Practical MECHANICS

1'6

JUNE – 1962

ONE MAN AUTO-GYRO

A mechanical TEACHING MACHINE

Tyres for THE MOON

LATHE GADGETS

VALUABLE NEW HANDBOOK

FREE TO AMBITIOUS ENGINEERS

Have you had *your* copy of "Engineering Opportunities"?

The new edition of "ENGINEERING OPPORTUNITIES" is now available—without charge—to all who are anxious for a worthwhile post in Engineering. Frank, informative and completely up to date, the new "ENGINEERING OPPORTUNITIES" should be in the hands of every person engaged in any branch of the Engineering industry, irrespective of age, experience or training.

We definitely Guarantee "NO PASS—NO FEE"

This remarkable book gives details of examinations and courses in every branch of Engineering, Building, etc., outlines the openings available and describes our Special Appointments Department.

WHICH OF THESE IS YOUR PET SUBJECT?

MECH. ENGINEERING
Gen. Mech. Eng.—Maintenance Eng. — Diesel Eng. — Press Tool Design — Sheet Metal Work — Welding — Eng. Pattern Making — Inspection - Draughtsmanship — Metallurgy — Production Eng.

RADIO ENGINEERING
General Radio — Radio & TV Servicing — TV Eng. — Telecommunications — Electronics—Sound Recording—Automation—Practical Radio —Radio Amateurs' Exam.

CIVIL ENGINEERING
General Civil Eng. — Municipal Eng. — Structural Eng. Sanitary Eng. — Road Eng. Hydraulics—Mining—Water Supply — Petroleum Tech.

ELEC. ENGINEERING
General Electrical Eng. — Installations—Draughtsmanship — Illuminating Eng. — Refrigeration — Elem. Elec. Science — Elec. Supply — Mining Elec. Eng.

AUTO ENGINEERING
General Auto. Eng. — Auto. Maintenance — Repair — Auto. Diesel Maintenance — Auto. Electrical Equipment— Garage Management.

BUILDING
General Building — Heating & Ventilation — Plumbing — Architecture — Carpentry — Painting & Decorating — Specifications & Quantities — Surveying — Architectural Draughtsmanship.

WE HAVE A WIDE RANGE OF COURSES IN OTHER SUBJECTS INCLUDING CHEMICAL ENG., AERO ENG., MANAGEMENT, INSTRUMENT TECHNOLOGY, WORK STUDY, MATHEMATICS, ETC.

Which qualification would increase your earning power?
A.M.I.Mech.E., A.M.S.E., A.M.I.C.E., A.M.Brit.I.R.E., A.F.R.Ae.S., B.Sc., A.M.I.P.E., A.M.I.M.I., A.R.I.B.A., A.I.O.B., A.M.I.Chem.E., A.R.I.C.S., M.R.S.H., A.M.I.E.D., A.M.Mun.E., CITY & GUILDS, GEN. CERT. OF EDUCATION, ETC.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
410A COLLEGE HOUSE, 29-31 WRIGHT'S LANE, W.8

THIS BOOK TELLS YOU

- ★ *HOW to get a better paid- more interesting job.*
- ★ *HOW to qualify for rapid promotion.*
- ★ *HOW to put some letters after your name and become a "key-man" . . . quickly and easily.*
- ★ *HOW to benefit from our free Advisory and Appointments Depts.*
- ★ *HOW you can take advantage of the chances you are now missing.*
- ★ *HOW- irrespective of your age, education or experience- YOU can succeed in any branch of Engineering.*

156 PAGES OF EXPERT CAREER - GUIDANCE

You are bound to benefit from reading "ENGINEERING OPPORTUNITIES," and if you are earning less than £25 a week you should send for your copy *now*—FREE and without obligation.

POST NOW!

TO: B.I.E.T. 410A, COLLEGE HOUSE, 29-31 WRIGHT'S LANE, W.8.

2½d. stamp if posted in an unsealed envelope.

Please send me a FREE copy of "ENGINEERING OPPORTUNITIES." I am interested in (state subject, exam., or career).

____

NAME ____________________

ADDRESS ____________________

____

WRITE IF YOU PREFER NOT TO CUT THIS PAGE

THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD

Practical MECHANICS

Vol. XXIX | June, 1962 | No. 338

Editorial and Advertisement Offices
"PRACTICAL MECHANICS"
George Newnes Ltd., Tower House, Southampton Street, Strand, W.C.2.

Phone: Temple Bar 4363
Telegrams:
Newnes, Rand, London

SUBSCRIPTION RATES
including postage for one year

Inland – – – – 22s. per annum
Abroad – – – 20s. 6d. per annum
Canada – – – – 19s. per annum

CONTENTS

CONTRIBUTIONS

The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Mechanics." Such articles should be written on one side of the paper only, and should include the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor, should be addressed: The Editor, "Practical Mechanics," George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

FAIR COMMENT

COVER TOPIC

THIS month's cover illustration is no doubt an exciting possibility to many of our readers and we do not regard building and even flying an Autogyro as being beyond the capabilities of a great majority of you.

Unfortunately this has not been designed as, or intended to be, a do-it-yourself project, at least not at the present time. Undoubtedly though many readers will realise it would have a great potential in this respect. Several American firms have already entered this field and many enthusiasts have built and flown their own machines. Not all of those men have been licensed pilots, in fact some had never flown an aircraft before. If such a machine were marketed as a do-it-yourself project in this country, certain regulations laid down by the Ministry of Civil Aviation would have to be adhered to, this would include a Certificate of Airworthiness being granted to the aircraft before it was allowed to fly. The pilot would also have to be qualified. Possibly these regulations are not so stringent in the U.S., this would be understandable as they have more room to "play" in.

Beagle Aircraft, the company that has undertaken the production of this Autogyro, was formed only 18 months ago under the chairmanship of Mr. Peter Masefield to challenge U.S. domination of the executive plane market, and are now marketing no less than seven different types of aircraft.

MAN POWERED AIRCRAFT

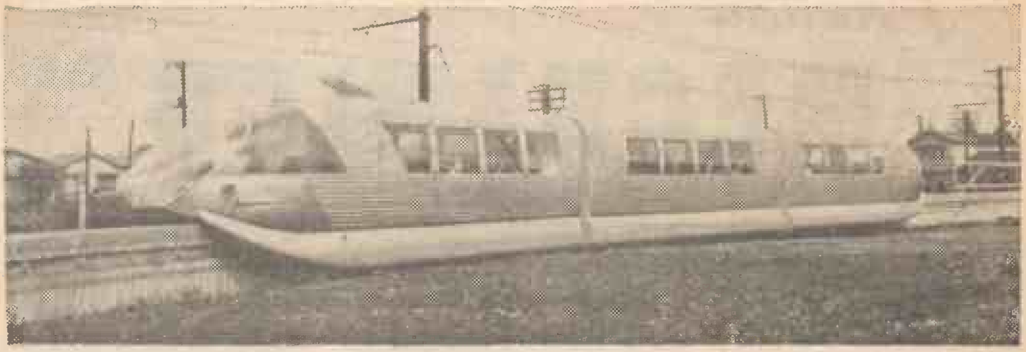
A flight of over half a mile—in fact 993yds—over level ground and at a maximum height of approximately 8ft and an average height of about 5ft, was achieved by Mr. J. C. Wimpenny on 2nd May at Hatfield Aerodrome, flying the Hatfield Man Powered Aircraft Club's Puffin. The average speed for the flight was approximately 19½ m.p.h.

Mr. Wimpenny is Chairman of the Hatfield Man Powered Aircraft Club and leader of the Puffin design team, but he is not an athlete. He will now receive a special prize of £50 offered by a member of the Royal Aeronautical Society (who wishes to remain anonymous) to the first man to fly a man powered aircraft for a distance of half a mile. The flight was officially observed by Mr. B. S. Shenstone, vice-chairman of the Society's Man Powered Aircraft Group. Also witnessed by representatives from 13 countries who are attending a meeting in London and who were visiting the de Havilland works at Hatfield.

The Puffin made its first flight on 16th November, 1961 and since then more than 50 successful flights under full control have been made by Mr. J. H. Phillips and Mr. J. Barnes, both de Havilland test pilots, and latterly by Mr. Wimpenny.

The Puffin is one of several contenders for the £5,000 prize offered in November 1959 by Mr. Henry Kremer for the first Man Powered Aircraft Flight of one mile, to be flown over a figure-of-eight course. To qualify for the prize the aircraft must also be at a height of at least 10ft at the beginning and end of the course. The time limit of February 1962 originally placed on the Kremer competition, has recently been extended.

The July, 1962, issue will be published on June 29th, 1962. Order it now!



A three-car Monorail on the test track in Tokyo. These trains are now running in the nearby Zoological Gardens.

MONORAILS: how they work

by R. J. SALTER

EVERY so often it is suggested that a solution to the traffic problem in the large cities of the world can be found in the use of monorail transit systems. In this article the different monorail systems will be explained and the few modern monorails which have been built will be described.

The idea of running a train on a single-rail track is not new, for well over a hundred years ago a British engineer built one which carried food between a warehouse and the docks alongside the Thames.

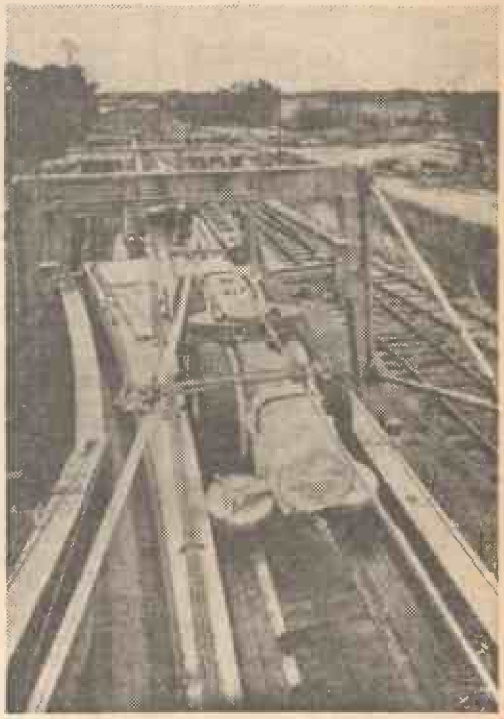
Since that time many different kinds of monorails have been devised. Generally speaking they may be divided into suspended and supported monorails according to whether the monorail car runs on top of the rail or is suspended beneath it.

In spite of the many schemes which have been proposed by inventors and engineers throughout the years only two successful passenger-carrying monorail systems have been built.

Early Monorails

The first to be put into service was the Listowel and Ballybunion Railway in Ireland. It first ran in the year 1888 and ran successfully for the next 25 years. At last, in 1924, mounting repair costs and competition from motor cars and buses made it uneconomical to run the train any longer. Top speed of the train was said to be 27 m.p.h., although for most of the time it chugged along steadily at 18 m.p.h.

It was a supported monorail with the passengers seated on either side of the single rail and the passengers had to sit in equal numbers on either side to balance the carriages. The tale is told that one day a cow had to travel on the train, there was a long delay whilst railway officials searched for a load to balance the cow.



One of the Rubber Tyred Bogies which supports a Monorail Car. Two guide wheels can be seen at the front of the four load carrying wheels.

A solution was only found when two calves were discovered which balanced the weight of the cow. On the return trip a calf was placed on either side of the carriage to keep the train balanced.

Three years later, in 1901, the other successful monorail was built over the Wupper River in Germany. Known as the swinging railway, these cars are suspended beneath a steel rail which runs for over nine miles along the river.

Well over a thousand million passengers have been carried on this monorail since it was first opened to traffic with only two casualties to travellers.

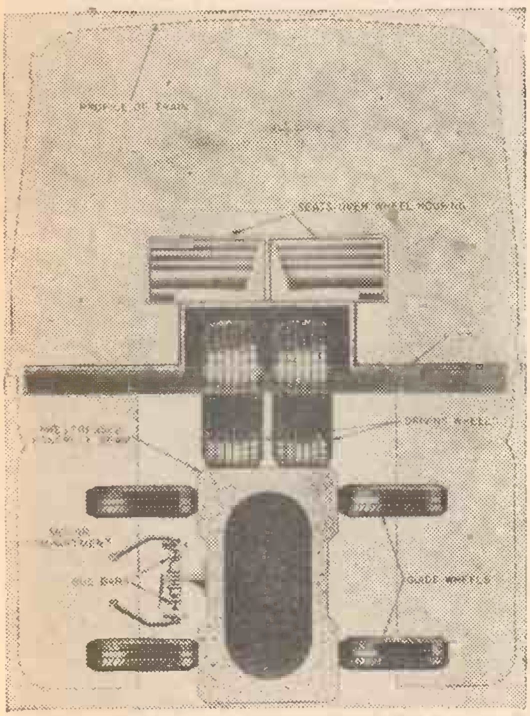
Both these monorails are so old-fashioned, however, that they cannot be compared with the fast, swiftly accelerating monocars which have been designed to solve the traffic problems of the crowded cities of the world.

So far modern monorail transit systems have only been constructed in the form of test tracks, but their performance under simulated working conditions makes it obvious that some day soon they are going to play a vital role in city transportation.

The Alweg System

One of these test tracks is at Fuhlingen, near Cologne. It is the proving ground of the Alweg organisation, whose monocars sit astride the track, their driving wheels running on the top surface of the single rail.

With a length of just over a mile the single rail is formed of a massive reinforced concrete beam mounted on the top of reinforced concrete pillars. These pillars, which carry the monorail high above city traffic, are spaced about 50ft. apart and support the strong hollow monorail beam which is itself 4ft. 6in. wide and 2ft. 6in. deep. If the track is going to be any length at all very many of these beams will be required and plans have been made to produce them at the rate of one every five hours. To do this, special steel shuttering with built-in vacuum mats will suck the water out of the wet concrete instead of waiting for it to dry out naturally.



This is the arrangement of the driving and guiding wheels on the Alweg Supported Monorail Car.

Just as ordinary trains need points to switch from line to line so it is necessary for monocars to move from rail to rail. This can be done by swinging a track beam on a pivot so that the monotrains can be directed to the correct track.

Running on the concrete track beam would be trains consisting of two or three articulated cars. A three-car train would have a total length of 96ft. 6in. and a width of 9ft. 9in. Seating capacity of this train would be 76.

Usually electric power is used to drive the monocars, which pick up the current from a live rail recessed into the side of the track beam. A three-car train has six axles, four of which are motored, giving a total power of 640 h.p. to drive the 40-ton loaded train.

Disneyland Monorail

A similar monorail layout to this was put into service two years ago at Disneyland, California. Built for pleasure purposes alone, the one-mile-long monorail track passes through the pleasure grounds and carries two modernistic 82-passenger trains. Because the line curves and dips so much the maximum speed has been fixed at 20 m.p.h.

Once again the trains run on pneumatic tyres and the driving power is supplied by two 55 h.p. motors in each train.

On any railway system signalling is of the greatest importance and monorails are no different in this respect. At Disneyland a system of lights on the dashboard of the train show safe, caution and stop. If a driver ignores the signal to stop the brakes go on automatically.

Because the monorail track is usually high in the air to avoid busy city streets special plans have been made to carry passengers up to the higher level. At Disneyland high-speed elevators travelling at 125ft. per minute quickly lift passengers to the overhead stations.

During the one-mile journey through "Tomorrow Land" these monorail travellers cross the submarine lagoon and cross over the super-autopia highways. Finally the monorail track runs parallel to a track on which three 1890 locomotives steam up and down. A striking contrast between transport of the last century and the transport of the future.

A French Suspended Monorail

Another test track, this time using suspended monocars, has been built at Chateauneuf-Sur-Loire in France. A steel box rail forms the monorail track this time and all the electrically powered driving machinery is enclosed within the box rail. Maximum acceleration of the monorail cars on this line is 4½ m.p.h. and, when braking, the deceleration is even greater at 6 m.p.h.

Two braking systems are provided for maximum safety—one is vacuum operated and the other applied to the electric driving motors. Doors of the train will only open at a station and should the train break down between stations an escape ladder can rapidly be lowered from the floor of the train.

The trains themselves are made up of a power wagon and one or more trailers. At each end of the power wagon is a double-flanged wheel running on the top of the rail and two smaller wheels running on the side projections of the rail. Driving power is supplied by a 420 c.c. engine giving enough power for the unit to climb a gradient of about 1 in 18 when pulling a trailer. Maximum speed on the level is about 3 m.p.h.

The London Airport to Victoria Monorail

A very different type of monorail has been proposed to run between London Airport and Victoria Station. Known as the Air-Rail system, it would speed air travellers to and from London Airport in special pneumatic-tyred coaches travelling on an elevated concrete beam high above the congestion of the city beneath.

Special concrete beams would be used supported on columns and the route selected by the proposers of the scheme is alongside or over the existing tracks of the Southern Railway, passing through Clapham Junction, Putney, Barnes, Richmond and Feltham.

The most exciting feature of this proposed monorail system, however, is the monocars themselves. They would look rather similar to a Green Line coach except that they would have two sets of wheels. There would be the normal road wheels on which the coach could travel on the highway and another set of wheels beneath the centre of the vehicle which would run on the monorail beam track. As with the Alweg model the Air-Rail catch would straddle on the rail for stability and the monorail wheels would be in the interior of the coach with the passengers sitting above and on either side of them.

It is proposed that the coaches should be made of magnesium alloy and plastics, capable of carrying 50 seated passengers and travelling at the present time at speeds of up to 100 m.p.h.

At first it is planned to travel the full distance without intermediate stops. When the passengers arrive at Victoria they will not need to change coaches, for the monocoaches will then travel on their normal road wheels to the final destination.

As traffic increases there is no doubt that the demand for a fast, uninterrupted traffic system bringing passengers right into the central areas of our cities will grow. Perhaps the solution will be found in the monorail.

The trial car operating on the track holds 56 seated passengers, although with standing passengers 125 passengers can be carried.

The Monorail Transporter

Lest it should be thought that the monorail is entirely untried under modern conditions, mention should be made of the monorail transporter. Day in and day out it successfully carries practically every kind of material in climates ranging from the heat of the Equator to the freezing cold of the Polar regions.

This Monorail Transporter can often be seen carrying bricks and other materials across building sites. The track is made of 12ft. rails with a running head on the upper surface and a channel section at the bottom of each trail on which run the guiding and stabilising wheels.

This suspended Monorail Car is seen here running on the test track at Chateauneuf-Sur-Loire.

Part of the mile long Monorail track at Disneyland, California.

A Mechanical Teaching Machine

By Schoolmaster

MANY parents, teachers and others may want a teaching machine in order to aid youngsters in the junior school with their class work in English and arithmetic. The teaching machine described in this article will help a great deal towards this end.

A teaching machine is a mechanical device which when supplied with material called a programme will help a youngster to learn without an adult always being on hand to guide them. This article will show you how to make the machine and at the same time give a guide to the making up of programme material. A programme being the question and answer material made up for use in the machine.

The box shown in Fig. 1 is the machine ready for use. The left-hand window shows the question and the pupil writes the answer to this question in the right window. Pulling the lever at the back of the box uncovers the correct answer and working, if any, and the child can check his work against this answer. A turn of the handle at the side of the box brings into view a new question and blank answer paper, while at the same time the lever mechanism is released and a shutter covers the correct answer to the new problem.

