. or 3ft. in diameter, which have landed at many places on the earth and that were sent out to record what they saw. The Saturnian space ship that landed in America had seven decks and was manned by a crew from many planets. Here, again, I ask for concrete evidence, which I am certain will not be forthcoming.

He dealt with the reported landing of a flying saucer at Lossiemouth. Here, again, I would invite Lord Dowding to read my comments on that subject in issue dated December, 1954. He regaled his audience with a story of an American who had talked with the captain of a 300ft. flying saucer, which landed before him. She was a beautiful woman named Ora Rhanes. We are told that the American's wife was now suing for divorce and naming the woman from outer space as the co-respondent. It will be rather interesting to see if Ora intervenes. The *oral* cross-examination will be rather interesting! As an extra tit-bit we were informed of an American account of a flying saucer occupied by two lovely women, one blonde and the other brunette, wearing ankle length dresses and girdled belts! In his peroration Lord Dowding said: "You may go away from here thinking that every one of these stories is nothing more than the figment of a diseased imagination or a deliberate lie. But there must be a truth behind this, and the only way I know of arriving at that truth is to take all the evidence that comes along and analyse and dissect it." I cannot believe that Lord Dowding, who like Adamski is a spiritualist was really serious. If so, he is easily convinced.

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What is a Scoop?

THIS journal and its associated group of Practical Journals has unquestionably been responsible for more journalistic scoops than all journals of a similar character put together, during the past 21 years. A perusal of our files will show that we have been ahead of our competitors in most cases by months. We are particularly careful, however, to sift our material before we give the credence of publication herein to any specious claims which may reach us. Publication of matter in this journal is accepted as hallmarked fact. Readers accept us and our opinions as being authoritative.

During the past 10 years we have received and analysed masses of material relating to atomic power which we have promptly consigned to the wastepaper basket. The passage of a few years has confirmed the accuracy of our judgment. We have resident editors in most countries of the world, whose duty it is to collect material for us. Not many journals are able to afford this world-wide service. It was in this way that we received sometime ago details of a fanciful atomic locomotive of the future, details of which have been propounded by one of the lesser known American Universities. It was a flight into the realms of fancy, and we rejected the material on that score. That is not the sort of information we consider a scoop.

"The Practical Householder"

THE first issue of *The Practical Householder* was sold out within two hours of publication, notwithstanding a very large initial print, and a heavy reprint. There can be no doubt that the new journal has taken its place as a National magazine, for it has immediately achieved a National circulation. Its circulation is, indeed, I believe, larger than any other monthly magazine in this country. Readers who took the precaution of accepting our advice and placing a regular order for it were not amongst the tens of thousands of disappointed would-be readers of the first issue, copies of which are now quite unobtainable. The enormously increased supplies of No. 2, however, show that the advice has now been taken.—F. J. C.

THE Earth Satellite Vehicle

A Review of Some of the More Recent Developments in this Field

By FRANK W. COUSINS, A.M.I.E.E., A.C.I.P.A., F.R.A.S.

ON THE COVER

Our cover shows the most favoured conception of the future manned space station—that of the wheel, the individual sections of which might be of heavy-duty plastic. These sections would be flown up to the orbit in a collapsed state and assembled to form the wheel, the whole then being inflated, thus providing sufficient rigidity and also a breathable atmosphere for the crew. Rotation of the wheel by means of a small rocket impulse would induce a condition of artificial gravity, and the inner wall of the outer rim would thus become the floor.

Power requirements would be met by means of the condensing mirror-trough, mercury vapourised by the sun's rays being utilised to drive a turbo-generator and produce electricity.

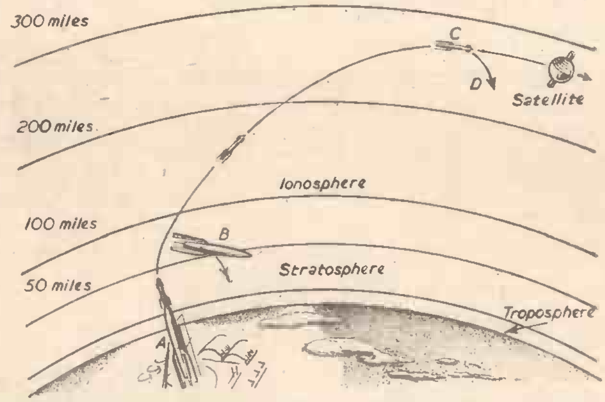
READERS of this journal will have been kept on a path of sound thinking during the flying saucer and spaceman craze for pseudo-science by the many wise editorial comments.

It is a special pleasure now to write on the genuine advances made toward the placing of an Earth satellite vehicle in space.

It should be appreciated at the outset that this is only the incunabula of true space travel and that it is time we rid our minds of the fantasy of space flights to the planets in the next few years. Not long ago a popular daily paper under the ægis of the Interplanetary Society talked of honeymoons on Mars and a well-illustrated book has shown us spacemen disporting themselves on an outer satellite of Saturn upward of one thousand million miles from the sun. It is worth noting that man is an ephemeral creature with a delicate metabolism soon disrupted by change of pressure and temperature, needing infinite care in right living and environment. Even our model factories and selected home life cause a multiplicity of neuroses which have made us the greatest drug takers in history. "Most of the universe," to borrow Eddington's phrase, "is antiseptic." It is either too hot or too cold and the physical data known to us concerning most of the planets suggest that they are about as hospitable as the Antarctic or the Gobi Desert. I have never heard of anyone honeymooning in these regions! Let us leave the mental climate of the earthbound astronaut for responsible information.

The non-scientific Press has recently reported that Russia and the United States are each to build an Earth satellite vehicle and that they are to co-operate through the International Geophysical Year[1].

The British research workers are not to do such spectacular things, but they are proposing to use rockets to explore the ionosphere. The British rockets will travel to heights of 120 miles and carry 100lb. of scientific instruments[2].



A. First rocket propels entire assembly 60 miles up.

B. Spent first rocket falls away and the second deflected from vertical carries satellite up to 250 miles.

C. Third rocket takes over, accelerating satellite to max. speed in high atmosphere.

D. Last rocket falls away. Satellite moving in orbit at 18,000 m.p.h.

Fig. 1.—Pictorial presentation of the launching of earth satellite vehicles.

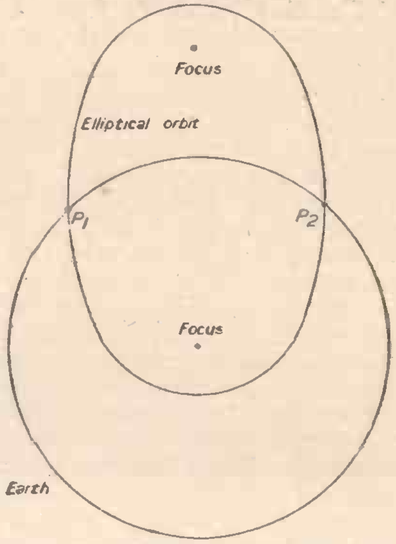


Fig. 2.—The Keplerian orbit of space rockets.

The International Geophysical Year has been explained on the radio and reported in the Press[3]. The Astronomer Royal, Sir Harold Spencer Jones, discloses that this is the third attempt in the past 75 years to gather important data on astronomy, scientific radio, geodesy and geophysics. The International Geophysical Year will extend from July, 1957, to December, 1958, so that the "year" is in reality 18 months. It is a part of the programme to use rockets to find out about the electric currents in the high atmosphere and photograph the sun in the far ultra-violet region. Further data will be sought *inter alia* on wind velocities at great heights. The programme will also include a world-wide attack

An orbit such as the one that the small Earth-satellite that the U.S. reportedly is to launch would take is painted on a picture of a globe in this artist's conception.

on the problems associated with longitude and latitude, related to seasonal variations in the rate of rotation of the Earth and the tilt of the axis. The scheme is supported by 36 countries, including the Soviet Union, and cannot fail to add to our knowledge of our home and its epidermis of atmosphere.

The Earth Satellite Vehicle

It is against this background of intense scientific endeavour that we should now place the more complicated and expensive project of the Earth satellite vehicle. What exactly is an Earth satellite vehicle? It is a man-made satellite of the Earth used to convey something (in the initial stages instruments). The vehicle will orbit the Earth as a moon. The first Earth satellite vehicles will be very small objects, their actual size being about 2ft. in diameter.

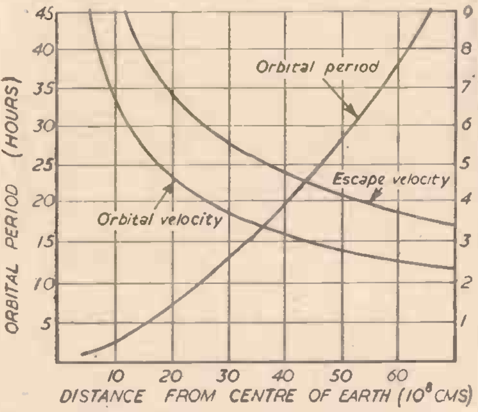


Fig. 3.—Graph showing, inter alia, orbital period and velocity.

The President of the United States has approved plans for the launching of small unmanned earth-circling satellites and leading American scientists refer to the said satellite as "The Bird." Their explanation of the experiment is as follows.

A rocket of two or more stages will be built. Instead of a bomb its payload will be an object of 100lb. about the size of a basket ball. The whole contraption will be launched vertically, in order to escape from the dense atmosphere as quickly as possible. On launching the first stage rocket will drive the machine up through the lower atmosphere—perhaps 50 or 60 miles. When its fuel is spent the first stage of the rocket shell with its fuel tanks and other auxiliaries will drop away. At the instant of drop away the second-stage rocket will be fired. The trajectory of the machine will be altered to the horizontal or near horizontal. When the second-stage rocket's fuel is used its shell and auxiliaries will also drop away; and likewise for a third stage if there is one. The "bird" will now be flying free at a velocity of 18,000 miles per hour, circling the Earth in one hour and a half at an altitude of 200 miles or more. The "bird" will be too low and too slow to escape into space. Friction with air molecules will reduce its velocity and under gravitational forces the "bird" will descend in a shallow spiral to more dense atmosphere, where it will burn itself out in the same way as a meteorite does.

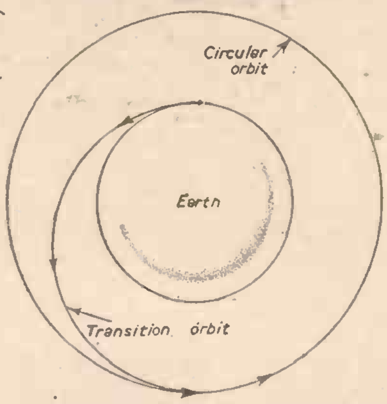


Fig. 4.—The optimum path for establishing a body in a circular orbit round the Earth.

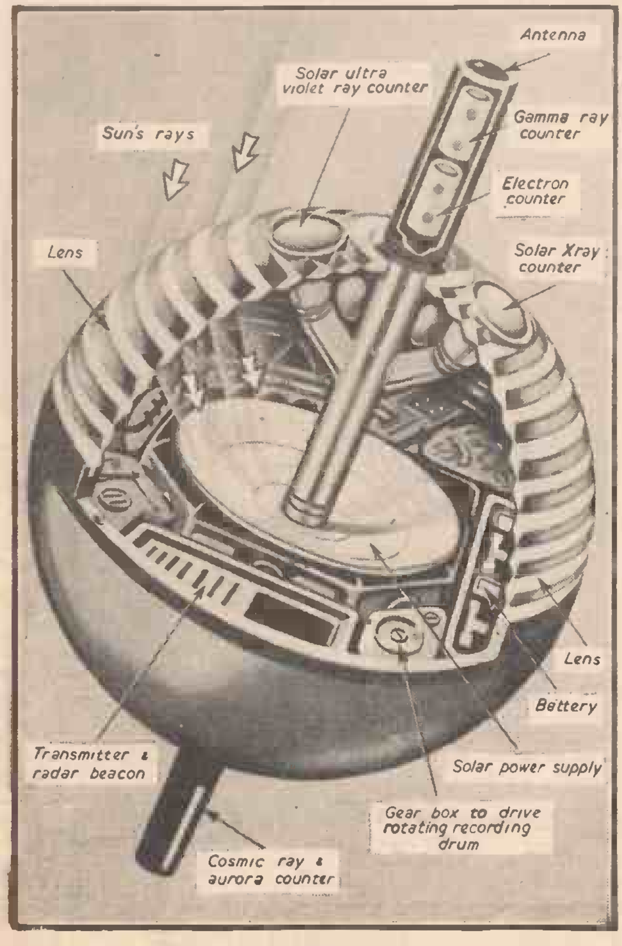


Fig. 5.—The Singer satellite shown partly sectioned.

The *modus operandi* is readily appreciated from Fig. 1, which shows the launching of the satellite in stages.

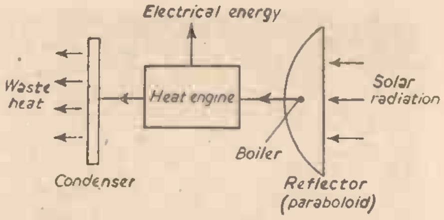


Fig. 6.—The ideal solar generator.

Some questions at once come to mind on the problems of such a project and the salient features may be covered by three main heads:

1.—The fundamentals of man-made satellite orbits.

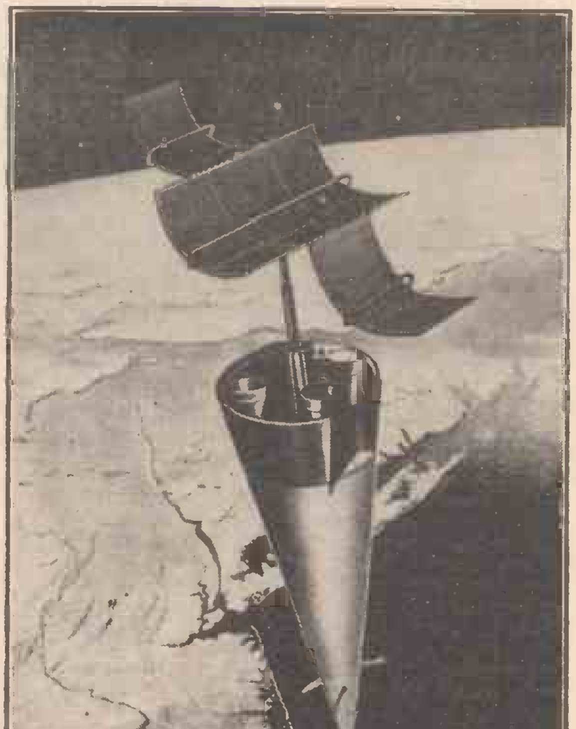
2.—The structure of the satellite *per se.*

3.—The scientific value to be gained from an Earth satellite vehicle.

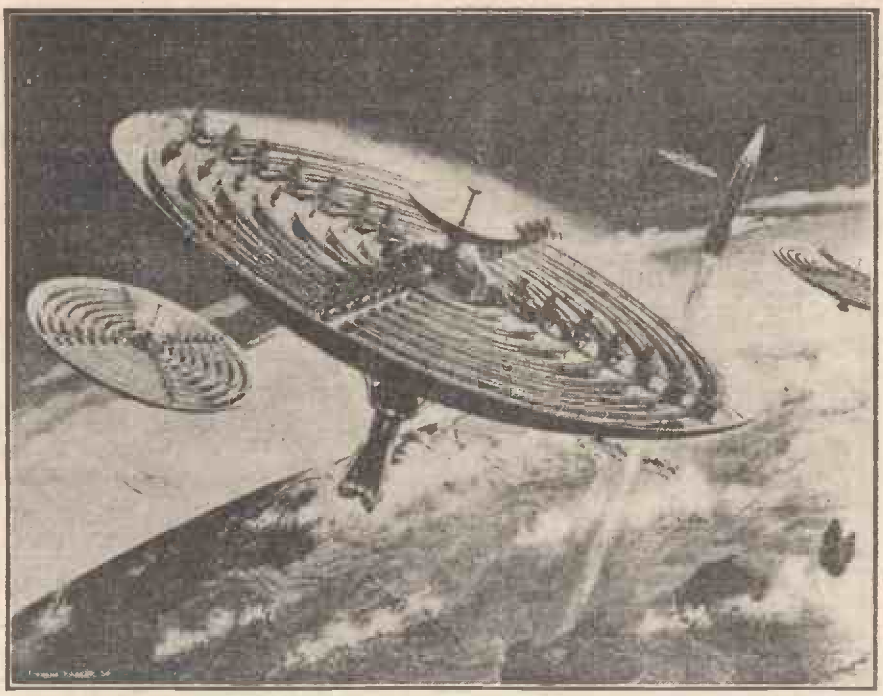
1.—The Fundamentals of Man-made Satellite Orbits

Regular readers of PRACTICAL MECHANICS will recall Mr. P. Bown's article in the May issue of 1952, p. 278. For those who are new to this field of study the following may be of interest.

Velocity of Escape: If a body falls from an infinite distance toward a planet owing to the attraction of the said planet and the body started from rest it will reach the planet surface at a maximum speed of $v=\sqrt{2gR}$ where g is the value of gravity at the planet surface and R is the radius of the planet. Conversely, if a body is ejected from a planet with the velocity found above it will go off into space—the planet losing control of it. In the case of the Earth, g is 981 and R is 638×10^6.



This is an artist's conception of a baby space ship, which, according to Dr. Wernher Von Braun, a leading rocket authority, could be built and sent aloft as a man-made satellite to circle the Earth for 60 days at a 200-mile altitude and speed of 17,200 miles an hour. It would contain a maze of scientific devices including television, which would enable Earth watchers to see how three highly intelligent Rhesus monkeys react to being sent aloft in the air-tight craft.



President Eisenhower gave his approval in July to a project in which the United States plans to launch small, unmanned satellites which will circle the Earth at an altitude of between 200 *and* 300 *miles at a speed of* 18,000 *miles an hour. This artist's conception of a satellite is an example of predictions which have appeared in periodicals from time to time.*

Hence $v=\sqrt{125\times10^{10}}=112\times10^4$cm/sec. or 11.2 kilometres per second, about 7 miles per second.

The escape velocity and the velocity of a rocket when all its fuel has been used up determine the orbit of the rocket under the influence of its momentum.

The orbit will be an ellipse, parabola or hyperbola depending on whether the rocket's velocity is less than, equal to, or greater than the escape velocity at that point in the gravitational field where the fuel is all used up (in rocket jargon "all burnt").

To date the majority of rockets launched have had an "all burnt" velocity less than the velocity of escape and have described part elliptical orbits, with the centre of the Earth at one of the foci—a true Keplerian orbit. The orbit cuts the surface of the Earth at two points (see Fig. 2), the launching point P_1 and the impact point P_2.

It is often said that a projectile takes a parabolic path; this is untrue unless the Earth's centre is at an infinite distance. For short ranges, where ordinary guns and shells are concerned, the centre may be considered to be at infinite distance, but with high altitude rockets the Earth's centre is at a *finite* distance and the path is an ellipse.

The satellite is, however, a man-made object pursuing its path with no expenditure of energy and this appears to flout the orthodox teaching of mechanics and suggest perpetual motion. It is well to remember Newton's law that matter once in motion tends to keep that motion unless disturbed; isolated in space the satellite is able to effect this. The satellite called the "bird" may not attain true space and the friction due to air molecules impinging on the "bird" will cause it to spiral in to the Earth's surface.

If a body is accelerated to an orbital velocity less than the velocity of escape it will be possible to maintain it in an orbit about the Earth. The orbital velocity required is equal to the reciprocal of root two times the escape velocity at that height. The velocity needed is 0.707 times the velocity of escape. The velocity known as orbital velocity has a value such that the centrifugal force equals the gravitational force. At the limits of the atmosphere this velocity is about eight kilometres/sec. and it decreases with height. Fig. 3 shows an interesting graph due to Mr. E. Burgess, an expert on rocket flight and the theory of Earth satellite Vehicles. Mr. Burgess has produced two valuable works worthy of close attention by students of the subject. [4,5].

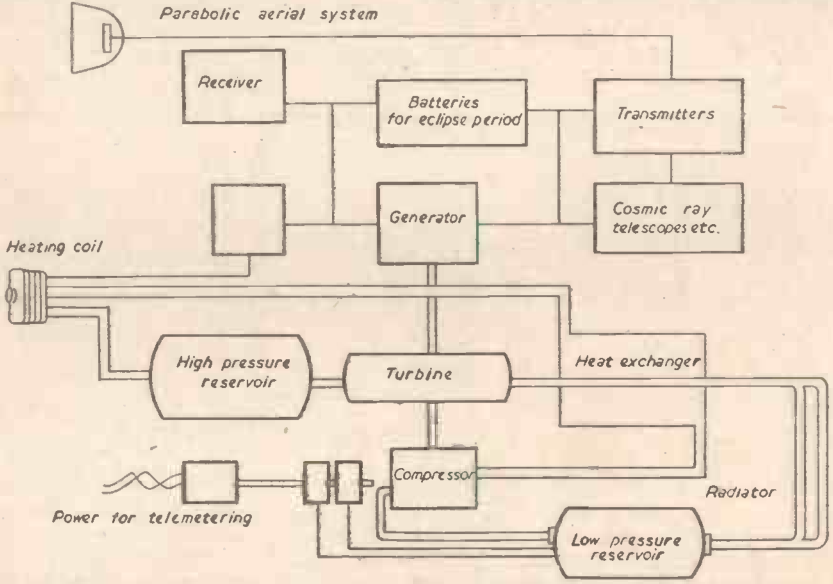


Fig. 7.—Schematic diagram of power unit and electrical system for Burgess artificial satellite. (Working fluid is Mercury vapour or Argon. Note : Mercury vapour solidifies at 38.9 *deg. C., whereas Argon freezes at* −189 *deg. C.*

The optimum path for establishing a body in a circular orbit about the Earth is shown in Fig. 4.

ii. The Structure of the Satellite *per se*

What will the satellites be like that we may expect to orbit the Earth in the next few years? Certainly nothing like the space-fiction writers would have us believe. They are to be small, "about the size of a basket ball," is the American cryptic phrase.

In a ball of that size only a few instruments could be fitted. The first satellites may, in fact, be solid spheres.

Later, larger spherical satellites may be set in motion. One suggestion is the Singer Satellite, named after its inventor, Professor Singer, of Maryland University, U.S.A. This satellite is shown in Fig. 5. It has a solar power supply, storage battery and radio transmitter. A variety of instruments may be included.

The author is not sure to whom the honour is due in the matter of designs for solar generators in artificial satellites. Mr. Burgess proposed a detailed design as early as 1949. Much valuable information on the power generation in artificial satellites has been gathered together by Mr. Cross[6]. The preferred generator of electricity consists of a heat engine of suitable form with an efficiency limited by thermodynamic considerations, working between a high temperature boiler receiving solar radiation and a lower temperature condenser radiating waste heat away into space.

A sketch of the ideal solar generator is shown in Fig. 6. A sketch of the Burgess satellite is given in Fig. 7.

iii. The Scientific Value to be Gained from an Earth Satellite Vehicle

The launching of a spherical object into a satellite orbit would provide some data of value even if it had no instruments aboard. Observation by telescope and radar of the sphere in its passage about the Earth would tell something by its change of position about the size of its orbit and the density of the upper atmosphere. Accurate measurement of the time it takes to cross oceans and continents will give information on the size of the said oceans and continents.

Satellites equipped with instruments will naturally be of added value to the student of the upper atmosphere especially in the study of the powerful radiation encountered at about 200 miles above the Earth. In fact we know very little about conditions 50 miles above the Earth and a multi-stage rocket carrying the satellite will be able to radio a continuous flow of data on the ambient pressure, temperature and radiation.

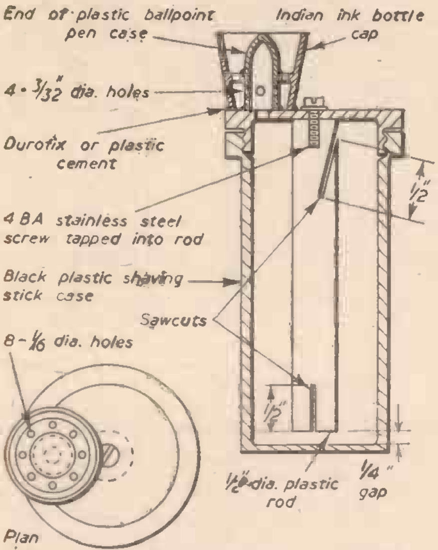
In this final reference the British investigation with special rockets in the ionosphere will possibly be very fruitful. At 50 to 100 miles above the Earth are layers of electrical ionisation that make long-distance radio communication possible. This region is

(*Concluded on page* 74)

A 16 MM Enlarger and DEVELOPING TANK

Two Accessories for Use with the 16 mm. Camera Described in P.M., July issue

By P. G. MOBSBY



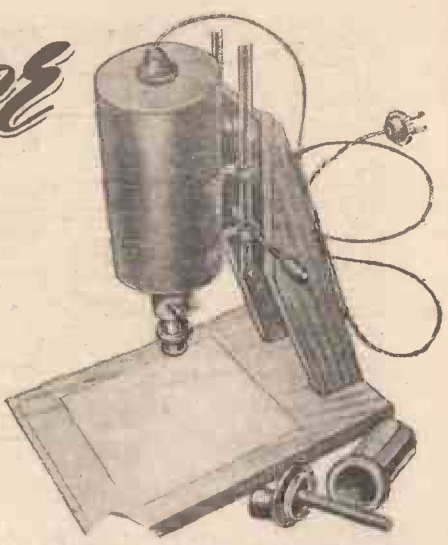
Developing tank Fig. 1

The Developing Tank

THIS is constructed from a plastic shaving stick case, a short length of plastic rod, an Indian ink bottle top and the end of an old ball-point pen case. The method of construction is given in Fig. 1 and is self-explanatory.

In order to obtain a satisfactory bond with the adhesive, it is essential to well roughen the surfaces to be joined to remove all surface gloss.

To load the tank, which must be done in the dark room, fold the corner of the film and tuck into the top slit in the plastic rod, loosely wind the film on to the rod in a spiral and tuck the other end of the film into the bottom slit in the rod, doubling over the end as before. Insert the spiral into the tank and screw down the lid. The remainder of the processing is done in daylight.



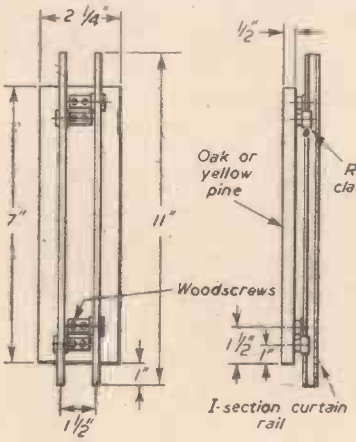
To fill or empty the tank unscrew the lid a quarter turn to allow the air to escape past the threads of the lid, tightening again on completing the operation.

To ensure even development shake the tank gently every 10 seconds or so.

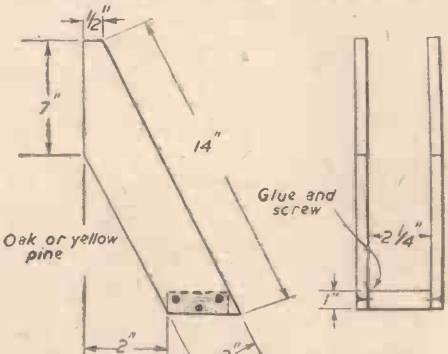
The tank capacity is about 25in. of film.

The Enlarger

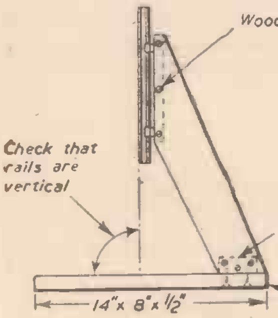
The main items required for this are as



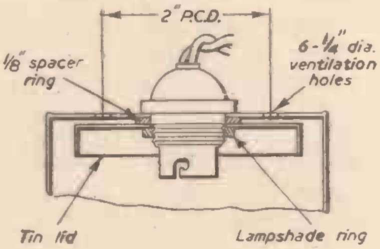
Rail track Fig. 2



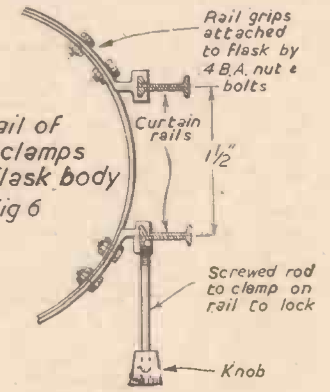
Support pillars Fig 3



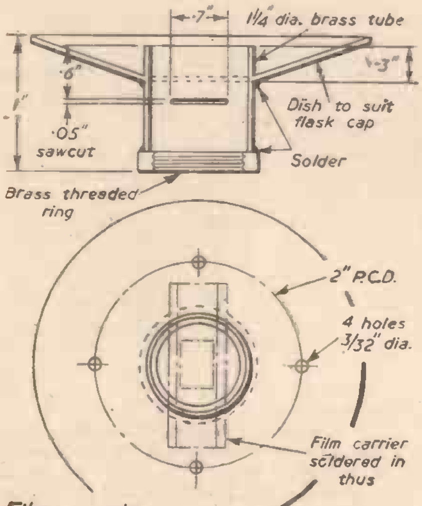
Assembly to base Fig. 4



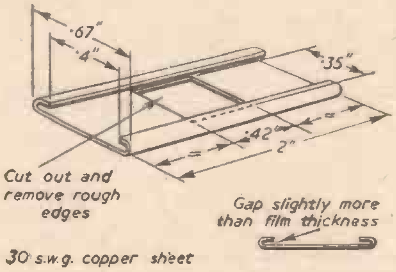
Bulb holder Fig. 5



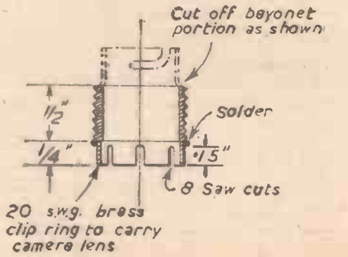
Detail of rail clamps on flask body Fig 6



Film carrier assembly Fig. 7



Film carrier Fig. 8



Lens carrier Fig 9

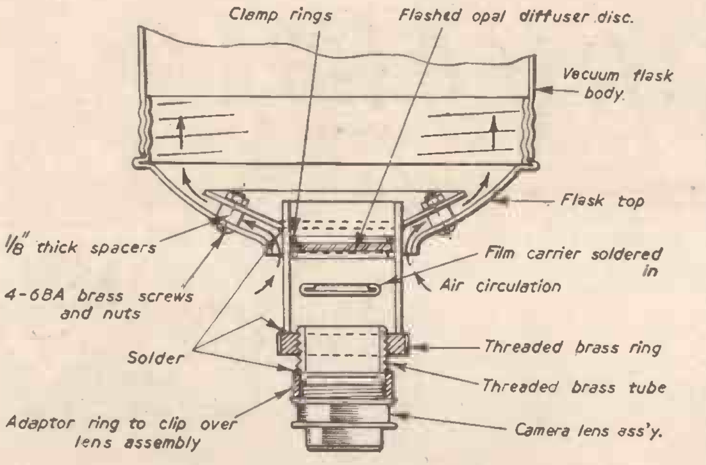


Fig. 10.—The optical assembly.

follows: an old vacuum flask case, two lengths of I-section curtain rail, a brass electric light socket, a short length of brass tube and some wood for the framework and base of the enlarger.