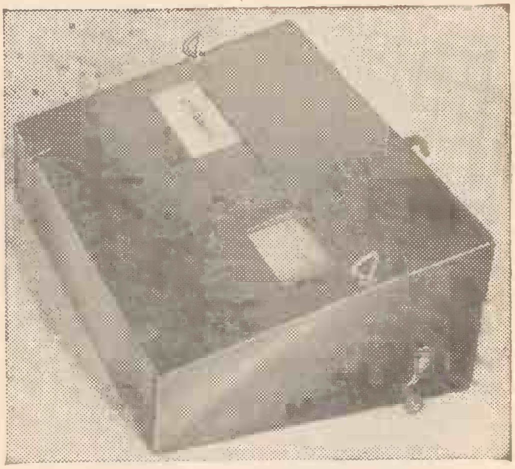


Fig. 1.—The completed machine ready for use.

Programmes

A programme consists of questions and answers so arranged that if they are properly graded the child can learn without the aid of adult supervision. To begin with I suggest that the machine should be used for revision purposes or in some part of a subject where the child has difficulty in grasping a certain point. For example, in arithmetic the child may have difficulty in understanding some point of his work. The technique involved is this: Write out a question and have the working and answer covered. The pupil works out the problem in the answer space and then pulls the back lever, which uncovers the correct response. The child's answer can now be compared. Incidentally, at this point the child's answer is covered by a sheet of clear perspex. This prevents any alteration of the pupil's answer and an honest comparison can be obtained. The next question can be similar to the previous one so that if the pupil is wrong then help has been given to him from the previous correct answer. If he is right then the next question is purely revision, and so it goes on.

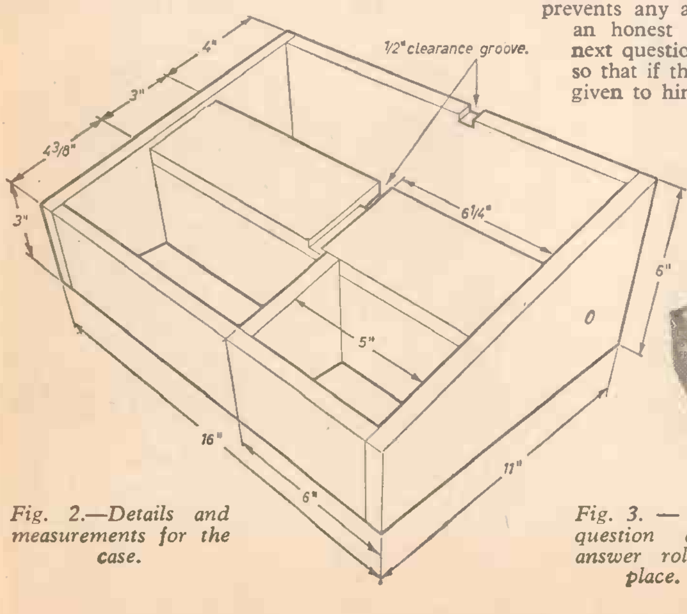


Fig. 2.—Details and measurements for the case.

Fig. 3. — The question and answer roll in place.

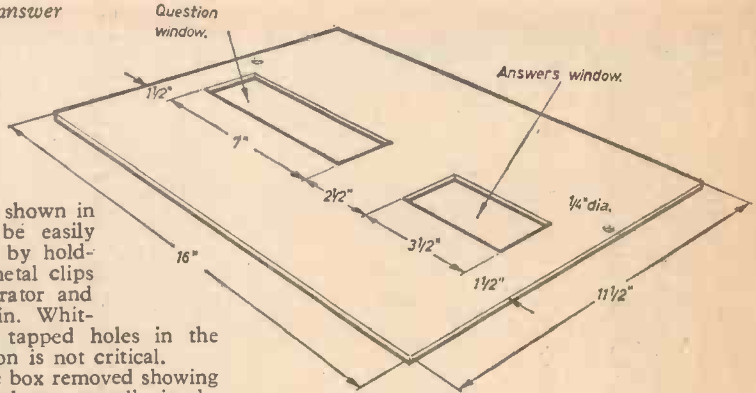


Fig. 6.—The question and answer windows.

Case Construction

The case (Fig. 2) is made from ½in. thick wood with an 18-gauge sheet metal top having the two windows cut out as shown in Fig. 6. The top has to be easily removable and this is done by holding it in position by two metal clips at the edge nearest the operator and two screws, in this case ¼in. Whitworth, which go into two tapped holes in the wooden frame. Their position is not critical.

Fig. 3 shows the top of the box removed showing the programme—question and answer roll—in the left-hand compartment and the pupil's answer roll in the right-hand one. The wooden bar in the centre is used as the writing baseboard (Fig. 4) and is almost level with the box edge. There should be a difference of about ⅛in. between them. This is enough to make sure that the paper is kept flat and still gives plenty of movement clearance.

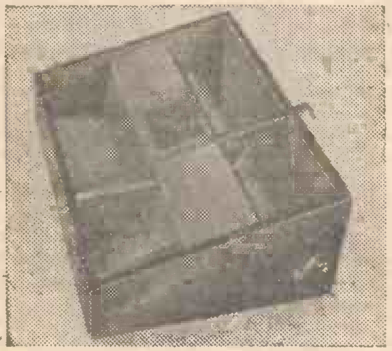


Fig. 4 (Left).—The writing baseboard across the centre, after rolls have been removed.

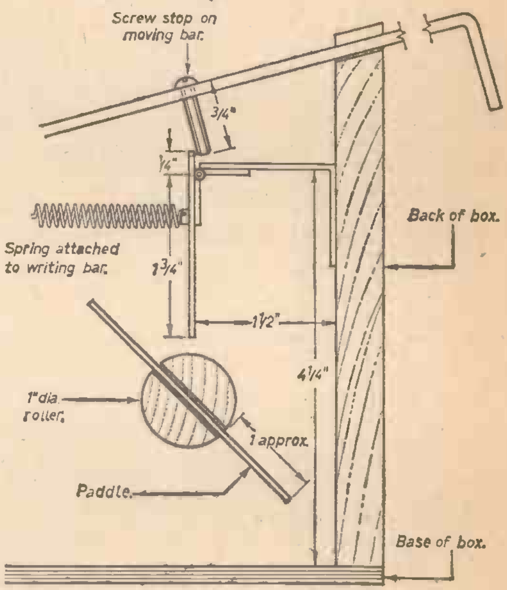


Fig. 7 (Above).—Details of the trip mechanism.

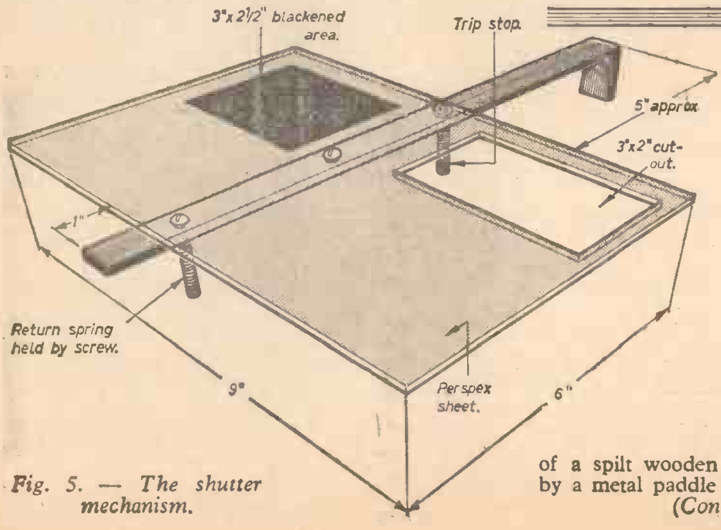


Fig. 5. — The shutter mechanism.

The long metal bar holding the thin perspex sheet moves in a groove in the wooden bar and also in a slot at the top of the box. The bottom side of the box acts as the return stop for the steel bar (½in. x ⅛in. cross-section). The bar is pulled back by a light return string attached between its underside and the box side.

Roller Mechanism

The take-up roller for the paper rolls (Fig. 7) consists of a spilt wooden roller, 1in. diameter, separated by a metal paddle under the metal bar.

(Continued on page 425)

FLASH DATA at your fingertips

by A.E.Bensusan

MANY flashguns, particularly the less expensive ones, carry no flash calculating systems at all. Some have a stuck-on label, often useless to the serious worker because its recommendations would result in drastic over-exposure.

In order to overcome this lack of data where my own flashgun is concerned, I settled for a double chart method which can be used to give not just the guide numbers but also the related distances and apertures which are, of course, the actual requirements. My flashgun, a Danish-built Elwis, has two slightly sunk panels and so I made use of them. However, the charts are small enough to be attached anywhere on the plastic moulding of the unit.

Since I rarely use anything other than a No. 1 bulb, the data was assembled only for that size. Anyone using the No. 5 and 1B or Atlas Double-lite as well, could have smaller charts located together or in different places on the flashgun. The table of guide numbers printed on a flashbulb pack was copied with a 35mm. camera, fitted with a No. 2 supplementary lens at the closest setting of $12\frac{3}{4}$in. The negative image was enlarged to a print size of $\frac{5}{8}$in. x $1\frac{5}{8}$in. The figures are quite bold enough to be read in even dim lighting.

The second chart was made by listing vertically along one edge, all the guide numbers appearing on the first chart. Against them were put all the distances engraved on the camera lens scale. A few minutes' calculations in dividing the distances into the guide numbers resulted in a complete set of aperture numbers. These were rounded up to the nearest half of whole stops, and the entire chart was typed on white paper with pencil lines between the columns.

A second copy negative was made as described earlier and, this time, enlarged to $\frac{1}{2}$in. x $1\frac{3}{16}$in. The glossy prints were cut out and attached to the flashgun with rubber cement, a coating being allowed to dry undisturbed on the charts and on the plastic before pressing the charts into contact.

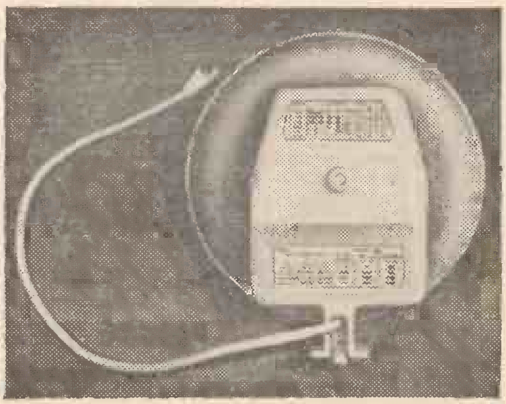
Should the flash guide numbers be changed as a result of bulb modifications, it will be a simple task to peel off the charts and substitute a revised set. Until then, they will remain firmly fixed.

GUIDE No.	DISTANCE (FEET)							
	3½	4	5	6	8	10	15	30
55	16	14	11	8	7	5·6	4	2
75	22	18	16	11	9	8	5·6	2·8
110	32	28	22	18	14	11	8	4
150			32	22	18	16	11	5·6
220				32	28	22	16	8
300						32	22	11

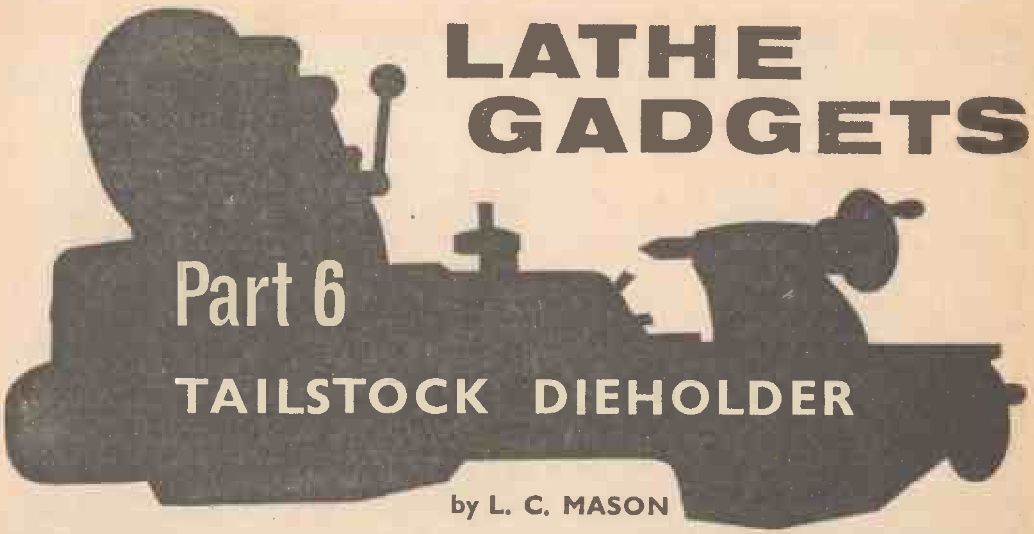
The second chart.

Anyone wishing to prepare a similar set of charts should relate the copy negative image size to the magnification possible with the enlarger. Few enlargers will work right down to "same size", and the degree of enlargement in my own case was only in the region of x1·5. Difficulties in this direction may be overcome by making the camera to subject distance greater, the negative image size will then be smaller and the required enlarger magnification correspondingly greater.

Being able to read the appropriate guide number for given film and shutter speeds off one table, relate it to the distance indicated on the lens mount by means of the table, and instantly have the aperture, makes flash work far easier and more accurate. No loose papers, cards or calculators, everything is right there on the flashgun.



The author's Flash apparatus is shown above with both charts in place.



LATHE GADGETS

Part 6

TAILSTOCK DIEHOLDER

by L. C. MASON

THE great value of a tailstock dieholder for obtaining threads truly square to the job is shown by the fact that several different examples are available commercially.

The simplest type is a holder in one with a morse taper shank to fit the tailstock barrel, calling for the complete tailstock to be slid along the bed to present the die to the job. A slightly more elaborate version has its own arbor tapered to fit the barrel at one end, and providing a few inches of parallel portion projecting. The holder takes the form of a sleeve sliding on the parallel portion of the arbor, so that the tailstock can remain solid on the bed. In some examples, the sleeve type holder is made double-ended, so that two sizes of die can be dealt with.

The one shown in Fig. 1 offers a number of advantages, in that it can accommodate three sizes of die, needs no separate arbor of its own, is used with the tailstock clamped on the bed, and can utilise the tailstock calibrations to indicate the length of thread cut.

This also is a sleeve type, but slides over the extended end of the tailstock barrel itself. Length of thread cut can be read off the tailstock calibrations as the back end of the holder uncovers more of the scale as it moves towards the chuck.

Two of the three sizes of die are carried in mild steel adaptor rings on the ends of the holder body. The normal small $\frac{13}{16}$in. die carrier occupies one end, while the other caters for 1in. and $1\frac{5}{16}$in. dies. The ML 7 tailstock barrel is 1in. diameter, and the body of the holder is bored an easy sliding fit on this. With this size bore, a $\frac{13}{16}$in. die needs an adaptor of some sort. Accordingly, the adaptor here takes the form of a false end to the holder, having a $\frac{1}{16}$in. thick flange behind the die, and being spigoted into the bore of the holder. It is held by two screws into the oval end face of the holder.

At the other end of the holder used for the bigger dies, the $1\frac{5}{16}$in. size die can be accommodated direct in the bored out end of the holder. As will be seen, the end of the holder is thickened out for this and the usual three adjusting screws. For 1in.

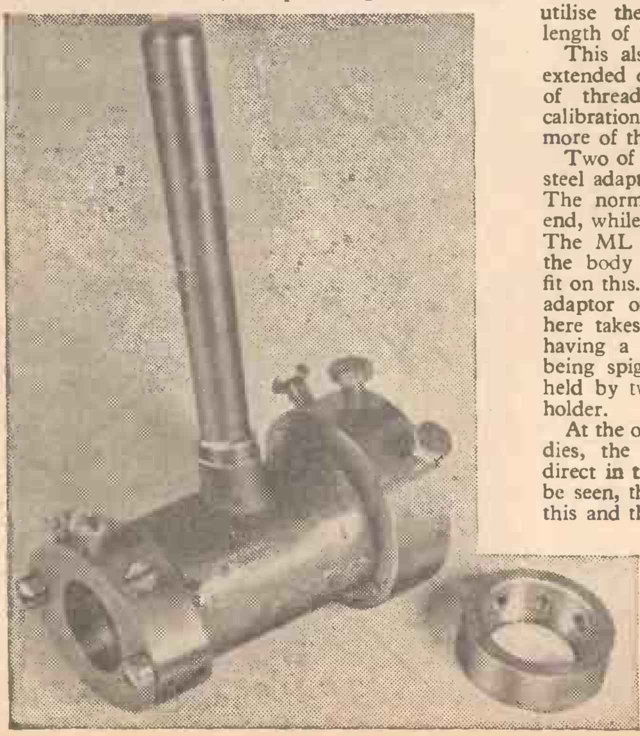


Fig. 1.—Tailstock dieholder, with large die adaptor ring removed.

dies, although these would fit direct into the 1in. bore of the holder, they still need an adaptor of some sort to prevent them being pushed back into the 1in. bore. A mild steel ring is therefore provided, fitting the $1\frac{5}{16}$in. hole and bored out 1in., having a $\frac{1}{16}$in. thick flange behind the die to locate it endwise. This ring is held in place by the three adjusting screws tapped through the end of the holder. If fits are good, the ring will be held perfectly flat when the screws are run through it to bear on a 1in. die.

Most model engineering work will probably call for the use of a $1\frac{3}{8}$in. die for the greater part of the time, so the large adaptor ring can be left out till it is required to use a 1in. diameter die. To use either of the larger size dies, the holder is slipped over the tailstock barrel small end first, so one screw holding the small adaptor is removed, the other slackened off and the adaptor swung round clear of the bore.

In the writer's experience, when a steel rod held in the chuck requires a coarse thread needing a large die, it is rarely possible to hold the rod tightly enough to thread it completely with the tailstock die. However, the ability to use the larger size dies is well worth while through being able to "chase up" a screwcut thread, where only a shaping up of the thread is involved, or to start a complete thread truly square. Some brasses and light alloy can generally be threaded complete.

The body of the casting was in this case machined up from an iron casting, having the centre bore cored out to $\frac{3}{4}$in. The pattern is about the simplest form possible, being a plain turned wooden cylinder in one with the two symmetrical core prints, split along the centre line, and loosely dowelled. The small boss for the operating handle was merely a stub of $\frac{1}{2}$in. dowel glued in a hole drilled in the pattern.

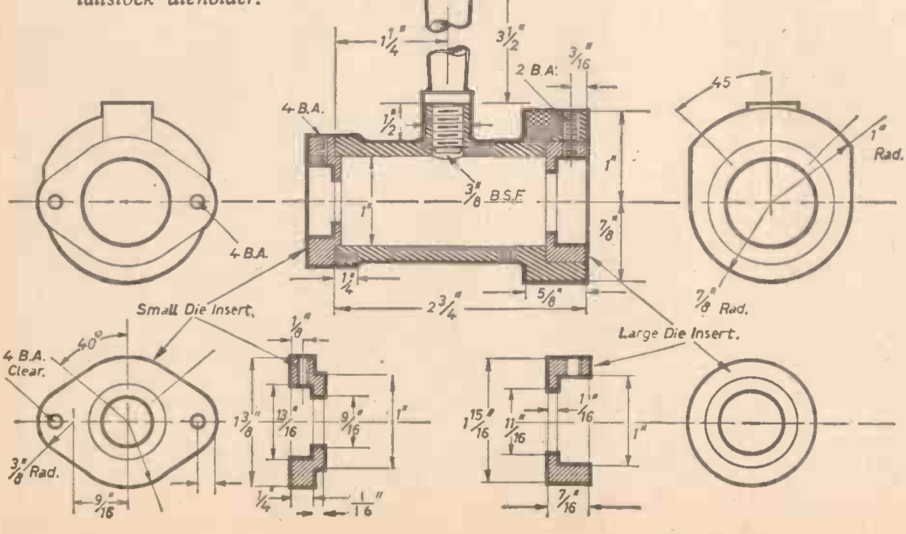
For those who might prefer to machine the whole thing out of the solid, a short end of 2in. steel shafting would provide the material. The

two different radii at the large end are by no means essential, and the end could very well be left circular of 2in. diameter. Where the boss comes in the casting for the handle, the bar could be left the full 2in. diameter in a belt $\frac{1}{2}$in. wide, when a ring of knurling round it would provide adequate hand grip for using the small dies. A $\frac{3}{8}$in. tapped hole could accommodate the handle when necessary.

All the machining on the casting was done in the four-jaw, facing the large end first to provide a flat surface to back against the chuck while boring. Cuts should be light on account of the fair overhang. Then came boring, small end outwards. The turned portions of the small adaptor were turned next in the three-jaw, fitting the spigot to the completed bore, and the adaptor fitted to the bored end of the holder. The casting with adaptor attached was then offset in the four-jaw to machine the larger radii on both adaptor and holder, the smaller curves round the screw holes being finished by hand. The adaptor was removed, the casting reversed in the chuck, and the outer surfaces of the large end machined, with the $1\frac{5}{16}$in. bore

With the large adaptor machined to fit the $1\frac{5}{16}$in. hole snugly, clamp the adaptor ring in place with a bolt and washers through the bore and drill and tap for all three 2B.A. adjusting screws through holder and end ring together. The threads will thus line up, and after removal of any burrs removal and replacement of the ring is a matter of seconds. Constructional details are given in Fig. 2.

Fig. 2.—Constructional details of tailstock dieholder.



Changing Heat to Electricity

Power Plants of the Future

By R. J. SALTER, B.Sc. (Eng.) Hons.

DURING the past few years scientists and engineers have been busy developing new sources of electricity for use in remote under-developed areas of the earth and also for use in outer space.

For long the field of the research scientist these devices which can change heat directly into electricity without the need of steam raising plant, turbines and generators, have recently developed into practical power plants.

One way in which heat is changed directly into electricity is by the thermionic generators. Without moving parts these generators consist of thermocouples which are composed of two dissimilar metals joined in a closed circuit.

When the two metals of a thermocouple are kept at different temperatures the atomic structure is disturbed setting up a flow of electrons or an electric current.

A thermionic generator of this type has now been produced for commercial purposes by the Westinghouse Electronic Company. It will produce 100W and the Northern Illinois Gas Company will use it to neutralise corrosion in natural gas pipelines and to power pumping station equipment.

A small electric fan can be operated when a flame is applied to a thermionic converter approximately 1in. dia. A thermionic converter, which can be used to transform energy directly into electricity, "boils" electrons out of hot metal.

The generator has a height of 2ft, weighs 75 lbs and the heat which is changed to electricity is provided by gas burning at the bottom of a chimney which passes through the generator.

An alternative to gas is the use of radioisotopes which decay spontaneously creating heat. Because the rate of decay of these materials is fixed by nature they provide a dependable source of heat which does not require any supervision.

Using a heat source such as this coupled to thermionic generators a dependable supply of electricity can be obtained over a period of many years without any attention at all. Because of this great dependability a radioisotope powered thermionic generator was chosen to power the instruments of an automatic weather station which has been put into operation on Axel Heiberg Island in the most northerly part of Canada.

Heat is supplied by about a pound of strontium-90 which is converted directly into five watts of electrical power. For the sake of safety the strontium-90 has been prepared in an insoluble, nearly indestructible form and enclosed in a lead case and an outer case of stainless steel. Special care has been taken so that in the case of accident the radioactive unit will not break open.

This power unit operates a radio transmitter which reports automatically the readings of an anemometer, thermometer and barometer every three hours.

Experts believe that most of the word's weather is born in the polar regions where manned weather stations would be impossible. Automatic weather stations such as this one can go on operating for years sending out a continuous stream of information.

Yet another of these thermionic generators was built into the U.S. Transit IV-A navigational satellite. This time the heat producing fuel is plutonium-238 which will keep working for several years, producing in five years as much power as five tons of conventional batteries. It is planned to launch four of these navigational satellites so that eventually any ship or aeroplane making electronic contact with them will be automatically given its latitude and longitude.

Another down to earth application of the direct change of heat to electricity has been made by Allis-Chalmers who have developed a tractor powered by just over a thousand fuel cells. The fuel cell transforms heat given off by the combustion of a mixture of propane gas and oxygen directly into electricity.

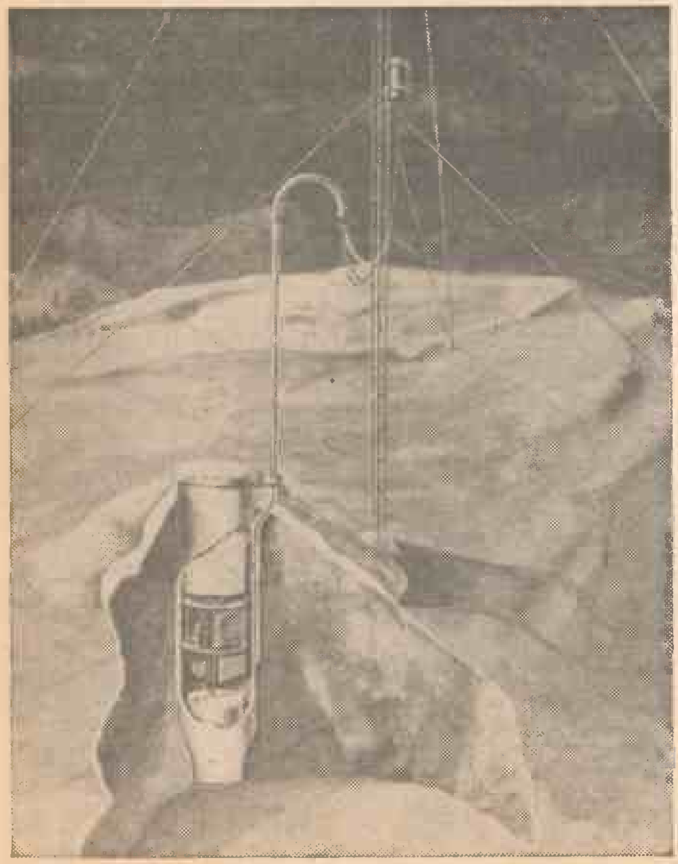
The tractor is of commercial size and is capable of ploughing with normal equipment but it is only being used for research purposes.

Driving power comes from a standard 20 h.p. direct current motor driven by the thousand and eight separate fuel cells. They are joined in 112 units of nine cells each, the units being arranged in four banks so that electricity can be taken from any combination of the banks. The fuel is fed from cylinders mounted on the vehicle and fed into the cells by a series of tubing.

As with the accumulator the fuel cell has electrodes and an electrolyte. The ordinary accumulator stores electricity in the cell and has to be recharged whilst the fuel cell does not need to be recharged because it instantaneously converts chemical energy to electricity energy as the fuel in the form of a gas is fed into the cell.

A farm tractor is not a very exciting beginning for the fuel cell but it is a start with a very revolutionary power source. A great deal more work can be got out of the fuel cell than out of the internal combustion engine because the fuel cell remains cool.

These are just a few of the devices which are being developed to change heat to electricity. Practical applications of scientific discoveries made many years ago.



The cutaway drawing shows the first atomic powered weather station in a remote area north of the Canadian mainland. The station is partially buried in the frozen earth.

(Photo courtesy U.S. Information Service)

A HOME CHARGING PLANT

By L.R. REPAGE

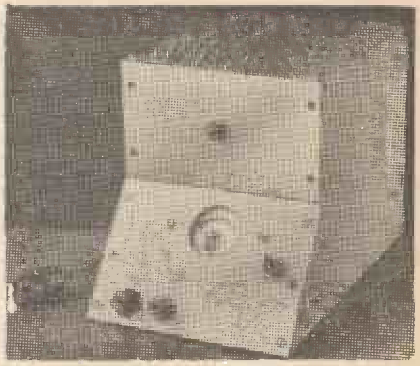


Fig. 2.—The completed plant ready for use.

AN accumulator charger is a very useful instrument to have available in a workshop, amateur electroplating is an interesting field which can be explored by means of such electrical apparatus. It is of course necessary for converting the alternating current at high voltage, down to a low voltage direct current and as A.C. current is now more or less universally used, the transformer and rectifier system must be used.

Components

In constructing this instrument, the circuit has been kept as simple as possible, at the same time including one or two items to give an extra safety factor. It was for this reason that a photoflood photographic lamp was wired in series with the primary of the mains transformer. This lamp is a safeguard against serious overload and does not reduce the normal performance in any way. Should a short occur in the primary then this lamp would light up and indicate something was wrong. Also a small neon lamp was included across the primary and gives the necessary red glow immediately the apparatus is switched on.

As can be seen in Fig. 2, the finished instrument, with its sloping panel has a neat appearance. The panel and baseboard with all the components thereon forms the nucleous of the charger, whilst the protective cover is made to fit and is screwed to this baseboard. The panel and detachable cover was almost entirely constructed of standard sheet Formica. This material is an excellent insulator and is dampproof too. Fig. 1 shows the chassis and the wiring to the components. For simplicity of illustration this wiring has in some instances been shown extending beyond the chassis. The wiring will of course be much shorter and direct in

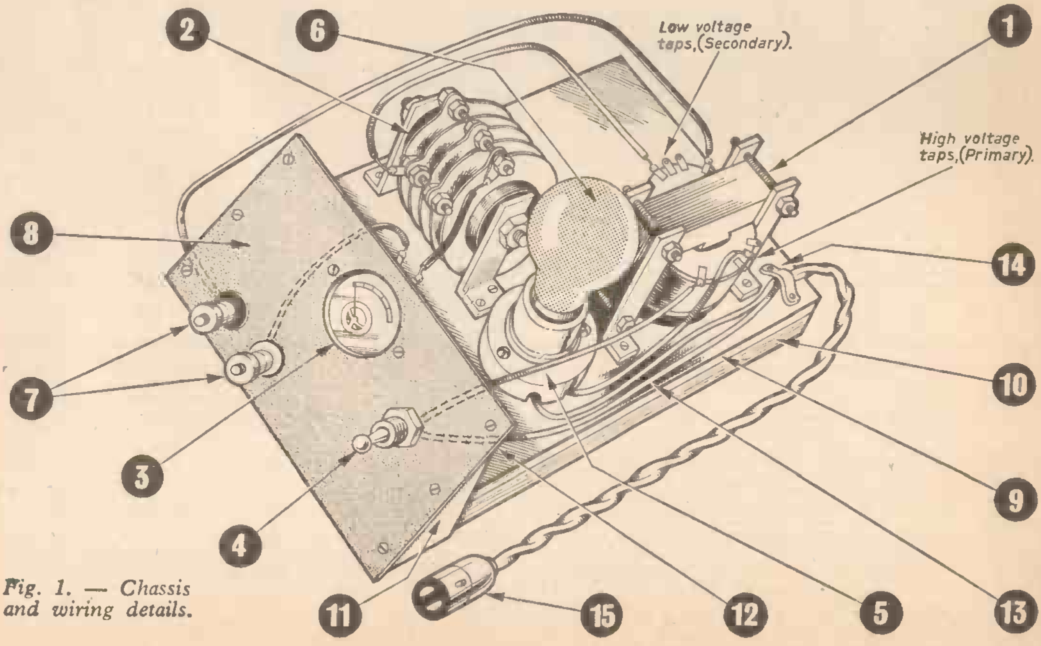


Fig. 1. — Chassis and wiring details.

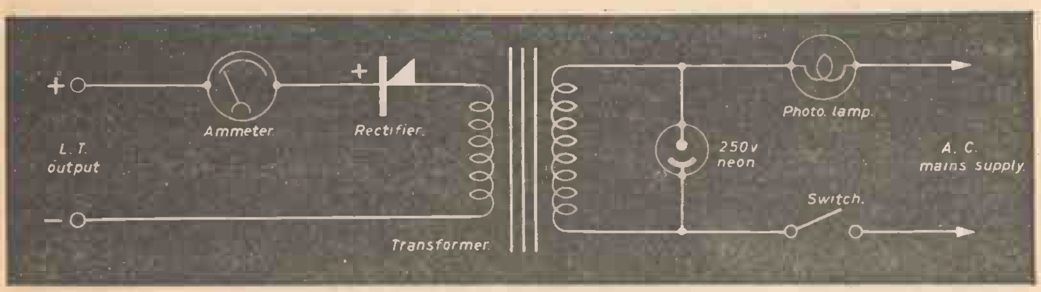


Fig. 3.—The theoretical circuit diagram.

practice. All wiring should be good quality heavy gauge lighting flex. Soldering is preferable and if insulated terminals are used on the transformer, soldering tags may be put on first and the wire connections soldered thereto.

Mains Transformer

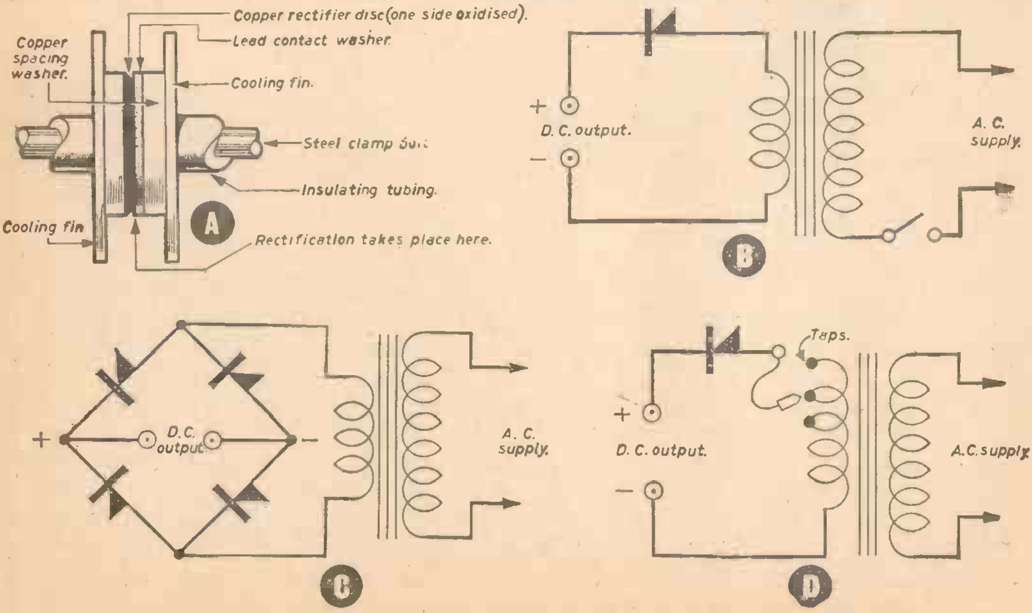
Only stout gauge secondary winding is used for this (see (1) in Fig. 1) and according to the components used this may be in the region of 3·5V, 9V, or 17V. There is always a drop in voltage when a rectifier is in series and this should be allowed for when purchasing the transformer for any particular voltage output. If an existing transformer has also a high tension secondary, this must not of course be used and must be carefully taped up with insulating tape to avoid accidents. Transformers are always clearly marked by the manufacturers on terminals, or against the tags, usually in voltages. The one shown in Fig. 1 is hardly likely to tally with its connections, so should not be taken as correct for all transformers. Great care should be taken to see that the primary and secondary windings of the transformer are correctly wired to their respective circuits.

The Rectifier

This is shown in (2) in Fig. 1 and it is this of course which changes or converts the low voltage A.C. in the secondary to direct current. The model shown in Fig. 1 is an old one connected to give simple half wave rectification. The ammeter is shown at (3), this indicates the rate of charge. Models vary so the diameter and fixing arrangements will determine the panel and fixing holes.

A mains type toggle on/off switch is shown at (4) in Fig. 1, it has to carry the full 250V main current, so a light type must not be used. Part (5) in Fig. 1 is a batten type electric lamp holder and (6) shows the 250W photoflood lamp. As has been explained this acts as a safety series resistance, but only glows slightly. Part (7) shows the terminals. These should be clearly marked with coloured discs showing correct positive and negative terminals;

Fig. 4.—(A) Single rectifying unit; (B) Half wave rectification; (C) Full wave rectifying arrangement; (D) Half wave circuit with wander plug.



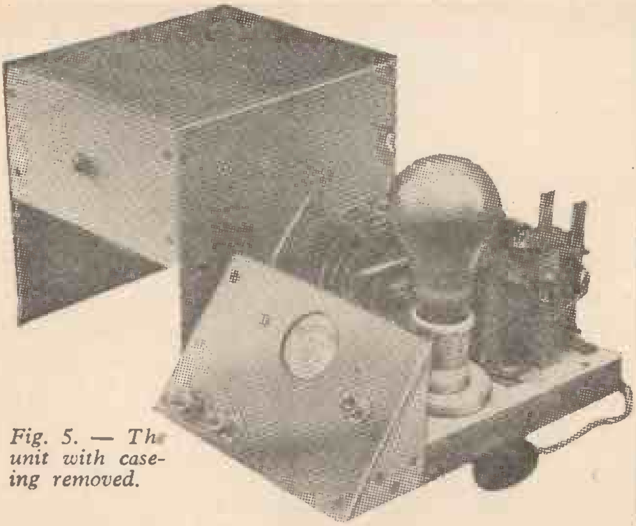


Fig. 5. — The unit with case-ing removed.

MATERIALS REQUIRED

1 Mains transformer (charging type) of required amperage.
1 Metal rectifier rated as per mains transformer amperage.
1 Ammeter, panel fixing type, say 1-5 Amps.
1 Mains type 250V toggle on/off switch.
1 Batten type lamp holder.
1 Photoflood lamp 250W.
2 Heavy Duty terminals.
1 Mains 250V neon complete in mounting.
1 Sheet of Formica 1ft 6in. square.
4 Dozen brass c/sk. screws, ¼in. No. 4.
2ft Length of ⅜in. x ⅜in. strip wood.
1ft 6in. length of 1in. x ½in. strip wood.
1 9in. x 6in. piece of ½in. 5 plywood or ½in. hardwood.
Length of mains rubber covered flex.
Expandable metal—6in. x 9in. (Light alum. type.)

(8) is the sloping control panel of Formica and (9) the ½in. thick hardwood platform; (10) shows the side pieces or battens, 1in. x ½in. hardwood; (11) is the angle supports for the control panel and (12) is the platform covering. The latter two are made from Formica. Part (13) shows the flexible insulated wires from mains to switch, series lamp and primary winding of transformer. These can be bunched together and fixed to baseboard as at (14), with a small shaped clamp. Part (15) shows a two pin plug, mains type.