Enlarger Framework

Commence by making the complete wooden structure as shown in Figs. 2, 3 and 4. The rails and rail clamps may be bought from a well-known departmental store. Two 12in. lengths and eight clamps are required.

Ensure that the rail assembly is parallel and at right angles to the base.

Enlarger Body

This is made from the vacuum flask case. Cut a hole in the bottom to take a lamp socket, as shown in Fig. 5, and drill the six ¼in. diameter ventilation holes. Next take a tin lid of suitable size, cut a hole in the centre and thread over the lamp socket as shown, securing with the lampshade ring. This forms the ventilation light trap.

Attach four of the rail clamps to the enlarger body as shown in Figs. 6 and 11. Bend them to suit the contour of the body, and ensure that they are a nice sliding fit on the rails.

Substitute a long threaded rod for one of the grubscrews in one of the rail clamps, this rod fitted with a suitable knob being used to lock the enlarger on the rails.

Film Carrier Assembly

Fig. 7 shows the constructional details of this item. The threaded brass ring is obtained from the brass lamp socket mentioned above.

Note that the dishing of the brass plate must be sufficient to suit the flask top, see Fig. 10.

Next make the film carrier as shown in Fig. 8. This part is then slid through the slots cut in the brass tube and soldered into place. Ensure that the picture cut-out is central in the tube.

Lens Carrier

This is also made from the brass light socket, using the bayonet connector portion, as shown in Fig. 9.

Make up a brass ring such that it will grip the camera lens assembly, and solder this in position on the bottom of the thread as shown.

Optical Assembly

Fig. 10 shows how the completed units are assembled into the screw top of the vacuum flask. Note the disc of flashed opal diffuser. This can be obtained from a photographic dealer. The clamp rings to hold the disc in place are made from 16 s.w.g. wire.

In order to eliminate the slop in the threads of the lens carrier, wrap the threads with cotton until they are tight in the threaded ring.

Drill the flask top to suit the film carrier dished plate and attach with 6 B.A. screws and spacers, as shown.

Final Assembly

Fit a 40-watt pearl bulb into the enlarger and screw in the optical assembly. Fit the enlarger body on to the rail track and lock with the locking screw. Check that the axis of the optical assembly is at right angles to the base in both planes.

Paint all external and internal surfaces with matt black paint except for rail track and inside flask body.

No doubt many readers who are photography enthusiasts and who have the necessary facilities will be able to improve on this design and include some of the luxury refinements that the higher-priced commercial enlargers possess.

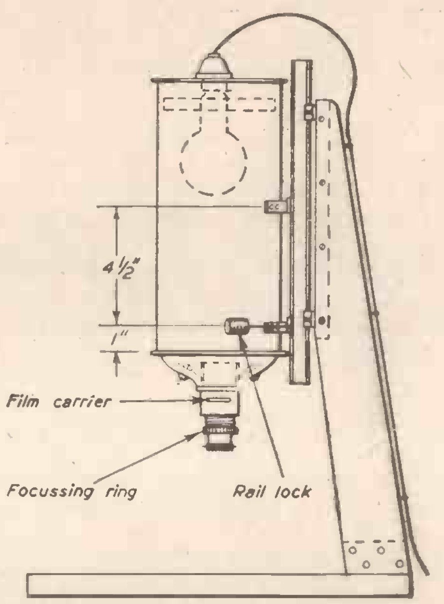


Fig. 11.—A view of the completed enlarger.

The Rolls-Royce Conway Jet Engine

A Unit for the Long-range Civil Airliner of the Future

ROLLS-ROYCE Limited announce that a Conway aero engine (seen in Fig. 2) has completed a British Government type-test at 13,000lb. thrust. Incorporating the by-pass principle, the Conway has the lowest specific fuel consumption of any type-tested jet engine. One of the aircraft it will power is the four-engined Vickers V.1000 military transport.

The by-pass engine resembles the normal jet engine, but has an additional duct through which some of the air from the compressor by-passes the combustion chambers and re-enters the jet stream aft of the turbine, see Fig. 1. The advantage of this type of engine over straight jet propulsion is that although the by-pass engine works at a high pressure ratio giving high internal efficiency, it also produces by means of the by-pass a final jet containing a greater mass of air moving at a lower speed which gives a higher propulsive efficiency. The result of this arrangement is to improve the specific fuel consumption, thus making it particularly suitable for future large long-range Civil Airliners.

The lower jet velocity in conjunction with the latest form of Rolls-Royce jet nozzle will help to reduce jet noise, one of the most serious civil aviation problems of today. Installation and fire protection are also assisted by the duct of cool air which surrounds the hot parts of the engine.

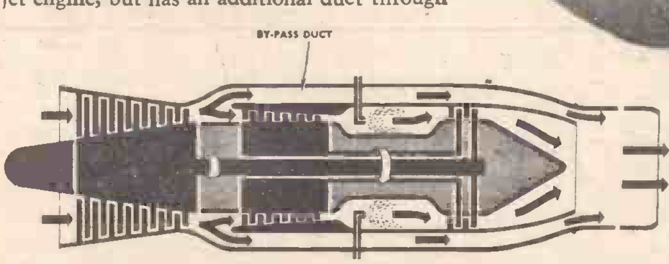


Fig. 1 (Left).—The Conway in diagrammatic form.

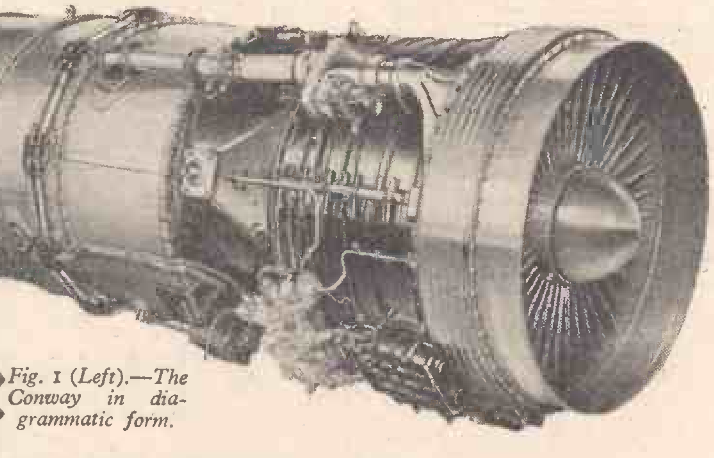


Fig. 2 (Right).—The Conway jet engine.

Making a JIG SAW

A Useful Addition to the Home Workshop

By E. O'SHEA

THIS machine was built to serve as a combination band saw and fret saw for wood and metal working. Built at a cost of under 30s. it has proved invaluable to the author by eliminating hours of laborious hand sawing. Wood up to 2in. thick and metal up to ⅛in. thick may be tackled with ease.

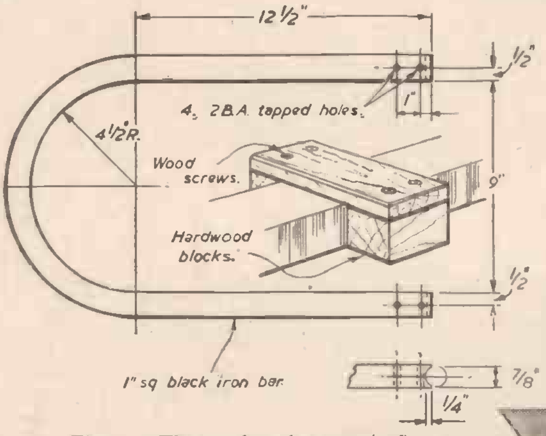


Fig. 2.—The saw bow (one required).

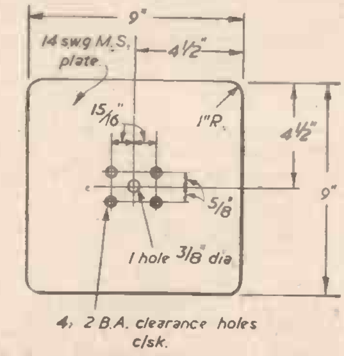


Fig. 3.—The table (one required).

Saw blades used are of the pegged type, 6in. long; coping saw blades for wood and "Junior" hacksaw blades for metal. The complete jig saw and stand may be seen in Fig. 1.

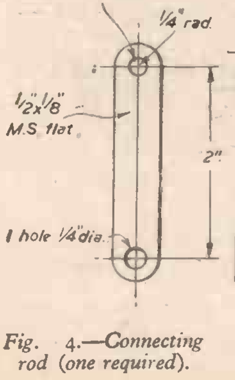


Fig. 4.—Connecting rod (one required).

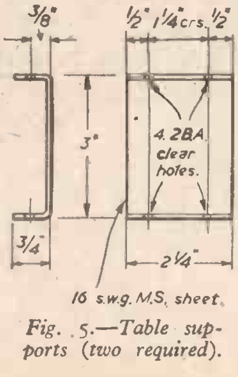


Fig. 5.—Table supports (two required).

Stand and Motor

The whole machine is mounted on a wooden stand, 12in. long by 12in. wide by 9in. high, with the motor housed underneath. In this manner the complete jig saw may be neatly fitted on a bench. A ¼ h.p. motor of the capacitor-start type is suitable. A motor of this type may sometimes be bought second-hand from a local refrigerator engineer at a very reasonable price.

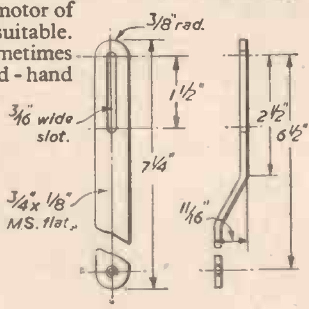


Fig. 6.—The guide arm (one required).

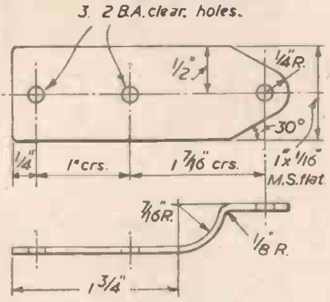


Fig. 7.—Tube clips (four required).

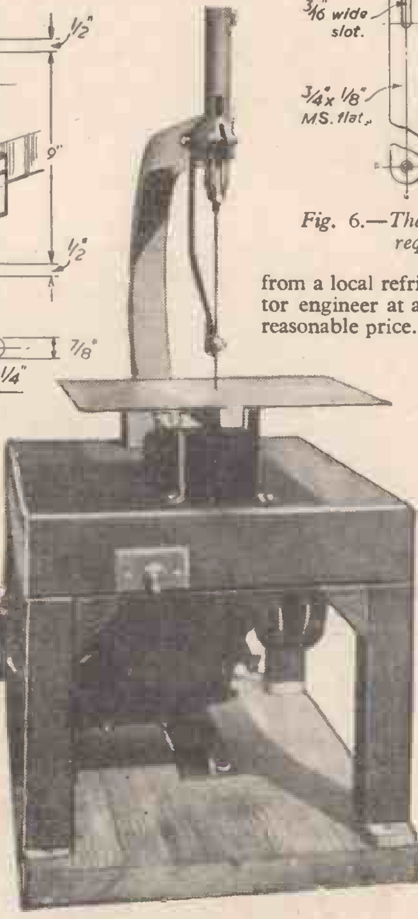


Fig. 1 (Left).—A photograph of the completed jig saw.

The Saw Bow

The saw bow (Fig. 2) was made by a local blacksmith from 1in. square black iron bar. A template drawn out full size proved useful for him to work to.

The two circular grooves were cut on a lathe using a ⅞in. diameter cutter mounted on an arbor in the chuck. The saw bow was mounted and run up to the cutter. It was necessary, after the grooves were cut, to return the bow to the blacksmith for alignment. This was done in a few minutes by placing a piece of ½in. bore gas tube in the grooves and easing both legs of the bow until the pipe lay true in the grooves.

The saw bow is clamped to the stand as shown in Fig. 4. This method of mounting holds the bow tightly in position and, provided the hardwood blocks each side are true, vertically square with the stand. The hardwood blocks are screwed to the stand from the underside.

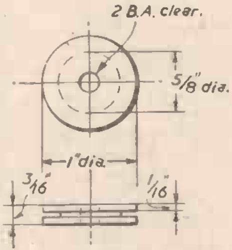


Fig. 8.—Blade guide. Material is M.S. rod and one is required.

Fig. 3 gives details of the saw table, and its supports are shown in Fig. 5.

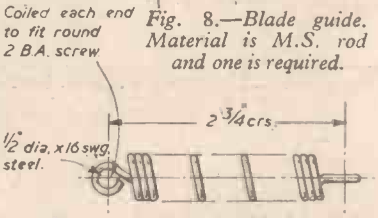


Fig. 9 (Right.—The spring (one required).

Top and Bottom Tubes

These are made from ½in. bore gas tube machined out to ⅝in. diameter. It is important that the plungers that fit inside them are a good sliding fit (see Fig. 11 and Fig. 12). Unless this is so the machine will not run quietly or smoothly. Details and dimensions of the clips for fixing are given in Fig. 7. The spring for the top tube is shown in Fig. 9.

Blade Guide and Arm

The blade guide arm (Fig. 6) is adjustable

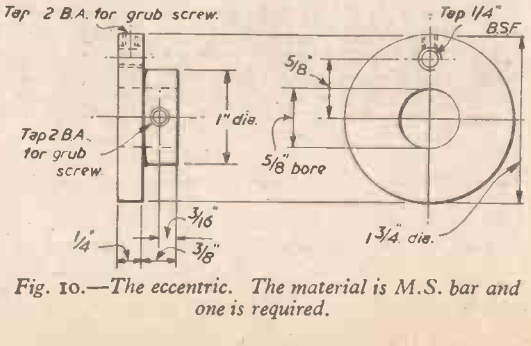


Fig. 10.—The eccentric. The material is M.S. bar and one is required.

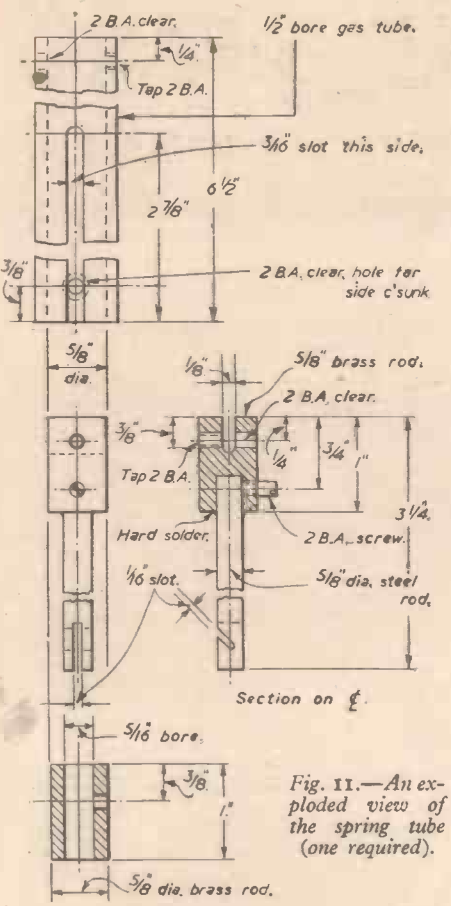


Fig. 11.—An exploded view of the spring tube (one required).

and may be raised or lowered. The blade guide itself (Fig. 8) should be free-running and sit against the back of the blade when the machine is in operation.

A 2 B.A. steel bolt is used to fix the guide to the arm.

Drive

As shown in Fig. 13, the complete driving mechanism is mounted on the underside of the stand and is carried on a ⅝in. bore die-cast plummer block; this being held in position by two ¼in. diameter bolts. If a cast-iron vee-pulley is not obtainable one of the die-cast aluminium alloy type may be used. It should be loaded to give it additional weight. This can be done, quite simply, by laying the pulley on its side and filling the depression there with molten lead. When the lead has cooled either rivet or bolt right through the lead and pulley. A heavy pulley is necessary since it also serves as a flywheel.

A 1¾in. diameter pulley mounted on the motor spindle will give the required speed for fast, clean cutting. This is, of course, when a motor giving 1,450 r.p.m. is used.

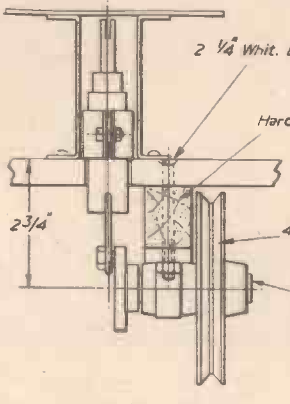


Fig. 13.—Details of drive, are quarter full size approx.

It is important to align the plummer block carefully when assembling the drive. Ensure that the connecting rod (Fig. 4) is vertical. Any slight error then is permissible since the "little-end" of the rod is free to move a small amount along the steel screw which connects it to the lower plunger.

The connecting rod has a ¼in. B.S.F. steel bolt at its "big-end." A grub-screw in the eccentric (Fig. 10) serves to stop the bolt rotating.

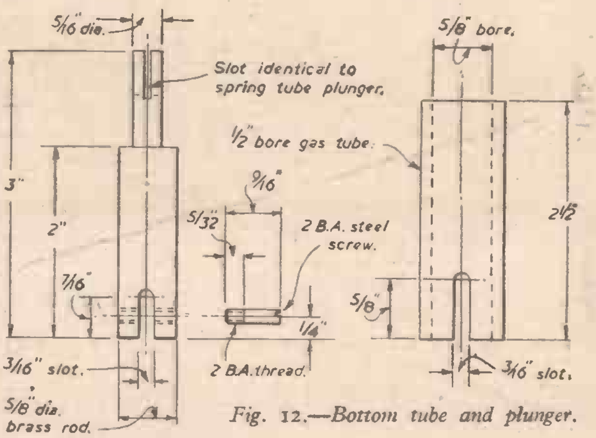


Fig. 12.—Bottom tube and plunger.

Wiring

Wiring is straightforward. An on-off toggle-switch is mounted on the front of the machine. A three-way terminal block is placed underneath the stand to serve as an anchor point for mains leads. The toggle-switch should be placed in the live lead, as shown in Fig. 14.

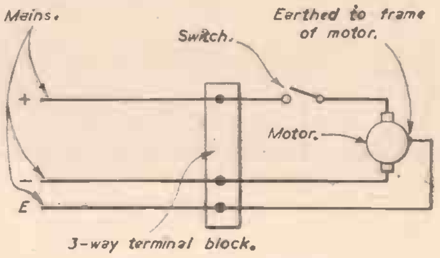


Fig. 14.—The circuit.

Finishing

Finally, the appearance of the completed jig saw is considerably enhanced if the stationary metal parts are given a coat or two of machine-grey enamel and the stand a coat of varnish stain.

Do not forget to give the moving parts an oiling periodically. With very little attention the jig saw will give many years of sterling service.

A Useful Drilling Jig

A Hint Sent in by J. E. Drinkwater

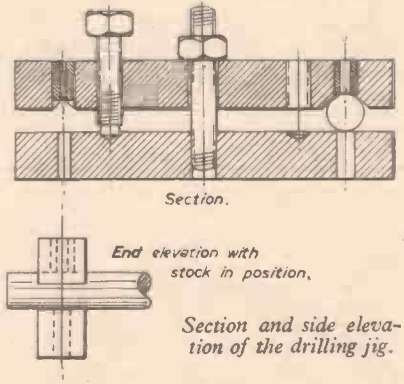
IT is very convenient to have a device which will enable holes to be drilled diametrically in round stock without difficulty and the jig illustrated will cover a wide range of sizes, both as regards holes and the bar to be drilled.

Referring to the sketch, it will be seen that the jig consists of two M.S. bars, having a stud in the centre, a "V" at each end and a set-screw to adjust the bars which, when in use, must be brought parallel before tightening down on the centre nut. The set-screw is changed to the other tapped hole when the opposite end of the jig is to be used.

Each "V" must be formed so that the angle will be truly bisected by the c/l of the drill. This done, a small pilot hole is drilled, starting at the bottom of the "V" for accurate location. The hole is then enlarged from the top face of the bar to receive the guide bushes.

In its simplest form, or where a lathe is not available, the pilot hole can be enlarged to the size required, thus dispensing with the use of a bush.

It is hardly necessary to say that the bushes are made to fit either end of the bar. They should be a push fit and when the jig is set up the bush to be used is pressed into contact with the part to be drilled.



Section and side elevation of the drilling jig.

As a guide to dimensions: ⅝in. sq. bars 5in. long would provide a range of holes up to ¼in. in ¾in. stock. The holes in the lower bar are axially true with the guide bushes and of a size to clear the largest drill to be used. By providing a slight countersink these holes can be used to locate balls for drilling, also.

THE EARTH SATELLITE VEHICLE

(*Concluded from page 70*)

little understood from the point of view of its formation and maintenance. One special investigation planned is an attack on the *air-glow*, which is a process in which light is absorbed from the Sun during the day and released in the subsequent 48 hours.

Other experiments are to be designed to yield data on meteorite disintegration, ultra-violet radiation, cosmic rays, wind speeds and mass-spectrometer analysis of the composition of the ionosphere.

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RADIO CONTROLLED MODELS

By Members of I.R.C.M.S.

4.—Control Box : Wavemeter : Interference : Layout

READERS will recall from No. 1 of this series in the August issue how steering control of a model boat or other equipment can be obtained by the "Mark/Space" system. In this system the rudder is arranged to move to, say, starboard when the transmitter is sending a continuous signal or "Mark," to move to port when the transmitter is switched off, which we call "Space," and to remain stationary when the transmitter is switched on and off rapidly (say, three to eight times per second). For 50 per cent. of the cycle the transmitter is "on" and for the remaining 50 per cent. it is "off," and this is known as sending "50/50."

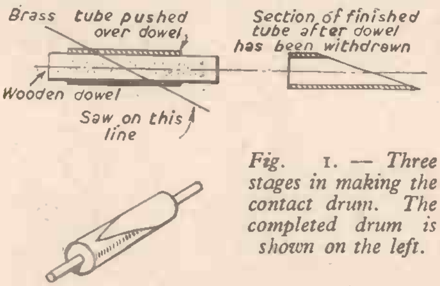


Fig. 1. — Three stages in making the contact drum. The completed drum is shown on the left.

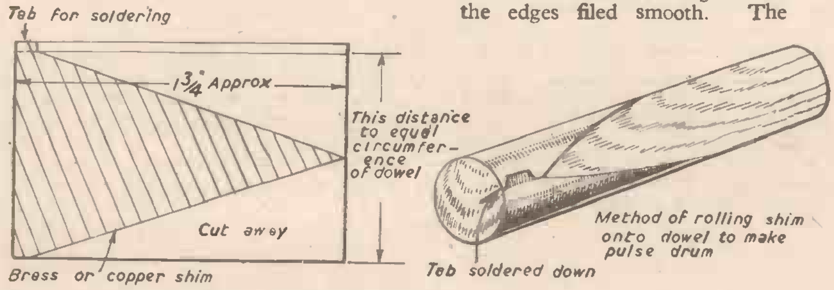
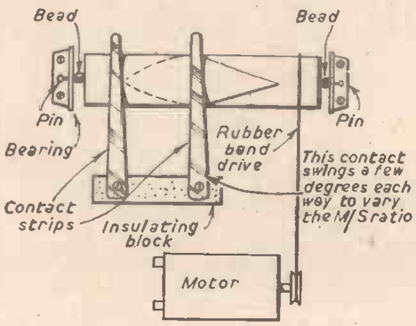


Fig. 2.—A simpler way of making the contact drum and (right, below) the drum arrangement shown diagrammatically.



The Control Box

Last month the transmitter was described and we must now look for a convenient way of switching it on and off. A very well tried control box which can be easily built is one using a small motor-driven switch to give the "50/50" switching of the transmitter. However, if the control box switches the transmitter in such a way that instead of sending "50/50" the transmitter is "on" for 60 per cent. of the cycle and "off" for 40 per cent. (known as sending "60/40") the relay operated by the receiver will be on one contact for a greater percentage of the cycle than the other. Thus the rudder motor instead of oscillating an equal amount in each direction (and keeping the rudder substantially stationary) will tend to turn, say, two turns clockwise and one-and-a-half turns anti-clockwise each cycle. This will cause the rudder to "creep" slowly to one side when it should be still. This could be very troublesome and some scheme is therefore necessary to enable the "50/50" setting to be adjustable so that this creep can be eliminated. Once the adjustment is made it is not usually necessary to touch it again and therefore the adjustment is usually catered for inside the control box and is set up before the lid of the box is screwed on.

The Contact Drum

Obtain a piece of thin-walled brass tubing about ½in. outside diameter by 2in. long and turn a piece of dowel so as to be a tight fit in the bore. The tube should be cut as shown in Fig. 1 and the edges filed smooth. The dowel should then be removed and replaced by a further length which has previously been drilled to take a length of ⅛in. diameter rod. A tight fit is required. When finished the drum should resemble the sketch Fig. 1. A simpler job can be made by cutting a wedge-shaped piece of brass or copper shim and rolling this round the dowel. The joint should be overlapped slightly and soldered, but care should be taken to make the bump at the joint as small as possible (see Fig. 2).

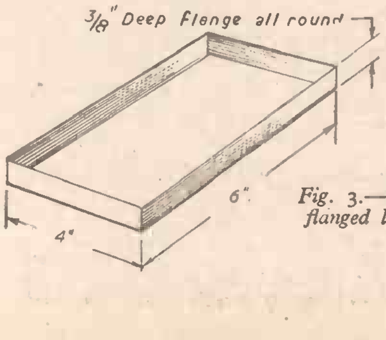


Fig. 3.—The flanged lid.

Next, take a piece of 18 s.w.g. aluminium, measuring 6¾in. by 4¾in., and make a flanged lid as shown in Fig. 3. All the components will be mounted upside down on this lid. Other components needed are a single-pole three-way "Yaxley" type switch, a "Mighty Midget" motor, an "on/off" switch and a knob approximately 2½in. diameter for the switch. Mount these components as shown in Fig. 4. Also shown is how the contact drum is mounted in its bearings and how the two wiping contacts made of springy brass about 0.015in. thick are fitted. The contacts are mounted on a block of insulating material (wood if you have nothing better) and the one at the end of the drum, which is always in contact with the brass part of the drum, is rigidly fixed. The other contact should wipe over the drum about half-way along its length so that during each revolution it is on the brass part for 180 deg. out of the 360 deg. This contact is not fixed rigidly, however, and must be able to swing a few degrees from side to side. This is the way in which the "50/50" signal is adjusted to eliminate rudder drift. The end of the contact drum shaft is fitted with a small pulley and coupled to the motor by an elastic band. Power for the motor is provided by a three-volt battery and a twin-cell cycle-lamp battery will give ample life. With this battery supplying power the pulley should be ½in. diameter. This will mean that the contact drum will run at about 200/300

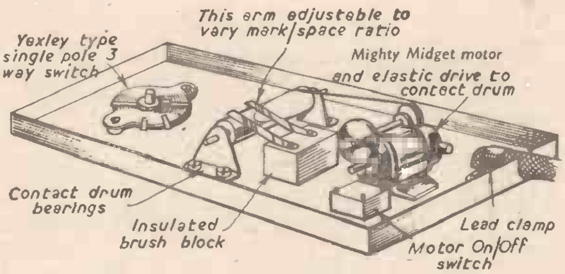


Fig. 4.—How the components are mounted.

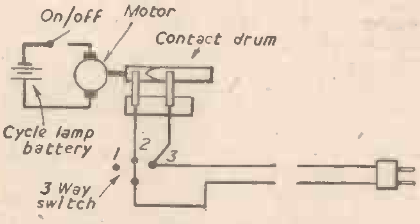


Fig. 5.—Wiring for control box.

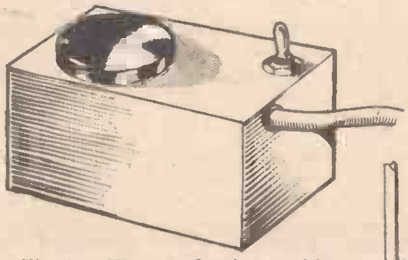


Fig. 6.—The completed control box.

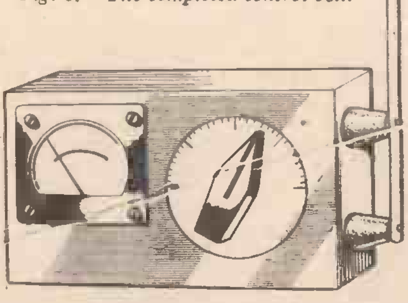


Fig. 7.—A view of the completed wavemeter.

r.p.m. If for any reason this speed is not produced the pulley size should be altered or a resistance put in the motor circuit to reduce its speed. Alternatively the simpler method drawn in Fig. 2 can be used, where the elastic band drives directly on the pulse drum.

Transmitter/Control Box Connection

Fig. 4 shows how the lead from the transmitter is brought to the control box. Make a really good job of anchoring this, which should be a twin-core, tough, rubber-covered flexible lead, so that if it is inadvertently pulled no damage will be caused. This lead forms part of the H.T. negative or positive supply to the transmitter (apparently it makes no difference which). The other end of this lead must be fitted with a suitable plug to fit into the transmitter so that the two units can be easily separated. A telephone-type jack is quite useful for this, but if the H.T. positive is being switched be sure to obtain a jack on which both connections are insulated from earth, particularly if the transmitter is being fitted into a metal box.

Having mounted all the components wire the base according to Fig. 5. It will be seen that the "on/off" switch controls the switching motor whilst the three-way "Yaxley" switch is arranged so that in position 1 the H.T. supply to the transmitter is broken, giving "Space" or, say, "Port Rudder" position. Position 2 means that the contact drum switches the H.T. on and off, giving "50/50" or "Rudder Stationary." Position 3 supplies continuous H.T. current and gives a "Mark" or "Starboard Rudder."

Fig. 9.—The interior of the wavemeter, showing simplicity of construction. In this version the aerial is attached to the top of the case.

Finally, make the bottom of the box deep enough to accommodate the cycle-lamp battery and fix the lid carrying all the parts to it with self-tapping screws going into the flanges. Fig. 6 shows the finished box.

Fit a large-size control knob. When sailing any boat, and particularly a fast one, steering may be easy when the craft is moving away from the operator. When approaching or moving at right angles the problem is much more difficult and it is easy to become confused with a small knob. With the box described the operator should try to imagine that he is putting his hand down on to the top of the boat and by turning the knob twisting it in the direction in which he wants it to go. This works with the boat in any position.

Wavemeters

In last month's article, which described the transmitter, it was pointed out that a wavemeter was necessary to enable the transmitter to be tuned so that it radiates at the correct frequency.

Due to the fact that some people seem to manage without a wavemeter, newcomers are tempted to think that they are superfluous. This is a mistake since the wavemeters used are very simple to make and provide a very convenient way of checking that the transmitter is working correctly and that it is "in the band." A wavemeter can also be very useful for comparing the power output of transmitters.

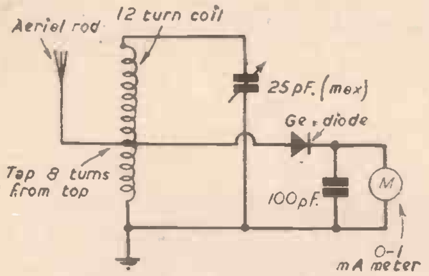


Fig. 8.—The wavemeter circuit.

Components needed for the construction of a wavemeter :

1—100 pF mica condenser.
1—25 pF (max.) variable condenser.
1—dial and pointer marked in suitable divisions with 180 deg. movement.
1—germanium diode.
1—0-1 mA meter.
2—small stand-off insulators.