Construction

The details for the construction of the chassis, the sloping panel and the detachable cover are clearly shown in Fig. 2. The sloping panel is fixed to the platform by means of two Formica angle pieces, which are fixed to the platform by three screws. After cutting out the Formica sides, back and vertical panel, the ⅜in. x ⅜in. strip wood is first glued to the sides by Evo-Stik and screwed from outside, though this may not be necessary. Note that there is a right and left hand side and the ⅜in. square stripwood will have to agree each side. When completed it will be found best to screw each side piece to the platform, then screw on the back and finally the vertical panel. A final trim-up may be necessary here to make this seat nicely against the sloping panel. The light expandable metal panel can then be fixed to the top ⅜in. wood surround by four screws. This gives the necessary ventilation although not much heat should be present if the circuit is working correctly. In the prototype the small 250V neon indicator was fitted in the centre of the vertical panel. This has proved a trifle inconvenient when removing the cover. It might be preferable to fix the indicator to the sloping panel above the on/off switch.

(Concluded on page 425)

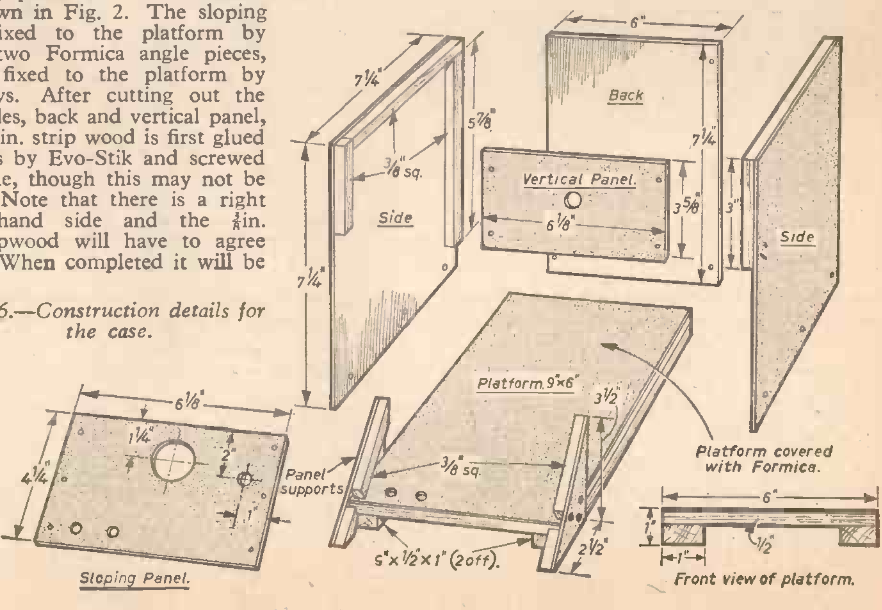
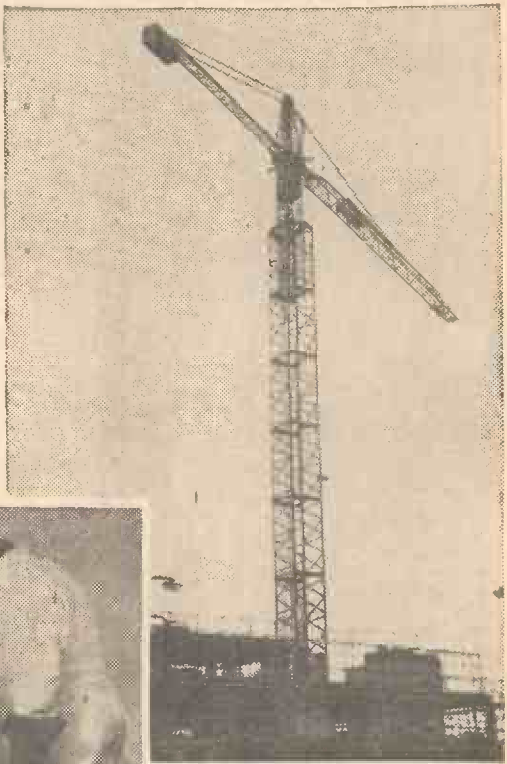


Fig. 6.—Construction details for the case.

SCIENCE NOTES



Up to 381 Feet

A PIGNON French Crane that was specially designed for multi storey buildings in France is operating at The Elephant and Castle on the Site of the new 13 storey L.C.C. School of Printing and Graphic Arts. It is the first of its type to be used in this country and it can lift loads up to 10 tons, and when fitted with special anchorage can be raised to 381ft which would make it one of the highest in the world.

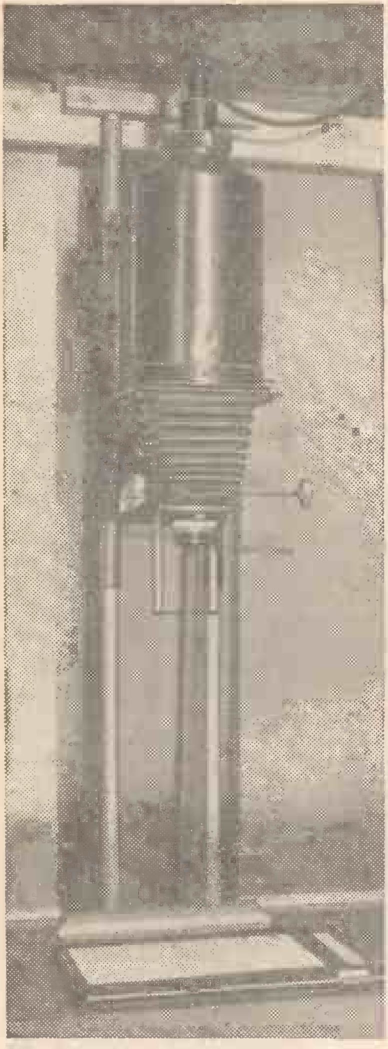
Apprentices Build Their Own Hovercraft

EIGHTEEN apprentices have designed and built their own Hovercraft as part of a training scheme at the English Electric Aviation Company at Stevenage New Town, Herts. With one of the apprentices at the controls the hovercraft was given a test flight during which it carried out many manoeuvres.

Council Flat Astronomer

WHEN twenty-four-year-old Mr. Edward Hobby, returns to his home on the Sumner Estate, Peckham, London, after work each day, he goes to the balcony of his flat and has a look at the moon! Mr. Hobby is a very keen amateur astronomer and he uses a 6in. Telescope he made from ex-surplus equipment. All he is waiting for now is the first flight to the moon, which he should be able to watch from his balcony.

A TWIN COLUMN ENLARGER AND COPYING STAND



The completed apparatus set up ready for use.

Enlarger head showing negative stage and carrier.

Enlarger head mounted on the brackets.

THE essential requirements of an enlarger are first that the negative, lens panel and baseboard shall all be parallel and their centres shall lie on a straight line at right-angles to their planes; second that the illumination of the image on the baseboard shall be even. If these two conditions can be fulfilled there is no reason why any handyman cannot make an efficient instrument which will be stronger and cheaper than a commercially available one.

The most generally used type of enlarger is the vertical one and the components for constructing it *can* be purchased separately, but it is more fun and cheaper to make everything onself. The piece of equipment to be described is completely home made and, with the exception of the milling in the focussing parts, can be readily built with a few tools and a vice. It is robust, all-metal and will accommodate negative sizes up to 3¼in. x 2¼in. The head runs on twin columns for extra stability and is counterbalanced for ease of manipulation; it can be removed to make available the remainder of the enlarger as a copying stand.

Construction

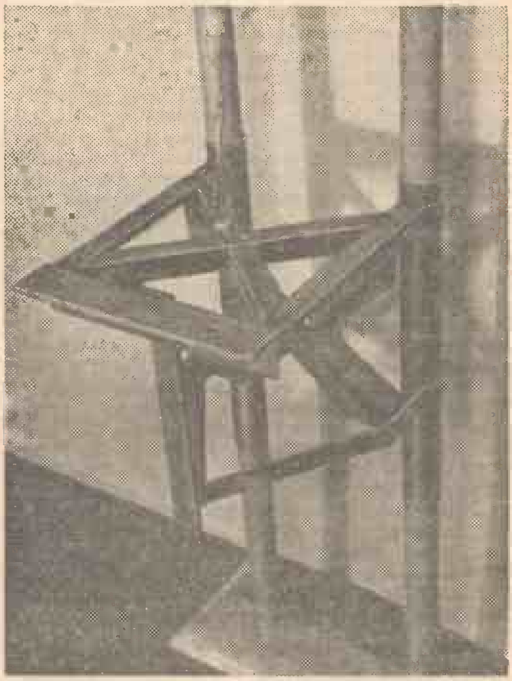
The bracket holding the enlarger head runs vertically on twin 3ft. 6in. length columns of ¾in. o.d. electrical conduit. These are galvanised—which ensures freedom from rusting—and are not chromium plated as is usual in most enlargers, thus minimising any chance of stray reflections. The bracket is made from 22 gauge brass tubing which is a very easy sliding fit on the conduit. A lacework of 20 gauge brass ½in. angle is built up on the cantilever principle with a piece of 1in. x ⅛in. steel angle to act as a support for the actual enlarger head. A length of ½in. x $\frac{3}{16}$in. brass strip extends vertically downwards from the 1in. angle and provides for critical adjustment of the head when finally truing up. As can be seen, the author's own model is a permanent installation, but if the enlarger is to be transportable the support of the twin columns can be modified. The bases of these columns are clamped 5in. apart in a piece of wood screwed to the baseboard and they are also firmly held at the top between two pieces of wood which have half a hole scooped out for each tube. (This is most easily achieved by holding the pieces of wood together in a vice and drilling the ¾in. holes along the dividing line; the pieces are then separated and a few shavings taken off the inner

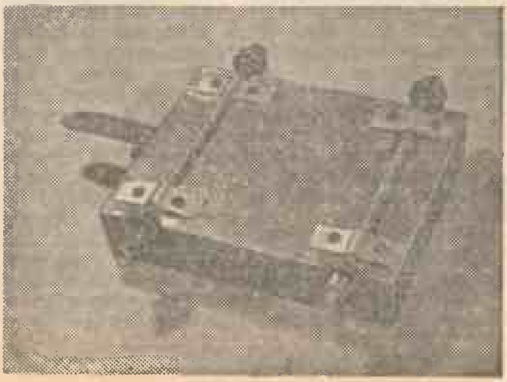
(Above).—A close-up of the focusing movement.
(Above Right).—The condenser unit.

edge with a plane.) Running down from the back of the columns' upper support are two lengths of ½in. x ⅛in. steel angle which are secured at their lower ends to an extension of the baseboard. Obviously the greater this extension the more stable will be the enlarger. These lengths of angle serve a dual purpose as they also act as guides for the counterbalance weight.

Enlarger Head

The head consists of the negative stage, focussing unit and lens panel, condenser mount and lamphouse. It is built around the negative stage and so this latter must be really tough to bear the weight and strain imposed on it: ¼in. thick Dural or brass is recommended. A rectangular hole is cut—large enough to accommodate the maximum size of negative to be used (in the example shown this is 3¼in. x 2¼in.)—and this hole is arranged off centre to allow room at the back of the plate for the parallel rods carrying the lens panel; these are lengths of ⅜in. stainless steel with a "flat" filed along their length and are held to the underside of the ¼in. plate with c/s ¼in. bolts. The lower ends are rigidly held by a piece of 16 gauge brass strip. The lens panel is of ⅛in. plate and it runs on the rods, being held in position at any point on its travel by the sprung rubber-covered rollers sunk in the two bearings. The rollers have square central holes which are a tight fit (a slight taper helps) on to similar square pieces of brass soldered and bolted on to a ⅛in. hard brass rod which protrudes to the right of the enlarger and has a tapped disc and locking nut to serve as the focussing knob. The lens panel is tapped to take a suitable lens flange held on by c/s 4B.A. screws. The lens used should have a focal length approximately equal to the diagonal of the aperture in the negative stage (i.e., about 4¼in.) and should preferably be one designed for an enlarger, although a camera lens *can* be used. A 4B.A. rod is screwed into one of the rear corners of the lens panel and holds a plastic red filter which can be swung into position beneath the lens.





(Centre Right).—Bracket for enlarger head.
(Right).—The counterbalance weight.

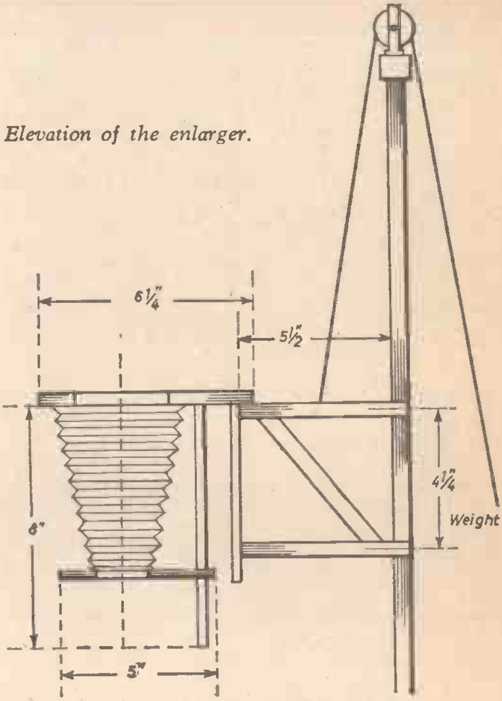
Lamphouse

The negative carrier consists of two pieces of thin, optical quality 5in. x 4in. glass—old glass negatives will do after the emulsion has been removed by soaking in hot caustic soda solution—with a strip of adhesive plaster along one of the long edges to give a book-type holder. The condenser mount is a 6in. x 4in. piece of 16 gauge brass having a hole cut in it the same size as that in the negative stage. It is hinged to the latter at the rear, leaving a ¼in. gap when parallel to the stage. A piece of ⅛in. ebonite is screwed to the underside of this plate, again with a 3¼in. x 2¼in. aperture cut in it. The purpose of this is to admit of its use as the top half of a glassless negative carrier, a similar piece of (loose) ebonite forming the bottom half in place of the glasses.

Soldered to the top of the condenser mount is a ring of 1in. 16 gauge brass strip which admits the base of the lamphouse as a snug fit. Two 1in. 6B.A. bolts are fixed at the front and rear as locking screws for the lamphouse when it is in position. The lamphouse itself is a large cylindrical container with the bottom removed and should be at least 5in. in diameter. Ventilation holes are drilled at the shoulder and an annular ring situated ½in. below these provides an efficient light baffle. The lamp is held vertically in a brass lampholder soldered to a length of brass tubing which passes through a suitable lid in the tin; vertical adjustment of the lamp position gives even illumination on the baseboard at any degree of enlargement. At the base of the lamphouse is a pair of 4½in. diameter glass condensers in a condenser mount. The latter is a shallow tin with a large hole cut in the lid and base, the two lenses being separated about ¼in. to allow for expansion when warm and held in this position by a spacer. The author's condenser mount is home made, but this item can be purchased. It lays on the hinged plate and is held in position by two 1in. 6B.A. screws passing through the aforementioned ring and also through the lamphouse—slots being cut in the latter to allow of this. The weight of the lamphouse assembly is sufficient to keep the negative quite flat when inserted in the carrier, the latter being easily accessible merely by raising the upper part of the hinged unit.

The enlarger head is bolted to the bracket by means of two r/h ¼in. B.S.W. bolts. To a suitable point on the bracket is secured one end of a length of flexible steel wire which passes over a clothes line pulley at the top of the columns and is then taken down to the counterbalance weight. The weight itself is made from scrap lead heated in an iron dish and poured, when liquid, into a mould made from sheets of asbestos held in place with, say, house bricks. The size of the weight depends on the amount of lead required to counterbalance the head and bracket and these two should be weighed together on the kitchen scales. As the weight is designed to move on the inclined steel angles at the back of the enlarger a factor must be used to divide the weight of the head plus bracket based on the angle of inclination of these runners to the vertical. Knowing the density of lead (about 11·4), the required volume can be calculated from the formula:

Elevation of the enlarger.



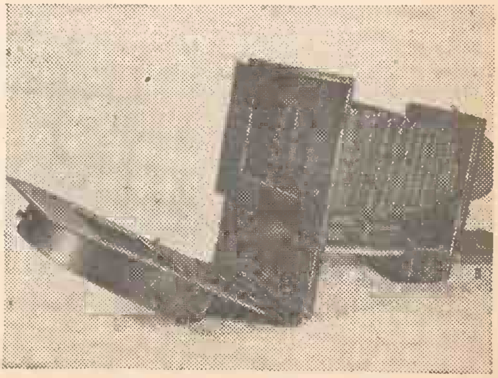
$$W = \frac{a \times b \times c,}{5260}$$

where W is the weight of lead required, and a, b, c are the three dimensions of a rectangular block. W is in ounces and a, b, c are in inches. If the weight of the combined head and bracket is M, and the angle of inclination mentioned above is y then,

$$W = \frac{M \times d;}{\cos y}$$

if the height of the twin columns is d and the length of the inclined runners is e, then this can be expressed as

$$W = \frac{M \times d.}{e}$$



Another view of enlarger head.

The enlarger head.

Thus the dimensions of the actual weight required can be ascertained.

Meccano axles are fixed to the underside of the weight with small brackets and pulley wheels allow the weight to travel up and down the runners smoothly.

Truing Up

Before painting, all vertical parts are made vertical and all horizontal parts levelled with the aid of a spirit level, packing with washers on the retaining bolts being the easiest way of achieving this. The head can be adjusted in one direction by suitable packing between it and its support and in a direction at right-angles to this by placing washers at the lower end of the vertical $\frac{1}{2}$in. x $\frac{3}{16}$in. rod previously mentioned as being for this purpose.

All internal parts should be painted with matt black paint and the exterior parts in black "crackle."

Copying Stand

As has been mentioned, the enlarger is readily modified for copying work. The head is removed and a bracket carrying a camera locking screw is placed in position and bolted to the steel bracket. The camera can then be affixed with the lens pointing vertically downwards: if the camera is a single-lens reflex the viewing screen will then be in a convenient position by this arrangement. When used for copying—due to the difference in weight between that of the camera and the head—there will probably be a tendency for the bracket to move up the enlarger columns. This can be overcome in two ways: (1) the counterbalance weight can be made in two parts, one piece being removed when the camera is in position; (2) a locking screw can be incorporated in one tube of the bracket consisting of a short length of $\frac{1}{4}$in. brass rod bent at right-angles and tapped at one end, this end passing through a nut soldered to the tube. It should be noted that if the enlarger is not intended to be used for copying this locking device is unnecessary as there is enough friction inherent in the design of the apparatus to keep the enlarger head and bracket in any position on the columns whilst allowing fingertip movement when required due to the counterbalance weight. All the brass and Dural parts were obtained from J. Smith & Sons, St. John's Square, Clerkenwell, E.C.1. All nuts, washers and bolts were obtained from the same source.

Messrs. Woolworths sell the pulley wheel and the bellows were bought from Brunnings, in Holborn.

"Humbrol" matt black paint is sold by Boots Cash Chemists and almost any good paint shop sells black "crackle finish" paint.

The negative stage and lens panel are connected with enlarger bellows—*much* easier to buy than make—and the fabric of the bellows is stuck to the two plates with Evostick.

The stand being used for copying.

Automatic control system for oxy-acetylene cutting

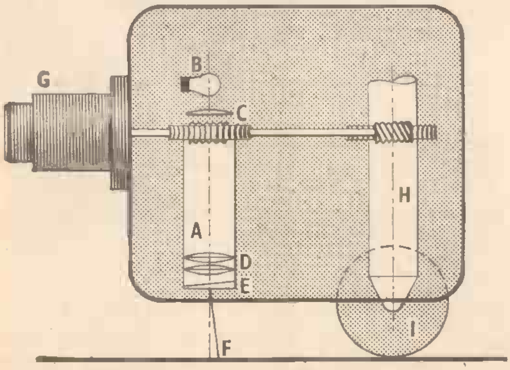
SPECIALISED designs of optical equipment have been devised to automatically control oxy-acetylene torches in order to follow the lines of drawings within the closest tolerances. Formerly the nearest approach to this was the direct following of a template, where the torch connected to a pantograph, traced a path identical to that of the part to be cut out. This meant that a steel template had to be initially prepared for the purpose and which was followed by a magnetic device to cling to its surface.

Complicated shapes, however, gave trouble and the process was frequently time-consuming and expensive.

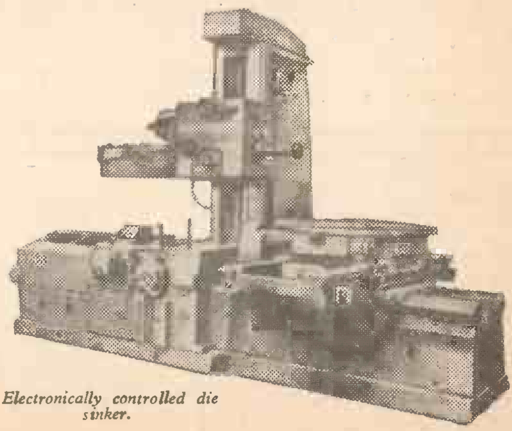
The latest photo-electric system "reads" the drawing by picking up reflected light from a light spot directed on to it and which in turn directs the tracer around the contour. The optical unit receives this light spot through prism and lens, as obtained from a lamp or light bulb with its own lens. Light is sent through the optical system from this lamp, which is mounted so that it is free to rotate about a vertical axis. This is so designed that the light spot is free to search in a circle when projected on to the tracing table. The steering motor is directly geared on the same shaft which steers the driving wheel to this optical system, whereby shapes can be reproduced by oxy-acetylene cutting which otherwise would be expensive and virtually impossible to make by steel template methods. Briefly, the photo-electric arrangement, whose operation is directed by the intensity of the light which it receives, governs the action of the motor that operates to change the direction of progress of the driving wheel. Should the light intensity received diminish, the system functions to cause the motor to steer the driving wheel and move the tracer in one particular direction.

The system operates the motor to steer this tracer in the opposite direction when the intensity becomes greater. When the point is reached where the intensity of light received by the photo-electric system is in balance the tracer continues moving in one direction—i.e., until such time as an alteration is again made in the light intensity.

In order to implement the action the tracer is linked up with gear wheels, using both right-hand worm and left-hand worm, so that clockwise or anti-clockwise rotation is obtained as the signal is received. As a rule the light from the lamp is deflected approximately $\frac{3}{32}$in. from the centre of the optical unit. The tracer is enabled to follow what are otherwise easily prepared drawings by this continuous searching of the electric eye for the contours or lines of the pattern beneath it. This system is probably seen to best advantage where a comparatively small number of shapes have to be cut, since by the earlier system the costs of preparing a steel template would virtually render it not worth while. Not only this but contours of which the template are incapable of reproducing offer no difficulties when prepared as a drawing, which the electric eye can "read" with ease and translate into systematic cutting, whereby the scope of the system is virtually unlimited.



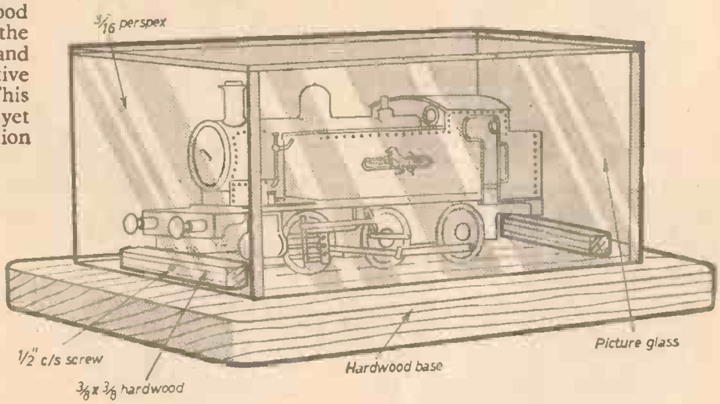
'A'—*Optical unit.*
'B'—*Light bulb.*
'C'—*Lens for light bulb.*
'D'—*Optical unit lens.*
'E'—*Prism.*
'F'—*Light spot.*
'G'—*Steering motor.*
'H'—*Tracer unit.*
'I'—*Tracer wheel.*



Electronically controlled die sinker.

A simply constructed display case

By T. S. LANE

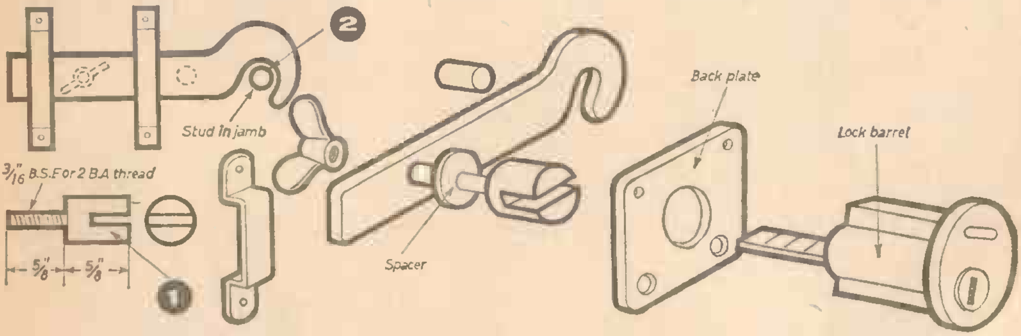


IF a display case is made in the traditional fashion by wood framing and glazing, the model is frequently dwarfed and obscured by the comparative massiveness of the case. This easily-made case is neat and yet strong enough to give protection to the model.

Two pieces of $\frac{3}{16}$ths perspex are cut of sufficient size to give adequate clearance of the model's height and width. These form the ends of the case and should be absolutely squared up. Drill a hole $\frac{3}{16}$ths of an inch from the bottom of each to take ½in. c/s head wood screw. Three pieces of thin ("picture") glass are cut to the length of the model plus a little for clearance. The top piece must be of such a width as to overlap the side pieces. A neater finish is obtained if the edges are rubbed down with a carborundum paste. The five pieces can be stuck together with clear Bostik and set aside to dry.

The base is of hardwood of about ½in. thickness. Two small blocks, the width of the perspex and ⅜in. cross section are glued to the base so that the case just slides over them. After the model is arranged in place on the baseboard, the screws are pushed through the holes in the ends and driven home into the blocks, so securing the cover in place. It is advisable to fasten the model securely to the base before finally screwing down the cover.

The locking problem of sliding doors



THE catch described here can be made up from material from the waste box. The lock barrel was a spare and the key was made by following instructions in the October, 1961, issue of this magazine. It should be noted that the bezel ring on the lock has to be left off as there is not otherwise enough clearance for the door to slide back.

Fitting of the lock proceeds in the normal manner for a Yale type lock. An inch-and-a-quarter hole takes the barrel which is held in place by two set screws which are cut to length to suit the door thickness.

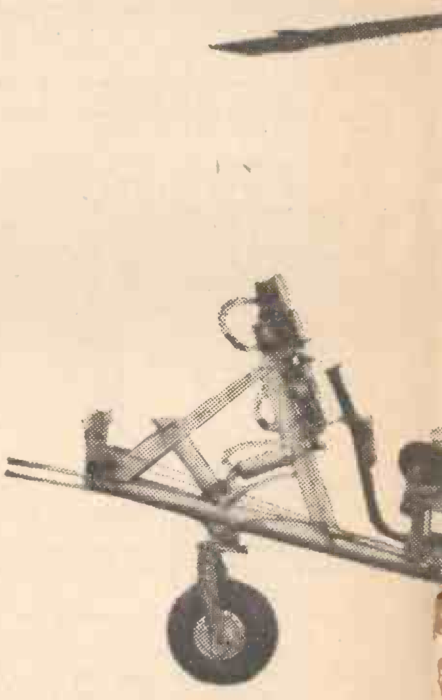
The part marked 1 in the drawing is a piece of rod 1¼in. long and of such a diameter as to be a sliding fit in the large hole in the lock back plate. One end of this is turned down to take a thread ⅜in. long. 2 B.A. was found to be about the size.

The catch is made of $\frac{3}{16}$th alloy or mild steel and is held in place by a wing nut. Two "keepers" of ¼in. wide strip limit its up and down movement. See No. 2.

When assembling the catch, the flat actuating strip connected to the barrel must be cut so that it just enters the slot cut in part No. 1. One or more spacers may be needed between this part and the catch. When the wing nut is tightened down it will be seen that the catch can be lifted from outside by turning the key in the lock. If the wing nut is tightened when the catch is in the locked position, it will be found that there is enough play in the lock mechanism to enable the catch to be lifted from the inside.

A ONE MAN AUTOGYRO

Control stability can be a pr
W/C Wallis has achieved a re
which he flies happily (cent



DESCRIBED BY R. F. WINKLEY

THERE is considerable scope in this country for a small, single-seat lightweight autogyro, as there are many military and civil applications for which this type of rotating-wing machine can be used. These could include aerial dispatch service, photography, light cable laying, agricultural use, fishing and whaling observations, surveys, road traffic control and the inspection of power lines.

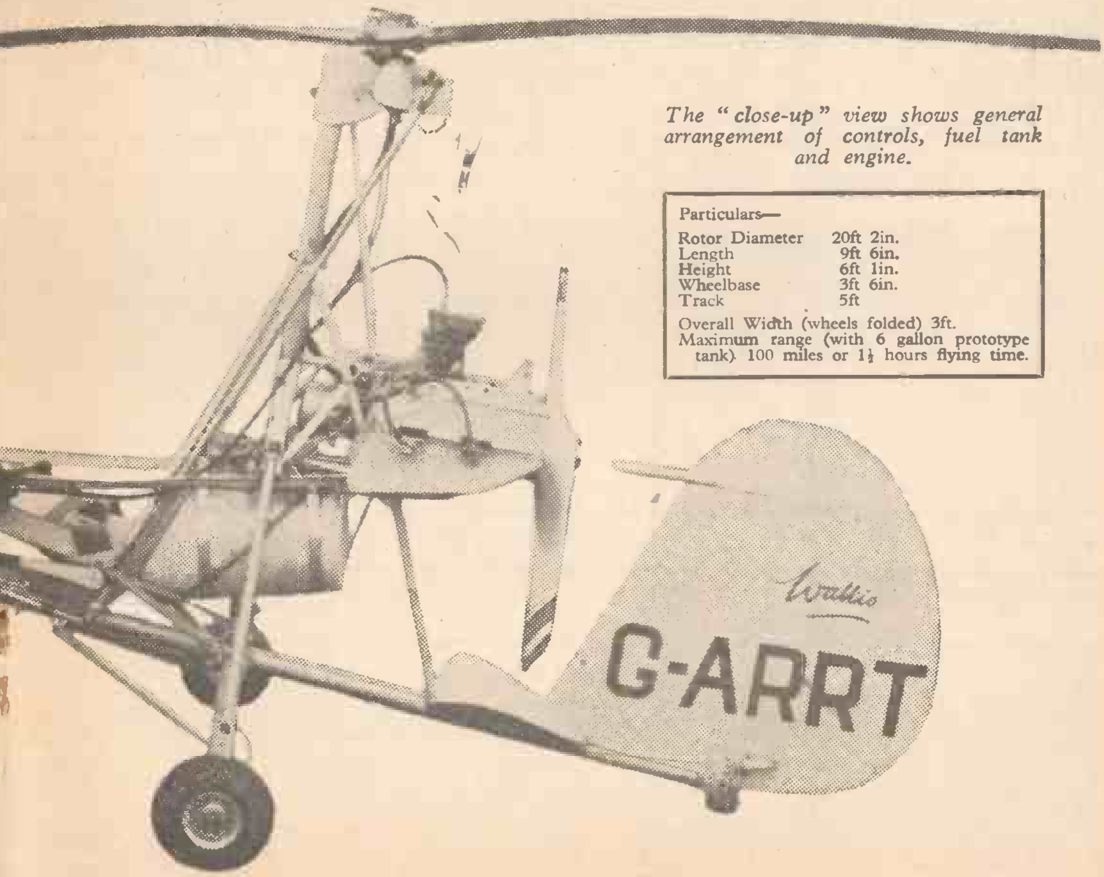
The Beagle-Miles-Wallis autogyro technically known as the W.A.116 was designed by Wing Commander K. H. Wallis, R.A.F., one of the foremost experts in the autogyro field, and is the culmination of many years research and experiment.

Incorporating many new ideas, it has been developed as a sturdy, simple to fly, easy to maintain and inexpensive method of air transport. It is ultra-light in construction—an empty weight of 250 lbs is envisaged when a streamline cockpit has been fitted. The aircraft may be towed along the ground, or used as a ground vehicle, and when employed in either of these roles the rotor blades are secured fore and aft by attachments, which can be carried beneath the fuselage in flight.

The modest dimensions allow the W.A.116 to be easily stored and the main wheels may be folded to facilitate storage still further. This autogyro was designed and built as a personal private venture by Wing Commander Wallis, starting from the basis of a small American machine which was designed for construction by the do-it-yourself amateur. It was soon decided that certain design features would have to be changed, particularly the controls, in order to produce a serious operational autogyro.

The result of this new design is the W.A.116. It has been adopted by Beagle Aircraft, who are now conducting a development programme with Wing Commander Wallis's own machine. Jigs have been erected at the Shoreham-by-Sea factory and work is in hand on the first batch of aircraft. This machine operates on the simple autogyro principle—that is to say the main rotor is autorotating. It is not driven directly by the engine—as in a helicopter—but windmills in the airstream provided by

blem with rotating-wing aircraft, but narkable standard in his own machine re photo) "hands and feet off".



The "close-up" view shows general arrangement of controls, fuel tank and engine.

Particulars—	
Rotor Diameter	20ft 2in.
Length	9ft 6in.
Height	6ft 1in.
Wheelbase	3ft 6in.
Track	5ft

Overall Width (wheels folded) 3ft.
Maximum range (with 6 gallon prototype tank) 100 miles or 1½ hours flying time.

the forward motion of the aircraft. There is, however, a spin-up device on the 116 by which the rotor can be started from rest prior to take-off, and this pre-spinning contributes greatly to the very short take-off run, about 30 yards.

The aircraft is powered by a 70 B.H.P. four-cylinder horizontally-opposed engine, driving a "pusher" two-blade propellor, and mounted behind the main pylon and the pilot's seat, controls are similar to those of a fixed wing aircraft.

As it now exists, the W.A. 116 is a beautifully built little machine that speaks volumes for the engineering design ability and workshop craftsmanship of Wing Commander Wallis. His method has been consistently to find simple design solutions, but in every case the simplicity is that of refinement, not of crudity, and in this essential his aircraft is fundamentally far removed from the original American line of thought.

So far as performance goes it is as yet too early to quote definitive figures simply because the necessary calibrations have not yet been done, but Wing Commander Wallis has demonstrated clearly that in zero-wind it will leap into the air in about 30 yards and climb very steeply at something over 1,000ft/min., and land in half a tennis court. It has already flown at a gross weight of 650 lbs, it will cruise at 55 m.p.h. and has reached 7,000ft still climbing—a ceiling governed by the pilot succumbing to icing.

The air-to-ground photos below were taken from the Autogyro with an ordinary 35mm camera held in the hand.

L.B.S.C's $3\frac{1}{2}$in. Gauge EVENING STAR

PART 16
DETAILS OF MECHANICAL LUBRICATOR

DRILL another $\frac{3}{16}$in. hole on the centre-line of the right-hand side of the tank, at $\frac{3}{16}$in. from the top, through which the bearing will pass when the pump is assembled. Don't leave any burring. The lid is made from a piece of 18-gauge sheet brass measuring 2in. x $1\frac{3}{4}$in. Snip a $\frac{1}{4}$in. square out of each corner, and bend down $\frac{1}{4}$in. of each side, so that it will just snap on to the tank top. After fitting, silversolder the corners, but only just use the weeniest bit of silversolder, or the lid won't fit. Smooth off any sharp corners.

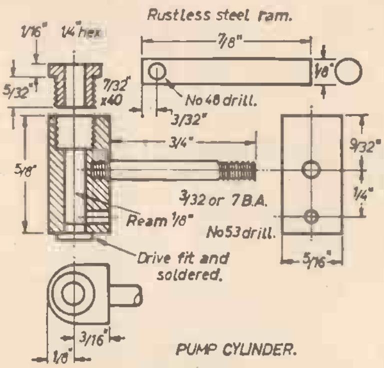


Fig. 101.

Oil Pump

Chuck a piece of $\frac{5}{16}$in. square brass rod truly in the four-jaw, face the end, centre, drill to $\frac{3}{16}$in. depth with No. 23 or $\frac{5}{32}$in. drill, and tap $\frac{3}{16}$in. x 40. Part off at $1\frac{1}{4}$in. from the end. At $\frac{1}{4}$in. from the drilled end, mill or file a recess on one of the facets, $\frac{5}{16}$in. long and $\frac{1}{16}$in. deep. At the other end, mill or file a $\frac{1}{16}$in. rebate $\frac{1}{2}$in. long, on the same facet. Make a centrepop exactly in the middle of the recess, that is, $\frac{13}{32}$in. from the bottom of the stand, and with a pair of dividers with the points set $\frac{1}{4}$in. apart, strike an arc across the facet below the recess, with one of the divider points in the centrepop. On this arc, at $\frac{1}{16}$in. each side of the centre-line of the stand, make two more centrepops. Warning to beginners—take the greatest possible care to get that bit exactly right, as the efficiency of the oil pump depends on it.

Next, very carefully indeed, drill the right-hand centrepop with a No. 53 drill, until it breaks through into the tapped hole. Avoid forcing the drill, or you'll have another kind of break which will necessitate a visit to the tool stores. Drill the left-hand centrepop to a depth of $\frac{1}{16}$in. only; then, with a little chisel made from a piece of $\frac{1}{8}$in. silver-steel, reduced to $\frac{1}{16}$in. at the end, chip a groove from the hole to the bottom of the stand, as shown in Fig. 100. The distance between the holes at their inner edges, must be not less than $\frac{1}{16}$in. otherwise the port in the pump cylinder will bridge them, and there will be what our electrical friends call a short circuit. It won't blow any fuse, but will prevent the pump from working properly!

Now drill a No. 41 hole through the stand, from centrepop in the middle of the recess. Turn the stand over, and open out the hole from the other end, to a depth of $\frac{1}{8}$in. with a $\frac{1}{4}$in. pin drill. Finally, at $\frac{3}{16}$in. from the top of the stand, drill a No. 23 hole, and tap it $\frac{3}{16}$in. x 40. This hole, and the hole in the middle of the recess, must go dead square through the stand, so if you haven't a reasonably accurate drilling machine, use the lathe, with the drill in the three-jaw chuck, and the stand held tightly against a drilling-pad in the tailstock barrel. True up the faces above and below the recess, by rubbing on a piece of fine emerycloth laid on the lathe bed, or something equally flat and true.