Winding the Coil

In addition a coil must be made up using a ¾in. dia. former and 18 s.w.g. enamelled wire. The former can be a paper tube or wooden dowel, or anything of suitable diameter, since it is slipped out of the coil once this has been wound. Starting at one end of the former, leave about 2in. of the 18 s.w.g. wire spare and then wind on eight turns. Bare a small part of the wire here which will later be used for soldering a tapping, and then wind another four turns, so that we now have a 12-turn coil tapped at eight turns. The coil can now be slipped off the former and should be stretched out so that its overall length is approximately 1⅛in.

A metal box will be needed for the meter and some of the small boxes available on the surplus market can be employed here, otherwise any box approximately 2½in. × 3in. × 6in. will do.

The 25 pF condenser should be of the ceramic base type with silver-plated vanes and with a standard ¼in. diameter spindle.

Mount the meter, variable condenser, dial and stand-off insulators as shown in Fig. 7. Now take the previously prepared coil and solder the end nearest to the tapping to the variable condenser tag connected to the moving vanes. These vanes are earthed to the box via the spindle. Connect the other end of the coil to the fixed vanes. From the tapping point two leads must be taken. The first goes to the bottom stand-off insulator and should be led through a hole in the box to the terminal on this insulator. The top insulator is simply used as a support for the aerial, which is made from a piece of ¼in. diameter brass tubing. The aerial should be about 12in. long. The other lead from the coil tapping goes to one side of the germanium diode (it does not matter which). The other side of the diode is connected directly to the meter and the other meter terminal is earthed to the box. Finally the 100 pF mica condenser is connected across the meter terminals. The circuit is given in Fig. 8. The interior of the wavemeter is shown in Fig. 9 and Fig. 10 shows a similar model.

Testing and Calibration

The only testing required is to hold the wavemeter aerial about 12in. from a transmitter aerial with the transmitter switched on. Turn the wavemeter tuning control slowly and a reading should appear on the meter. If no reading is obtained reverse the connections to the meter, since this may be reading the wrong way. It is worth going to some trouble

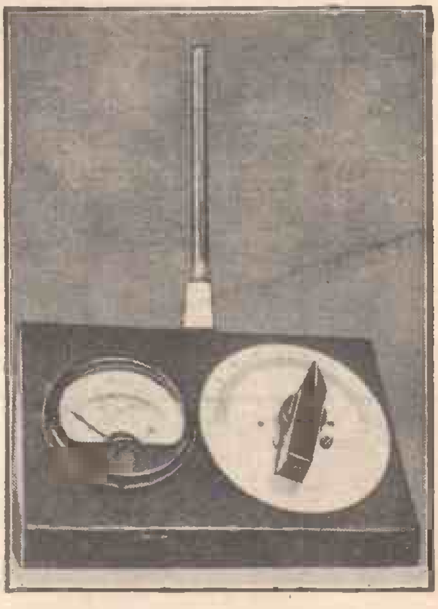


Fig. 10.—A photograph of a wavemeter similar to the model described. This model was built into a case having a sloping front and a sliding back for easy access.
(Note that the meter reads relative strengths only—the voltage scale readings are not applicable.)

to get the wavemeter calibrated accurately and the best way is to enlist the aid of a radio man with a suitable signal generator. To calibrate in this way clip the signal generator earth connection to the wavemeter box and hold the signal lead of the generator close to the wavemeter aerial. Set the generator to 27 Mc/s and switch on. Swing the wavemeter control slowly until the maximum meter reading is obtained, then weaken the signal input by holding the signal lead farther away and again tune for maximum reading. Note the dial reading on the wavemeter. This process should be repeated with frequencies on each side of the 27 Mc/s setting until the full coverage of the wavemeter is known. (N.B.—Once calibration has started do not bend or move the coil in any way since this will alter the calibration.)

For checking transmitters for frequency hold the wavemeter 1ft. or 2ft. from the transmitter and adjust for maximum meter reading. Comparing the dial setting with that obtained during calibration will indicate the transmitter frequency.

Interference Suppression

The suppression of interference from relay contacts and motor commutators is a most important point in all types of radio-controlled models. When the model is completed and testing commences it may be found that all is well when things are first switched on. However, as soon as a signal is sent the intergear may start behaving very erratically. This will almost certainly be due to radio interference within the model. What happens is that on receipt of a signal the receiver operates the relay, which in turn operates the rudder motor. Now either the relay contacts or the rudder motor may produce a small spark, and this is a source of radio frequency signal. The receiver, which may be located only a few inches away, can easily pick this up, therefore causing the relay to operate again. The whole process is consequently repeated over and over again.

Fortunately it is not too difficult to prevent this happening and condensers of approximately 0.01 µF should be connected across the relay contacts. It may be found necessary to use larger condensers, but if this is the case a 22-ohm ¼-watt resistance should be connected in series with the condenser to reduce the risk of contact welding.

To suppress Servo motors 1,000 pF mica condensers should be connected across the brushes and if this is not sufficient the small iron-cored chokes used for TV interference suppression should be connected in series with the motor leads as near as possible to the brushes.

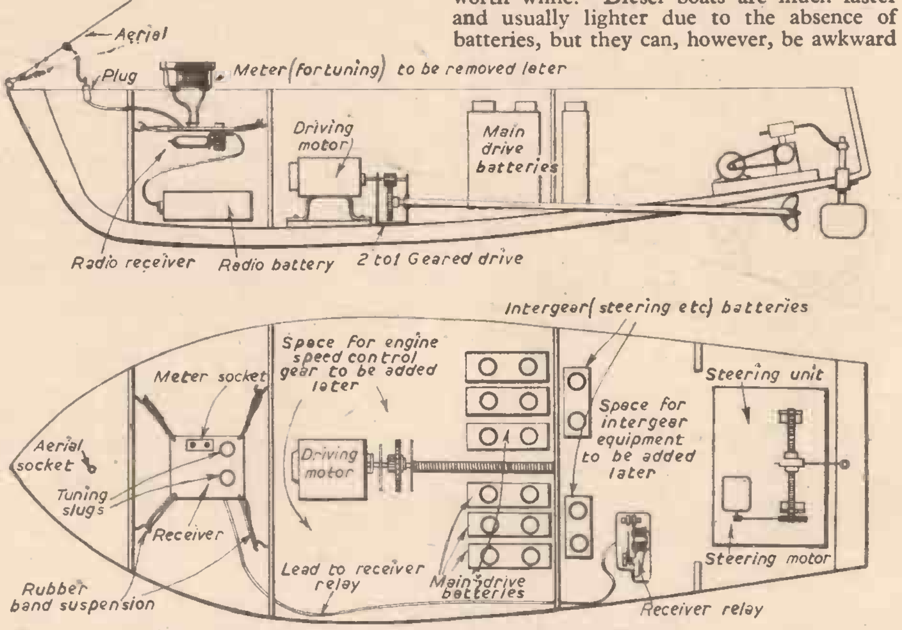


Fig. 11.—A typical radio-controlled boat layout.

Layout

Readers will have widely differing ideas on the type of model they wish to use, but with model boats there is a fairly clear-cut division on propulsion methods, i.e., electric or diesel. The electric types are normally slower, but are easier to handle; they also lend themselves more readily to speed control, etc., at a later date. Propulsion batteries can be quite a problem, but the small Nife accumulators can be strongly recommended. Incidentally, do not use the propulsion batteries for the steering motor, since as these run down the steering will become sluggish. Separate dry batteries are well worth while. Diesel boats are much faster and usually lighter due to the absence of batteries, but they can, however, be awkward to start, rather dirty and vibration is a source of trouble.

For all radio-controlled boats, however, remember that quite a lot of weight is involved and we would recommend the beginner to consider only a boat not less than 36in. long and as broad as possible, otherwise difficulties will appear in the shape of lack of freeboard. Fig. 11 shows how the radio-controlled boat should be laid out.

(To be continued)

Making an Angle Lamp

By D. SCHRODER

As these lamps are rather expensive I decided to make my own. To this end I purchased some 16-gauge aluminium sheet and with the use of a vice, hammer, drill and a pair of metal-snips I was able to make one for a few shillings. The method is as follows:

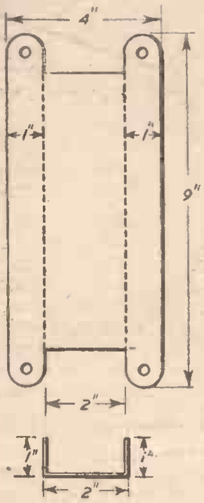


Fig. 1.—The section of channel.

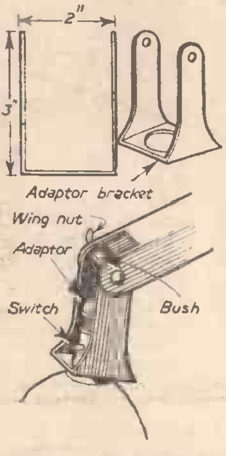


Fig. 2.—The adaptor bracket.

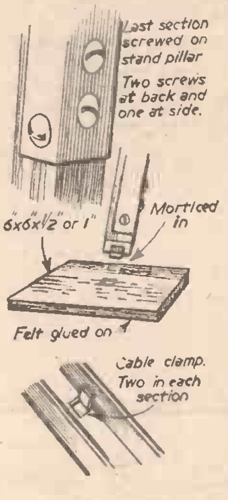


Fig. 3.—The stand pillar and the cable clamps.

Cut the sheet into 9in. by 4in. strips and bend 1in. of both sides over to form a channel for the frame. Cut out 1in. from each end and drill the sides ¼in. as shown in Fig. 1. Make up four sections of channel in this way, bending in a vice over a 15/16in. by 9in. block, which also was used in the drilling of the holes. A ¼in. copper tube was cut into three pieces 7/8in. in length for use as spacers. The pieces were assembled with one section fitting into the next, the copper tube fits inside and a bolt with a wing-nut is passed through with washers on both outer surfaces of the section. An adaptor bracket is made as in Fig. 2 from 16-gauge aluminium.

A small plastic shade was fitted and the base was made as in Fig. 3. By having the base on a wooden block, as shown in Fig. 4, I used this lamp indoors on the table, but it could be adapted for a variety of jobs.

The cable is carried inside the channel, being held in place by the little punched flaps as shown in Fig. 3. The base is felt covered, the cable being carried through the base and away via a groove on the bottom. The tension in the wing-nuts must be eased before the angle of the lamp is changed.

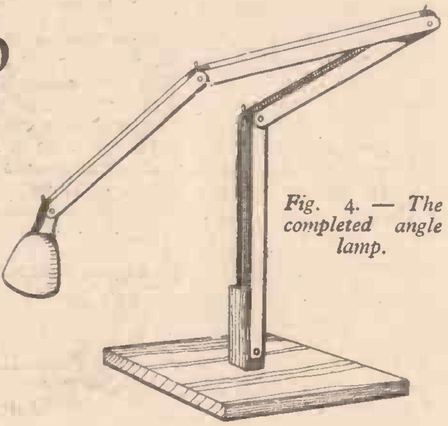


Fig. 4. — The completed angle lamp.

AN ELECTRO-MAGNETIC MOTOR

Make this Novel Motor from Odds and Ends

By A. B. ORR

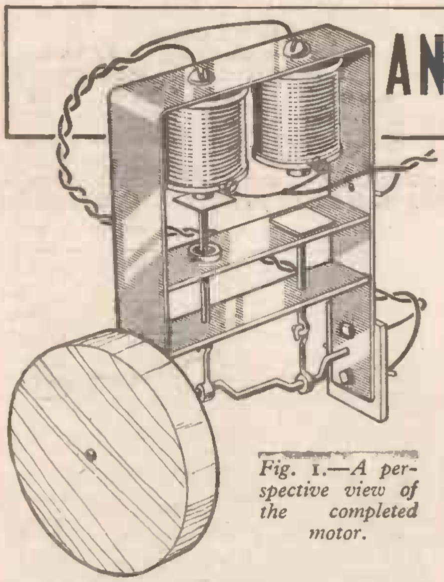


Fig. 1.—A perspective view of the completed motor.

THE motor was made from two electro-magnets—removed from a kitchen bell indicator unit, but which could be home-wound—some strip metal, some curtain rollers, and about 1ft. of 14-gauge baling wire. It should be noted that the dimensions given are not critical and need only serve as a guide.

The principle is extremely simple. When one of the magnets is excited it draws up a piston, the current flows in the magnet until the piston is at the top of its stroke, when the current is cut off. The flywheel carries the wiper on until it makes contact with the second segment. The piston under the second magnet is drawn up, and so it goes on. This principle is plainly shown in Fig. 1. It should be emphasised that the power output is negligible, so do not expect too much from it.

Construction

Begin by bending the frame to the shape shown in Fig. 2, the length across the top will depend on the magnets used. The cross members are soldered in place and after this the magnets secured. In the original, the magnets used had one end of the core tapped to take a small nut and they were bolted directly to the frame. If, however, those available have no provision for mounting they can be clamped in as shown in Fig. 3.

When the magnets are secured, the cross members should be drilled to take the 14-gauge wire used for the piston rods, directly under the cores of the magnets. Using the same drill, drill the frame for the crank bearings.

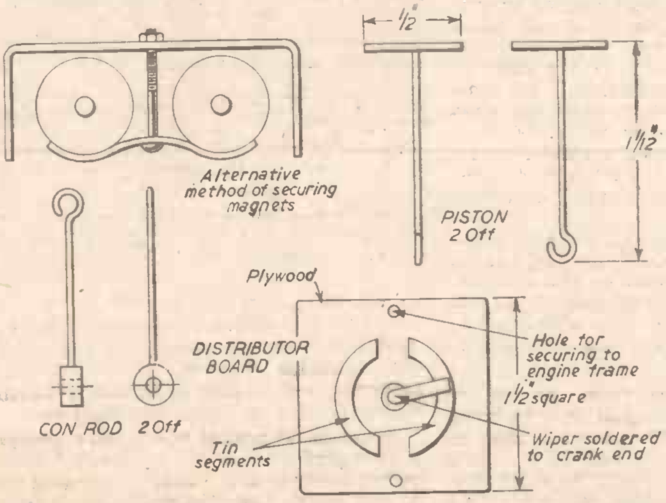


Fig. 3.—Method securing the magnet; the pistons and connecting rods; the distributor board.

The Crank

This is bent from the baling wire to the shape shown in Figs. 1 and 4. Two curtain rollers are slid on as big ends and the crank is mounted in the frame. A further curtain roller could be soldered on to the end of the crank to act as a collar, and the flywheel is secured to the opposite end.

Flywheel

This need not be heavy. The original was a 2½in. wooden wheel from a toy lorry and served the purpose well. Any available wheel of approximately the right size should suit.

Connecting Rods and Piston Rods

The connecting rods are made from 14-gauge baling wire, to the shape shown in Fig. 3. One end is bent to form an "eye" while the other is soldered to the curtain roller "big end" on the crank. The method for making the piston rod is identical, except that a small square of tin is soldered on the opposite end to the eye.

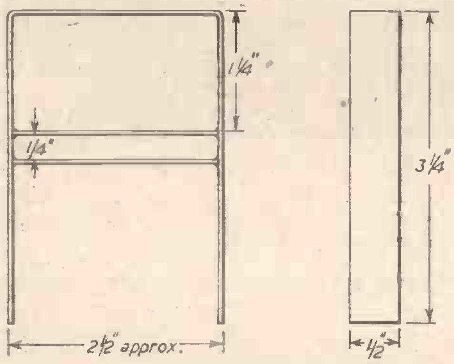


Fig. 2.—Details of the frame.

To ensure the correct length of rod, take a 2½in. length of wire and form an open eye at one end. Slide this up through the hole drilled in the cross members, and hook the open eye on the piston rod through the eye on the connecting rod and close it. Next bring the crank down to bottom dead centre and cut off surplus wire above the top cross member, leaving just enough above it on which to solder the ½in. square tin-plate piston. Repeat the procedure for the second crank and piston. The length of the piston rod in the original is marked in Fig. 3. The tin-plate pistons can now be soldered on. Taking each crank in turn, adjust the magnets so that at top dead centre there is about 1/16in. clearance between the magnet cores and the respective pistons.

Distributor

Any insulating material will do for the 1½in. panel, plywood being used on the original. A hole is drilled in the centre to take the end of the crank which should protrude about ½in. through the frame (see Fig. 4). The panel is then mounted on the frame, using two small 1/16in. bolts. They should be as near the edge as possible so as not to impede the travel of the wiper.

Two segments are cut from tin plate and glued to the panel. The wiper, which is made from a piece of old clock spring, is now soldered to the end of the crank and bent so as to bear lightly on the segments. The layout of the distributor board is shown in Fig. 3.

Wiring should be carried out as in Fig. 4. No snags should be encountered with this simple circuit.

Running

The motor will run from either a 3- or a 4½-volt battery. After ensuring that all moving parts are free and lightly oiled, it is necessary to time the distributor. This is done by bringing the first piston just past B.D.C., turning clockwise. With the piston in this position, the first magnet should be energised, i.e., the wiper should be just making contact with the segment. The piston is then brought to T.D.C., when the wiper should break contact with the segment. Sellotape can be used to mask off the segments, leaving exposed only the portion required. Repeat for the second magnet and the motor is ready for its trial run. As it is not self-starting, a flick of the flywheel is needed to set it going.

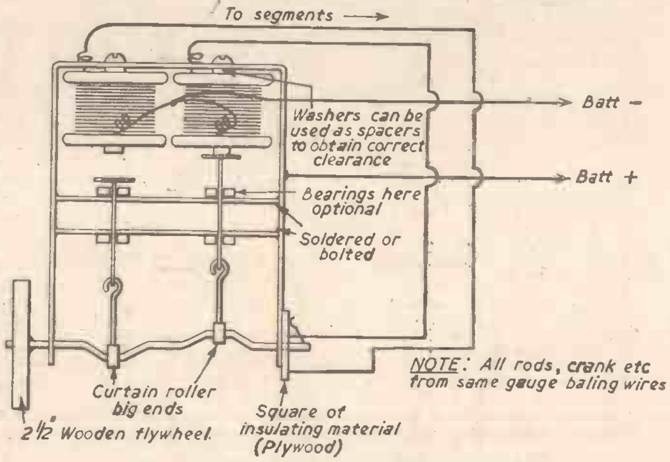
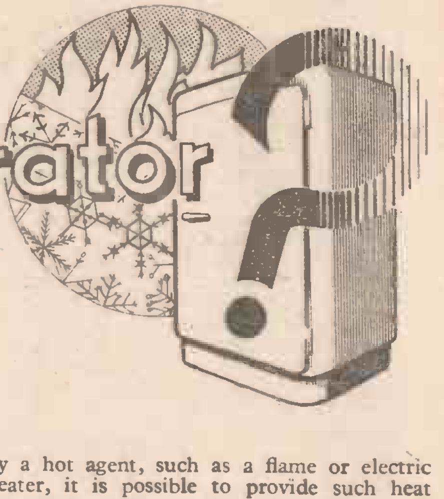


Fig. 4.—Elevation and circuit diagram.

If results are poor, i.e., the motor runs erratically or not at all, the timing should be checked to ensure that the wiper is making and breaking contact at the correct times. The flywheel may also be too heavy; it need only be heavy enough to carry the wiper across the small gap between the contacts.

The Gas Operated Refrigerator



How and Why it Works

By A. R. MYHILL,

F.R.I.C., M.Inst.Gas E., M.Inst.F.

DOMESTIC refrigerators belong to two types: the absorption type and the mechanical compressor type. The latter, although in many forms more thermally efficient than the former, has, for domestic purposes, the disadvantages that it may need a certain amount of mechanical maintenance from time to time, since it has moving parts consisting of a motor and pump, or compressor, and it is not entirely silent in action. The absorption type on the other hand operates as a sealed, closed system, and has no moving parts. It is perfectly silent and needs no mechanical attention. Domestic gas-operated refrigerators work on the absorption principle, and are put into operation merely by lighting a small gas jet which, in effect, provides the source of heat for keeping the circulating systems working. The amount of gas necessary to do the job is generally controlled by means of a thermostat which can be pre-set to achieve any desired degree of cooling or rate of freezing.

The Physical Laws

The physical laws which underlie the operation of refrigerators of all types are those relating to the three states of matter: solid, liquid and gaseous, and the thermal phenomena connected with the changes from one state to another. Speaking simply and, to some extent, figuratively, a substance in the gaseous form "contains" more heat or energy than the same quantity of the same material in the liquid form, and the liquid in its turn contains more heat than when the substance is in the solid state. Thus, a pound weight of steam contains more energy (or heat) than a pound of water, and a pound of water contains more heat than a pound of ice.

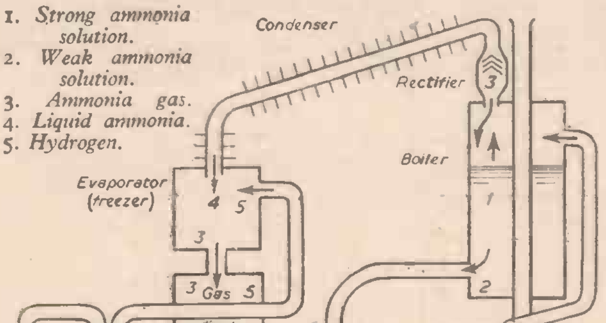


Diagram showing principles of construction and operation of a gas-operated refrigerator.

In addition, the higher the temperature, whether of solid, liquid or gas, the more heat will the substance contain.

If, therefore, a piece of ice, metal, wax or any other solid is melted, so as to pass into the liquid state, it takes up heat to do so as, for example, from a gas jet or a furnace. If, again, the resulting liquid is boiled, the steam or vapour takes up the added heat necessary to achieve this change of state. Conversely, when steam or any other vapour condenses to liquid, it loses heat from itself, in passing into a lower-energy form, and this lost heat is given up to its surroundings. When liquid water freezes to form ice, it similarly gives up heat to its surroundings.

Let us consider what happens when water, starting as ice, is heated, first to melting point and then raised to such a temperature that it boils completely away. Ice may be at any temperature below freezing point. The first effect of applying heat is to raise its temperature. When this has reached 32 deg. F. (or o deg. C.), i.e., the freezing point, the ice commences to melt, but no further increase in temperature results from the continued application of heat until the whole of the solid has been converted into liquid.

Liquid water at freezing point contains more heat than the same weight of ice, and this heat is known as its latent heat of fusion. It does not increase its temperature, but serves to change its state. If heating is continued still further, the temperature of the liquid will gradually rise until the boiling point (212 deg. F. or 100 deg. C.) is reached.

Boiling will commence and the whole system will remain unaltered in temperature until all the water has become converted into steam, the added heat being known as "the latent heat of vaporisation." Further heating of the steam will have the effect of raising its temperature indefinitely as more heat is supplied, since steam is then gaseous and, above the boiling point, possesses the general properties of all gases.

Conversely, if we reverse the process and abstract heat from steam, it will pass into the liquid form by condensation, and from the liquid to the solid state by freezing, and no fall in temperature will occur at the boiling or freezing points until complete change of state has occurred.

If any circumstance arises, or can be produced, whereby a liquid is evaporated, abstraction of heat will take place from its surroundings in order to provide the latent heat necessary for the conversion of liquid to gas. Although in the examples given such heat has been assumed to have been provided by a hot agent, such as a flame or electric heater, it is possible to provide such heat from surroundings at "cold" or "normal" temperatures and, because heat is taken from such surroundings, these in their turn become lowered in temperature according to the principle of the conservation of energy (heat). A familiar example of evaporation and consequent cooling at normal temperatures is observed when a stream of air or wind passes over a wet surface. A liquid in contact with a so-called permanent gas such as air, will tend to evaporate into the gas. By blowing across the surface of the liquid the vapour immediately in contact with it is removed and replaced by fresh air which takes up more vapour, and thus a continuous process of evaporation continues with consequent loss of heat (i.e., lowering of temperature) from the surroundings. The degree of lowering of temperature which can be achieved in this manner depends upon the particular liquid employed, being related to its boiling point and latent heat. For a given liquid the rate of cooling produced by evaporation becomes greater as the velocity of the impinging air stream increases. If, for example, a liquid of low boiling point and high latent heat, such as ether or petrol, is evaporated by blowing across the surface of the liquid contained in a wide, shallow vessel such as a watch glass, the rate of heat loss may be so great that freezing of the water vapour normally contained in the ambient air will take place, and the underside of the vessel will soon become encrusted with ice or snow crystals. This, in principle, is the process by which cold is produced in the gas-operated refrigerator.

In practice the action of the machine is considerably more complicated. To continuously evaporate a continuous supply of a suitable liquid would be obviously too costly in material and could not be carried out in a practical and convenient manner under ordinary domestic conditions. As a result of many years of trials and laboratory investigation, an extremely ingenious system has been evolved whereby a suitable liquid can be made to evaporate and the vapour condensed for re-use, all within a closed circuit. The design of the machine, including the layout and proportioning of its parts, has now produced workable and foolproof results.

Choice of Liquid Refrigerant

While it is true that many liquids would be capable of doing the work, it has been found that ammonia possesses several physical properties which make it eminently suitable for the process and apparatus employed.

Ammonia at normal atmospheric pressure and temperature is a gas. It is easily liquefied by the application of moderate pressure and/ or moderately low temperatures. It has a high latent heat of evaporation from liquid to gas. It is extremely soluble in water, dissolving to a very much greater degree in cold water than in hot water and is, therefore, readily driven out of solution by the application of moderate heat. By boiling an aqueous solution it can be completely expelled.

In the refrigerator liquid ammonia (not to be confused with ammonia *solution* in water) is caused to evaporate by bringing it into contact with a " permanent " gas—in practice hydrogen—which takes up part of the vapour in the same manner that an air-blast will evaporate water from a wet surface. In effect, the liquid ammonia on reaching the hydrogen-filled space vaporises, and the vapour diffuses into the gas, tending to reach an equilibrium and to produce a hydrogen-ammonia saturated mixture, in accordance with Dalton's Law of Partial Pressures.

It is this evaporation which produces the cold in the refrigerator.

The means whereby the necessary operations can be made to take place in a closed circuit without attention and avoiding mechanical parts will be understood by reference to the sketch, which has no claim to represent the appearance or relative sizes of the components. The proportioning, levels and general disposition of the various vessels and conduits are matters of extreme practical importance and are not dealt with in detail here.

With the exception of the chimney under which the gas jet burns, the whole of the apparatus, containing water, ammonia and hydrogen is sealed under a pressure of about 20 atmospheres (300 p.s.i.).

Sequence of Operation

In the boiler is water in which ammonia gas has been dissolved. About 30 per cent. of ammonia, by weight, is contained in the solution. In practice, a small quantity of a substance added as a corrosion inhibiter is mixed with the water. The ammonia solution partly fills the boiler and fills the liquid heat exchanger and the lower part of the receiver as shown. All free space, i.e., space not occupied by liquid, is filled with hydrogen under pressure.

The numbers appended to the diagram show the contents of the various vessels and tubes when the machine is operating. Operation involves a complex circulating system, the energy for which is supplied by means of the gas flame burning at the base of the chimney which is surrounded by the boiler.

The heat from this flame causes ammonia gas to be expelled from the solution in the boiler, displacing the hydrogen in the free space and passing upwards through the rectifier to the condenser. The function of the rectifier is to condense, and return to the boiler, any water spray or vapour, so that ammonia passes in a pure gaseous form to the condenser, which is a tube, coil or other duct cooled by means of radiating fins.

The liberation of ammonia gas from the solution in the boiler results in an increase in the specific gravity of the boiler contents, since a strong solution of ammonia in water is considerably lighter than water itself.

A circulation system is thereby established in which the comparatively weak, heavy ammonia solution passes downwards through the outer jacket of the liquid heat exchanger, and is delivered at the top of the absorber, where it meets with ammonia gas, as will be described later.

Meanwhile, the ammonia gas driven out of solution by the heat of the boiler enters the condenser at the highest level of the apparatus, where, as a result of the pressure and the lowering of temperature provided by air-cooling, it liquefies. The liquid ammonia flows downwards into the evaporator (or freezer), and it is in this chamber that the real process of refrigeration takes place. The evaporator generally has the form of a coil, and is frequently welded to a metal box which may contain compartments where water or food products may be frozen. The main storage chamber of the refrigerator is cooled by natural currents of air passing in contact with the coil and its attachments.

When the liquid ammonia running from the condenser reaches the evaporator it enters an atmosphere of hydrogen, which is in a state of induced circulation from the receiver, upwards through the absorber, and thence going to the top of the evaporator. The stream of hydrogen, therefore, has the effect of evaporating the liquid ammonia, and thereby producing the necessary cooling effect. The resulting mixture of hydrogen and gaseous ammonia, now being considerably heavier than the original hydrogen, falls by gravity through the gas heat exchanger outer jacket, and proceeds downwards into the receiver, over the surface of the contained liquid, and thence upwards through the absorber, a vessel functioning as a "scrubber," where the ammonia gas is removed and the specific gravity correspondingly reduced. The hydrogen circulation is thus maintained in action, the resulting nearly-pure hydrogen now being in a condition to evaporate more ammonia as it emerges into the top of the evaporator.

The removal of ammonia from the hydrogen-ammonia mixture is carried out by the solvent action of the weak solution running from the lower portion of the boiler, as previously described. The gaseous mixture, having passed over the surface of the liquid in the receiver, passes upwards through absorber in counter-flow to the descending stream of weak ammonia solution. This solution, by taking up additional ammonia gas, becomes strengthened to a concentration suitable for readmission to the boiler. It passes into the receiver and, from this vessel, is circulated to the top of the boiler for re-use.

The means which are adopted for raising the strong ammonia solution from the receiver, through the inner section of the liquid heat exchanger and to the top inlet of the boiler consist in the use of a bubble pump, which is a very simple device, comprising a few turns of spiral tubing encircling the lower portion of the chimney or heating flue of the boiler. The heat from the flue produces bubbles of ammonia gas in the vertical portion of the tube, which results in the formation of a column of relatively light liquid-gas mixture so that an upward movement is continuously maintained.

Mention has been made of two heat exchangers. These have several functions. They conserve heat and this reduces fuel consumption. The liquid heat exchanger, also by cooling the weak ammonia solution passing from the boiler to the absorber, makes it more effective in dissolving the ammonia gas in the absorber.

The gas heat exchanger cools down the hydrogen leaving the absorber for the evaporator, and makes possible the attainment of a corresponding low temperature in the latter vessel, enabling freezing point to be reached in this position.

A Simple Thermostat

A Device Constructed for Use with a Photographic Print Drier

By S. P. v. d. WESTHUIZEN

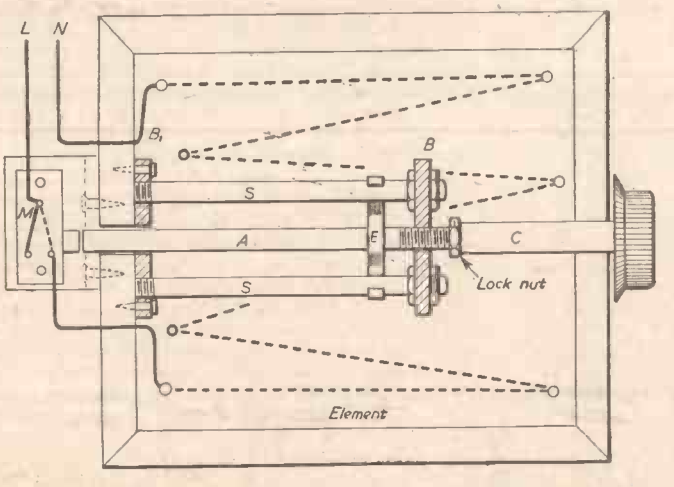


Fig. 1.—A plan view of the thermostat.