The pump cylinder is made from a piece of $\frac{5}{16}$in. square rod, faced off truly at each end to a length of $\frac{5}{8}$in. Scribe a centre-line across one end, and at $\frac{1}{8}$in. from the edge, make a centrepop. Chuck in four-jaw with this pop mark running truly, drill through with No. 32 drill, and ream $\frac{1}{8}$in. Open out the hole to $\frac{5}{32}$in. depth with $\frac{3}{16}$in. drill, and tap $\frac{7}{32}$in. x 40. Make a little gland to suit, from a piece of $\frac{1}{4}$in. hexagon rod, by the same process as the cylinder glands, drilling No. 32 and reaming $\frac{1}{8}$in.

On the facet farthest away from the reamed hole, scribe a line down the middle, and make a centrepop $\frac{9}{32}$in. from the top, with another exactly $\frac{1}{4}$in. below it. Drill the first one No. 48, to a bare $\frac{1}{8}$in. depth. Beginners will probably "overshoot the platform" as the enginemen say, and pierce the bore, but it doesn't matter, as the trunnion pin seals the hole, which is tapped $\frac{3}{32}$in. or 7B.A. The lower hole is drilled No. 53 into the bore. Both holes must go through dead square, same as those in the stand. Run the $\frac{1}{8}$in. reamer through the bore again, with the gland screwed in place, to clean out any burring and true up the gland, then turn a little plug to fit tightly in the bottom of the bore, shown in Fig. 101. This should just reach to the bottom of the port. Squeeze it in, and solder over the head, to make sure oil doesn't force it out. These wee pumps can exert enormous pressure. For curiosity's sake the gauge tester at one of the British Railways locomotive works, tried one on his full-size testing machine, and stopped at over 600lb per sq in. to avoid straining his master gauge.

The trunnion pin is a $\frac{7}{8}$in. length of $\frac{3}{32}$in. rustless steel (silver-steel will do if rustless isn't available) screwed for $\frac{1}{8}$in. length at one end, and $\frac{3}{16}$in. at the other, to match the tapped hole in the cylinder. True up the portface before screwing it in, and make quite certain that it stands out exactly at right angles to the portface. If it doesn't, the portface won't bed down truly to the rubbing faces on the stand, and oil will come out between them, causing failure of the pump. The pump ram, or plunger, is a $\frac{7}{8}$in. length of $\frac{1}{8}$in. rustless steel, with a No. 48 cross hole drilled $\frac{3}{32}$in. from one end. The gland is packed with a strand of graphited yarn. The spring is wound up from 22-gauge tinned steel wire (piano wire would do) and secured by an ordinary commercial nut. The outside of the cylinder can be rounded off as shown in the plan view, Fig. 101, but it isn't essential.

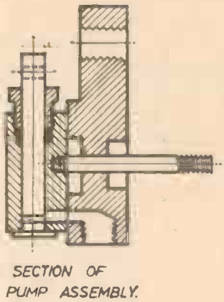


Fig. 102.

Crankshaft and Bearing

The crankshaft is a 1$\frac{7}{16}$in. length of $\frac{3}{32}$in. rustless or silver-steel, with $\frac{1}{8}$in. of $\frac{3}{32}$in. or 7B.A. thread on one end, and $\frac{5}{32}$in. ditto at the other. The crank is a $\frac{1}{8}$in. slice of $\frac{3}{8}$in. round rod with a hole in the middle, tapped to suit the shaft. At $\frac{1}{8}$in. from the centre, drill a No. 53 hole, tap it 9B.A., and screw in a $\frac{5}{16}$in. length of 15-gauge spoke wire, threaded to suit. Wire spokes of various gauges can be obtained from any cycle shop, and the material makes first-class crankpins, valve-gear pins and so on. As ratchet wheels can be obtained from our advertisers, it is hardly worth while setting up all the apparatus to cut just one. The hole in it will probably be under size, so open it out with No. 43 drill, and squeeze it on to the crankshaft, so that it is $\frac{5}{16}$in. from the longer screwed end. Take care to put it on the right way, so that it will ratchet the shaft clockwise, see Fig. 103.

For the bearing, chuck a length of $\frac{5}{16}$in. hexagon rod, face, centre, and drill to 1in. depth with No. 41 drill. Turn down $\frac{7}{8}$in. length to $\frac{3}{16}$in. dia. and screw $\frac{3}{16}$in. x 40. Part off at a full $\frac{1}{16}$in. from the shoulder, reverse in chuck, skim truly and chamfer the corners of the hexagon. Make a nut $\frac{1}{8}$in. thick from the same rod, to act as a locknut.

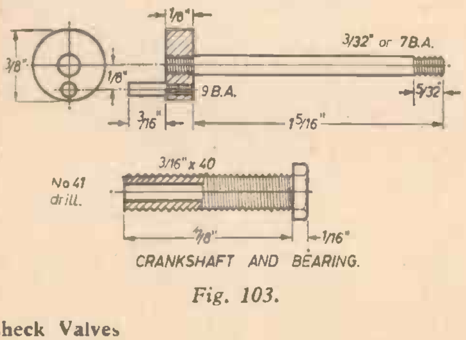


Fig. 103.

Check Valves

For the check valve under the tank, chuck a bit of $\frac{3}{8}$in. round rod — gunmetal or bronze for preference, but brass will do — face the end, centre, and drill No. 43 for about $\frac{3}{4}$in. depth. Open out the bottom with $\frac{7}{32}$in. drill and D-bit to $\frac{11}{32}$in. depth, tap $\frac{1}{4}$in. x 40 for a full $\frac{1}{8}$in. depth, and slightly countersink the end. Part off at a bare $\frac{11}{16}$in. from the end, reverse in chuck, turn down $\frac{7}{32}$in. length to $\frac{3}{16}$in. dia. and screw $\frac{3}{16}$in. x 40. Put a $\frac{3}{32}$in. parallel reamer through the No. 43 hole. Drill a No. 20 hole halfway along the body part, for the union nipple, which is made exactly the same as the nipples on the feed pump (see August 1961 instalment) and silversoldered in.

The cap is made in the same way also, but the hexagon head is $\frac{1}{4}$in. long, and instead of being solid, it is drilled for the spring which holds the ball in place. Before parting off, centre it and drill to $\frac{5}{16}$in. depth with No. 30 drill. Part off at $\frac{1}{4}$in. from shoulder, reverse in chuck, and chamfer the corners of the hexagon. The spring can be wound up from 22-gauge hard brass or bronze wire, and must be an easy fit in the hole. Touch the ends against the side of a fast-running grinding wheel, to square them off; a ragged-ended spring will push the ball off the seating instead of holding it in place. Seat a $\frac{1}{8}$in. rustless ball on the end of the reamed hole in the recess, and assemble the lot as shown in Fig. 104.

To make the delivery valve, chuck the $\frac{3}{8}$in. rod again, and proceed as described for the one under the tank, but this time, part off at $\frac{9}{16}$in. from the end. Reverse in chuck, open out the No. 43 hole with No. 32 drill for about $\frac{1}{8}$in. depth, and bevel off the end as shown in Fig. 105. Put the No. 20 drill right through the body part, and fit two union nipples at opposite sides. Fit a 2in. length of $\frac{1}{8}$in. copper tube into the counterbored end of the valve body, and a $\frac{1}{4}$in. x 40 union nut and cone on the end of the pipe. I usually make union nuts and cones a dozen or more at the time, and always have some handy. For the nuts, chuck a piece of $\frac{5}{16}$in. hexagon brass rod in the three-jaw, face, centre, and drill No. 30 to the full depth of the drill flutes. Open out to about $\frac{3}{16}$in. depth with $\frac{7}{32}$in. drill, tap $\frac{1}{4}$in. x 40, and part off at a full $\frac{1}{4}$in. from the end. Ditto repeat until you come to the end of the No. 30 hole, then re-centre, drill No. 30 again, and carry on until you have about a dozen nuts. Each one can be put separately into the chuck to chamfer the corners of the hexagon.

Make the coned nipples from copper rod. This, being soft, beds into the union cone even if the

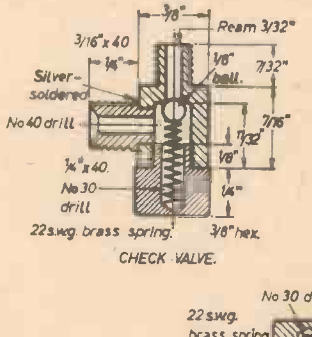


Fig. 104.

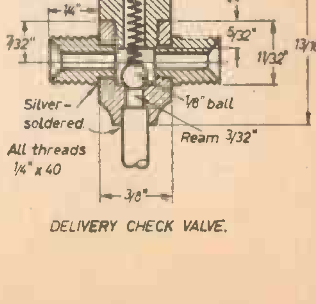


Fig. 105.

angles of taper are slightly different, and you never get steam leakage. Chuck a bit of $\frac{1}{4}$in. copper rod, face, centre, and drill No. 40 for about $\frac{1}{2}$in. depth. Turn down about 1in. length to an easy sliding fit in the union nut, then turn the end to a cone, either with the top slide set over to a 30° angle, or with a tool which has the cutting edge ground off to the same angle. Part off at $\frac{1}{16}$in. from the end of the taper. Repeat operation for the number required. Chuck one with the larger end outwards, and open out the hole for $\frac{1}{16}$in. depth with No. 32 drill, to fit on the $\frac{1}{8}$in. pipe. The two screwed nipples, and the pipe joint and cone can then be silversoldered at one heat. Take care to avoid getting any silver-solder on the taper of the coned nipple. Pickle, wash off and clean up, then fit a ball, spring and cap, same as the valve under the tank.

Ratchet Drive

The ratchet lever is filed up from a piece of $\frac{3}{32}$in. x $\frac{1}{4}$in. steel strip, and drilled as shown in Fig. 106. The pawls are filed up from the same material, and drilled No. 41 for the pivots. The driving pawl has a $\frac{1}{16}$in. hole in its tail for the spring. Caseharden both pawls as described for valve-gear parts in the January instalment. The driving pawl is attached to the lever by a $\frac{3}{32}$in. screw with $\frac{3}{32}$in. of "plain" under the head, and must be perfectly free to oscillate without side shake. The check pawl is mounted on a stud turned from a bit of $\frac{3}{16}$in. steel rod one end of which is turned to fit the hole in the pawl, and screwed for a retaining nut. The other end is turned down and screwed 8B.A., put through a No. 43 hole drilled in the tank, and is nutted inside (Fig. 106). The pawl is kept in contact with the teeth of the wheel, by a 19-gauge wire spring, bent as shown, and attached to the tank by an 8B.A. screw nutted inside the tank.

Assembly and Erection

Attach the pump cylinder to the stand, put the latter in the tank, and screw the check valve into it through the hole in the baseplate. Put the bearing through the hole in the side of tank, put on the locknut, and screw the end of the bearing into the tapped hole in the top of stand. It must not be tight enough to pull the stand out of place, but merely support it; then tighten the locknut against side of tank, and tighten check valve, so that the union on it points backwards. Hold the crank disc in position with the crankpin through the hole in the pump ram, and push the shaft through the bearing, screwing it into the crank disc. When tight, the shaft should be quite free to turn, having just a shade of endplay. Then put on the ratchet lever, setting the pawl against the teeth of the wheel, and secure it with a nut and washer. This should be free to oscillate, without any side rock. Finally connect the tail of the pawl to the hole in ratchet lever by a 30-gauge wire spring.

To test, put some motor oil in the tank, and turn the ratchet wheel until oil appears at the check valve outlet. Then press your thumb over the outlet as tightly as possible, and work the ratchet lever. If the pump is O.K. it will be impossible to prevent oil from squeezing past your thumb, no matter how hard you press. If no oil comes out, it will be escaping between pump cylinder and stand, and the retaining spring will need tightening up a little.

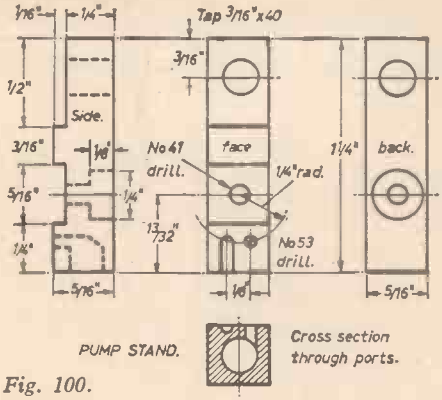


Fig. 100.

To erect the lubricator, temporarily clamp the baseplate extension to the top of the pony bolster, and run a No. 41 drill through the holes, making countersinks on the bolster. Remove lubricator, drill the countersinks No. 48, tap $\frac{3}{32}$in. or 7B.A., countersink the tapped holes on the underside of the bolster, and put screws in, about $\frac{3}{8}$in. long, see Fig. 106. Put the baseplate over the projecting screws, and secure with nuts. Bend the pipe attached to the delivery valve to the shape shown, and connect up the union nut to the screwed nipple under the oil tank.

The eccentric strap is machined and fitted exactly as described for the feed pump eccentric strap. The rod is made from a $4\frac{3}{8}$in. length of $\frac{1}{8}$in. steel rod, one end of which is screwed into the lug on the strap, and other end furnished with a little fork, made in the same way as those in the valve gear. This is attached to the ratchet lever by a pin made from 15-gauge spoke wire, screwed 9B.A. at each end, and nutted. Be sure to have all the parts working quite freely but without slackness. The ratchet lever should click one tooth of the wheel, at every revolution of the coupled axle.

Steam Brakes

Working brake gear on small locomotives is useless for stopping purposes. Any full-size driver will confirm that although the engine pulls the train, it is the brakes on the coaches that do the best part of the stopping. Although *Evening Star* is very heavy, the momentum of even a couple of passengers on an eight-wheeled car travelling at slow speed, would cause her to slide on the rails with locked wheels if the engine brakes were applied with any force. It is therefore necessary to fit brake gear to the car, and let the load on it provide the stopping power, having brake gear on the engine merely for the sake of appearance. As a matter of fact, the brake gear could be dummy, just consisting of the brake-blocks and hangers, the latter being fixed so that the blocks just kept clear of the wheel treads; but if there is one thing I detest more than another, it is fitting dummy gadgets on a little locomotive when they can be easily made to operate. For that reason I am specifying working steam brakes, which can be easily made and fitted.

The arrangement shown in the drawings, is similar to that which I fitted to my 4-6-2, which

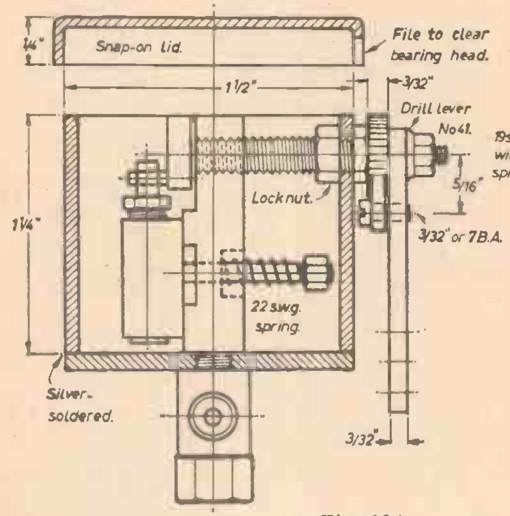
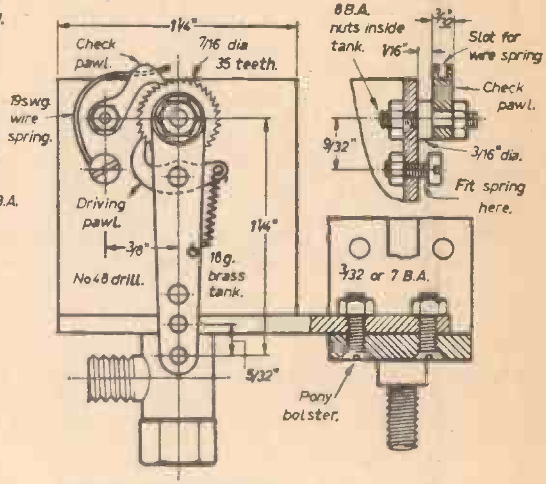


Fig. 106.



RATCHET DRIVE ASSEMBLY.

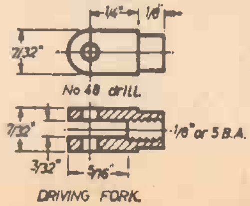
works perfectly. The cylinder and its supports differ a little from those on the full-size engine, which couldn't be reproduced as a working proposition in 3½in. gauge. For example, the full-size cylinder is a fixture, and to allow for the movement of the end of the actuating lever on the brake shaft, the piston-rod is hollow, with a little connecting-rod inside it, the upper end of which is attached to a gudgeon-pin, like the arrangement on a petrol engine. To reproduce this in 3½in. gauge would be about as useful for working purposes as putting wrist-watch works in a grandfather clock. The cylinder shown, being supported on trunnions carried in a substantial triangular bracket, allows for the "arc" end-movement of the long brake lever. The whole of the actuating gear is a single self-contained unit, easily detachable in case of necessity.

Brake-blocks and hangers

I mentioned in the introduction that the brake fitting was going to be a pretty tight squeeze, and it will need care and patience, but there is nothing to scare even a raw tyro. The brake hangers are filed or milled from ⅛in. x ¼in. mild steel, or offcuts of frame steel could be used. Dimensional drawing will appear next month. The ends should be rounded off as described for valve-gear components. The hanger supports are turned from ¼in. round mild steel in the three-jaw chuck. Turn down $\frac{9}{32}$in. length to ⅛in. dia. and screw ⅛in. or 5B.A., leaving about $\frac{3}{32}$in. of "plain" next to the shoulder. Part off at ⅞in. from the end, reverse in chuck, turn down $\frac{9}{32}$in. of the other end, so as to leave $\frac{5}{16}$in. between the shoulders, slip one end of the hanger over the turned end, and run the die on until it just touches the hanger. This wheeze ensures that when the whole bag of tricks is assembled, and the nut tightened, the hanger will just be free enough to swing without any side shake—which is as it should be!

The brake-blocks may either be cast-iron, or cut from steel ¼in. thick. Our advertisers will probably supply them with two or three blocks in a single casting, the hanger grooves being cast in. In that event, all the "machining" required will be sawing off the blocks, smoothing off any roughness with a file, cleaning out the grooves with a thin flat file so that they fit nicely over the hangers, and drilling the pinholes. Pin the blocks to the hangers with bits of $\frac{3}{32}$in. silver-steel, filing the ends almost flush. The blocks should be a wee bit stiff on the hangers, so that if the brakes are applied, the blocks should be able to bed down full length on the wheel treads, and stay at the same angle when released. They should not be loose enough to lop over and rub one end on the wheel treads when the engine is running. The hanger supports may be attached to the frame and secured by nuts on the inside, but don't fit the hangers permanently until the beams are made.

These are the next job. Four of them are made from ½in. x ⅛in. flat steel, the "odd man out" being $\frac{5}{16}$in. wide only, and all 4⅛in. long. Chuck truly in four-jaw, turn ¼in. length to ⅛in. dia. and further reduce a bare ⅛in. length to $\frac{3}{32}$in. dia. screwing $\frac{3}{32}$in. or 7B.A. Drill the No. 30 holes and file to shape, then fit the hangers on one side of the engine, and put on the nuts. Poke one end of the beams through the bottom holes—don't forget that the narrow one leads—put on the other hangers, and nut up the lot. When all the nuts are tight, each pair of hangers should be just free to move without being the least bit slack. Such close quarters makes good fitting essential, though there is nothing difficult about the job.



DRIVING FORK.

Fig. 107.

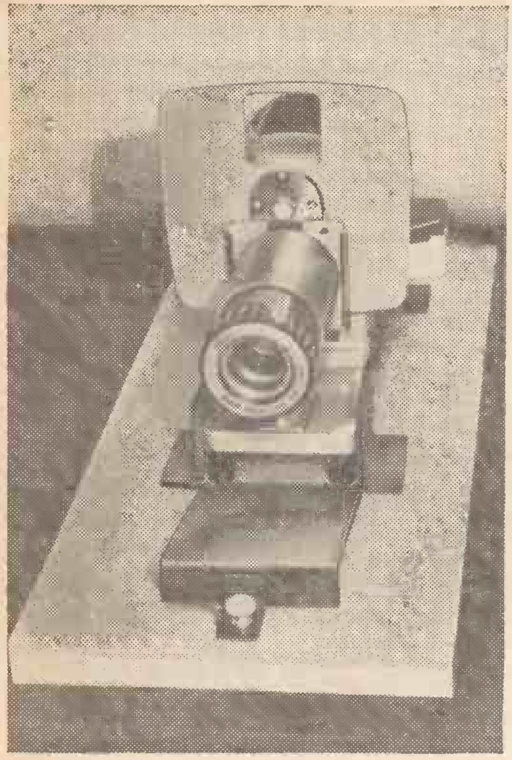


Fig. 1.—The completed unit.

Projector Tilt-base and Control panel

By "PHOTOGRAPHER"

ESPECIALLY when the screen is stood on a table or other non-adjustable support, the facility of tilting the colour slide or cine projector upwards through a small angle is a decided advantage. It permits the picture to be accurately aligned with the screen in a matter of moments. Additionally, the ability to control the projector lamp, together with a reading lamp for room illumination, without having to move from the machine prevents the operator stumbling about in the dark with, possibly, disastrous results.

The tilting arrangement described here is completely rigid and safe, and equally suitable for any make or model of projector. The provision of two appropriate switched sockets on the same base brings all electrical controls immediately under the hand.

The finished unit is shown in Fig. 1, with the tilting ramp right forward so that the arrangement can be clearly seen. In this position, the projector beam is horizontal, while with the ramp right back the front of the projector is elevated by approximately $\frac{7}{8}$in., thus affording adequate adjustment for all normal purposes.

The dimensions given in Fig. 2 are suitable for use with the popular and low-priced Argus 150 Panoramic projectors for 2 x 2in. colour slides. They can easily be adapted to accommodate any other still or cine projectors with baseplates not conforming to the $9\frac{1}{2}$in. x $3\frac{1}{4}$in. size of the Argus. The spacing of the five brackets and the length of the entire panel are the only dimensions likely to be affected.

The base may be made from $\frac{1}{8}$in. thick hardboard mounted on an underframe of planed timber approximately $\frac{3}{4}$in. x $\frac{1}{2}$in. Alternatively, solid chipboard with a plastic, veneer or hardboard facing may be used so as to dispense with the timber. If the latter method is adopted, recesses will need to be cut in the underside to accommodate the terminal block and the lower part of the ramp sliding arrangement.

All the brackets (three small and two large) are cut from 16s.w.g. brass or half-hard aluminium sheet, bent up at right angles and secured to the panel as shown. It is possible to drill the brackets and the panel and fix the parts together with nuts and bolts, but this work can be eliminated entirely by bonding with an epoxy resin adhesive such as Araldite. The strength of joints made by careful bonding is beyond reproach. The rear bracket may need to have a vertical slot cut in it in order to clear the cable and grommet fitted to the projector baseplate.

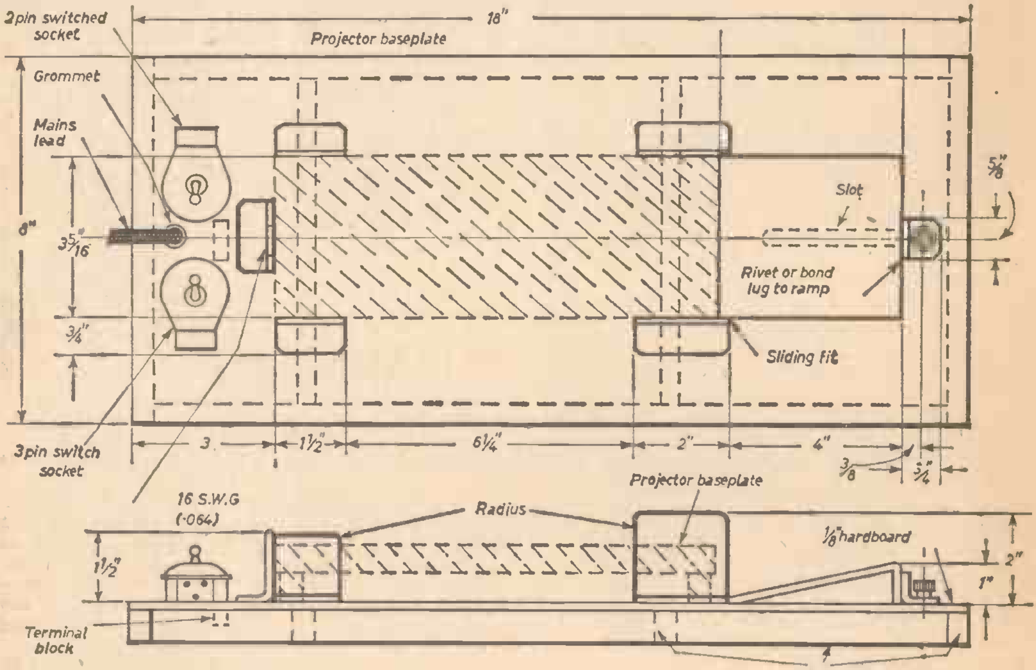
The tilting ramp is also made from 16s.w.g. metal so that, when formed, it is 4in. long and about 1in. high. This permits infinitely variable tilting, with quite fine adjustment, simply by sliding the ramp towards the projector and under its front feet, thereby raising them off the panel. A small leg of similar material, bonded to the front of the ramp or attached with rivets, has a clearance hole for a 2B.A. screw. Remove all sharp corners from the metal parts and paint them matt black before assembly.

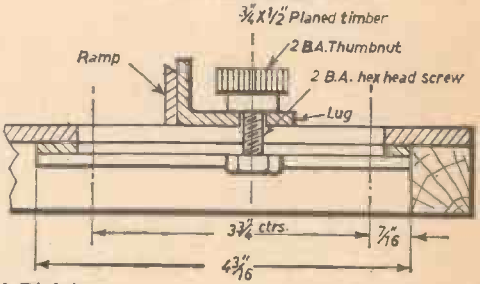
The hardboard has a slot cut near to the front end so as to give clearance for the locking screw but, as this material cannot be relied upon to preserve a good sliding fit indefinitely, it has a metal plate with a similarly sized slot bonded to its underside in reasonably accurate alignment. A narrow strip of brass or aluminium is bonded to one side of this metal facing plate so that it acts as a continuous guide to prevent a 2B.A. hexagon head screw rotating by bearing on one flat of its head. A 2B.A. thumbnut, either of metal or metal-cored plastic, fitted on top of the ramp lug completes the tilting arrangement. Fig. 2 will make the assembly clear.

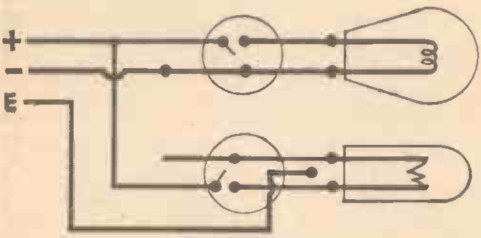
The mains input cable penetrates the base panel through a rubber grommet fitted into a hole at the centre of the rear part its three internal leads are taken into separate connections on a three-way terminal block bonded or bolted to the underside of the panel. Short leads are then run to a 2-pin and a 3-pin switched socket mounted on the top face of the panel. The wiring of these sockets, the 2-pin for a remote reading lamp and the 3-pin for the projector, must be in parallel and not series. Fig. 3 gives both schematic and pictorial wiring diagrams of the electrical system.

The mains lead may be as long as is necessary to reach a convenient wall socket, while the wires to the reading lamp will probably be of whatever length is necessary when the lamp is used normally. The projector cable, however, should be shortened back to 6in. or so, as it needs to pass only from the projector base to the adjacent 3-pin socket.

The additional electrical load imposed by short periods of using the 60 or 75W reading lamp at the same time as the projector bulb and, possibly, a built-in blower motor, is hardly likely to place any great strain on the supply. If any apprehension is felt on this account, the socket and plug pairs may be of the type having provision for cartridge fuses. An overload could only occur if there was a serious fault in the projector wiring or a blower motor, but having the fuses close at hand for possible replacement is convenient.







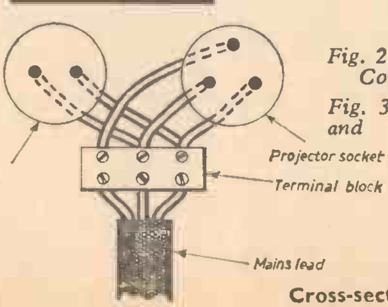
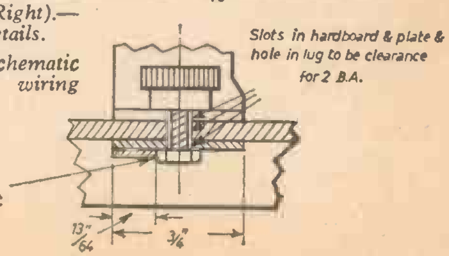


Fig. 2 (Above and Right).—Constructional details.

Fig. 3 (Left). — Schematic and pictorial wiring diagrams.



Cross-section on slot

TYRES for the MOON

THE first vehicle the United States place on the moon's surface may look something like the model pictured right, and, one of the interesting features of this picture is the "moon tyres".

Working from plans proposed for the first moon vehicle shot, and from information gathered over the years, a tyre has been designed that looks like nothing on earth. For one thing, it will be the largest tyre ever made—16ft in diameter.

Preliminary specifications, released by the National Aeronautics and Space Administration, limit the weight of the vehicle's two huge tyres and wheels to 125 pounds each. During the trip from the earth, the tyres can be only 10ft in diameter, NASA have decreed.

Mr. J. S. Hawkes, of the Goodyear Tyre Design Research Laboratories said: "We immediately had to forget conventional tyre-rim construction. The world's largest 'earth tyre', which we recently produced, was only 10ft in diameter and weighed 3,200 lb."

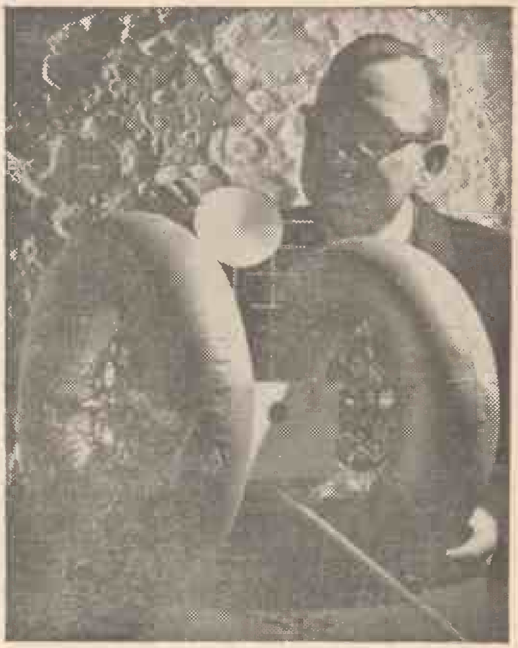
Weight restrictions, plus the demand for collapsibility during flight, ruled out rim, tread rubber, sidewalls, tubes, beads and cords, all used in most conventional tyre construction. The answer, according to Goodyear, is a rubberised-fabric doughnut, supported by an intricate lacing of polyester cord spokes, strung from a lightweight aluminium or fibre glass disc to which the axle will be attached.

Because the moon's gravity is one-sixth that of earth, the proposed 2,400 earth pound space vehicle will weigh only 400 moon pounds.

The moon tyre has been designed to operate with only a half pound of pressure per square inch. It will "envelope" such obstacles as 6ft boulders, jagged rocks, or even glass, any of which might be found on the moon's surface, according to present theories. Other possibilities, such as thick layers of dust, 7ft crevices and sloping crater walls, will be surmounted by the tyre's large diameter and its 4ft wide "footprint".

The temperature range of almost 500° on the moon—from 220°F during the moon day to 250° below zero at night—posed quite a problem to the tyre designers. Rubbers suitable for tyres become brittle at temperatures below approximately −100°F. Since it is planned that the moon vehicle will move only during the moon days (equal to about 14 earth days), an arrangement will be made for deflation at night. In a static condition, the rubber can withstand the extreme cold.

The fact that the moon has no atmosphere, and is a complete vacuum, prohibits the use of some materials normally used in tyres. The presence of cosmic rays makes it necessary to coat the cord spokes with some protective material, such as polyurethane.



A model of what the first vehicle to operate on the moon's surface might look like.

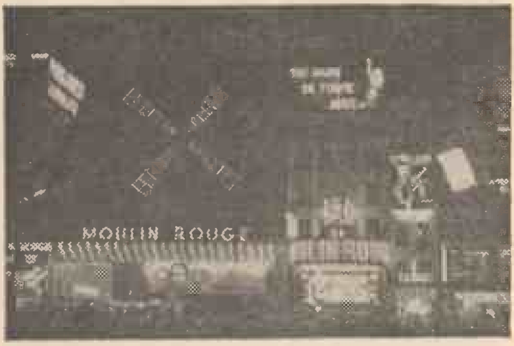
Methods of mobility, other than tyres, have been suggested for the lunar vehicle—jointed walking legs, tracks of metal or rubber—but such methods complicate the lubrication problem. Space contains only gases or solids—there are no liquids—and, as liquids are normally used as lubricants, any points of lubrication would have to be sealed and pressurised.

Tests of the Goodyear model with the 125 lb tyre, show that the full size type will carry loads at least triple the 200-moon-pound requirement. It is envisaged that America's first lunar vehicle will move at 3 m.p.h. for two days (a month in earth time), resting a night in between. In that time, it is planned that the moon car will have driven about 10,000 miles, gathering data to pave the way for man's first landing. It is believed that the Goodyear model design not only will work for the initial instrument moon vehicle, but also may be used to carry America's first man on the moon's surface.

Westinghouse scientists, in conjunction with the U.S. Air Force's Nonmetallic Materials Laboratories, in Dayton, Ohio, are endeavouring to create a substance, to be built into fabrics, that will remain flexible during a missile trip into orbit, and yet retain the capability of rigidising automatically when subjected to space environment. Such a structure could be delivered into orbit in a packaged state with a minimum of bulk and weight—two prime considerations in terms of missile payload. The object, once rigidised, would maintain its shape even though it was punished by temperature extremes, and exposed to ultra-violet radiation and other cosmic forces.

First steps in Colour Photography

by E. M. OAKES



Gay, colourful night scenes, such as this shot of the Moulin Rouge can be taken, using the new high speed colour films.

ALTHOUGH colour films have been on the market for a considerable number of years, taking photographs in colour can still be an expensive hobby. Unless a little skill is employed to eliminate failures quite a lot of money can be wasted. So for any of you who are considering colour in your camera this summer a few tips and facts may save a great deal of disappointment.

The budding colour photographer has two types of film to choose from, positive or reversal film—and negative type film. Reversal film will give you colour transparencies mounted in neat cardboard frames, these can be seen either through a hand viewer (prices ranging from under £1 to £4), or the more ambitious can buy a projector and project them big on to a screen. A projector can cost from £10 upwards. Ordinary coloured photographs can be made from transparencies if required.

For those of you who want colour photographs only, ideal for sticking into the family album, the negative type colour film is the best bet. As the name implies you will get your film back in the form of a negative, with all the colours reversed, for example, a blue sky would be yellow on the negative—red lips would come out a bluey-green. From these negatives colour prints can then be ordered which will be better and cheaper than prints from transparencies.

For quality the transparency is, at the moment, in the lead. Colour prints are never so crisp and sharp, and for group showing or an evening's entertainment reliving that holiday abroad, then a projector and a good set of transparencies are hard to beat.

Having bought our film it is useless to suppose that any old box camera will produce sparkling results. Colour film is much more delicate than black and white, and exposure must be extremely accurate to ensure even passable results. A reasonably safe exposure guide is included with each film but if you can afford an exposure meter then the results will more than justify the expenditure. The ideal camera size for a colour transparency is 35mm., indeed so popular have these become that viewers and projectors cater almost exclusively for this size.

Having got your camera-lens scrupulously clean and not covered by a layer of last year's dust—and loaded it with a nice new colour film we can now venture outside and set about the actual business of taking a colour photograph. You will find it best to make a start in fine, sunny weather, with the sun shining evenly on the front of the subject. Later on, when a little more experience has been gained, you may want to experiment under different lighting conditions.

If you don't want to give your best girl friend a green face then try and avoid large expanses of the same colour—especially strong colour—this can reflect itself over the entire picture, with very unflattering results.

Colour photography, once you have ironed out the technical snags, can be a very rewarding hobby and needn't be confined to the usual once-a-year holiday shots. Building up a set of transparencies is rather like making a film, think of the possibilities—your family growing up; for keen gardeners a permanent record of your choicest blooms.

A scene from the Artists Quarter, Montmatre, Paris.

Have *YOU* a hobby that could be made more interesting still by gathering together your own set of illustrations?

For extreme close-up shots a tripod is necessary, and a special 'close-up' attachment can be bought, fitting over the ordinary lens, which will enable you to get as close as a foot or even less to the subject.

So far we have dealt with colour outdoors, but there is no reason why good pictures cannot be taken inside—to record a friend's birthday party for instance. The simplest method of doing this is to use flashbulbs. A flashgun can be bought for around the 30/- mark, and you will also need a packet of flashbulbs, which can be used only once and then must be discarded.

Make sure that your camera is synchronised for flash (ask your dealer if in doubt) which means that

Imagine this picture (of the River Seine from the Eiffel Tower) projected on a screen 2ft wide—in your own living room—in glorious living colour. This is easily possible from a small 35mm transparency.

"Christmas Morning". An intimate family record shot like this can be so much more effective when taken in colour. A simple flashgun attached to your camera, using expendable flashbulbs is all that is needed.

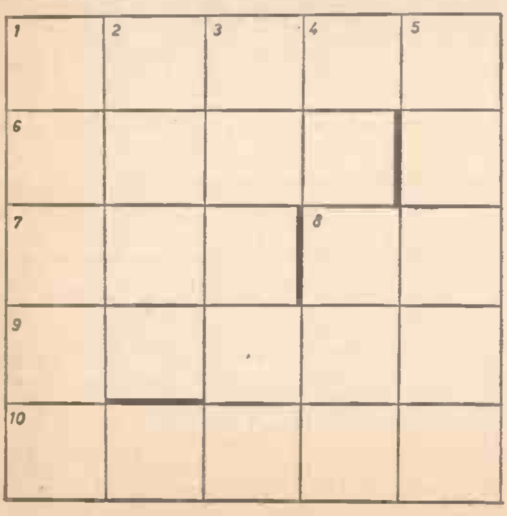
the flash goes off at the same time as you press the camera shutter. Special blue bulbs are needed with certain types of colour film so check with your dealer when buying them. Here again correct exposure is very important, this is determined by the guide number printed on each packet of flash-bulbs. Suppose you are taking a picture at a distance of ten feet and the guide number (sometimes referred to as the flash factor) is eighty, divide eighty by ten which gives an exposure of f8. Keep the camera set on 1/25th of a second and remember to keep quite still when taking the picture. Avoid smoky rooms which will flatten out the colours.