I RECENTLY constructed the print drier which was described in the May issue of PRACTICAL MECHANICS and found it necessary to have some means of controlling the temperature. I then made a thermostat for this purpose, which I found to work efficiently. Construction should be apparent from the diagrams, Figs. 1 and 2. The letters on the drawings are explained as follows:

M is a micro-switch 5 amp. 250 volts A.C.

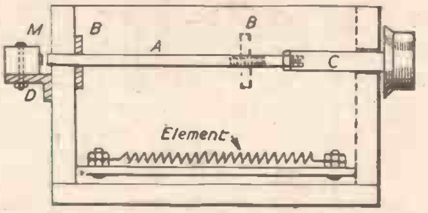


Fig. 2.—A side view of the thermostat.

B and B1 are two plates made of steel or brass 2in. x 1in. x ⅛in.

S is two steel rods 9in. x 3/16in.

A is an aluminium rod 11in. x ⅛in. (welding rod).

C is a brass rod 6in. long (approximately), depending on size of the box.

D is a bracket of steel to support the micro-switch. This bracket and plate B1 are secured to the box with C.S. wood screws.

E is a piece of clock-spring for extra tension.

The micro-switch is operated by the expansion of the aluminium rod when heated. The thermostat can be calibrated by drilling a hole through the side of the box and inserting a thermometer. The hole can be plugged afterwards.

The cost of making this thermostat was very reasonable, the only expensive item being the micro-switch.

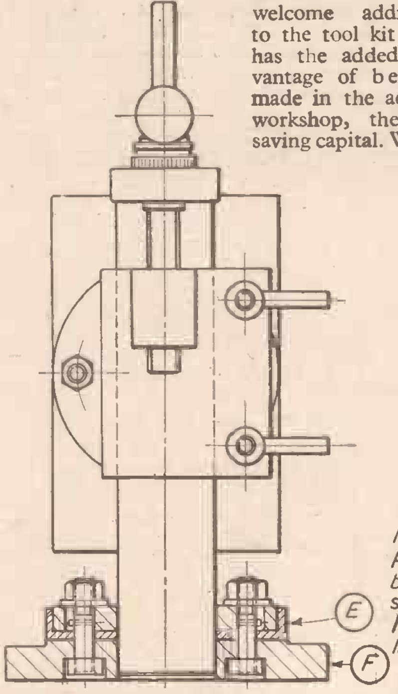
Equipment for the Home Workshop

7.—A Vertical Slide

By TUBAL CAINE

(Continued from page 38, October issue.)

NEXT to the lathe and drilling machine the most useful machine tool in the amateur's workshop is a milling machine, and these are sometimes seen as small versions of the orthodox type of tool found in the larger engineering shops. However, very few readers have unlimited means whereby they can install every type of machine and they must necessarily fall back on improvisation in an endeavour to finish a particular part of their model. For this reason, and the fact that space is also very limited on occasion, any accessory which is adaptable for use on the lathe makes a welcome addition to the tool kit and has the added advantage of being made in the actual workshop, thereby saving capital. What is perhaps more important still, however, the model engineer is then in a position to construct the assembly exactly to suit his personal requirements.



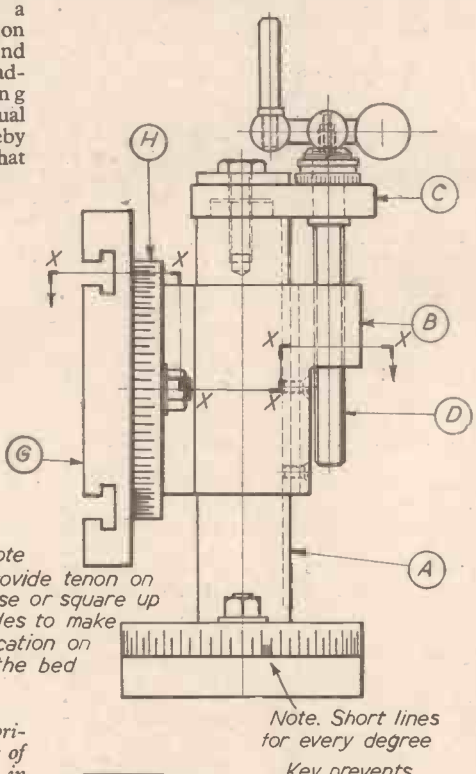
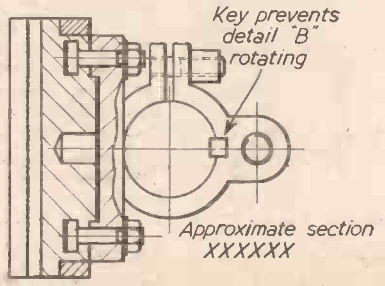


Fig. 1.—Assembly drawing of a typical fabricated slide for an average 3½in. lathe. Some of the lettered parts are shown separately in individual drawings.



Castings or Fabrication

One great disadvantage with making machine parts, if they must follow exactly orthodox lines, is that castings are necessary, and this means that time is wasted while patterns are built before you can secure the basis of the accessory. This factor undoubtedly deters many amateurs from making machine parts, but if they adopt the fabricated principle and build up all the details from steel plate and blocks, a serviceable article can be obtained.

Many individuals contend that a fabricated assembly does not possess the same good looks as the cast-built assembly, and while agreeing with these remarks to some extent, I maintain that with a little care especially to make sure all the sharp corners are removed, fabrication can still produce both a presentable article and one which gives highly satisfactory service over a long period. A coat of paint to match the other machines and accessories found in the workshop covers the rather unsightly welding fillets and considerably improves the appearance.

The Design

Fig. 1 illustrates the assembly drawing of a typical fabricated slide suitable for the average 3½in. lathe, and it will be seen that all the details are fairly easily machinable on that machine. Both the worktable and the base are graduated to allow angular setting—a great advantage over the fixed style of slide which only permits milling in one plane. It is hoped that, though this entails somewhat more work, all readers will attempt this form of construction. For those who prefer adjustment in only one direction it is suggested that the rotating details on the base member are omitted and reliance is placed solely on setting skill when clamping the parts to the actual worktable.

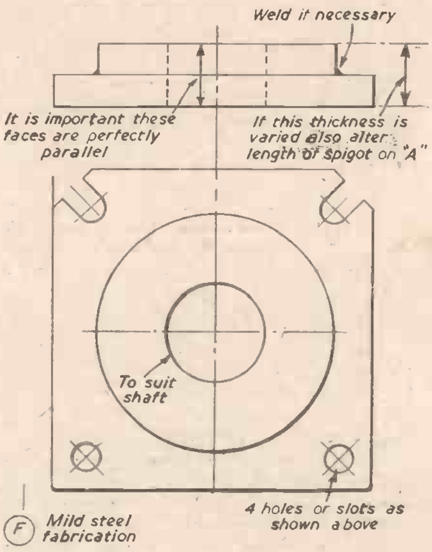
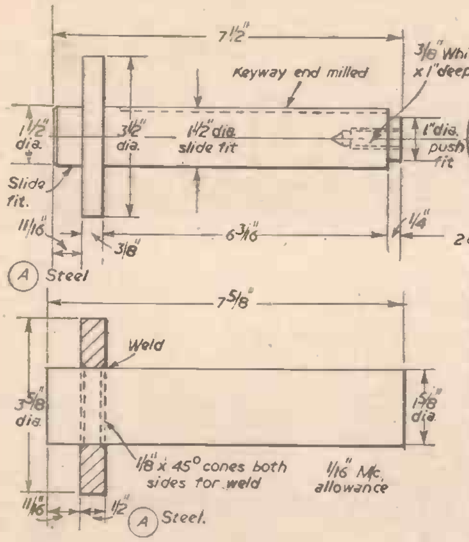


Fig. 2.—The base.

The base is a piece of mild steel of suitable size and thickness to locate on the bed of the lathe, and into this is inserted what is perhaps the most important item. This consists of a welded flange with a long circular steel bar, and at this stage it must be pointed out that care is essential to ensure that this shaft is both parallel and perfectly square with the underneath flange face. This is necessary to secure a shaft standing vertical with the bed—a feature which avoids the production of tapered faces on the work machined on the slide.

A similar accuracy is essential on the sliding detail locating on this shaft, and in this instance the bored hole is machined perfectly parallel with the flange face which forms the location for the table. A close degree of accuracy between the shaft and hole is of course needed otherwise there is a risk that severe vibration will occur, despite the provision of a locking device to hold that member to the shaft. It should be pointed out also that this locking arrangement is not provided as a means to overcome bad workmanship. It will hold though the bore is perhaps .01in. large, but movement will almost certainly take place when a deep cut is applied. So when machining the hole a fit above suspicion is essential for the good working of this accessory.

The top unit is simple and merely requires the recess to fit closely to the shaft top and



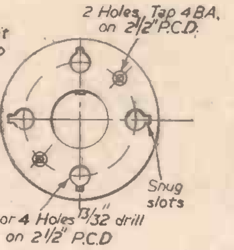


Fig. 3.—The vertical shaft. At the top is a machining drawing and below a welding drawing.

reaming the hole for the screw shaft. The turning of the handle and screw together with the index collars needs no explanation.

The Base

The drawing of the base in Fig. 2 has been included minus the dimensions as these will naturally depend on the size and make of lathe to be used. The principle, however, will remain substantially the same, and it may be seen that it consists of a flat rectangular plate bored to receive the shaft spigot and recessed to clear the bolt heads when the latter rotate as the accessory is indexed. Bolt holes to attach it to the top slide or bed of a lathe are either drilled or tenon slots are milled—these are provided in my particular slide in the four corners. I have made them to suit a series of thick steel blocks which I have in my possession, as this enables me to pack up the vertical slide at any time and so permit the machining of some unusual part of massive dimensions.

You can make the base circular if the only piece of material available is that shape, but I prefer in this case a rectangular item. There is a little more clamping area for the slide to seat upon, and also four clamping bolts can be used easily—one in each corner. Details of the base are shown in Fig. 2 and it is marked " F " in Fig. 1.

The Vertical Shaft

In addition to a machining drawing for this detail, a brief welding sketch is included to assist matters prior to finishing the part (see Fig. 3).

Turn and bore the flange and provide two angular cones to accommodate the welding material as some of this must, of course, be machined away in order to ensure that the flange is in contact with the base surface. The shaft should fit fairly closely in the hole but there is no real need to make it a drive fit. This item is marked " A " in Fig. 1.

Incidentally, some readers may wonder where to go to have these items welded and are perhaps tempted to abandon the construction because they have no facilities for such work. The local small garage is generally pleased to help for the payment of a few shillings. The small " one-man business " will usually weld this at a very cheap rate provided you make the pieces fit correctly and provide a drawing indicating exactly what you require. Alternatively, take your work along to the small workshop which employs a dozen hands and they will carry out this welding efficiently for you—even in country districts there are many of these shops which undertake welding repairs to agricultural implements.

How this item is machined is a matter of personal preference but the suggested procedure is first to machine the top diameter and underneath flange surface, holding the shaft in the four-jaw chuck and supporting it if the latter is rather small with the aid of a steady. When this is completed, face the surface where the holding bolts contact before removing it for the next stage.

Bolt the detail to a true faceplate and with the rear centre in position to exert a steadying influence to the shaft, very carefully turn this diameter making sure it is parallel. The actual size is not really important because the hole can be bored in the sliding detail to suit, but endeavour to make it a standard dimension, as this will often prevent misreading the micrometer and so causing scrapped work. Turn the end spigot while the shaft is in this position and then both diameters are concentric with each other.

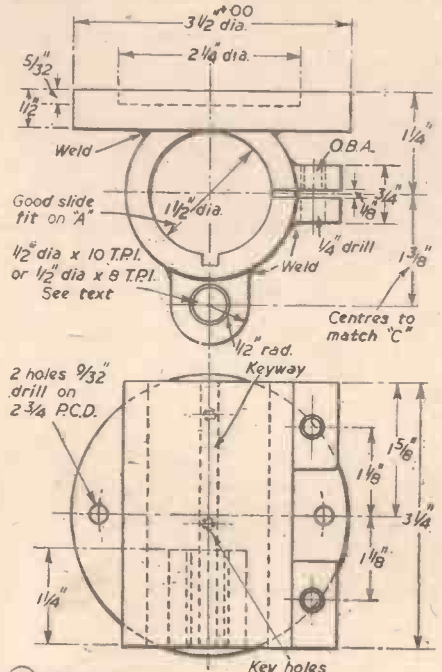


Fig. 4.—The sliding member. This is a machining drawing. Allow 1/16in. per face for machining.

The importance of turning the shaft diameter parallel was mentioned above and for this reason a very keen tool and one with a carbide tip should be used for this final operation. This overcomes the problem of tool wear which is possible when long diameters are turned and which increases the likelihood of errors. If of course your lathe does not turn parallel then there are two alternatives. Either set the headstock true, or try filing the shaft to remove the high spot. The latter procedure I do not like because very few individuals can make a first-class job of such work, and if the effort is viewed under a microscope a series of flats instead of a perfect round diameter would be seen, even though the work is performed by a turner having the highest degree of skill. Always attempt to finish-turn diameters of this description as this is the only way you can ensure that the surface is smooth and round.

The Sliding Member

This detail, shown in Fig. 4, is again welded from suitable pieces of steel plate, and the machining requires very little explanation with perhaps the exception of the large hole. For this work the ideal set-up is the mounting of the detail at the required height on blocks attached to the worktable, and to traverse a cutter bar which is in turn mounted between the lathe centres, through the bore. A grub screw behind the tool gives the necessary adjustment and if the clamping screws holding the tool are only partially loosened, a fine depth of feed is secured.

The Table

The dimensions of the working surface of this detail are 4in. by 5½in., but these are easily modified to suit the metal you have in stock. Generally, for model work, there is little point in making the area larger. It means there is more weight overhanging from the shaft, though this is sufficiently large to accommodate a few extra pounds, but there is no real need to add weight and so make the accessory awkward to handle on and off the lathe. Two slots for holding bolts are shown on the sketch of this item in Fig. 5 as this leaves a fairly large area free in the table centre—a good point when articles of small or narrow section require machining. This item is lettered " G " in Fig. 1.

The Screw

Only one point needs mentioning regarding this part, and that concerns the pitch of the thread which, of course, gives the necessary feed up and down the column. I have shown this as 10 T.P.I. as this is a convenient figure, but if you prefer a slightly coarser thread, then use 8 T.P.I. but adjust the divisions round the upper index disc accordingly. Arrange them in the same way as those on the lathe cross slide—each division to give a feed of .001in. as the disc is sufficiently large to make these divisions easily readable.

The Scales

It is not proposed to give full details on the engraving of these parts here because this is a matter which cannot be dealt with briefly, but some readers may wonder why they are made as separate details when apparently the lines could be engraved directly on to the vertical member and table base.

In the case of this latter item, the position of the square table makes this operation very awkward to perform, because the lines are in close proximity with the underneath face of that large rectangular steel block, and the engraving cutter must stand well out from the spindle—especially when cutting the lines at the corners—and this will make it extremely

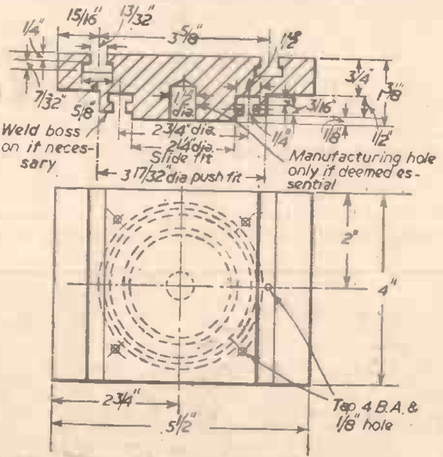


Fig. 5.—The table.

weak and liable to fracture. As a separate ring, engraving is a simple process and the disc is attached by means of small screws, see Fig. 6.

The lower set of lines is not inconvenienced in this way, but the handling of such a large part is not very convenient and as the same set-up is feasible for both rings, I have decided to utilise the same idea also for this arrangement, see Fig. 7.

Part " C " on the general assembly drawing is shown in Fig. 8.

General Notes

Splitting the sliding member (Fig. 4) in order to make it possible to clamp the set table to the column may present problems to the tyro, and though in the large engineering workshops a milling cutter is utilised to make this slot, it requires a large diameter cutter, and this is an unnecessary expense especially when another method is possible. It is also easily possible to fracture such a thin tool because it requires a certain amount of skill when feeding it into the metal if breakage is to be avoided.

For this work it is advisable to cut this slot by planing it through the detail; using for the purpose a short narrow parting tool held sideways in the tool post and using the saddle motion along the bed. Only a shallow cut is feasible, and you must, of course, make sure the headstock spindle is securely locked by introducing the backgear or some other means. Use plenty of cutting oil on the tool and see that you sharpen it properly before commencing to cut through the block.

Another process which can trouble some readers is the drilling and tapping of the screw hole in this moving member because the centres must correspond to those on the top bracket. The easiest way for the amateur to overcome this difficulty is to use the top item as a drill jig—both parts are placed in their respective positions on the shaft, properly aligned and a drill put through an already existing hole in the top bracket. The parts are then separated from the shaft and the work of opening out the tapped hole to the appropriate dimension and tapping the thread completed.

Keycutting is another process which appears both awkward and difficult, but, given the proper set-up, the operation is fairly straightforward. For the shaft (Fig. 3) you can clamp the part in vee blocks on the boring table and traverse it past a cutter held in the headstock spindle, using a simple two-toothed cutter for the job, but the slotting of the internal keyway is more difficult. However, the same tactics used for cutting the slot in this part are employed, only this time instead of a tool being attached to the tool post the bar between centres is applied with a tool so arranged to " cut sideways " in a manner of speaking. You must again prevent the bar from turning and this is done by attaching a carrier to it and bolting this accessory to the faceplate—the latter in turn being prevented from moving by the introduction of the back gear. All this appears very complicated but the sketch, Fig. 9, gives a visual explanation.

Finally, the importance of making the shaft diameter and flange face of " A " (Fig. 3) perfectly square with each other must be stressed and close attention given to the faces on " F " where indicated in Fig. 2.

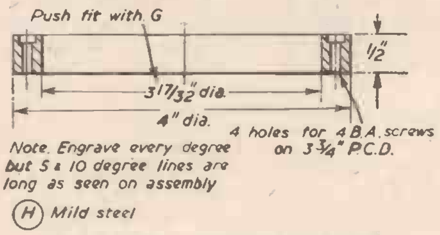


Fig. 6.—The upper engraving disc.

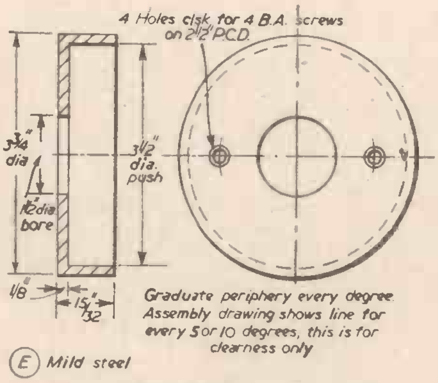


Fig. 7.—The lower engraving disc.

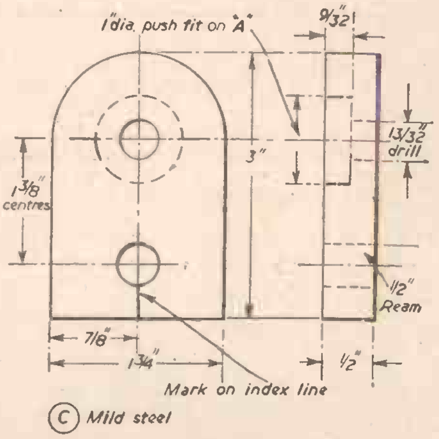


Fig. 8.—The top plate.

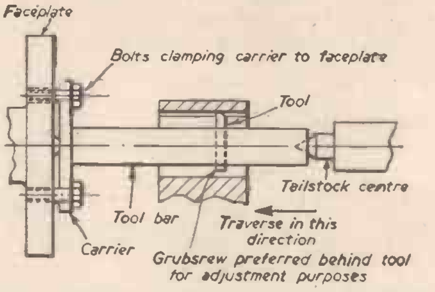


Fig. 9.—The set-up for cutting keyways in the lathe.

Similarly, the table surface and the 1½in. hole in the fabricated bracket are also important, but with a little care in machining there is no reason why you should not achieve a truly vertical table surface in any position you care to turn it. Remember a slight " run " on the shaft diameter can reproduce many errors on subsequent milled work, especially if the latter requires several settings before the final result is accomplished. It can mean that every face is .001in. or more out of square with the adjoining member, and though many model engineers may consider this is satisfactory, for high-grade milling it is not good practice.

(To be continued.)

Improving Caliper Brakes

By H. A. ROBINSON

OWING to the method of their suspension from the frame and lack of rim support, some caliper brakes tend to " jump " and bear unevenly, even if the wheel is only slightly out of the true. Certain makes exhibit this unfortunate characteristic when the wheels are quite true, but when new blocks or other conditions have increased the rim friction, even rust will bring about the trouble.

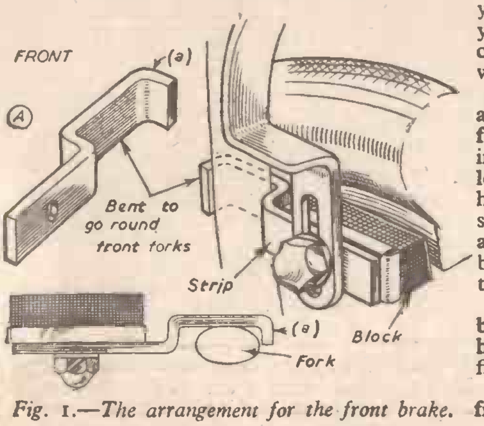


Fig. 1.—The arrangement for the front brake.

Recognising the fault, some manufacturers are now fitting their brakes with what they call " Retarders "—pieces of metal which, being in contact with forks and seat stays, prevent horizontal play of the blocks and so, of course, eliminate the jumping.

Retarders, however, are very easy to make yourself and are certainly worth putting on if you are having any trouble of the type described. If carefully fitted, they do not interfere with the appearance of the machine.

Figs. 1 and 2 show how the items are made and fitted for front and back wheels. For the front, two strips of thick gauge tinplate or thin iron are required, about ½in. wide. The exact length is found by test, but is in the neighbourhood of 4in. These pieces are bent at one end so as to go comfortably round the forks, and are then shaped to avoid the brake blocks and bring their ends in line with the brake shoes, to which they will be attached.

When correctly bent, mark where the brake-shoe bolts come and carefully drill holes here, flattening the edges neatly with a little filing.

To put in position, remove the brake shoes from the upright stirrup and place the strips over the bolt then exposed, their ends being round the back of the forks. Replace the brake shoes in the stirrup, tighten up, and the job is complete. Fig. 1 shows clearly how the parts lie with respect to one another.

Rear wheel retarder strips are made in just the same way and are fastened to the brake shoes in similar manner, but in this case the ends of the strips are bent round to a right-angle (Fig. 2) so that they come up against the seat stays. Should the brake-shoes try to jump, the turned-over ends of the strips *press* against the stays and so prevent movement. The action is just the opposite of the front wheel where the retarder gives stability by *pulling* on the fork.

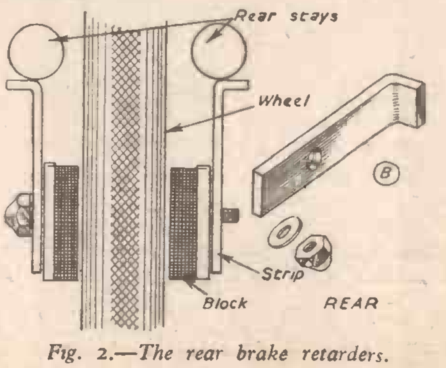


Fig. 2.—The rear brake retarders.

MAKING AN BLOWER

Fig. 1.—The co

Fully Dimensioned
Notes for the Cor
1½ or 3 kilowatt E

By D. HAR

UNTIL you have been in a room on a cold day with one of this type of heater on you do not realise how out of date the conventional coal and electric fires are. With this blower-heater there will be no more scorching in front while your back is freezing, for the whole room can be kept to a predetermined temperature.

The idea is that air is drawn in at the rear by an electric fan and is blown through either 1½ or 3 kilowatt elements and so circulates hot air into the room. In a short space of time all the volume of air in the room has passed through the heater.

With a variable thermostat controlling the room temperature the heater is switched off until the temperature drops beyond a certain point, when the heater will be automatically switched on again.

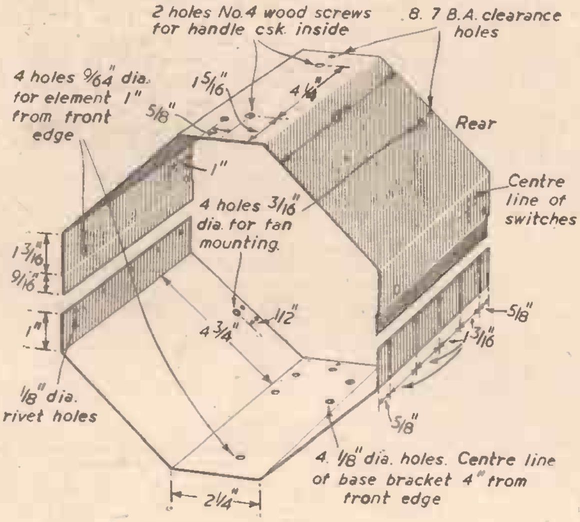


Fig. 2.—The body construction.

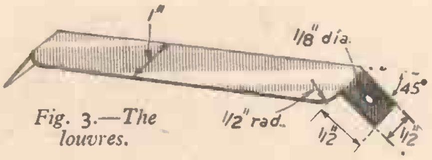


Fig. 3.—The louvres.

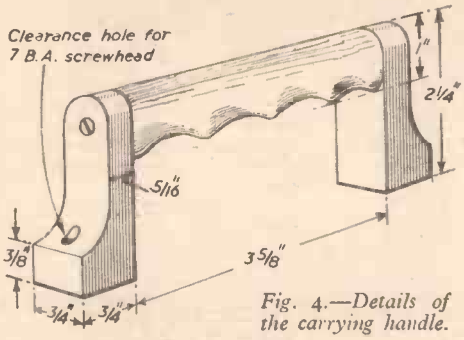


Fig. 4.—Details of the carrying handle.

To bring a room 22ft. x 12ft. x 9ft. high from 48 deg. F. up to 70 deg. F. it takes approximately 7½ minutes and maintains 70 deg. at the cost of 1d. per hour at 3,000 watts. A view of the completed fire is shown in Fig. 1.

The Body

This is made from 18-gauge sheet steel, and to simplify making up it is made in two halves as in Fig. 2. Both pieces are alike except that the top half has a joggle in it to bring the outside flush. As will be seen, it is an unequal octagon in shape, 8in. across one way and 9in. across the other.

Drill holes as per Fig. 2: 4 for the fan motor mountings, 4 for the base bracket, 4 for the element former, 2 for the handle and 8 for the rearguard.

Cramp the two halves together, mark for rivet holes and drill. Then countersink inside and outside and rivet together (I used ⅛in. duralumin countersink rivets).

The louvres, Fig. 3, are made from 18-gauge plate and there are 15 of them at 9/16in. centres. Rivet them on as you make them to length, starting at the top and bottom, working to the centre. If the rivets are countersunk on the outside it will look a much more workmanlike job when finished.

Handle

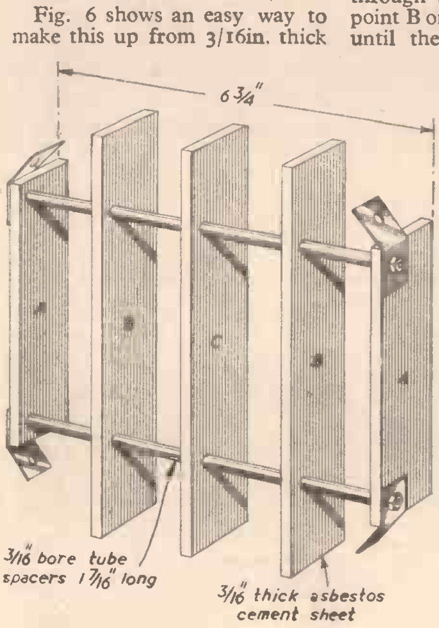
Make the handle from a good hardwood as shown in Figs. 4 and 5. Screw to the case from the inside wtih two No. 6 countersunk screws.

Former for the Element

Fig. 6 shows an easy way to make this up from 3/16in. thick sheet asbestos cement, with 3/16in. bore steel or copper tube as spacers and 3/16in. diameter brass or steel tie-bolts threaded at each end 3/16in. Whitworth or B.S.F. Cut out two from the asbestos sheet as in Fig. 6 at A. Two as at B and one as at C.

You can buy two 1,500-watt elements from: Technical Services Co., Shrubland Works, Banstead, Surrey, at approximately 2/9 each (just the wire without formers). Stretch this out until expanded to approximately 54in. in length (do this carefully and evenly).

Thread one end of the element through the former, starting at point B on Fig. 7, pull it through until the centre of the element comes to point A, carry on across and back again until the end reaches terminal C. Repeat with opposite end to terminal D. Repeat this with the second element to dotted lines, Fig. 7. Join the end to terminal D and the other end to terminal E.



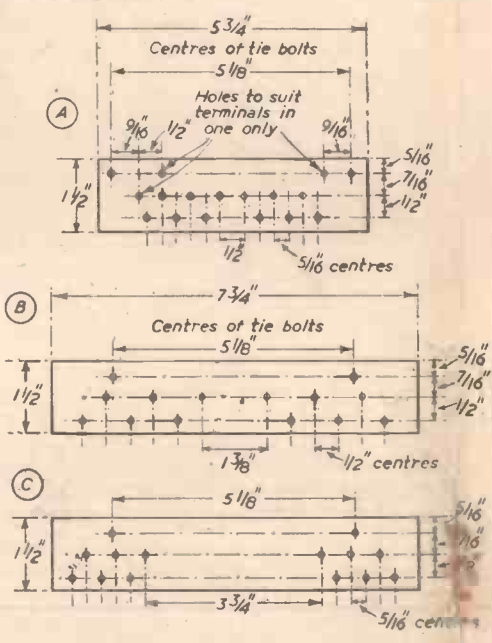


Fig. 6 (Above and Right.)—Making the former for the element.

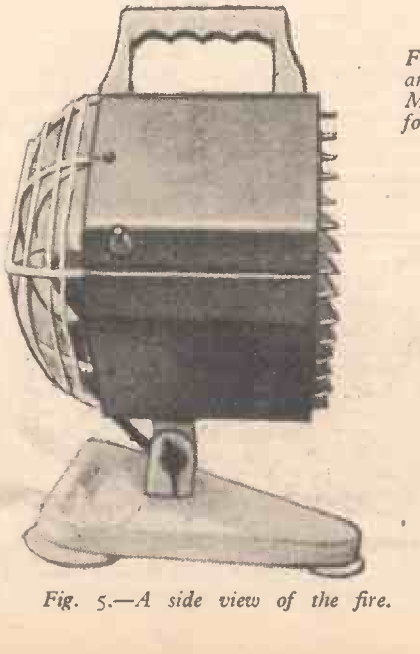


Fig. 5.—A side view of the fire.

Element Fixing Brackets

Make three element fixing brackets from 22-gauge steel plate, as Fig. 8, and one as Fig. 9. Fig. 9 is the top one and is slightly longer so that the bolt misses the handle. Assemble the complete element in the case with the terminals at the bottom, on the right looking at the front.

The Fan

The author's electric can was obtained from Milligans, 24, Harford Street, Liverpool, 3, for 50s., postage 2s., and is an induction motor

ELECTRIC HEATER

npleted fire.

Drawings and
nstruction of a
Blower-heater

RMER

with 7½in. diameter blades. Unfortunately, this firm have no more of these units, but readers may be able to adapt an old fan or buy a suitable motor and make the fan blades. Slide the fan into the casing and insert screws and grip washers supplied. Fig. 10 is a photograph of this unit.

The Switches

The switches are of the skeleton type used on electric immersion geysers, rated at 10 amps each.

Fix these at the rear of the casing, one each side, at the distance of 5in. from the front to the centre of the switch. Holes will have to be cut in the casing to allow the switch lever to protrude and also holes for securing. Insert a right-angle bracket behind them to obscure the switch mechanisms from prying fingers. Make these as small as possible so as not to restrict the air flow too much.

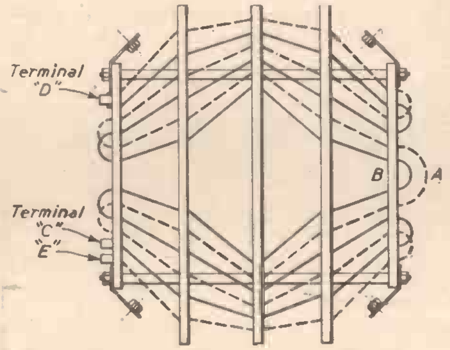


Fig. 7 (Left) Threading the element through the former.

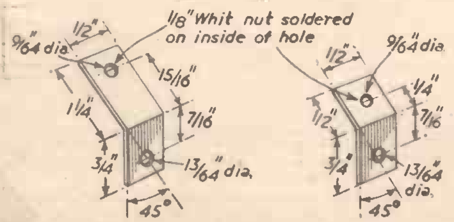


Fig. 9 (Left) and Fig. 8 (Right).—The element fixing brackets.

The Rear Guard

This is made from 3/16in. and 1/16in. brass or steel wire, obtainable from your ironmonger. The 3/16in. wire is bent to the shape shown in Fig. 11 and soft soldered to a disc 1in. in diameter × 16-gauge brass or steel plate. The other ends are screwed to the case with 7 B.A. screws to keep them in the correct position while soldering.

The 1/16in. wire is soldered round the 3/16in. wires as in rear view photograph (Fig. 12). About five rounds should be enough, and start and finish wire at the bottom.

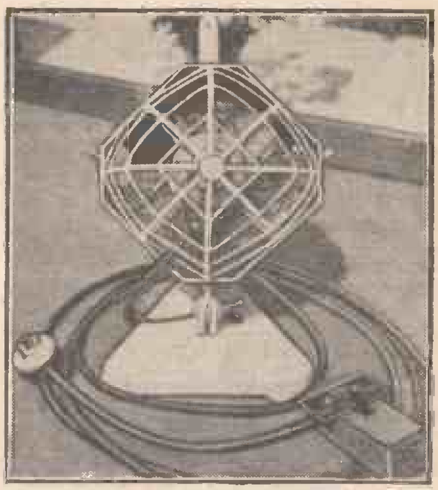


Fig. 12 (Right).—A rear view of the unit.

The Base Bracket

This can be made up as in Fig. 13. If electric or acetylene welding is not available at your local garage a little redesigning will be necessary.

The Base

This is made from softwood, ⅞in. thick, with ⅜in. thick feet, 2⅜in. in diameter. See Fig. 14 for details and dimensions.

Wiring

Carry this out very carefully as lives depend on it. Circuit details are shown in Fig. 15. The two wires from terminals C and E are 1/16in. diameter copper, insulated with insulating beads (obtainable from your electrical engineer). They go to one terminal on the switches, travelling along the bottom of the casing out of the way of the fan blades. The motor has a plug fitted to it and any 15-amp. insulated wire may be taken from the other terminals on the switches and joined to the plug, both to one terminal (live side). Take the insulation off another piece of 15-amp. wire for 4½in. and cover with insulation beads. Join this end to terminal D and the other end to negative terminal in the plug.

The trailing lead is of 15-amp. capacity (three core) and of length to suit. Join this to live, negative and earth on the motor plug. Next cut the wire about 9in. from the wall plug end, join in the thermostat, also obtainable from Technical Services Co., Model CS. The thermostat will be required to control a range of temperature between 50 and 90 deg. F.

You will need to make a cover for the front and ⅛in. plywood will serve, as can be

(Continued on foot of page 86)

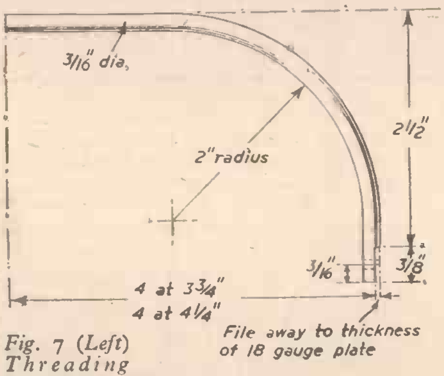


Fig. 11 (Left)—Bending the wire for the rear guard.

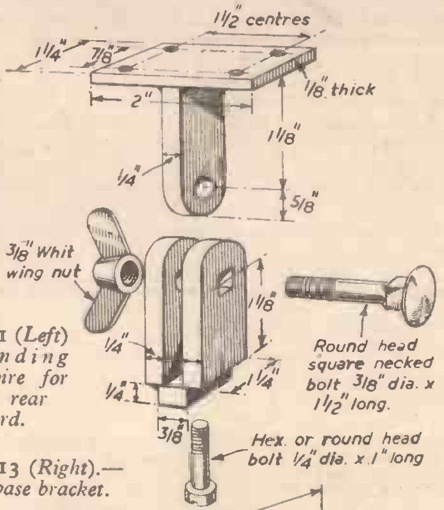


Fig. 13 (Right).—The base bracket.

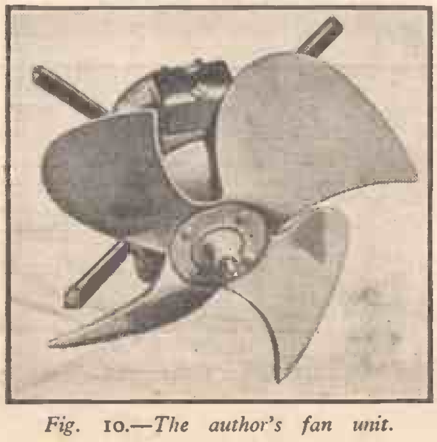


Fig. 10.—The author's fan unit.

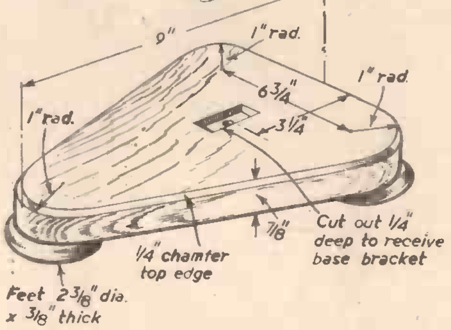


Fig. 14.—The base.

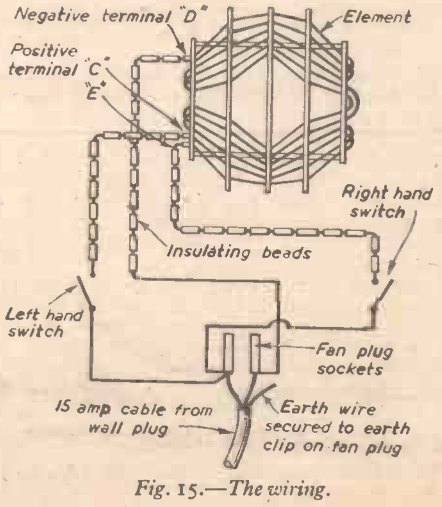


Fig. 15.—The wiring.

The Repair and Recovery of Old Wooden Boats

This Article Has Been Sent to Us By Messrs. Silver Dee Plastics in Response to a Query Published in Information Sought

THE reinforced plastics method of recovering boat hulls can be applied quickly, simply and economically by the home enthusiast or the workshop repairer and incorporates all of the advantages that have made the reinforced plastics boat hulls so popular. Old weakened wooden boat hulls can be repaired much more quickly and cheaply with glass reinforced plastic covering, and new wooden boats can be given years of additional wear by such a covering. Holes and minor injuries to the hull can be quickly repaired with similar materials. The coating is permanent and the monotonous recaulking, puttying and repainting jobs are avoided, particularly if a resin of the desired colour be used to finish the job.

The strength of the boat will be improved considerably by this glass fibre treatment and the danger of damage caused by floating debris considerably reduced. Speed will be increased by the treatment and barnacles and algae will not cling to the smooth bottom.

Tools and Equipment Required

The tools and equipment required for the recoating job are simple and are listed below:

Sand paper and sanding block or power sander.

Scraper, paint brush, squeegee.

Rolls of glass fibre cloth, polyester resin, catalyst and hardener.

Brushes should be rinsed in acetone between use in the resin.

Type of Boat Suitable for Covering

Any type of boat whether it be constructed of sheet plywood, moulded plywood or planks may be covered with resin impregnated fibrous glass. In fact, a canvas boat may be used as a mould for a complete boat by the same method if it is first made solid on the inside with clay or other filling.

Preparation of Boat Surface

Remove any metal fittings to permit a smooth continuous bonding surface. Next remove all paint from the surface of the hull by sanding or by means of a scraper. Paint removers, blow torch, or electric paint removers should not be used as an oily surface is produced which interferes with the resin bond.

Whilst sanding, examine critically for holes, cracks, depressions and dry rot. Remove dry rot and correct with plastic filler of the type Silver Dee R111/504 or plastic wood, and add additional screws where required. Sharp corners are preferably radiused, and oil, grease and dust must be removed before coating. Make sure all filler is rubbed down to the general contour of the boat.

The hull must be kept dry prior to the treatment.

Cutting the Glass Cloth

It is best to cut the cloth to fit the surface to be covered before catalysing the resin. Allow the cloth to overlap from 2in. to 6in.

To find the length of cloth required measure the boat from stern to bow along the gunwale. Allow 6in. to 12in. for overlap and multiply the total by 2. Measure from keel to gunwale at the widest point and allow some 2in. to 4in. overlap. This gives the width of fabric required.

Allow one layer of glass fibre for plywood hulls and two layers of cloth for planked type hulls.

As a guide a 12ft. boat requires 11yds. of 44in. glass cloth and two gallons of resin. A 14ft. boat requires 12yds. of 50in. glass cloth and two and a half gallons of resin.

Catalysing the Resin

Catalyst and accelerator should be added to the requisite amount of resin according to the particular resin used. Silver Dee Plastics supply convenient mixing instructions and performance tables for all of their resins. Only mix sufficient resin for immediate use.

Applying the Coating

Apply the prepared resin to the surface to be coated working into the wood by means of a brush. Allow the resin to "gel," at which stage it is very gummy to the touch and will hold the glass cloth in place. The time for this reaction will depend upon the amount of catalyst and accelerator added and the room temperature.

Next apply the tailored glass cloth to the surface of the "gelled" resin, carefully smoothing into position and removing wrinkles as you go. If two people are carrying out this operation the cloth can be carefully dropped on to the resin with the minimum of wrinkling. Pull out into position and staple, if necessary, to hold. Usually the resin will hold the cloth satisfactorily provided the cloth laying operation is not left too long. Cloth should preferably be applied to one side at a time. Complete the cloth lay-up process as quickly as practicable and then allow the resin to harden somewhat to anchor the glass into position. A squeegee may be used for the glass lay-up or the hands can be used, provided rubber gloves are worn, to remove wrinkles and air blisters.

When the glass cloth is securely held by the near hard resin a further coating of resin should be well worked into the glass covering. The base wood of the boat can be seen through the glass when it is properly impregnated with the resin.

An additional coating of glass can be added in a similar manner to the first if it is required.

Finishing

When the top coating of resin has hardened, cut away the excess material and very lightly surface the covered portion. Next apply a thick coating of resin which should be fairly heavily filled and coloured to the required shade. Alternatively the unfilled accelerated and catalysed resin may be applied and the boat finished with conventional paints.

A further alternative is to finish with one or two coats of catalysed epoxy resin paint available from Silver Dee Plastics. No accelerator is required for the catalysed epoxy resin paint, which provides a surface which is the equivalent of a stove enamel finish on metal.

Your boat is now completely impervious to worms and other organisms and will not rot.

Do not coat the boat with resin on both sides as the wood should be allowed to breathe.

Please note that the coating operation should not be carried out in damp weather, at temperatures lower than 21 deg. C. (70 deg. F.) and definitely not on damp wood.

Silver Dee Plastics, Hartington, Staveley, Chesterfield, Derbyshire.

MAKING AN ELECTRIC BLOWER HEATER (*Concluded from page* 85)

seen in photograph (Fig. 16). Join in the 9in. length of cable to the other end of thermostat and finally join on the 15-amp. plug.

Warning

This heater is used only on a 15-amp. circuit plug point.

When the heater is plugged in the fan will start. With one switch on 1,500 watts heat is provided; both switches on will give 3,000 watts heat.

Finishing

The whole body is painted inside and out with black heat-proof paint. The handle, rear guard and base are painted cream. (The cream paint is not heat resisting.) There is little choice in heat-resisting paints as only black and aluminium are made.

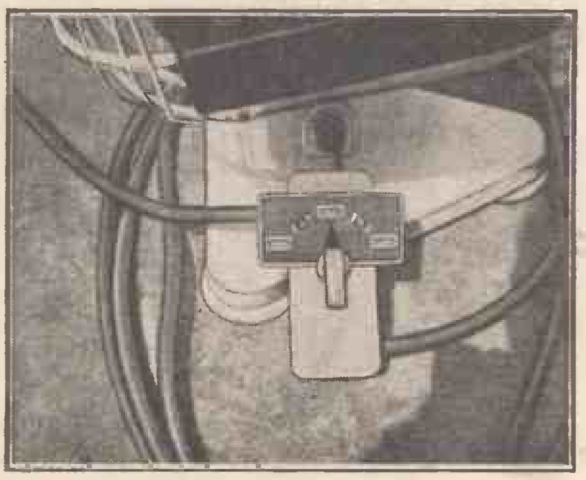


Fig. 16.—The thermostat.

For coolness in summer the fan only can be used.

Converting OLD CLOCKS

Useful Conversion Data for Giving a New Lease of Life to Abandoned Timepieces

By J. A. ROBERTS

(Concluded from page 17, October issue)

Fig. 7.—The author's full-second pendulum clock.

WITH a French clock, remove the pallets from their shaft without damaging it, mask the escape wheel by a disc fitted with a bush and setscrew located on the shaft, and arrange a friction detent. This can take the form of a spring pressing on the bush, clear, of course, of the setscrew, and mounted on a bracket in some convenient position. The bracket is provided with a tommy bar hole for adjusting purposes.

A feed arm and pawl assembly is arranged as in Fig. 9 which is rocked by the shaft, via the original crutch arm, the slotted foot of which embraces the pendulum rod as before. This selects and frees each tooth as the latter swings, and so turns the clock mechanism.

The diagrams are intended merely as a guide, as dimensions will depend on the movement used. The cruciform bar method can again be used, but the side arms may be shorter, as these movements are usually separated by about 2in. between the plates. Therefore, if these side arms are bolted to the rear plates they will be at least this much shorter. This is fortunate as, generally speaking, these movements are heavier than the Bulle, and might droop if the same length of side arm were used.

Though more work is involved in converting the French than the Bulle, more facility for correcting any error in the location of the crossbar is given as, though the same laws of feeding remain, it is easy to alter the length of the crutch arm or even make this fully adjustable. Fig. 9A shows that all gears, pinions and the mainspring, including, of course, the striking and chiming mechanism, if of this type, are stripped from the movement, only the main minute-hand shaft, the pallet shaft (now fitted with feed arm and pawl instead of pallets), and all gears and pinions connecting these two being retained.

The face, in this case, is bolted with separators to the outer movement plate, these separators being long enough to ensure that the face is free of the motion gear wheels, which assembly is replaced intact after any loose parts of the former striking and chiming assembly have been removed.

As there is some affinity between this method of converting a clock movement and that described in the February and March issues, particularly in respect of the detent and the direction of feed of the escape wheel, the said issues might with effect be referred to in this case.

Fig. 9B gives an elevation view of the detent and feed arrangements on an imaginary French clock movement; the length of the feed arm, and pawl, which may have to be curved in shape, are largely a matter of trial and error. It might be found convenient to mount the friction detent spring on to one of the three arms which usually separate the plates of these movements if one of them is near enough. This idea is shown in Fig. 9B.

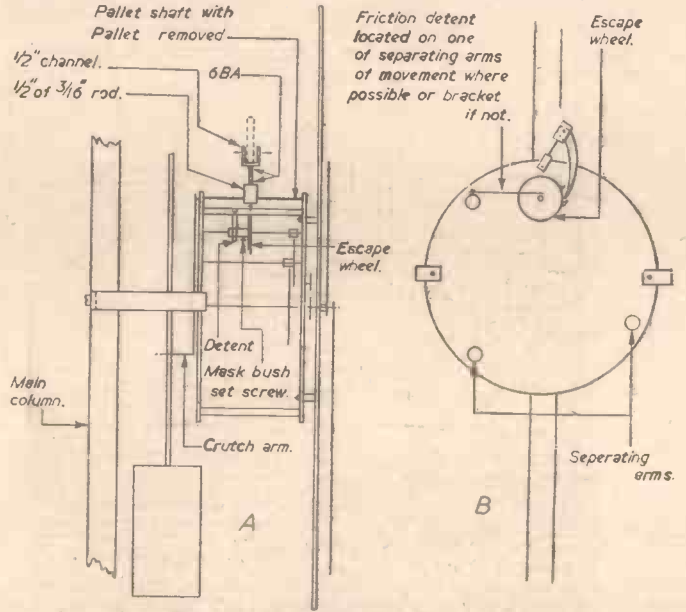


Fig. 9.—Mounting the movement.

The Power Unit

This will be familiar to readers of the earlier issues mentioned and so can be dealt with summarily. The layout, pictorially and theoretically, is the same, as are the values of the components and also their origin, and all are arranged on the base as shown in Fig. 10 and hidden under the pedestal cover. Only one battery is used, which all battery manufacturers make under various type numbers; it measures 4in. × 3in. × 1½in. approximately, with a 4½ volt rating.

This clock could run on batteries alone, particularly if a coil of higher resistance and with sufficient pull were used, as there is room under the pedestal cover for a number of them and two in parallel should run for a year, but where A.C. mains are available they may as well be used.

The pedestal cover is fitted with a trapdoor by means of which the batteries can be changed without disturbing the clock. The tapping point is useful for observing, by means of a milliammeter, the electrical performance and is plugged up by the plug shown during normal running. The original Bulle ran for two years or more on a battery one-third the size of the one specified, but it had a "feed-back" or regenerative circuit, the pendulum

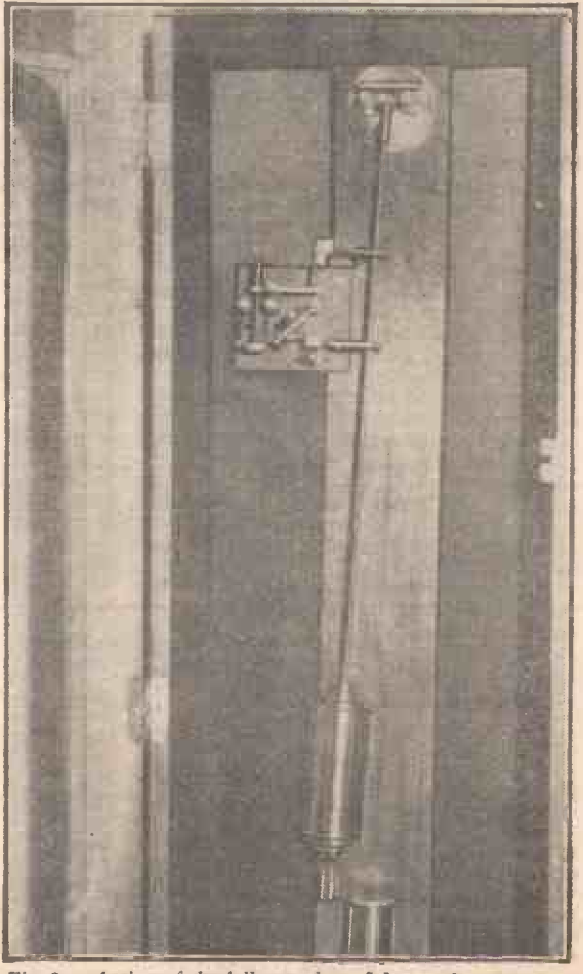


Fig. 8.—A view of the full-second pendulum and escapement

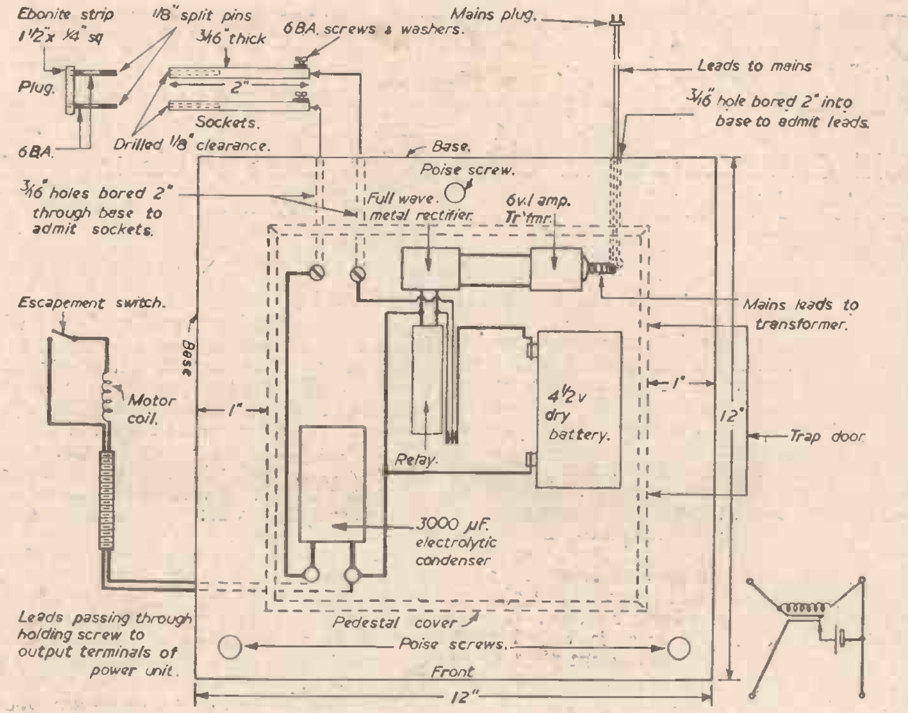


Fig. 10.—*The power unit.*

bob coil setting up a current in association with the permanent magnet over which it swung, this current being fed back in opposition to the battery current, the clock consuming only the difference, 5 milliamps. Unfortunately for the timekeeping capabilities of this system, this feedback principle, though ingenious, caused the pendulum bob/coil to swing for half of its distance under the influence of its own flux drag, which prevents the system and commercial applications thereof from ever being serious, accurate timekeepers.

Materials

No mention has yet been made of the metal used, this advisedly, as the work can be carried out in brass, copper or dural, according to choice, all finished parts being clear lacquered. Only the striker wheel and the horizontal bar of the bell crank switch, which should be case hardened with the aid of Kasenit, are of mild steel. The cabinet work can, of course, be finished in any colour, though black is recommended.

It might be found that, while running, clicks are heard on local radio sets if there is any tendency to sparking at the contact points. This might happen if a coil of too low a resistance is used, though the lower the resistance the greater will be the magnetic pull. The most economical and practical value of coil has, by trial and error, been found to be about 300 ohms.

Mechanical efficiency must be considered in the smallness of the gap and the amount of energy expended in closing it, the freedom (from play and stiffness) of pivots on trip head and bell crank switch, and the suggested refinement of a roller on the feed pin.

Resetting the Hands

A regrettable feature of this method of feed, i.e., direct from pendulum to main minute-hand shaft via, perhaps, three pairs of gear wheels and an escape wheel, is that the action of turning (resetting) the hands manually in either direction puts a load on to the escape or feed wheel. As the pendulum is connected mechanically therewith immediately this load is applied with pendulum swinging the latter will be dragged to a stop.

This occurrence will do no harm in the case of the French movement, where the drag will be "in track" with the pendulum, which will simply stop, some unwanted strain being applied to the feed arm pawl and its pivots. It is a different story in the case of the Bulle, where the drag will be "off track" by reason of the extended pin feed arm. This will cause the pendulum to twist in coming to a stop and damage to the slender feed arm(s), and possibly also to the pendulum suspension spring, will certainly be caused. This—and the rarely understood (by local clock repairers, at least) electrical circuit—have brought low most of the Bulles to the junk shops, from which many of them can now be rescued. The moral, therefore, in all this is simply *stop the pendulum before resetting the hands.*

A Full-second Pendulum Clock

This escapement is suitable for a full-second pendulum, and the dimensions given in Fig. 2 need not be greatly, if at all, enlarged. A movement from an old grandfather clock could be converted to "direct feed" as in Fig. 6, though a suitable backboard and cabinet would be required, or a movement modified as in Fig. 8 (March edition) could be used. The writer built such a clock some years ago and it is shown in the photographs, Figs. 7 and 8. However, as the "face at the bottom" design did not prove popular it was dismantled, most of the parts being incorporated in the free pendulum clock.

A "dropping switch" operated by the pendulum was used to switch on and off the movement, and as some readers might like to try it out a sketch of the slightly larger escapement with dropping switch and circuit is seen in Fig. 11. The escapement panel in this case measures 4in. × 3½in., and from this the dimensions of the escapement components can be judged, and these are not critical. The dropping switch itself is a 2in. length of brass (or other metal) strip ¼in. wide and ⅛in. thick drilled across its width by a fine drill, the shank of which can be used to form the pin upon which the switch pivots. This pin is fitted with a small head and is held in a similar manner to the bell crank lever already described, and the centre of the switch must be included in the centre line X. (See B in Fig. 11.) The movement itself is the identical one as described in the March issue, as is the advance/retard switch.

This gives us a master clock capable of driving a number of slaves, but if this facility is not desired and the face in the cabinet is the only one required to be driven the dropping switch could be eliminated entirely and the movement gears turned by a crutch and feed arrangement as described in Fig. 6, though, of course, larger, the movement being mounted on brackets or strips bolted to the backboard.

If the dropping switch is used an adjustable "finger" must be fitted to the pendulum rod as shown in Fig. 11D, by means of which the switch is pushed aside. The roller could be cut from a 3/16in. steel rod drilled to clear an ordinary household pin which is bent to the shape shown and soldered to the end of the piece of ⅛in. rod, this being first drilled transversely to admit same. This rod fits telescopically into a similar length of metal to that employed in supporting the trip head assembly.

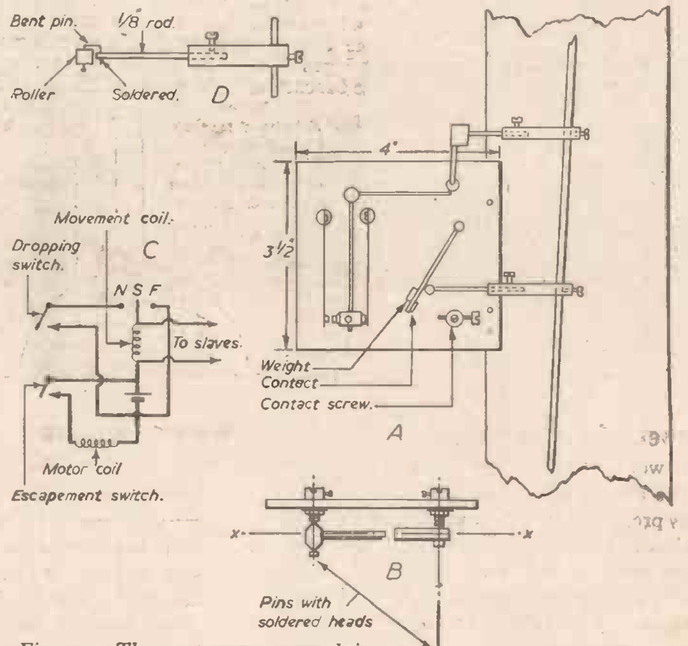


Fig. 11.—*The escapement as used in a ¾, 1 second or master clock.*

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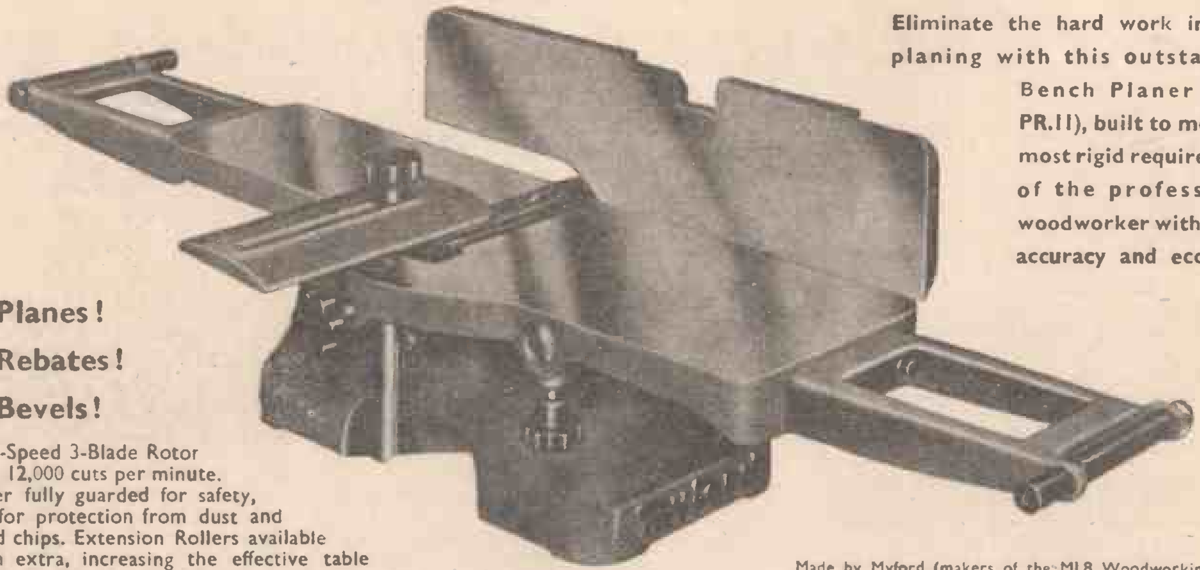

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An Enlarging Photometer

An Enlarging Accessory for the Amateur Photographer

By H. HUCKSTEP

Fig. 1.—The completed photometer.

A PHOTOMETER, in the sense in which the word is used in photography, is an apparatus with which to judge the exposures required in enlarging negatives, and since it actually measures the *density* of various zones of a negative, the word "densitometer" is probably a more apt one. Broadly speaking, however, the densitometer used in the dark-room is based on the principle of the old Bunsen photometer, which was used by Hurter and Driffield, in their famous pioneer researches into the sensitivity of photographic emulsions. Briefly, it consisted of a lamp-box with a means of varying the brilliance of the illumination against a scale, upon the top of which was a grease-spot on thin white paper. If the light which fell on the top of the grease-spot was brighter than that from the lamp, the grease-spot appeared dark against the paper, but if the reverse was the case—the lamp being brightest —then the grease-spot appeared as a bright dot on a darker background. Obviously then, by varying the brilliance of the lamp, a point would be reached when both it and the light from above became equal in strength, the grease-spot would apparently disappear entirely, and the position of the control lever would indicate the intensity of the incident light.

This enlarging photometer, shown in the photograph, Fig. 1, is a slightly improved version of Bunsen's device inasmuch as the grease-spot has been superseded by a comparator, in which the division between the translucent and opaque portions is sharply defined (as opposed to the blurred edge of a grease-spot), thus making for easy measurement. The means of light control is novel, too, as the iris diaphragm from an old camera shutter is employed in place of the usual rheostat or continuous density wedge, to perform this duty, thus doing away with certain drawbacks, and cutting down expense. Failing an old shutter, rotary stops could be used, or other similar devices to provide a progressive system of masking of the light.

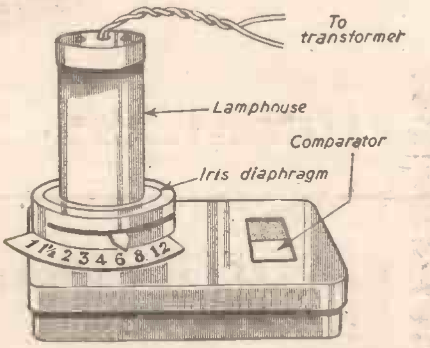


Fig. 2.—A general view of the photometer.

The lamp used is a 6-volt 0.45 amp. cycle dynamo bulb, run from the 5-volt tapping of a bell transformer, thus both increasing the life of the bulb, and providing a steady light which is little affected by mains fluctuations. It is screwed into a M.E.S. holder which is housed in a lamphouse formed from an old shaving-stick tin, which is soldered or cemented on the iris housing or shutter, see Figs. 2 and 3. The existing "stop markings" on the diaphragm body should be completely ignored, as they are not applicable under the conditions in present use, and the scale must be re-calibrated. The shutter body is attached, by its screw collar, to the lid of a shallow tin (such as is used for holding adhesive dressings), a hole being cut for the purpose. The whole of the inside of the tin is painted or lined with a *Matt* white surface, in order to diffuse the light within. The other square hole in the lid is to accommodate the comparator head.

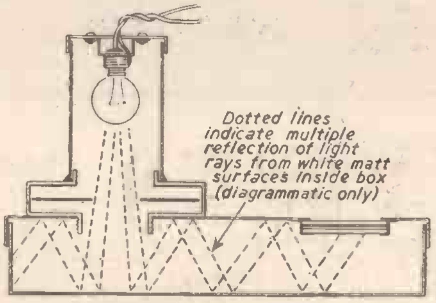


Fig. 3.—A sectional view.

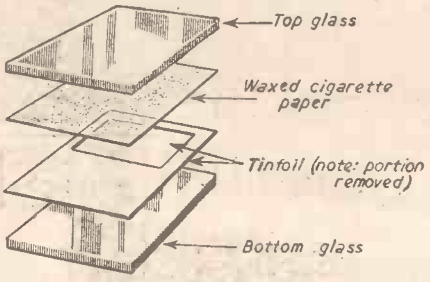


Fig. 4.—The order of assembly of the comparator.

The Comparator

A non-watermarked cigarette paper is very lightly rubbed with paraffin wax, which is then melted by gentle heat so as to leave the paper evenly translucent. There must be no excess wax; only sufficient to be completely absorbed by the paper. Next, the tinfoil mask is cut, and the whole assembled, as shown in Fig. 4, between two ½in. square pieces of thin glass or Perspex, preferably the former. It is edge-bound with gumstrip or Sellotape, and attached in place under the lid by means of surgical plaster. When viewed against a dark background, the completed comparator should appear as a square; one half dark, the other half (because of the tinfoil *beneath* this part of the paper) appearing light by comparison.

LIST OF MATERIALS

1 Small tin box for body.
1 Shaving-stick tin for lamphouse.
1 Shutter body from old camera.
1 6-volt 0.45 amp. cycle lamp bulb.
1 M.E.S. holder for bulb.
Bell wire.
2 Small pieces of thin glass.
Tinfoil, cigarette paper, adhesive plaster and gum strip.

Calibration

To calibrate the iris diaphragm scale, it is easiest to obtain a step-wedge of the type supplied with the Focal Enlarging Chart, or others can be obtained from Kodak or Ilford agents. The steps are portions of a film of differing density, the difference being about 50 per cent. each time. Each step is usually numbered, but the figures should be ignored.

Place the step-wedge in the enlarger carrier, switch on the light and adjust the lamphouse so that the magnification is about as low as it is likely to be used (say 1½ diameters). Place the photometer under the brightest step of the projected wedge, and adjust the photometer iris lever so that its diaphragm is wide open.

Now adjust the iris lever of the enlarger lens until the two halves of the comparator merge as one. From now on, do not touch the enlarger at all. All adjustments will henceforth be made with the photometer lever, until the scale is complete.

With the photometer lever wide open, mark the scale with a figure (1). Next move the comparator under the next brightest sector of the projected wedge, and readjust the photometer lever. Mark the scale 1½ (assuming that it is a wedge of the usual 50 per cent. increase type, which is easily ascertained), then repeat the process on each step, marking the scale 1, 1½, 2, 3, 4, 6 8, 12; 16, etc., as far as it will go.

Failing a step wedge, other methods of calibration can be used, such as the well-known method with a bare lamp (no reflector) in a dark room, in which circumstances the power of the light falls off as the square of distance. For example, at 6ft. the light will be a quarter as bright as at 3ft. distance. To halve the light, therefore, it need only be 1.4 times as far away ($\sqrt{2}$ approximately) as it originally was, and so on. This method is not as accurate as it sounds owing to the reflections inevitable from walls and ceiling, but it serves quite well. Again, a rough step-wedge could be made, using progressive thicknesses of cigarette paper, fogged film, etc.

Classifying Bromide Paper

Whichever method is used, it is necessary to ascertain next, the sensitivity and contrast range of one's bromide paper. This is not necessarily laborious, despite the very learned treatises which have been written on the subject. Merely choose one of your favourite negatives, and a packet of paper (let us say, Blank's Bromide, Normal) which is already known to be suited to it. Focus the negative in the enlarger, and measure the *lightest* portion which requires to show shadow detail in the print. Let us say that this produces a figure of $1\frac{1}{2}$. Now do the same with the *darkest* part of the negative, in which it is expected highlight detail to register, and this may read as 6. Find the square root of the product of these two figures, in other words, $6 \times 1\frac{1}{2} = 9$, and $\sqrt{9} = 3$, which is the final reading. Next, make a few test-strips and find the correct exposure in the usual way. Assume that this is 15 seconds. Paper speed is therefore 5, since $\frac{15}{3} = 5$—and all that is necessary in future is to multiply the final photometer figure by 5 to get the correct exposure when using Blank's Bromide, Normal, of this batch number. Other batches may be faster or slower, so a test of each supply is advisable. The test also showed that both the negative and the bromide paper possessed a contrast range of $\frac{6}{1\frac{1}{2}} = 4$ since both negative and print matched perfectly; therefore mark the box of Blank's Bromide Normal as follows: *Speed* 5, *Grade* 4 for future reference. All the other papers handled should be tested in the same way, of course, and care should be taken always to use one type of developer at the one temperature, and also that the photometer readings are taken in otherwise complete darkness.

The photographer who has read the very extensive literature on the subject may want to know why I have not mentioned the laborious job of grey-scaling of printing paper, with its attendant filing of samples, etc. The answer is that, by making the simple mental calculation described, we have virtually placed the tone range of our negative in the middle of the paper's zone of correct exposure. The usual method is to measure *either* the highlight *or* the shadow portion of the negative, depending upon a knowledge of the paper's grey-scale to accommodate the rest of the tones. The method I describe has another advantage. Whereas the usual, one-measurement system will give satisfactory results only with a perfectly matching paper, this present system automatically makes best use of whatever paper is available. The photometer, and the system of using it have been in use for many years, and can be recommended.

Making a Sawdust Heating Stove

This Design was Received, in Answer to a Query Published in "Information Sought," from N. G. CREWS

THE sizes can be amended to suit larger or smaller workshop, but the size described is for an average all-day burning stove for a fairly large workshop. It may seem large compared to the slow-combustion stoves burning coke, but the type of fuel necessitates a fairly large construction.

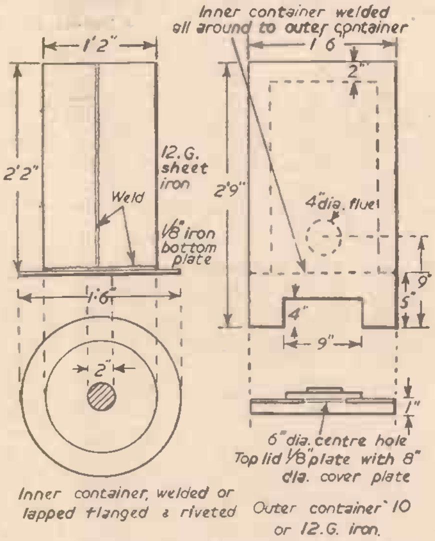


Fig. 1.—Forming the inner and outer containers

Construction

The outer container is rolled up from 10 or 12g iron and seam-welded or lapped and riveted. Air vent and flue outlets are cut out as shown in Fig. 1. The inner container is made in the same way, but instead of having an open bottom, a circular plate of ⅛in. iron with a 2in. hole in centre is welded on. This must be placed truly central so that a uniform space is maintained between the two containers when assembled. Next, slide the inner container into the outer from the bottom until the bottom plate is 5in. inside the outer container (Fig. 1). Maintain the annular space with four temporary wood packing pieces 2in. thick, and weld all around the bottom disc. Weld or rivet on the 4in. flue outlet elbow, which should be provided with a soot door (see Fig. 2).

The top is a ⅛in. iron plate 1ft. 6in. diameter with a 6in. diameter hole in the centre. Around the outer edge weld a strip of 1in. by ⅛in. iron, forming a lid. Two lifting handles and another 8in. by ⅛in. cover plate with lifting handle completes the job. A flue pipe at least 10ft. high should be fitted to the flue elbow.

The rammer and lighting hook are very easily made to the dimensions in Fig. 2. The stove should stand on a steel plate, underneath which should be asbestos if the workshop floor is wood.

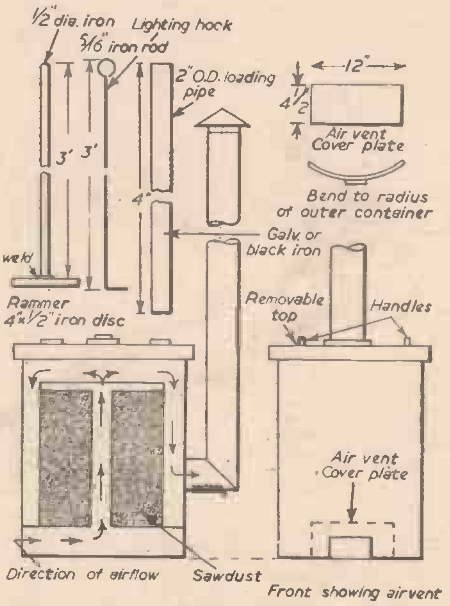


Fig. 2.—Two views of the stove and the accessories used.

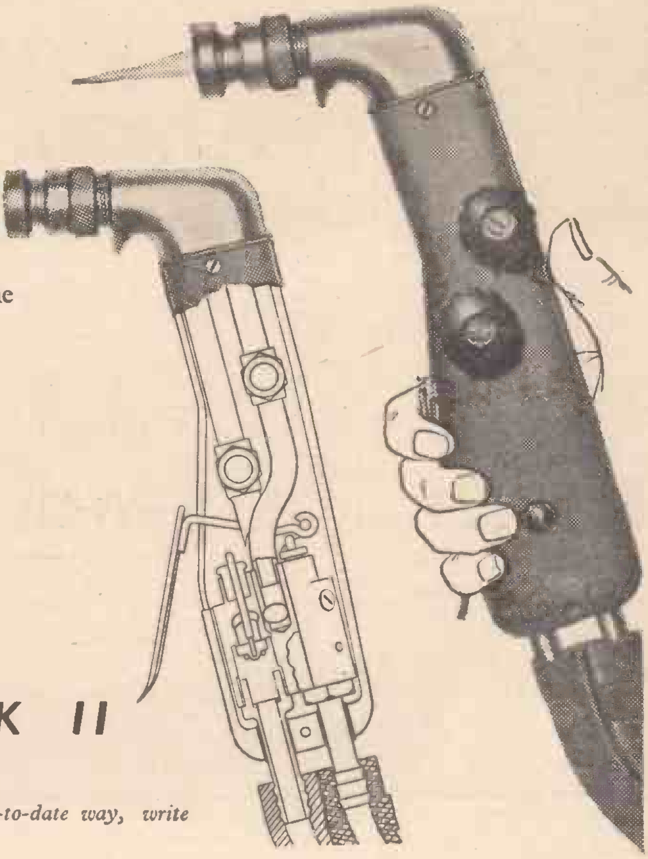
Method of Loading and Lighting

Loading: Remove top of container and lower loading pipe (made as in Fig. 2) through central hole until it touches the floor. One-quarter fill inner container with sawdust then, holding loading pipe centrally, ram the sawdust firmly with rammer. Add more sawdust and repeat ramming operation until container is full. Withdraw loading pipe with a twisting motion and verify that the wall of the hole has not collapsed at any point and blocked the airway. The loaded stove and airway may be seen in Fig. 2.

Lighting: It is necessary thoroughly to heat the flue pipe and create a draught to start the fire, and this is done as follows. Dip a fairly large piece of waste or rag in paraffin and place on lighting hook. Light and lower waste with hook until it reaches the flue pipe. Flames should immediately be drawn up the pipe. Withdraw hook, leaving the rag burning in the container. Next, prepare another paraffin-soaked lighter and place on floorplate near air vent. As the flue heater begins to die, light the second one and push it under air vent until flames are seen arising from the hole in the sawdust at top of container. Replace top lid and leave air vent plate off until fire is well alight. Draught adjustment is provided by aperture size in air vent, this being controlled by air vent cover plate.

The sawdust will burn with an intense smokeless flame, the central hole getting larger and larger as the fuel is consumed.

It is *most important* that the fire be left undisturbed, as its success depends on the central airflow being maintained. It is impossible to replenish the fuel, it being necessary to start from scratch when the container is exhausted. By careful adjustment of airflow, the size of stove described will burn for approximately eight to nine hours on one filling.



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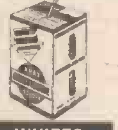

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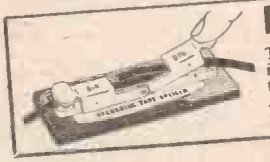

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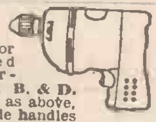

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THE O·GAUGE Model Railway

Coaches & Rolling Stock

Details for Making the Coaches and Wagons for the "O" Gauge Layout Described in our May, June, August and September Issues

By E. W. TWINING

LET us take passenger cars first. These are of the well-known corridor pattern with vestibule couplers at the ends. Should any reader wish to make a saloon type he can do so, but the seats, for one passenger only, will have to be brought out to the side of the coach, leaving a gangway down the centre, the corridor partition being omitted. He must remember, however, that the seat ends, next to and on both sides of the gangway, will be seen through the windows and must be given a nice finish if not an ornamental one. Obviously, too, the seats will have to be carved completely in one piece of mahogany, since there is no cross-partition between each pair of back-to-back seats, as there is in compartment coaches. As an alternative to making seats from one piece of wood for saloon cars, they can be built up in, say, pine and mahogany plywood cut out for the ends and glued to the pine.

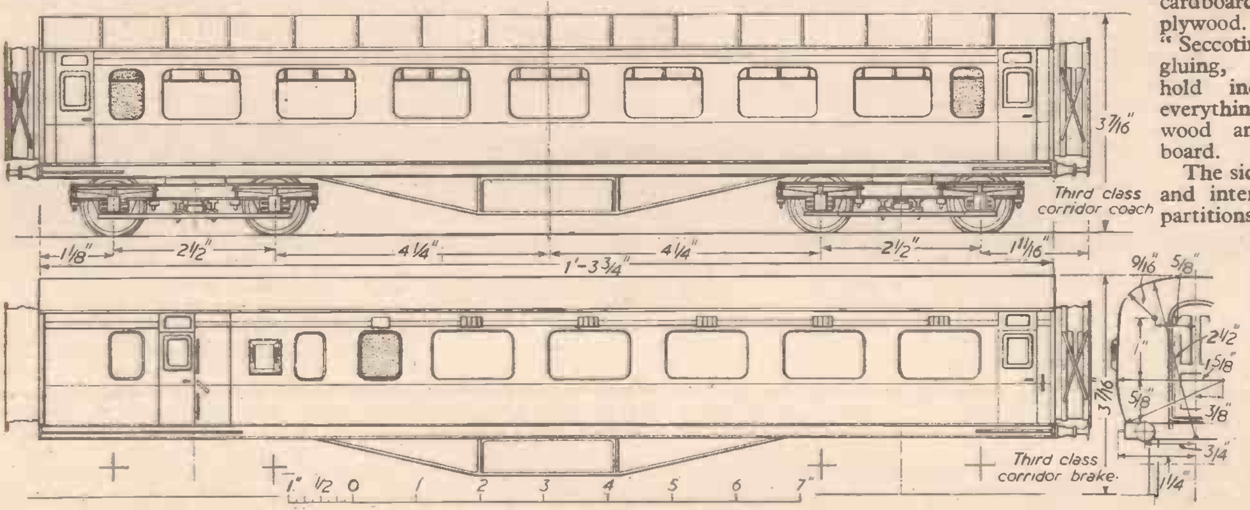


Fig. 1.—Elevations of third-class corridor coaches.

Constructional Details of Coaches

Fig. 1 shows the exteriors of third-class corridor coaches: an ordinary coach to carry passengers only and a third-class brake respectively, both with lavatory compartments. Obviously no fittings will need to be put into these last, since they will not be seen through the windows, which will be obscured.

Commencing from the rails and working upwards it is suggested that the reader buys his bogies completely finished and ready to put on to the foundation, or bottom panel, of each coach. The complete pair of bogies, numbered 616/0, which are shown in Fig. 1, are, according to the catalogue of Bassett-Lowke, Ltd., quite reasonable from the point of view of the labour which would be saved by buying. The bogie is as regards dimensions and appearance exactly as drawn.

The frames, axleboxes, springs, etc., are all die-cast in full and high relief; the axleboxes in anti-friction metal. The frames are attached to the cross-stretchers in such a way that all four wheels carry their due share of the weight of the coach; that is to say, the side frames are so compensated that the bogie will accommodate itself to inequalities in the track, should there be any, at, say, points and crossovers. The wheels are of iron on steel axles and are cast to resemble the Mansell pattern. A detachable steel bolster is included, which is attached to the underside of the coach by four screws. There is a much simplified bogie, No. 611/0 (which has a shorter wheel-base), in Bassett-Lowke's catalogue, but this, at only about half the price, is not suitable for a coach of correct appearance.

It might be worth the reader's while to make his own dies and cast the frames, springs, axleboxes and other details if he were making a couple of dozen or more coaches, but for less than that number it would be too long and complicated a job.

In Fig. 3 are shown bogie frames with wooden cross-stretchers and a wooden bolster, but if you do buy your bogies ready to apply to the bodies this will not be needed, for Bassett-Lowke's bogies are wholly of steel between the cast frames. The first item to be constructed, therefore, is the base board, which is equivalent to the solebars in a full-sized coach. For this a 3/16in. piece of plywood will be required, cut to the dimensions which can be scaled up from the drawings. To the bottom and to the top of this glue on a piece of fairly thick Bristol board, in order to reproduce the flanges on either side. Down on to the upper surface of this every part of the superstructure must be glued and a perfect joint must be made between the cardboard and the plywood. I advocate "Seccotine" for this gluing, which will hold indefinitely to everything, including wood and Bristol board.

The sides, ends, roof and intercompartment partitions, also the corridor sides, will all be made of Bristol board; the sides will each be made of three thicknesses and the roof and ends of two thicknesses each, whilst the partitions and corridor side are of one thickness. For all parts except the roof the thickness can be of about 3/64in. The two roof pieces can either be thicker or can be made of the same, but using three thicknesses, for you may find difficulty in bending the board to the comparatively sharp radius on either side; if you do I should adopt a thinner board, using a greater number of thicknesses, say three or four, to bring it up to the same as the sides. It would be as well to make a box-jig to hold the laminations of the roof whilst gluing, as drawn in Fig. 2.

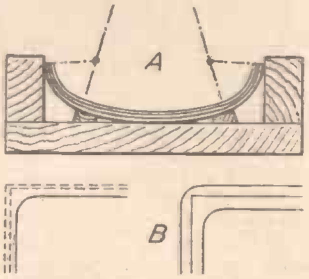


Fig. 2.—Jig for forming the roof and details of the window corners.

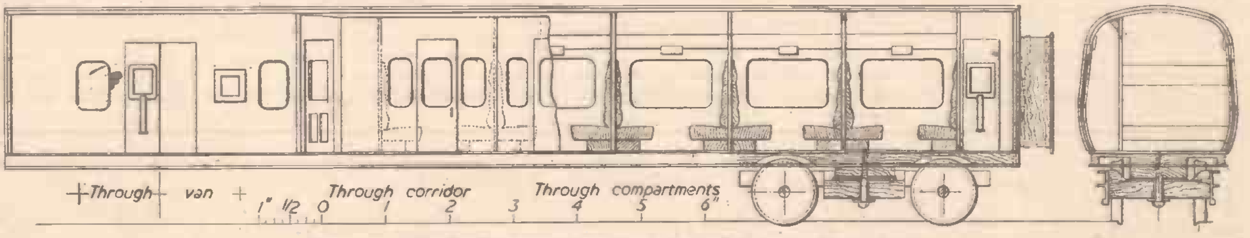


Fig. 3.—A longitudinal section through the third-class corridor brake.

Making the Roof

In this jig form the roof in an upside-down position. Bend the first Bristol board with the sharp curves around a roller, a ruler or a piece of round dowel wood of a little smaller radius than is needed; then, with the roller, put in the large radius bend, from one small radius to the other. Insert the Bristol board into the jig, bend the next piece in the same way; then glue the inside of the piece in the jig and the outer surface of piece No. 2, spreading the glue over the whole of each surface, and insert No. 2 into No. 1, pressing down well into position and making sure that contact is made over the whole joint. If there is a third piece do that the same, and likewise if there should be a fourth. In building up this roof, whatever thickness the Bristol board is, the thing to remember is that the total must be made to equal that of the sides because, when the jointing strap is in, the curve of the roof must come flush with the outsides of the two sides of the body. These sides are composed of three pieces of Bristol board. Bristol board is advocated because of its hardness. It is far stiffer and more rigid than any ordinary cardboard.

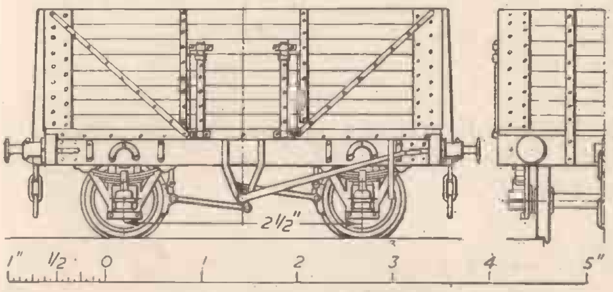


Fig. 4.—An open wagon.

The Windows

Now we will take the sides in hand. Each of these will be made up of three pieces of Bristol board and all of them will have openings for windows. For these windows the innermost and the outermost, on each side of the coach, will have openings of the sizes and shapes shown in the drawings, but the middle piece will have exactly similar positions for the windows, but the openings will be one-eighth of an inch larger, all round, and can be cut square at the corners as shown in Fig. 2B. Then for glazing use either sheet Perspex or celluloid of any convenient thickness so long as it is the same, or a little thinner than, the Bristol board. Celluloid will be the easier material to cut, because it can be done with a sharp, pointed knife on a board, cutting it, like the Bristol board, into strips and afterwards cross-cutting with the aid of a square.

Perspex, however, will have to be sawn or cut with a pair of tinman's snips: it is too hard to cut with a knife. If your sawing or shearing is not accurate you may pack all the pieces together and file them to size. However you do them make them of such a size that they will pass freely into the openings intended to receive them in the middle card and not show their edges in the inner or outer openings.

In the third-class corridor brake there are several more windows, but in both coaches there are windows to lavatories. These will have to be painted over very thinly with a film of grey paint. Matt celluloid can be obtained, which will be better for this if you can obtain the small quantity which will be needed.

The coach ends will be of obvious construction and these must be assembled on the base of the coach body at the same time as the sides. Each end will be of such differing sized cards as will enable the two, the sides and the ends, to meet with a zig-zag joint; in other words to rebate into each other. This will also apply to the ends and the roof, so cut the cardboard accordingly. In making all the corner joints it will be well to increase the strength with an additional angle of Bristol board added on the inside. This will apply particularly to the sides and to the ends where they join the floor and where the sides are joined to the ends.

Partitions and Seats

Next put in all the compartment partitions and against these glue all the parts of the seats. These seats and the upholstered backs of them can be formed from whatever material is preferred. In Fig. 3 they are shown wholly of wood and the advantage of wood is that it can be planed in long strips, then cross-cut with a fine-toothed saw to lengths.

It would be possible to make them of thin cardboard or paper, but in this case the shapes and the undulations of the backs may not be all alike.

Before the seats are fixed in position they may be finished, either with dead flat oil colour or poster water colour or, best of all, by flocking. This flock is powdered cloth and it can be bought in many colours. The surface of the seat and "upholstery" is shellac varnished, then given a coat of enamel paint of the appropriate colour and, whilst the last is still tacky, the flock is powdered or sprinkled on. Leave it for about four to six hours to dry and then shake off or dust off with a soft brush the superfluous flock which has not adhered to the enamel. If the job is properly done the effect will be that of a very fine cloth material and will appear to be to scale. The seats and all parts can then be glued in their places.

The Corridor Partition

You can now cut from a single piece of thick Bristol board the corridor partition. In the corridor-brake this will have an angle turned vertically in it next to the brake van and the angular piece will contain a door leading to a lavatory. On the opposite side of this lavatory to the corridor there will be a window of obscured or muffled celluloid. Now how much work is put into the corridor partition is a matter for the reader to decide. All that I would do would be to cut the window and door openings. I would not fill them with celluloid, for if you do you will have to provide at least two thicknesses of card and "glaze" with cellophane tissue, and the glazing, or the absence of it, will not be visible through the outer windows. Finish the interior, including the partition, by painting with oil colour. The correct colours to buy, in tubes, for this will depend upon what you are imitating. If it is a dark wood give it first a coat of raw umber with a little white added to it; if it is oak, paint with yellow ochre. Actually these will do for foundation colours. For finishing use, for teak or walnut, a thin glazing colour of raw or burnt umber. For mahogany, a mixture of burnt sienna with a little alizarin crimson, and for oak a little raw umber in Roman ochre.

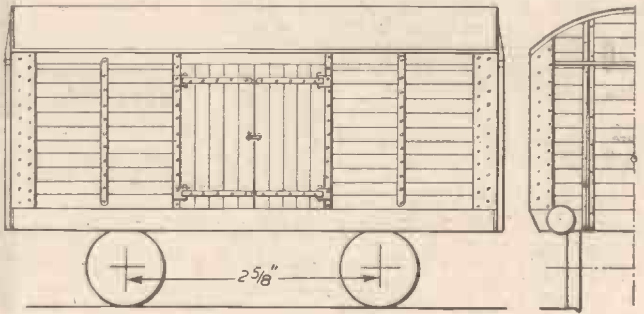


Fig. 5.—A covered wagon.

These glazing coats must be thin enough to just cover the ground colour; they are to be thinned by mixing them with Japan goldsize and applied with a hoghair brush (an artist's brush).

The inside of the roof may be painted with flat white oil colour, and when this is dry it should be put on by gluing all around the rebate strips and making the butt joints between the sides and ends with the roof with Seccotine.

The vestibule couplers are the only things to add to the body to finish it. These couplers may be hollow, be made of Bristol board and have a door painted or modelled on the coach-end; or they can be solid, made of wood and have a simple plain Bristol board outer face. I think wood is sufficiently elaborate because when they are coupled up only the outsides are visible and when they are uncoupled all that is seen will be represented by the piece of cardboard.

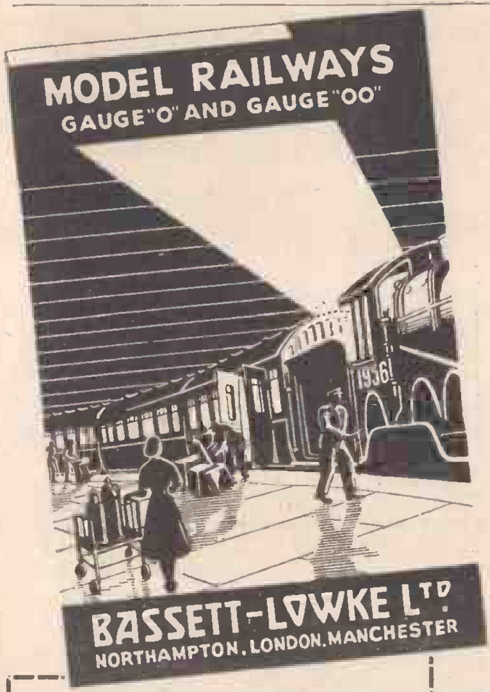
There will be buffers and couplings to add to the solebars (baseboard) at each end, and then the exterior may be painted. The British Railways colours are well known and may be copied by mixing tubes of oil paints. The colour below the waistline is crimson and there is a band of this above the windows. This may be got by mixing Indian red and alizarin crimson with a mere trace of white in it. Above the waist and up to the upper crimson band is deep cream colour made by a mixture of yellow ochre with white. Below the bodywork, i.e., the solebars, buffers, bogies, etc., everything is black. This includes the vestibule couplers.

First-class coaches are, as regards these small models, exactly the same as thirds, but they have more room in each compartment and in the lavatories. There will be six windows in each side instead of seven. The windows and their widths are the same but there are greater spaces between the glasses. That, with the class number on the door, is the only difference that it is worth while making between first class and third class.

Restaurant and dining cars should have no corridor, but be made as saloons with double seats down one side and single on the other side of a gangway. At each window there should be a table and the top of this may be painted dead or flat white. Then, on this white representation of table cloths may be stuck such miniatures as the modeller inclines to make.

Open Wagons

With regard to other rolling stock, everything may be made of wood, except the roofs which, because they have to be bent to curvatures, should be of Bristol board, just like the roofs of the passenger cars. But we will deal with open wagons of eight tons, 10 tons and 12 tons first. Fig. 4 shows a standard 10-ton wagon of British standard pattern. This is made entirely of wood with the exception of the running gear, the buffers, coupling chains and the straps and hinges,



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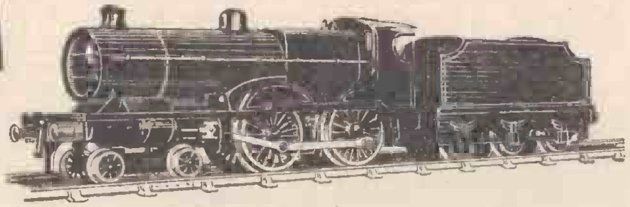

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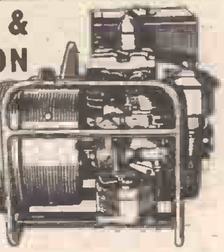

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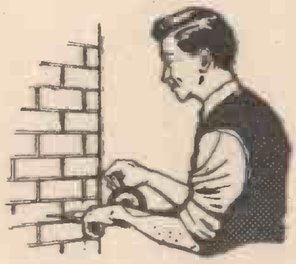

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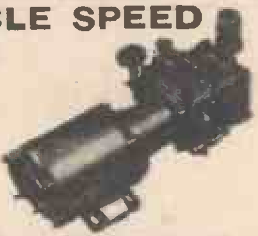

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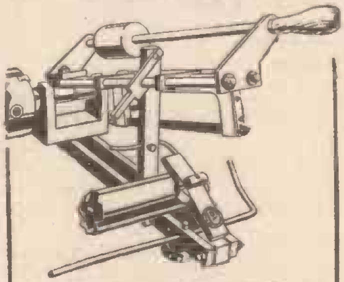

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on the body. The running gear is easily dealt with. It consists of, in the main, parts which can be bought in die-cast form from Bassett-Lowke, Ltd. Axle guards, No. A8 in their catalogue, are die-cast and are perfect representations of the full-sized parts. Four will be required for each wagon and these should be drilled to receive the shouldered ends of steel axles having cast iron wheels, which may be turned either 13/16in. or ⅞in. in diameter. The hand-brake gear which I have drawn is usually omitted on models, but it ought to be added if wagons are desired which will be complete in appearance. The brake blocks can be either die-cast or filed up from bits of brass. All the rest of the brake gear can be cut from wire and strip and soldered together for there is no need for any of it to actually work. The axle guards can be either pinned or screwed to the insides of the solebars. These solebars are glued up to the buffer beams to form simple rectangular frames and then a thin floorboard is added which will stiffen the frame. The top of the floor of the wagon will be wider than the solebar frame and will extend to the full width of the body. It may be recognised in the drawing by its having the hinges of the doors pivoted upon it. Then the four sides of the wagon are fitted and glued down upon the floor. The sides should overlap the ends and be both glued and pinned together. The ends are strengthened by having ⅛in. thick strips, glued and pinned and extending from the tops to the lower edge of the buffer beams. These should taper, in side elevation, from ⅛in. wide at the bottoms to 1/16in. at the tops.

The strapwork will all be drawn and inked in on Bristol board of much thinner gauge than was used for the coach bodies. Actually it is a very thick, hard paper that is wanted and a good cartridge paper will do. Having drawn every detail, take a darning needle, a good stout pin or a compass centre and, using the point of the implement, go over all the paper and prick through where the bolts or the boltheads come. This pricking had better be done upon a soft-wood drawing board, or a piece of good, hard strawboard, or some similar surface. When all the boltheads have been indicated turn the paper over and carefully cut every part out, doing the cutting with a sharply-pointed knife and preferably cutting downward upon glass.

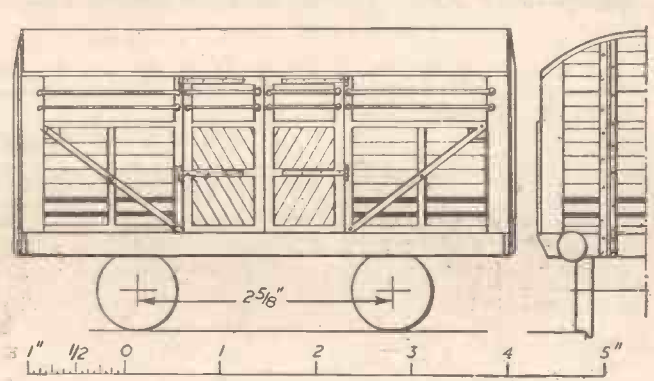

Fig. 6.—A cattle van.

I should have pointed out that it would be a good plan to score all the wood which is to be used for making open and closed wagon sides and ends with a joiner's scratch gauge. This will have to be very carefully done with a point which is set on an oilstone, so that it will actually cut, or score, a groove as would a pointed chisel or a graver. But it must be a tiny point and have very little projection beyond the wooden part of the gauge. In using the gauge be very careful to prevent its following the vagaries of the direction of the grain of the wood.

Having cut out all the strapwork glue it on to the body of the truck, spreading the glue evenly along each strip and not putting so much on that it will squeeze the surplus out at the sides. It would really be as well to apply the glue with a brush. When all is dry the model may be painted with two coats of flat lead colour, with everything below and including the solebars a glossy black. All the strapwork on the body will also be picked out in black. Lettering on the bodywork of wagons and vans must be done in white, with the exception of some private-owner wagons, and the reader should copy from the original both as regards the colour of the ground and of the lettering in these cases.

A Covered Van

Fig. 5 represents one form of covered van having double-hinged doors. A common variation of this is found in which the central portion slides to the right on rails and rollers. But this occupies a greater width in the vehicle since the sliding doors have, of necessity, to stand clear of the sides in order to be able to slide. In making this model I recommend that each side of the body be made up of three pieces so as to get the grain of the wood and the planks in the doors in a vertical direction. The joins between can be strengthened by lapped pieces glued to the inside. The top edges will have to be chamfered to receive the roof. This roof will be made of two or more pieces of Bristol board. If more than two are used, and it would be wise to add a good thick one, it will be of such a size as will come down inside of the van both at the sides and ends, so as to form a good rebate for gluing. The strapwork will be added as in the open wagon.

A Cattle Van

Fig. 6 is a model which will require a little more work in the making. It is a cattle van. For the relief work most of it is in wood and veneer would be good to use for this. Choose a thick veneer which will be uniform in thickness. The whole of each side is actually framed up and panelled with boards and there are two slits along the front and back of each side. The upper third portion of each side is open and there are two rails which are there to prevent cattle from putting their heads outside. Fortunately there are no openings in the ends so we have a solid structure to take the roof, which can be stiffened by an extra piece as was the covered van. Before the roof is fixed the interior must be painted flat white. For the roof give it flat white, both inside and outside. The rest of the body exterior will be lead colour.

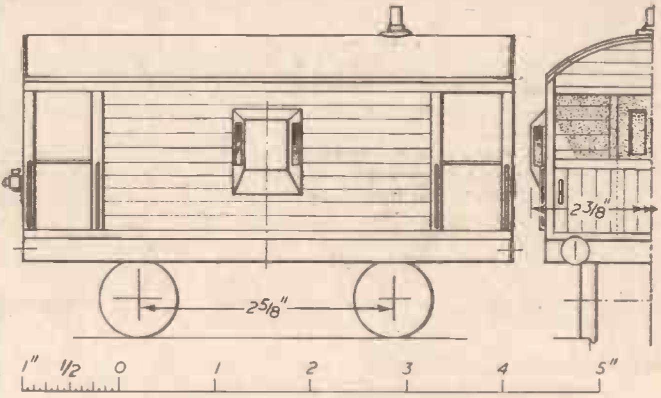

Fig. 7.—A goods brake van.

A Goods Brake Van

The last drawing, Fig. 7, is that of an ordinary goods brake van. The construction of the body of this will not be so difficult as the cattle truck, but the roof had better be stiffened with two pieces of deal running across under the ends and extending from the inner body to the two end pieces of Bristol board. The van contains a stove for heating in cold weather and obviously there is a flue from this. The vent is either a bit of copper tubing inserted through rings of Bristol board into the roof or the whole turned from a bit of boxwood and stuck on to the roof. The guard's look-out windows are made by little bits of celluloid, or strips of cellophane tissue, stuck on the insides of boxes of Bristol board shaped to have tapering sides and these boxes are glued to the sides of the van. There are vertical handrails at each side of the four entrances which can be made from tinned iron or tinned copper wire. These have their ends turned over and can be inserted into holes in the wood with a touch of glue. The horizontal, round guard rails should be fixed like the vertical ones.

Making Still Projectors

Some Pointers for Those Proposing to Build One of These Devices

By F. G. RAYER

A USEFUL lantern or projector can be made up without great difficulty, and results may compare favourably with those of expensive, ready-made units. The equipment may be made in a range of sizes, according to the purpose in view, from the small "toy" projectors, which may be operated from a dry battery, to the large, powerful, mains-type projector.

When such a unit is in view, some doubts may exist about the best or most suitable form of lighting and the lens arrangement. Once the requirements in this direction are understood the building is straightforward, as the actual kind or size of lantern body is of no great importance. It may be of wood or sheet metal, the latter being best with powerful lamps in view of the heat generated.

The projector may be made up to suit the type of film or plate in view. If a 35 mm. camera is available, this offers one of the cheapest ways of obtaining colour transparencies of any desired subjects, which are very effective when projected. Black and white transparencies are also feasible, of course, and lantern plates are readily available. These are printed by contact from the negatives, exactly as with paper contact prints, or may be made with an enlarger, so that the plate area can be filled with any chosen section of the original negative. Here 2in. × 2in. is a popular size. It is also possible to buy film strips and plates of various subjects, and these help to make up the collection.

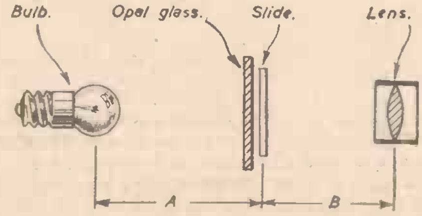

Fig. 1.—Lighting and lens for simple projector.

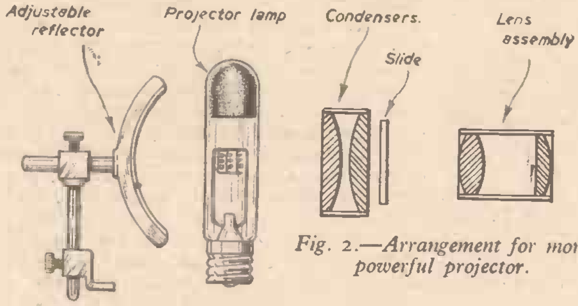

Fig. 2.—Arrangement for more powerful projector.

Simplest Projector

The simplest type of "toy" projector consists of a body housing bulb, slide, and lens only, situated as shown in Fig. 1. The lens may be a simple magnifying type, such as can be purchased very cheaply. For 35 mm. and 2in. × 2in. slides, a lens with a focal length of about 4in. is usual. If the focal length of a lens is not known, it may be found by focusing the image of the sun upon a sheet of paper and measuring distance between lens and paper. If the focal length is much less than 4in., the lens will not cover the corners of the slide, which will be very blurred, or absent altogether, on the screen. With a longer focal length, it will be necessary to have the projector farther from the screen to obtain a given size of picture, and this may be inconvenient in small rooms.

The distance "B" in Fig. 1 will require to be slightly over the focal length of the lens, and should be adjustable. This can be arranged by fitting the lens in a tube, which is a sliding fit in a second tube secured to the projector body. With a given lens, distance "B" has to be increased as the screen is brought nearer the projector. The correct distance is that giving the sharpest image on the screen and is found by trial.

Distance "A," between bulb and slide, is also best found by experiment. When the bulb is very near the slide, illumination is at its best, but will be greater in the centre of the picture than at the edges. As the distance is increased, the picture brightness falls, but becomes more even. The final position is thus a compromise.

The bulb may be of any type, preferably opal to give even illumination. A piece of opal glass may be fitted behind the slide, and will even out the illumination over the picture area. For a simple but more ambitious projector, a large-wattage mains bulb can be used, and this will give a much brighter picture.

Lens Aperture

Before considering larger projectors, the effect of the lens aperture (or diameter) should be borne in mind. Lenses of large diameter pass more light and thus give a brighter picture with a given lamp. Lens apertures are expressed as an f-number. This is the focal length of the lens divided by its diameter. For example, a lens of 4in. focal length and ½in. diameter would be an f8 lens. Similarly, a 4in., ¼in. diameter lens would be f16.

Every time the f-number of a lens is *doubled*, the light passed through is *divided by four*. The f16 lens would thus only pass one-quarter the light of the f8 lens, giving a picture of only one-quarter the brilliance. It will thus be seen that lenses of very small diameter are of very little use.

Proper projector lenses are seldom of smaller aperture than f4 (e.g., 1in. in diameter for 4in. focal length). This would pass four times as much light as the f8 lens, or 16 times that of the f16 lens. In high-class projectors f2.8 lenses are usual, and pass about eight times the light of the f8 lens. Lenses of this kind are helpful in obtaining brilliant pictures, but are by no means essential. The influence of lens-diameter should not be overlooked, however.

Picture Size

Secondly, the size of the picture on the screen bears a direct relationship to its brightness. If the projector is moved farther from the screen, for example, to obtain a

(*Concluded on page 103.*)

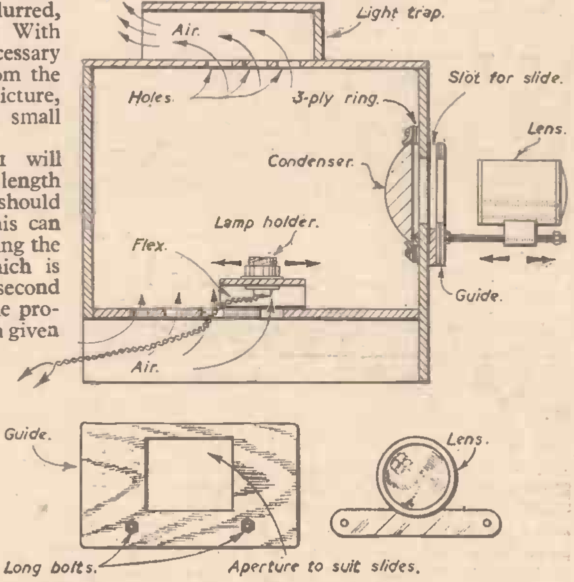

Fig. 3.—Simple form of body construction.

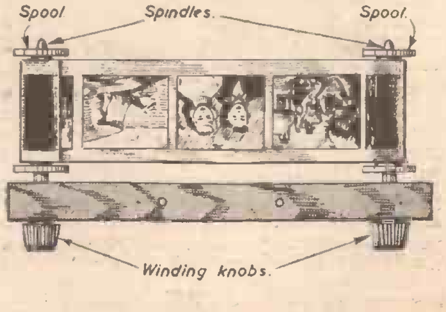

Fig. 4.—Holder for uncut film.

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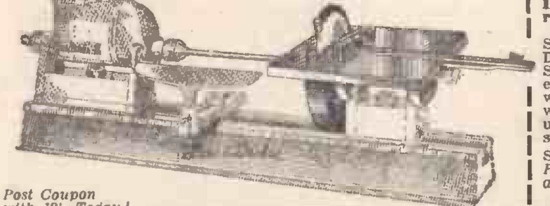

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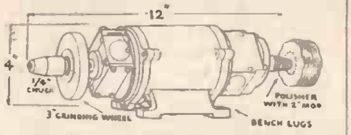

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picture twice as wide, it will also be twice as high and thus have four times its original area. As a result, the picture will fall to one-quarter of its original brilliance.

This means that small lanterns may give perfectly satisfactory pictures of moderate size, but are useless for large screens. It also explains why such powerful lighting is required when a large screen is used.

So long as this is not overlooked, the size of the screen depends on personal choice. If a proper screen is not used, the surface employed should be white and of a reflective nature. A linen or similar sheet, sometimes used, is very poor. Glossy white paper is better if a proper screen is not to be purchased.

Increasing Illumination

In addition to lens aperture, and the type of screen and its distance, the picture brightness depends on the strength of the illumination. This can be increased by using a more powerful lamp, or by employing an improved optical system.

Fig. 2 shows the system of a typical high-class projector. The reflector is usually of chromium plated copper, and reflects light back towards the slide. For illumination, a 250-watt lamp is usually large enough, for domestic purposes, but lamps of 500 and 1,000 watts are employed, the latter usually with blower cooling to maintain air circulation. These larger lamps are more suitable for halls, or circumstances requiring a very large picture, and need not be considered for home use.

The light from the lamp, and that thrown by the reflector, is concentrated by the condenser lenses. These, with reflectors and suitable lamps, may be purchased from photographic dealers and postal suppliers. Distance between condensers, lamp, and reflector is adjusted to give maximum brightness on the screen. A single condenser lens may be suitable; this depends on its curvature. If it is to be purchased especially for this purpose, it may be of similar, or slightly shorter, focal length to that of the projector lens. Its diameter should be such that it will cover the corners of the slides. Its flat side is positioned against the slide. In very large projectors, a piece of heat-resistant glass may be interposed between condenser and slide, to avoid undue heating of the latter.

The condenser and reflector will considerably increase illumination. There is no reason why a simple reflector should not be used in Fig. 1 for this purpose. A car or cycle-lamp reflector could be used. When reflector and condenser are correctly positioned an intensely brilliant spot of light will be thrown just in the position the projector lens would occupy.

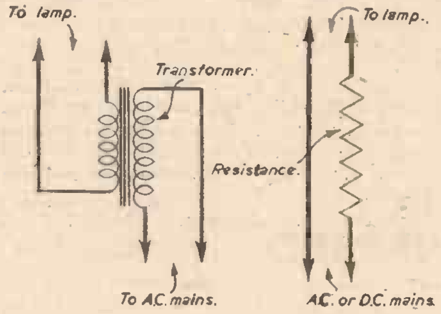


Fig. 5.—Circuit for low voltage projection lamps.

Construction

A straighforward projector body is shown in Fig. 3. Air can enter the lantern at the back, pass up through holes in bottom and top, and emerge from the back of the light trap. Free air circulation is very necessary, especially when using lamps of large wattage. Back or top may be hinged, to permit of attention to the lamp.

The guide, with aperture, may be of wood. An open space may be left between guide and lens, as shown, as no light will escape here if it is correctly concentrated by the condenser. A ready-made projector lens can be used, or one can be constructed. The simple single glass does not give such critical definition, and two lenses, preferably achromats of rather longer focal length, mounted at each end of a tube, will be better. This tube can be bolted to a wooden piece sliding upon long bolts, as shown. A good projector lens usually has three or more glasses or lenses, and will give a clear picture over the whole area. Simple lenses, though quite good, may give reduced definition towards the edges of the pictures, or the subjects towards the edges may tend to have their outlines broken up into rainbow hues.

Some provision for adjusting the position of the lamp should be made, so that it can be set to suit the focal length of the condenser. Wooden construction is not recommended for very large lamps in view of the heating.

Accessories

It is not unusual to keep 35mm. positive films uncut, and these or 2in. × 2in. or 2¼in. × 2¼in. films may be wound across the lantern aperture by fitting two axles to a support as in Fig. 4. The spools should slip upon the axles, projections engaging with the spool slots. Many projectors are fitted with a removable film-strip winder of this kind, which is more convenient than having many small, separate plates.

Low voltage bulbs are often used and require to be operated from a transformer or resistance, as in Fig. 5. Care must be taken to preserve sound insulation to avoid any possibility of shocks. The transformer secondary may be earthed for this reason. A good projector, for home use, may employ a 6- or 12-v. car-type bulb, operated from a transformer. Large lamps of the kind shown in Fig. 2 are usually for 110 v., and the transformer or resistance is thus essential with ordinary mains. For a 250-watt lamp the resistance will require to pass over 2 amps., so that a fairly large, wire-wound element is necessary.

Science Notes

World's Biggest Submarine Tunnel

WITH a length of 2½ miles this record tunnel is to be built beneath the bay of Havana, Cuba, by a French firm. The tunnel will connect the capital with a proposed new town on the other side of the bay.

Aluminium Bearing for Railways

WHEN journal bearings on the wheels of railway rolling stock become hot, they result in hotboxes, which increase the operating costs of railways. Now an aluminium bearing has been developed which possesses several advantages over the previous bronze type. It is about one-third the weight and does not produce what engineers call copper penetration, which reduces the strength of the steel axles to breaking point.

An Earth Dam in Europe

THE first European "earth dam" will be opened in 1960 at a spot 1¼ miles above the confluence of the Ubaye and the Durance, at Serre Poncon, in the South of France. It will provide electric power and also allow for a great irrigation scheme. Built on a concrete base it will be 394ft. high and will cause a lake 11 miles long.

Gold Film Glass

A NEW advance in de-icing technique for aircraft is the introduction of gold film glass. The windscreens of high-flying aircraft are coated with a transparent gold film on the surface and this is electrically heated.

Synthetic X-ray Subject

MADE to resemble the human body this dummy is used as a test object in studies of subject contrast in X-ray pictures. Fashioned from a human chest skeleton the model has sponges for lungs and a wooden heart. Other spaces inside are packed with cotton. To put flesh on its bones the model's rib cage was wrapped in yards of plastic tape. The advantages are that the model will stand motionless for an indefinite number of chest photographs and will provide an unchanging standard.

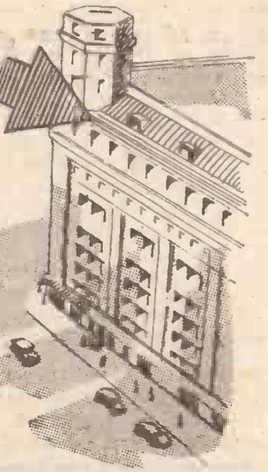
Astronomy and the Electronic Brain

SCIENTISTS at the University of California have, with the aid of Univac, the amazing electronic computor, been able to examine the evolution of Sirius. Without the aid of this computor, the task could not have been undertaken because none of the scientists would have lived long enough to complete the calculations required.

The most advanced research aircraft yet built in Britain, the Fairey Delta 2 is capable of exceeding the speed of sound in level flight. Its 60 degree sweptback delta wings represent the most advanced configuration yet flown on a British plane.

A feature of its demonstration at Farnborough was the use of the F.D.2's "Droop Snoot," in which the whole of the needle nose, including the cockpit, can be lowered by the pilot to improve forward view during take-off and landing.

Letters to the Editor



The Editor Does not Necessarily Agree with the Views of his Correspondents

Signwriting

SIR,—I was very interested in your article dealing with "Signwriting," September, 1955, by Cecil Jasper and would like to draw your attention to some technical details which would appear, in the opinion of many of our successful authorities on paint technology, to be incorrect. I refer to the paragraph "Choice of Colour" in which the author states: "Dark colours are less likely to develop defects than light colours, and the latter show up the dust. Light shades also absorb and retain more heat from the sun's rays than dark colours."

It should, in fact, read:—

Light colours are less likely to develop defects than dark colours, and the latter shows up the dust (dust is normally light grey-brown in colour) and will be a contrast to a darker background. Dark shades also absorb and retain more heat from the sun's rays than light colours.

Heat retention is governed by the amount of heat-light reflected from a surface, hence the lighter the colour of the surface the greater will be its reflective quality and therefore less heat will be retained.

Tests taken by the U.S. National Bureau of Standards to determine the varying extents to which the sun's rays raise the temperature of painted surfaces showed these results: of two panels with an inclination of 90 deg. to the horizontal, one Black (lampblack) showed a temperature of 100 deg. F. and the other White (flat paint) showed 44 deg. F.—GEORGE K. GUMMERSON (Edinburgh).

Copying Diagrams

SIR,—*Re* your article "Copying Diagrams" in the September, 1955, issue, I would like to make one or two comments.

The author says "Many post-war films have lost the useful ability to give absolutely opaque blacks . . . which leads to background." This is quite untrue since it is possible to obtain negatives of Log 3, or more, density range quite easily. Possibly the "process" film he used was the Ordinary or Fine Grain type which is intended for tone work. If Process Line Film is used, of any colour sensitivity, the negative can be made to print easily without loss of fine detail and no necessity whatever to clean up the print.

With regard to the "Surface Printing Method," known actually as "Reflex" printing, the document paper should be bought as "Reflex document" paper. This will give far better results than any other type of paper. With all these a standard M.Q. or Gaslight type developer will give excellent results.—W. R. RODGERS (London, S.W.17).

Gas-filled Balloons

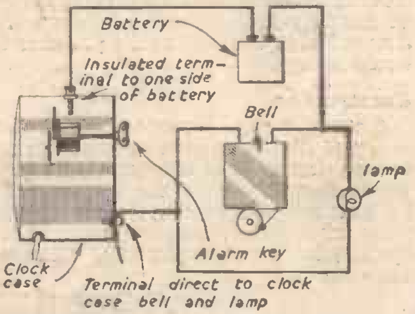
SIR,—After reading of the various ways of filling balloons with coal-gas or hydrogen, some readers may be glad to know of the following simple method.

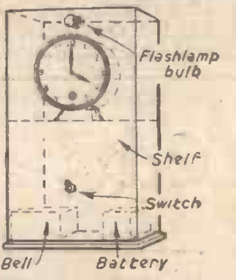
Take out the valve from an old motor-car inner tube and connect it by means of a suitable rubber tube to the gas main, having first pressed out as much air as possible from the inner tube.

The inner tube will quickly fill with gas; pinch the end of the supply tube between the thumb and forefinger, remove from main and insert in the balloon. Release the thumb and forefinger and the balloon will become slightly inflated. To inflate fully, stand on the inner tube or, better still, place a couple of short boards on the inner tube and stand on them. Tie up the balloon. The job is best done in the open air, but do not let go of the balloon or you will not get it back.—H. D. JENKINS (Somerset).

Electric Alarm System

SIR,—I have seen many types of electric alarm systems published in PRACTICAL MECHANICS, but I have one in use, assembled many years ago, which is about as foolproof as it is possible for any system to be, the reason being that there are no moving parts to operate the circuit. All that is needed in the conversion are two small holes drilled in the clock case to take two 4 B.A. terminals.





(*Above*)—The circuit and (*Left*) the plywood box.

One is insulated from the case and is fixed immediately over the alarm spring after winding it up. The other is to make direct contact with the case, removing any paint, etc., round the hole. I used a bit of Systoflex over the shank of the insulated terminal, with a fibre washer on either side of the case and then tightened it up. This terminal should be long enough to make contact with the alarm spring as soon as it begins to unwind, thus acting as a switch as the spring expands. (See sketch.)

I also fixed a flashlamp bulb over the clock face, with a length of stiff insulated twin wire, which lights when the alarm operates the bell or buzzer. The bell can be switched off by simply winding up the alarm again.

In my model I fixed all the parts in a plywood box with a shelf on which to stand the clock. This was secured by means of an angle bracket soldered to the back and screwed down on to the shelf. Above is a sketch of the circuit, which is perfectly straightforward, and the plywood box. The bell-buzzer (combined) in my system was bought from a multiple stores for 5s.—H. BARNETT (Chesterfield).

Glass to Metal Adhesives

SIR,—I notice in the September issue there is an answer to a query dealing with metal to glass adhesives. I would like to mention that from practical experience one of the most effective cements for such a purpose can be made by mixing sodium silicate (Crosfield "Pyramid" No. 1 is an ideal grade) with powdered metals such as zinc, aluminium, antimony, etc. Such a cement hardens within twenty-four hours and it can then be polished if necessary. A further little known application for this type of cement is for closing casting defects and repairing cracks in engine cylinders, the resulting job being both gas-tight and water-tight.—T. TRAVERS (Johannesburg).

The Mechanical Potato Peeler

SIR,—We have observed in the August issue of PRACTICAL MECHANICS an article entitled "A Mechanical Potato Peeler."

In this the use of our Pyruma putty fire cement is recommended as a liner for the cylinder and the rotor.

We must, however, point out that Pyruma putty fire cement is not waterproof, and is not indeed recommended for use where it comes into contact with moisture at all. Any of your readers who employ Pyruma in the manner recommended in the article may well, therefore, be disappointed in the results they obtain.—J. H. SANKEY & SON, LTD. (Ilford).

Astronomical Telescope

SIR,—A letter in "Your Queries Answered" for September and headed "Astronomical Telescope Design," prompts me to comment.

Mr. G. W. Tyrrell (of Lancs) in "bending or breaking" his tube, destroys in effect the advantages of a refracting telescope and introduces the disadvantages of a reflecting telescope.

A 6in. achromatic O.G. costs £60 to £80 new, therefore to pay anything approaching this sum and then introduce the possibility of marring the perfection of the O.G. is pointless; terrestial use, yes; astronomical use, no. An O.G. of this size if first quality will stand 300 × magnification; imperfections or errors introduced or otherwise will also be magnified 300 ×.

I, personally, do not think the prisms or mirrors would be too expensive. There are plenty available among the ex W.D. surplus stores at reasonable prices.

The problem of resilvering does not exist now, as aluminising—which can be washed in soap and water—is the vogue these days; this type of coat will last about five years with reasonable care.

The equatorial mounting of the "bent" tube would be less prone to vibration (this being the snag with most long-tube scopes) and, in fact, I think much easier to design and build.

I would suggest a good 8in. reflector telescope for half the cost and twice or nearly twice as powerful.

I have built several 6in. and 8in. telescopes of this type and consider them ideal for the back-garden astronomer, and much more convenient to mount and use.—GEO. A. SLATER (Stanmore).

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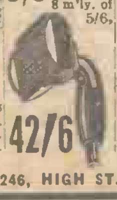

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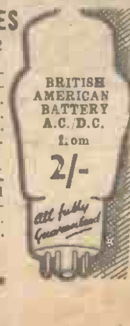

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The "Fedra" flat lead forms a precision chisel-point of the ideal dimensions 0.017in. × 0.047in. throughout its total length. It draws lines of the uniform width of 0.017in.

The lead is securely held within the sleeve and can be used to within a small fraction of its total length. The flat sleeve (5/16in. long) slides smoothly along the edge of the ruler without contact between lead and ruler.


The Fedra Constructor Pencil.

The "Fedra" Constructor Pencil has a vulcanite body with perfect and lasting threads on all its components. Two sides of the hexagon body are grooved to give easy and secure hold at the correct drawing angle.

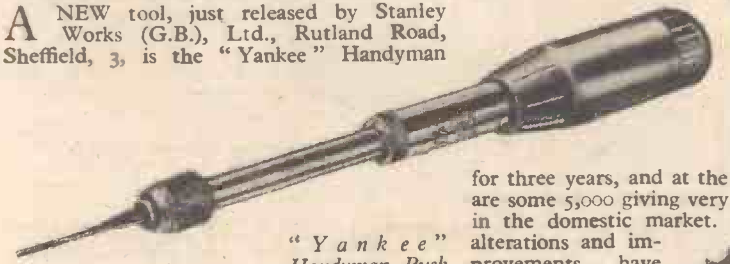
Refill leads are available in tubes of one dozen leads (0.017in. × 0.047in. × 1.2in.) in all grades from 4B to 9H (4B, 3B, 2B, B, HB, F, H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H).

The price of the "Fedra" Constructor Pencil is 8s. 6d., and refill leads are available at 1s. 6d. per tube.

The pencil, which is manufactured in Germany, is retailed in this country by W. G Pinner and Co., 1, York Road, Birmingham, 16.

"Yankee" Handyman Push Drill

A NEW tool, just released by Stanley Works (G.B.), Ltd., Rutland Road, Sheffield, 3, is the "Yankee" Handyman Push Drill. This handy tool, for craftsmen and amateurs alike, makes quick work of drilling holes for nails, screws and brads in wood, plaster, plastics, etc.


"Yankee" Handyman Push Drill.

The drill is operated by pushing, and a concealed spiral mechanism rotates the chuck and drill point. As the spring returns the handle for the next push, the drill point rotates backwards to clear the chips.

A special feature of the push drill is the tough plastic magazine handle—grey with an attractive red screw cap—containing four drill points, 5/64in., 7/64in., 9/64in., 11/64in., in individual compartments. The exposed metal parts are in polished aluminium and chromium plate, and the overall length with a drill point fitted in the chuck is 10½in.

The price of the push drill is 19s. 3d.

Wolf Tools Price Reduction

FROM Wolf Electric Tools, Ltd., comes an announcement of a reduction by 10s. in the price of the "Cub" drill to £5 9s. 6d. The erection of new factory extensions equipped with the latest machinery has resulted in greater capacity and output.

This means lower comparative production costs, enabling Wolf to give their customers the benefit of 10s. cut in the price of the "Cub."

"Nubo" Catalogue

FROM Messrs. Gerald Stains, Ltd., Ross-on-Wye, Herefordshire, we have received a catalogue of hand tools and workshop accessories known under the trade name of Nubo. These range from complete elaborate tool kits for the farmer, the carpenter, the electrician, the builder, etc., down to nuts and bolts, and include a vast range of items in between. The catalogue is available from the above address, and readers requiring a copy or further information should write direct.

P.I.B. Free Literature

A LIST of the free literature and visual aids available from the Petroleum Information Bureau has been sent to us and mentions the various pamphlets, film strips, episcope photographs, sets of samples, molecular models, etc., which they supply. These latter items are on free loan for periods up to 14 days.

They cover all the aspects of the oil industry, including prospecting, drilling and refining, transport, production, and many others. Also available are pictorial wall sheets and charts, and a map of the world's oil-producing areas and refining centres, which costs 2s. Enquiries should be addressed to The Petroleum Information Bureau, 29, New Bond Street, London, W.1.

Bullows PR. 303E Spray Painting Plant

THE Bullows PR.303E spray painting plant has now been available for three years, and at the present time there are some 5,000 giving very satisfactory service in the domestic market. However, certain alterations and improvements have been made to the plant in its original form.

There have been some failures of the bonded rubber coupling, this has been replaced by a claw type coupling, which it is impossible to break or wear out.


Bullows spray-painting plant.

The lubrication system is operated by air pressure, and a few cases have occurred where plants have been connected up in such a way that they have operated at a lower pressure than the minimum for safe lubrication. A minimum pressure valve has been designed and is now fitted as standard to all machines. The effect of this is to make it impossible for even the most careless operator to damage the machine because, even with the discharge wide open, this valve ensures a safe minimum working pressure.

The machine incorporates a hydrovane compressor which is absolutely silent in operation and all moving parts are submerged in an oil bath so that wear is virtually eliminated. The compressor with its 1/3rd h.p. motor weighs 42lb. and is easily carried in one hand. The L.800 internal atomisation gun and hose complete the plant.

The price is £48 plus 5 per cent. and the plant is available from stock at most decorating and building merchants. The maker's address is Alfred Bullows and Sons, Ltd., Long Street, Walsall, Staffs.


The B. & D. Heavy Sander.

New Black and Decker Tool

THE Black and Decker 7in. heavy duty sander has now been replaced by a completely new machine which delivers 90 per cent. more power and yet is lighter in weight. Known as the 7in. Heavy Duty Optional Speed Sander-Grinder, this unit is mainly for use in industry. It is available in three models with spindle speeds of 4,200, 5,200 and 6,000 r.p.m., each unit being designed for a specific range of work. Thus the low speed and standard models are suitable for use with planer heads for wood, saucer grinding wheels, wire cup brushes, and sanding discs, while the high-speed machine has been designed primarily for use with nylon bonded, depressed centre cutting-off wheels. These wheels require high speeds and constant power for satisfactory operation and are extremely versatile. It is possible to rough-grind, finish grind and notch a wide range of materials ranging from cast iron to marble with the same wheel.

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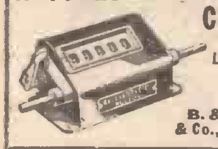

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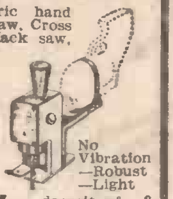

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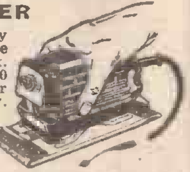

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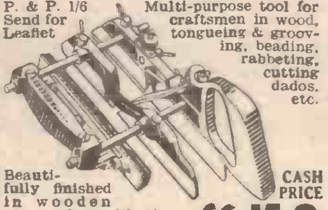

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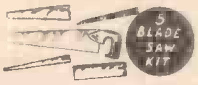

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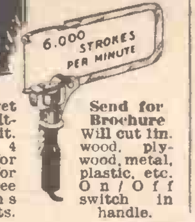

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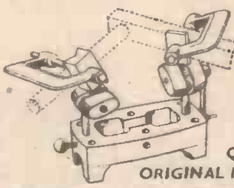

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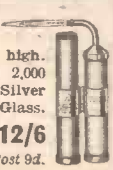

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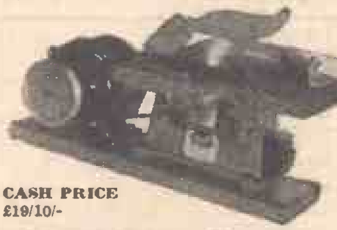

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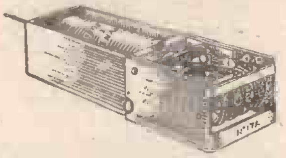

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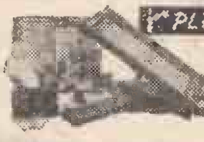

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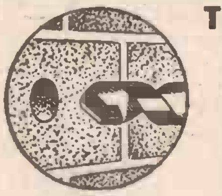

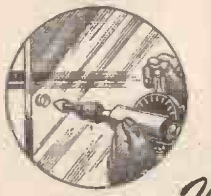

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Casting Concrete Spheres

CAN you give me details for making ornamental globes or balls in concrete—6in. to 12in. in diameter—for use as ornaments on gate-way columns?—H. R. Rishworth (S.W.14).

THE concrete spheres of the type you mention are very difficult for an amateur to make without adequate equipment. You would best make such articles by casting the two opposite halves or hemispheres of the globe in steel moulds and then pegging the two hemispheres together with a thin layer of fresh cement between, the whole finally being finished off by surface grinding.

The alternative method is to cast a solid block or cube of concrete and then to treat this in the old-time manner of the traditional stone mason—that is, by chipping the material as closely as possible into globular shape and finally by grinding down the roughed-out article on a moving band coated with alexite powder.

For your own use we advise the method of hemispherical casting, and joining the two halves together.

Making Water-colour Paint Tablets

I WISH to make a quantity of children's solid water paints (the usual tablet type). Could you tell me the best method of manufacture?—J. R. Butler (Reading).

WATER-COLOUR paints of the "cake" type are fairly easily made. Carefully grind together 70 parts (by measure) of the dry, powdered colour and 30 parts of white dextrine. Then mix the product into a thick paste with cold water containing about 2 per cent. of its volume of glycerine (i.e., 98 parts water, 2 parts glycerine). The resulting "dough" is then well tamped down into little trays having sliding bottoms. The material is then set aside for two or three days to dry in the air. For another day or two it is dried in a warm oven. After this the now solid cakes of colour are pressed out of the frames by finger pressure.

You can obtain white dextrine fairly cheaply from Messrs. Henry Smith & Co., Ltd., Diggle, Yorks.

In very cheap paints the colour is often adulterated with common whiting or china clay or with a mixture of these and zinc oxide, but this usually results in a decrease in the body and shade depth of the colour. Sometimes, too, such adulteration results in the colour taking on itself a smudgy appearance.

Paint Peeling from Wood Surfaces

I HAVE two oak gates that I wish to paint, but I have been told that paint will peel off oak; is this true? If so, is there any method of prevention?—A. Forte (Co. Durham).

THERE is no property inherent in oak which causes paint to peel off the wood. If you have personally experienced this peeling off of the paint from an oak surface, you may be sure that the same paint would peel equally off another wood. Peeling of paint is usually caused by inferior paints, by inadequate cleaning of the wood surface or by bad treatment of the latter, such as exposure to the extremes of heat, cold, damp, etc.

In the case of a door the woodwork should be rendered grease-free by dint of scrubbing with soap and water. It should then be brushed over with glue-size and, after drying, given a thin layer of a grey priming paint. Over this one or two layers of a good surface paint should be placed. Remember always that if a paint layer is too thick it will tend to blister, peel, craze, flake and to fall away, for all of which deficiencies the wood cannot be blamed.

Copper-plating Fault

WHEN trying to copper-plate a strip of iron I found that the cathode became coated with a substance not unlike soot, but copper in colour. It was easily rubbed off.

What was this substance? Can it be avoided and what prevented the cathode from being plated? The anode I used was copper earth rod and the electrolyte, copper sulphate solution with just a little sulphuric acid. Power was from two cycle lamp batteries.—M. Kneller (Ramsgate).

THE sludgy, brown material which accumulates on your cathode is a mixture of cuprous oxide, Cu_2O, metallic copper and other substances of very complex composition. It should not be present and is caused by having the electrolyte too strong or too warm, or by having it too acid. Another prolific cause of this effect is the use of too heavy a current. For instance, a current derived from two cycle lamp batteries is far too much for the work which you are doing.

Use the following solution: copper sulphate, ¾lb.; sulphuric acid, 2 oz.; water, ½ gallon. This solution should be used cold and with a voltage not exceeding 3 or 4.

Moss Elimination in the Greenhouse

CAN you please tell me if there is any way in which I can get rid of, or stop forming, a type of moss or cryptogamic plant that keeps appearing on the soil in my greenhouse, and also in the garden?—L. Cooke (Leicester).

YOU can rid your greenhouse soil of moss by dusting powdered lime on the soil from time to time and then by digging the lime in. This is a much better method than by treating the soil with substances such as copper sulphate solutions which, although they will eliminate the moss, at the same time act as poisons to plants and consequently contaminate the soil. If the moss appears on walls or other surfaces which are not directly in contact with the soil, dissolve 1lb. of copper sulphate in a gallon of water and brush the solution hot on to the affected surfaces. Do not, however, allow the copper sulphate solution to drip or drain into the soil. For treatment of the soil alone the lime dressing method is the safest and the cheapest.

Lining Copper Containers with Rubber

I WISH to coat the interior of several small copper laboratory containers with rubber. Will you please state how this is done? Is it possible to paint the interiors with liquid latex and vulcanise by either hot or cold process?—C. Hyland (Buxton).

IF the copper containers are not too big, the simplest way of effecting your aim would be to purchase a tube of rubber cement, and to thin this down to paint consistency with solvent naphtha. The resulting paint could be applied in two separate coats with a soft brush.

Rubber latex would hardly be successful when used as a painting medium. It would not spread evenly over the metal, and it would tend to give rise to a film which would strip off very readily.

Neither the rubber solution film, nor the latex film would react well to any vulcanisation, since any hardening of the rubber film would cause it to strip away. If, however you wish to carry out your own experiment, in this direction, a cold vulcanisation process would be preferable as it is gentler in action and its hardening effect on the rubber film is less.

Painting Garden Ornaments

WHAT is the best paint to use for painting plaster garden ornaments that will retain a gloss and keep waterproof ?—G. F. Halfyard (Surrey).

THE use of gloss paint on garden ornaments of plaster is not very successful because, ultimately, the paint deteriorates and flakes away in patches, thus exposing the underlying plaster to a very rapid deterioration. The best way to tackle this job is to give the ornaments a liberal brushing over with a solution of 2 parts of glue in 98 parts of water. After this, they should be brushed over with a 50-50 mixture of formalin and water and allowed to dry out thoroughly. This treatment will insolubalise the glue. The articles so treated are then given a priming paint coating of any desired colour, after which they are given two coats of the gloss finishing paint required, this being applied preferably by spraying.

Regilding an Antique Mirror

I RECENTLY acquired a carved antique mirror, on which the gilding had almost disappeared, and an effort had been made to make this good with an ordinary silver paint that had in itself deteriorated very badly. I have cleaned this down to the alabaster and now wish to regild the frame. Can you please let me know how this should be done and what materials to use ? I notice that a red paint is used as a base over the alabaster —can you please also tell me what this is ?—R. E. Peckham (Southampton).

THE gilding of your antique mirror was not based on alabaster (which is a mineral), but on gesso; which is a mixture of whiting and glue. In stripping the existing gilding down to the actual gesso, you have, to some extent, lowered the value of the article as an antique piece, since you have removed the original gold work and, also, some of the red-lead linseed oil groundwork of the gilding which testifies to its age. It is the practice nowadays not to remove original gilding from antique articles, no matter how poor the condition of the gilding may be.

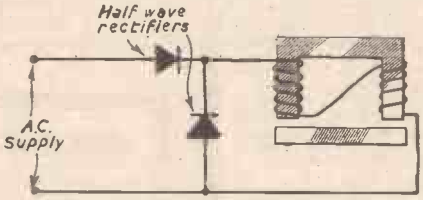
In the circumstances, you have two alternatives. The first is to brush over the bare and exposed gesso foundation a mixture of equal parts of egg white and *cold* water and allow this to dry out thoroughly. Then breathe on the area to moisten it very slightly, and apply gold leaf to it, burnishing it to the required degree of brightness by means of a gilder's burnishing tool or with the aid of a small agate or a flat piece of polished steel. The alternative will be to paint the area over with one of the " antique gold " lacquers which are to be had from dealers in artists' materials. The result will be a rather raw-looking one, but it will mellow with age, since these imitation gold paints are not as permanent as the real thing.

An Electrical Vibrator

I HAVE recently been experimenting with a self-made vibratory feeder for pins operated by an electromagnet at mains frequency. The results are very promising, but the present machine lacks control and feeds the pins either too violently or too feebly. Could you give me any information on the construction and the names of any books on this subject ?—H. A. Beck (Stroud).

ELECTRICAL vibrators for use on A.C. may be either rotary or electromagnetic. The rotary type may consist of a small motor which is mounted on the platform which is to be vibrated. The motor merely drives an unbalanced weight, such as an eccentric disc, which is mounted on the motor shaft. On a supply of given frequency the frequency of vibration will depend on the speed for which the motor has been wound; whilst the amplitude and vibratory force will depend on the amount by which the driving weight is out of balance. Such vibrators are supplied by Messrs. E. P. Allam and Co., Ltd., of Southend-on-Sea.

Two or three forms of electromagnetic vibrators are very briefly indicated in the book " Magnets," by C. R. Underhill, published by the McGraw-Hill Book Co. This book, however, contains a good deal of technical information regarding electromagnets in general. Another useful book on electromagnets is " Electromagnets and Windings," by G. Windred (George Newnes, Ltd.). The frequency of operation or vibration on a given A.C. supply can be halved by supplying the electromagnet through a rectifier which is fed from the A.C. mains, with a similar rectifier connected across the coil to act as a discharge resistance, both rectifiers being of the half-wave type. The vibration can be controlled by supplying the rectifier through a tapped transformer or supplying the electromagnet through a variable resistor, or by adjustment of the air gap of the electromagnet.



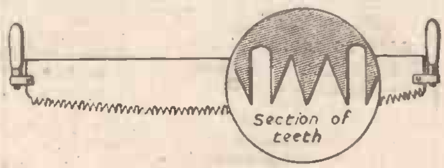
Using half-wave rectifiers.

Assuming that only a small amount of vibration is required the table could probably be mounted on rubber supports or silentbloc mountings.

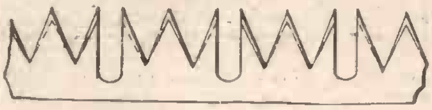
Sharpening a Cross-cut Saw

I HAVE been unable to find details for sharpening the saw shown below ; can you help ?—Herbert Linford (Oxford).

THE teeth of the saw should have a cutting edge for their full depth. Alternate teeth should be set in the same direction, i.e., adjacent teeth should be set in opposite directions as in other types of saw. Both edges of the centre tooth on alternate sets of teeth should be filed at an angle on the same side of the saw; whilst the inner edges of the two outer teeth on the other sets should be cut at an angle on the same side of the saw. Then the saw should be turned over and the operation repeated on the other side of the saw, this time cutting the centre teeth on the sets on which the centre teeth have not been sharpened and so on. The sketch should clarify the position.



Mr. Linford's saw.



How the saw is sharpened.

Information Sought

Readers are invited to supply the required information to answer the following queries :

Installing an Austin Engine in a Boat

AFTER carrying out some repairs and alterations to my 16ft. 6in. boat, I hope to install an engine. Could you assist me in obtaining the necessary information to convert my 1940 Austin 8 h.p. engine for this purpose and the best method of installation ? —W. H. DAVEY (Exeter).

Aquarium Heater

I WISH to make a 60-watt electrical heater of the type used in small tropical fish aquariums and would much appreciate any information concerning the various materials needed.—J. BUTCHER (Wembley).

Gelatine Finish to Lithograph and Letterpress Prints

I WISH to apply a gelatine finish to some lithographic and also some letterpress prints.

I should be obliged if you would kindly let me know how this can be done.

I believe glass is used as the surface to which the print is fixed while the gelatine matter is drying. I also understand, however, that chromium covered rollers can somehow be used to speed up the process when dealing with quantities.—H. P. (London).

Moulding Garden Ornaments

PLEASE tell me where I may obtain information on making garden ornament moulds. I can make the originals but have not sufficient knowledge to make moulds such as animals, birds, figures which have " undercutting." Also, is a mixture of 1 part cement to 2 parts sand correct, please ? What paint can be used on these cement figures ?— D. R. MARSH (Bristol).

Self-inflating Water Cushion

I AM seeking information upon the construction and self-inflation of a water cushion. The principle required is similar to that used in the R.A.F. rubber dingies.

The project I have in mind only has the capacity of a large settee cushion. Since I expect a valve will have to be incorporated to permit a safe level of expansion from the chemical/gas inflating medium I would prefer a harmless variety as a precaution against inhaling—if this should be possible.

The chemical/gas container must be as light and as small as possible. Would a plastic envelope give longer service than rubber ?— H. WILLCOX (Nottingham).

Aquarium Thermostats

I DESIRE to make thermostats as used by aquarists in their fish tanks either adjustable or set to about 70 deg. F., and would be glad if you could help.—E. WEBB (Surrey).

Bottle and Jar Seals

I HAVE seen some orange juice bottles that have a plastic seal over the cork, and would like to employ a similar method to seal a suction metal lid to a 1lb. jam jar. Is this practicable and how can I do it ?

Can you suggest any other method of making these tops airtight, attractive and safe if in contact with food ?—V. SMITH (Sussex).

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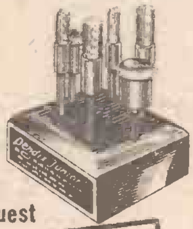

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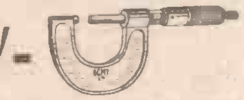

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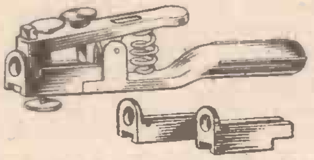

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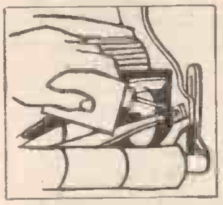

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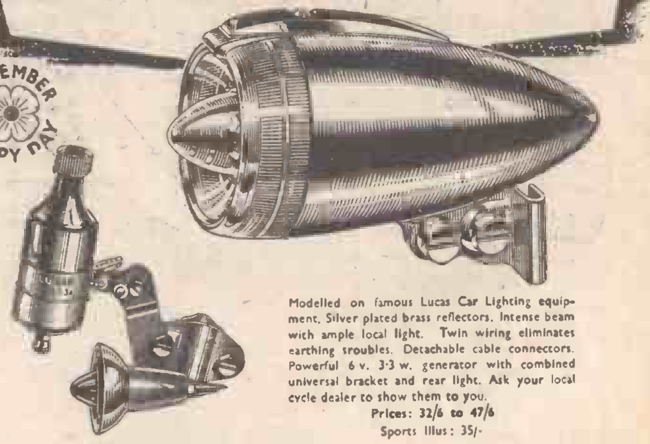

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THE Cyclist
Editor : F. J. CAMM

VOL. XXIV NOVEMBER, 1955 No. 402

All letters should be addressed to the Editor, "THE CYCLIST," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2
Phone: Temple Bar 4363
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WHAT I THINK

By F. J. C.

Frank Urry Retires

IT is with great regret that we announce that our esteemed contributor F. J. Urry, M.B.E., is retiring from journalism, as he can no longer be an active participant in the pastime of cycling and, therefore, feels that he is not entitled to write on it. It has always been his point of view that when he would not get around under his own power he would retire. He is still able to do 10 to 12 miles without a rest in good weather, but long-distance journeys, the real essential of happy touring, are not now physically possible.

Frank Urry has done more than any other writer to encourage and develop the pastime of cycling. His pen has kept clear of cycling politics and sport, and concentrated on the real purpose of the bicycle—to provide pleasurable exercise by means of touring both in this country and on the Continent. He and his father before him ploughed this furrow and he has inspired many other writers to imitate him. They never, however, developed his style and phraseology and travel-tempting pen pictures. His father, the late Jack Urry, founded the oldest cycling journal in the world—*Bicycling News*—on which Alfred Harmsworth, later Lord Northcliffe, served his apprenticeship as a journalist and the last editor of which when it existed as a separate journal was the present writer. It was in the columns of *Bicycling News* that the paragraph resulting in the formation of the Cyclists' Touring Club with which he was to be associated for so many years appeared. His great work for the C.T.C. was acknowledged time and again, and hallmarked by the presentation of the Bird Trophy. For many years he was responsible for the printing of the *C.T.C. Gazette*. Internecine conflicts and jealousies within the club, however, caused Frank Urry a few years ago to sever all connections with it, and to return the trophy to them. Readers will join with us in wishing Frank a long and healthy retirement.

Causes of Accidents

IN a recent issue we dealt with the causes of accidents, and our comments have inspired a letter from A. F. Bagshaw, of Ashbourne, and we quote his letter in full:

"I have just read your editorial on the above subject in THE CYCLIST. As you say, the answer is more and better roads.

"Surely another point of great importance immediately arises as a result of your conclusion? The design of new roads *must* be undertaken by road users, not by a body of people who have no experience of road travel. I consider myself to represent the average motorist, covering about 14,000 miles a year, mostly in Staffordshire and Derbyshire, but including occasional runs of a few hundred miles. I doubt very much if I could design a trunk road, but I would be able to avoid so many of the idiotic features of even recently made highways. For example: I know of dozens of bus stops placed on blind corners; busy junctions heavily policed *except* when traffic is at its heaviest; Halt signs almost obscured by foliage; misleading direction and road signs; DANGER—Men at Work notices left up when all work is finished with the result that one is inclined to disregard them on future occasions; Keep Left signs which prevent a driver from seeing if the road is clear; dangerous junctions where both roads look like the main road.

"The main trouble arises because of the different relative speeds of vehicles. Thus, a 10-ton lorry often has a stream of 50-60 or more cars stuck behind and obliged to follow it for miles.

Malmesbury Abbey
Wilts.

The great Norman arch that once supported the tower of this fine building.

"To overcome this, the 'planners' at their desks, to which they have no doubt travelled by tube, propose to tear all over England putting down wide straight roads in imitation of the Romans. At vast expense.

"Surely a simpler solution is to introduce dual-carriageways of about five miles in length every 10 or 20 miles. The faster traffic would, on these stretches, become disentangled from the slower and bottlenecks would be avoided.

"In France, where a driver usually goes flat out all the time, I have never had a 'nasty squeak,' but here I expect one at any time. I suppose that I nearly have some sort of accident every 1,000 miles—luckily I have actually had only one when an elderly gentleman ran into my stationary car because he was watching something out of his rear window! As you say, speed is not always the cause.

"Posters and campaigns are useless and far too mild. British people will not be regimented. The most effective way to get a door broken down is to put 'Private' on it.

"I am an auctioneer, and during the summer I have seen at least six farmers either limping about or wearing peculiar surgical appliances round their necks. Enquiry has produced such answers as, 'Oh! A lorry ran into his car at a junction . . .' or 'He ran into a car which stopped suddenly . . .'

"An essential driving technique is anticipation. This requires imagination—and so few people have it.

"Finally, I consider the police—outside the large towns—to be quite useless in traffic direction. I have seen them turn purposely away when they could have helped a driver to emerge from an awkward entry into a main road. They put up far too many notices which demand the drivers' attention, and too many coloured flashing lights which confuse and annoy."

We have received many letters on this subject but the above epitomises most of the points of view. We have, of course, received a few of the tirades from some of the firebrand members of the N.C.U. and the C.T.C. who want all motorists wiped off the roads, disciples of the late Fitzwater Wray, who are always "fighting for cyclists' rights" (no one has ever wanted to take them away!).

Death of Sidney Vanheems

WE regret to announce the death of S. M. Vanheems, who was for 10 years secretary of the R.R.A. and at one time a prominent member of the Bath Road Cycling Club, Ltd. He was 80 years of age. He became secretary of the R.R.A. in 1923, when the affairs of that organisation were in a mess. Vanheems set to work to put the machinery in order and devised the system of filing and recording which is still in use and has so greatly benefited other secretaries. He was president of the Bath Road Club Ltd. for a long number of years and successfully piloted this club through the 1914-18 war. He continued to take an interest in its affairs almost up to the time of his death.

The New Lighting Laws

AS from October 1st last, all pedal bicycles, pedal tricycles, tandems and tandems with sidecars must have a lamp showing a white light to the front. The position is left to the convenience of the user. On all cycles purchased new after October 1st a rear lamp with a lens diameter of at least 1½in. All such vehicles must also carry a red rear reflector. The regulation says that all cycle rear lamps must have an illuminated area of not less than 1½in. diameter or, if not circular, have an illuminated area of not less than the area of a circle of 1½in. in diameter and of such a shape that a circle of 1in. diameter may be inscribed therein.

How to FORM and RUN a CLUB

(Concluded from the October issue)

SPECIAL attention is directed to the latter part of Rule No. 5. When a Special General Meeting of members has been called for some specific object, no other business, except that for which the meeting has been called, may be transacted. There is a reason for this. It is on record that a small clique of malcontents sent in a requisition for a Special General Meeting for some trivial object, and reading the notice many members thought it not worth while coming to the meeting to discuss such a trivial matter, but the malcontents turned up in full force. At the meeting, under "other business," their leader put a highly revolutionary proposal to reduce the annual subscription by half.

One more rule deserves to be emphasised, that which prohibits second-claim members from sitting on the committee and from holding challenge trophies or club records.

Model Rules for a Cycling Club.

1. That the club be called the.................. Cycling Club (or Wheelers). That it be affiliated to the N.C.U., B.L.R.C., C.T.C., etc., and that its objects be the promotion of cycling in all its branches and general sociability among the members.

2. That the annual subscription be......... payable in February. Honorary members .... New members to pay an entrance fee of .... Members whose subscriptions are not paid by May 1st shall forfeit the right to take part in any club functions.

3. That the management of the club be vested in a Committee consisting of the officers, the auditor, and six other members, all of whom shall be first claim (six to form a quorum), to be elected annually at the Annual General Meeting to be held in January. At such meeting shall be presented a balance sheet, prepared by the Hon. Treasurer and audited by one of the members duly elected for that purpose. Vice-Presidents may attend Committee and General Meetings, and speak, but they have no vote unless they pay an active member's subscription.

4. That the Committee shall meet once in each month, or upon receiving four days' notice in writing from one of the Secretaries. Any elected member of the Committee absenting himself from three consecutive meetings (without giving a satisfactory explanation) shall be deemed to have resigned his seat, and the Committee shall have power to fill the vacancy.

5. That it be within the power of any twelve members to call a Special General Meeting by written request to the Hon. Secretary, not less than seven days prior to the proposed date, such request to embody the purpose for which the meeting is to be called, and only such business shall be transacted at that meeting.

6. That in the event of the conduct of any member being considered detrimental to the interests to the club, the Committee shall have full power to deal with the matter and its decision shall be final.

Members out on an autumn club run.

7. That club runs and tours be under the supervision of the Captain, or in his absence of the Vice-Captain.

8. That candidates for membership shall be proposed and seconded by two members of the club, and shall be elected or not by vote at any meeting of the Committee.

9. Candidates for Vice-Presidencies shall be approved by the Committee before being voted upon at a General Meeting.

10. That no member shall be allowed to compete in any club event unless he is clear on the books and, unless he is prevented by illness or accident, must make at least 15 points between January 1st and December 31st before receiving any prize or medal. Points to count as follows:

Riding to the rendezvous on Sunday, 1 point. Competing in an open event in the club's name, 1 point. Helping a member who is competing in an open event, 1 point.

11. That the colours of the club be.........

12. That club runs start from......at......a.m. on Sunday. Winter runs at............a.m. Members meet at Headquarters on......... evenings (friends invited).

13. Items for the Agenda of the Annual General Meeting must be in the hands of the Hon. Secretary at least 21 days before the date of the meeting.

14. The Committee shall have power to settle any points not provided for in these rules.

15. New members elected after 30th September in any year shall, upon payment of the subscription, be entitled to all the privileges of membership up to the 31st December in the following year.

Racing Regulations.

1. All handicaps to be framed by a board of four handicappers to be elected at the A.G.M.

2. Three handicap prizes to be given in each club race, in addition to fastest time prizes. In the event of fewer than ten entries, no third prize; if less than six entries, no second prize to be given. No rider may take more than one prize in any event.

3. That a road Championship Gold Medal or special trophy, if one exists, be awarded to the member making the highest m.p.h. at 25, 50 and 100 miles and 12 hours during the season, by taking the m.p.h. at each distance and averaging over the four distances. The Path Championship and Gold Medal to go to the winner of a Scratch race to be run for the title at a distance to be decided upon at the A.G.M. Second and third men to receive silver and bronze medals.

4. Second claim members shall not be eligible to hold any trophies, Club championships or Club Records, but may compete in club races and for standard medals in Time Trials.

5. An attempt for a standard medal may be made in any time trial run under R.T.T.C. rules during the season. Not less than seven days' notice must be given to the Club Road Racing Secretary.

6. Members already holding Club Standard medals must beat their previous best times to qualify for another medal. A new member must beat his previous best time before taking a Club Standard medal, except when beating club record. Tandem riders to qualify for standard medals, must both be members of the club. (Author's note.—These regulations are to prevent (a) a man collecting a set of standard medals in one club, joining another club and taking a set of medals in that club without showing an improvement in his riding; and (b) a mediocre rider pairing up with a "crack" from another club and taking a medal for a ride in which he may have done only a third of the work !)

7. Entrance fee, 2s. 6d. for club time trials.

8. Only one Club medal may be taken in the same class in one season, and in no case may two medals be taken for one ride.

9. The fee for club events must be in the hands of the Racing Secretary at least five days before the event. The Committee have power to withdraw any race.

10. That no first claim member be allowed to ride in an open event in the name of any other club without the Committee's consent.

11. R.T.T.C. Rules and Regulations shall be observed in all club time trials.

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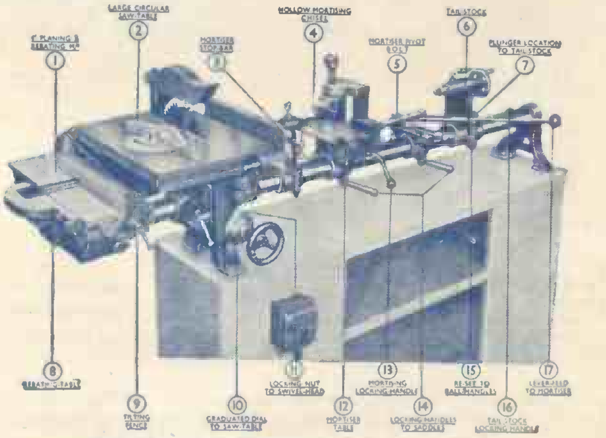

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