When you receive your eagerly awaited results, be they negatives or transparencies, you will want to know if they can be improved upon, and why some of them perhaps, have not quite come off. If all has gone well your transparency will be of medium density and will be as near as possible something like the original scene. Should it be dense and "blocked up" then it will be *under* exposed, and should have been given more exposure when it was taken. An *over* exposed transparency will be thin, pale and washed out looking.

It is important to know a good colour negative when you see it as you will be able to send back only the good ones for printing and thus save considerable expense. A colour negative is a light browny colour all over, even to the edges, and not clear like its black and white cousin. The image should be of average density when held up to the light. If *under* exposed it will be unduly thin and pale, lacking in shadow detail. An *over* exposed negative will be dense and heavy.

Well, having said all this, I can only hope that you will now go out and buy a colour film with a little more confidence than you had before, and that you will find your finished results well worth the *extra* effort you will have put into taking them.

TRY YOUR HAND AT A MATHEMATICAL CROSSWORD



ACROSS

1. $\frac{\text{One million} - x^3}{43}$
6. x^2
7. $3x - 24$
8. x
9. $1300x - 55$
10. Twice 1 down

DOWN

1. See 10 across
2. $x^2 + 12$
3. x^3
4. $40(x^2 - 395)$
5. $\frac{x^3 - 15x + 10}{2}$

Solution on page 425.

A SIMPLE TIME SWITCH

for the tropical aquarium*

E. J. PRESTON

ONE of the many uses of this apparatus is to control artificial lighting in the tropical aquarium. It is essential that a tropical aquarium should have a certain amount of artificial light in order that the plant life may survive. The amount of light or the length of time of light varies in accordance with the size of aquarium.

This time switch has been designed to give 6 hours of light in every 24 hours—i.e., 3 hours in the morning and 3 hours in the evening, but can be adjusted to suit various time periods depending on the size of the aquarium.

How it Works

It works on the revolving cam principle as seen in the cutaway view, Fig. 1. As the cams revolve clockwise the arm that runs on the large cam drops under spring action and makes a contact with the arm that runs on the small cam. The arms will remain in contact for 90° of rotation of the cams—i.e., 3 hours. After the cams have turned through an angle of 90° the arm that runs on the small cam drops under spring action, breaking the contact. During the remainder of the revolution both arms are raised to their original position and the whole process is repeated.

Clock Mechanism

Fig. 2 shows an exploded view of the mechanism. It can be seen that an old alarm clock is used to drive the cams, but any clock mechanism can be used providing it will run for not less than 30 hours without rewinding. The face and hands of the clock must be removed and 4 brackets made from thin gauge steel, bent as shown, are bolted to the studs which hold the main body of the clock together. Holes are also drilled in the brackets to enable the clock to be mounted.

The Arms

The arms are made from steel sheet $\frac{1}{32}$in. thick. The arm that runs on the large cam has a tongue protruding with a clearance hole through it and a nut soldered on top to carry a contact screw. A hole is drilled in each arm for mounting and two small holes are drilled close together in each arm which enables the springs to be hooked on.

The Springs

The springs can be made or purchased. If it is desired to make them they should be made from spring steel wire about 20 S.W.G. and coiled round a mandrel of about $\frac{1}{8}$in. diameter. The mandrel can be revolved in a hand drill or lathe. Having coiled the springs they should be cut to length, one about 1in. long and the other about $\frac{7}{8}$in. long, and hooks bent at each end. The springs must now be heated to about 850°C., quenched, and then tempered. An ideal method of tempering is to dip the springs in oil and then burn off the oil over a gas ring.

Cam Assembly

Fig. 3 shows how the cams are made and assembled as one unit. The cams must be made from some insulating material such as Tufnol, Perspex, etc. In this case Tufnol was used. The length and diameter of the spigot (A) will vary, depending on the clock mechanism used. A hole is drilled through the centre to fit on to the clock spindle and a hole drilled and tapped carries a grub screw. Cam (B) is 2in. diameter and about $\frac{3}{16}$in. thick. It can be cut from sheet or machined on a lathe from bar. The radius is reduced by $\frac{1}{8}$in. for 90° and continued at a tangent until the full diameter has been regained. A hole is drilled through its centre the same size as that of the spigot. Also 3 holes are drilled on a $\frac{1}{2}$in. radius, one being on the centre line and the other two at 30° and 60° from it. Cam (C) is $1\frac{3}{4}$in. diameter and is made in a similar fashion. Similarly 90° of its radius is reduced by $\frac{1}{8}$in. and continued at a tangent until the full diameter has been regained. A hole through its centre is drilled the same diameter as that of the spigot (A) and cam (B). A hole on a $\frac{1}{2}$in. radius is drilled 90° from the step and is of the same diameter as that of the group of 3 holes in cam (B). The cam unit is now ready for assembly. A locating pin is pushed through cams (B) and (C) until it enters the spigot (A) about $\frac{1}{8}$in. Another locating pin is pushed through cam (C) and enters one of the three holes in cam (B). If a time period of 1 hours is desired then the pin should enter the hole marked 1 in cam (B). If 2 hours are required it should enter the hole marked 2, and likewise if 3 hours are required it should enter the hole marked 3. If time periods for more than 3 hours are required then radius "y" must be extended a further 90° on each cam. This gives a maximum range of 1—6 hours. Having decided as to what time period is required the cams (B) and (C) can be glued together and also the spigot (A) can be glued to cam (B).

Assembly

Fig. 1 shows a cutaway view of the assembled mechanism. Push the cam unit on to the clock spindle and lock into position by tightening the grub screw. Mount the clock in a wooden box.

(Concluded on page 426)

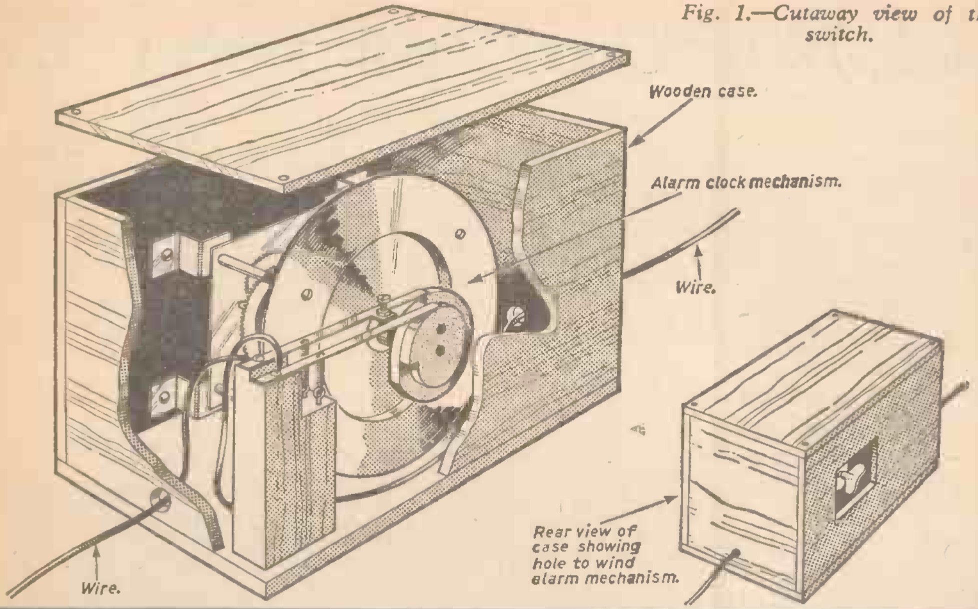


Fig. 1.—Cutaway view of the switch.

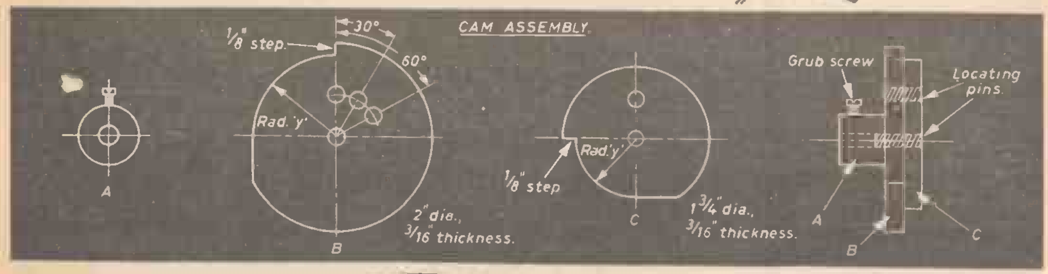


Fig. 3 (Above).—Details of the cams.

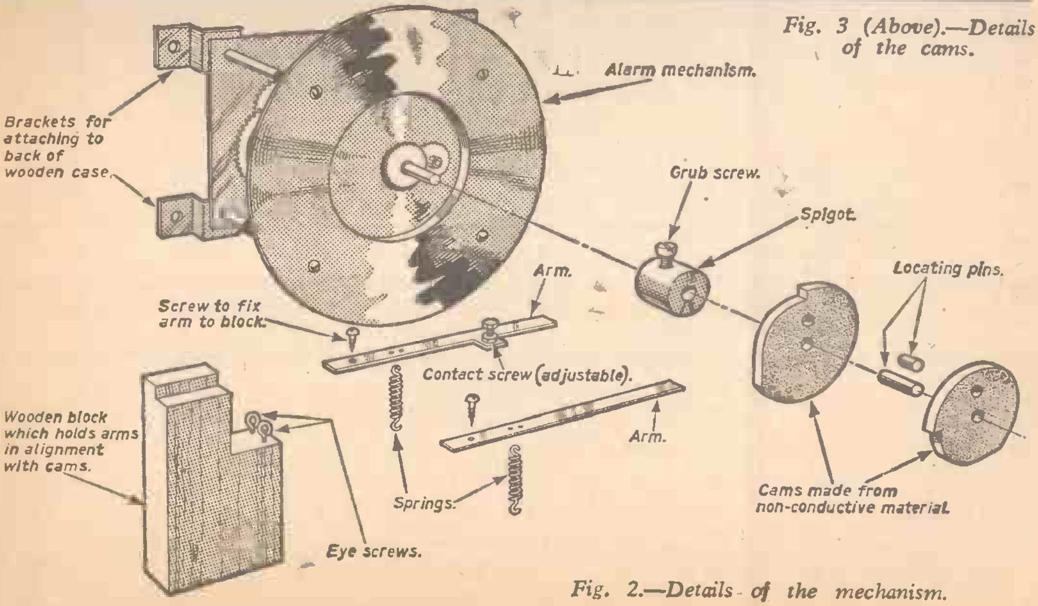


Fig. 2.—Details of the mechanism.

CALCULATING SUN-DIAL MARKINGS

by JAMESON ERROL

THE body of a sun-dial may, within reason, be of any size and of a variety of shapes. The dial itself and the gnomon must, however, conform to certain laid-down principles over which the sun, of course, has by far the greatest control. The method set out in this article makes for a high degree of accuracy and is not over-difficult either to follow or put into practice.

Fig. 1 shows the preliminary drawing for a dial, the essential lines being later transferred to the brass dial-plate. The 10in. measurement is naturally elastic provided other calculations conform. A large sheet of good quality drawing paper will be needed in addition to the usual pens, ink, compass, ruler, etc. Proceed as follows:

Draw line *AB* and Noon Line *CD* at right-angles to it. The second Noon Line is distant from the first by the thickness of the material comprising the gnomon. At a distance of 10in. from *AB* draw *EF* parallel to it. London being 51½° latitude, and reference to a trig. table giving the line as 0·8726, draw line *GH* parallel to the other horizontal lines at a distance of 0·7826 x 10in., i.e. 7 4/5in. With intersection of the lines *CD* and *GH* as centre, scribe a quadrant and divide its periphery into six equal parts as shown. Through the points thus marked draw radial lines to meet the line *EF*. Now draw radiating lines to the intersection *C* which will give the true positions of the hour lines. Transfer them (by tracing) to the actual dial, marking them on both sides of the gnomon and allowing space between Noon Lines equal to the thickness of the material from which the gnomon is made.

The dial-plate may be round, square, octagon-shaped, or of any desired design, size and thickness. the gnomon, however, must conform to certain orthodox rules, and a suitable and pleasing shape is shown in Fig. 2. Its size must be such that a shadow extending the length of the Noon Line is cast at the summer solstice. In London the altitude of the sun at summer solstice is 62°, and if this angle be sent out from the end of the Noon Line as in the diagram, it will determine the length of the gnomon so that an adequate length of shadow is cast when the sun is at its highest.

The complete structure must, of course, be perfectly level, and should have its 12 o'clock line pointing due north and south, allowance for magnetic variation being made.

Concrete or stone for the main structure and brass or bronze for the dial-plate and gnomon are very suitable media to use. None is unduly affected by sharp climatic changes, and all are durable.

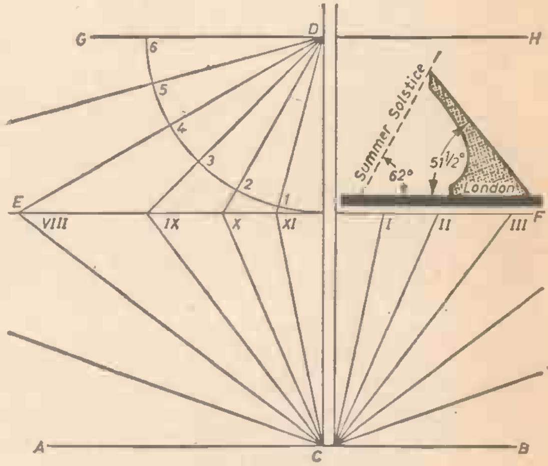


Fig. 1.—Setting-out the dial.
Fig. 2 (Top right corner).—A suitable design for the gnomon.

Electronic Nurse Tends 900 Patients

ONE of the reservations in the White Paper describing the Government's ten-year hospital plan—that progress may be held up by a shortage of staff — is answered by the "electronic nurse" recently announced by EMI Electronics Ltd.

This is a system for automatically transmitting to a central point information regarding the general condition of up to 900 patients in various wards of a hospital. A nurse seated at the central receiver console can read off dials the temperature, blood pressure, pulse rate, respiratory rate and other similar information for any particular patient or all patients in turn.

Where any abnormality is shown, immediate attention can be given to the patient in question. In all cases, the data shown on the dials can be recorded on the patients' history cards for easy reference.

If the characteristics of a particular patient should at any time go outside the individually set limits for that patient, an alarm is immediately given on the receiver console, and the bed number and other information for that patient are automatically displayed. This alarm system overrides any data for another patient which may be shown on the console at that moment.

It is not intended that nurses' services should ultimately be dispensed with. On the contrary, by this technique of "nursing by exception", nurses are relieved of routine duties and can be employed more advantageously attending to those patients who need them most. Patients can be monitored more frequently than they would be by conventional methods—including while they sleep.

A simple attachment is made to each patient. It causes no discomfort, the patient can sleep easily when it is attached. Each attachment is connected to a small box fitted to the headrail of the bed.

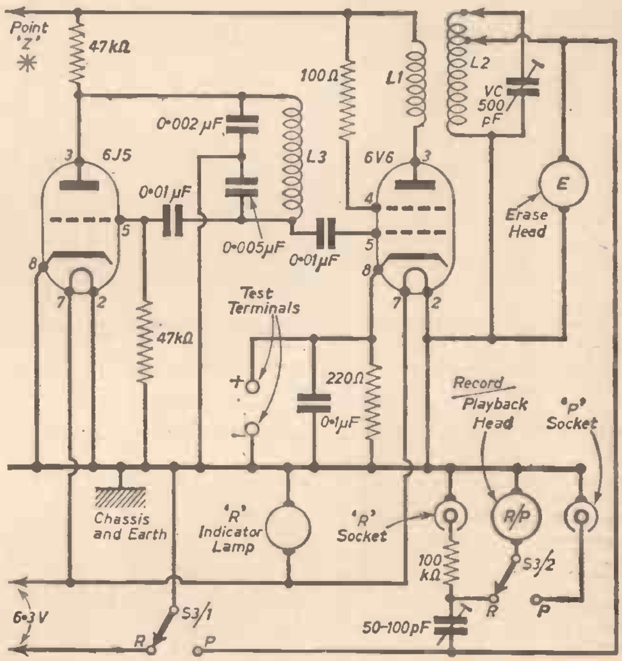
These boxes are connected in turn, via a bed selector to a transmitter for each ward. Several transmitters are wired to the hospital automatic local telephone exchange, from which a normal telephone line runs to the receiver console.

AN ADVANCED OSCILLATOR FOR A TAPE DECK

By J. H. B. GOULD

IN the article on the construction of a tape deck in the September 1961 issue of "PRACTICAL MECHANICS", a very simple form of oscillator was described, and there may be circumstances under which it would be difficult to make the circuit perform reliably; as for example, where the erase head imposes a heavy load on the oscillator or where a serious mismatch exists between oscillator and head.

For such situations, and for those who would prefer an added measure of stability or power, the following circuit is suggested.



Circuit details.

Circuit Details

It will be noted that this circuit is very similar in principle to the one previously described, but now the functions of oscillator and power amplifier have been divorced. It uses the same components as previously, with a few additions: a triode valve, a variable capacitor and inductor (L3). This last is identical to L1; in other words, it is a copy of the high-frequency transformer described previously, but without the tapped secondary winding.

Only one point needs to be made about construction. The variable capacitor "VC" should be of the preset type with a screwdriver-slotted shaft. It need not be mounted on the panel or the motor board, for it is a once-for-all adjustment.

Unlike the previous circuit, this version has to be aligned; but this is a very simple operation. A low-range voltmeter, 0-6V, e.g., a battery voltmeter, is connected to the test terminals (see diagram). With the oscillator energised, "VC" is adjusted to give a *minimum* reading on the voltmeter. If the voltage varies but no definite "trough" can be observed, set "VC" to the minimum reading possible and disconnect. If "VC" is observed to be in its "maximum capacity" position (plates fully meshed), solder a 100pF capacitor in parallel with it. If "VC" is found to be in the minimum position, connect it to the next lower tap on L2.

TRADE NOTES

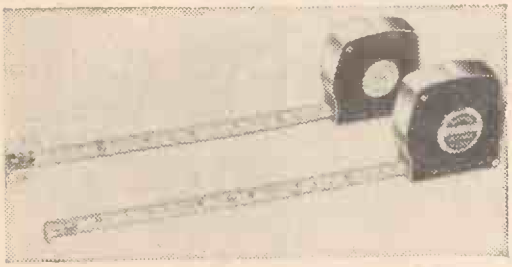
A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

Stain-Go

A NEW Preparation for Protecting and Cleaning the Hands.

STAIN-GO is a bland cream, sold in convenient polythene tubes, it protects and cleanses the hands. Applied before beginning dirty jobs of all kinds, it prevents grime from penetrating into the skin. Washed off with soap and warm water—or even a tissue or cotton wool—it removes dirt gently but surely.

Price 2/6 a tube, obtainable from chemists.



New 6ft and 10ft Riband Rules

NEW additions to the range of measuring equipment made by James Chesterman & Co. Ltd., of Sheffield, are the " Sixty " and " Sixty-Six " Riband Rules.

Both rules are revolutionary in design, having strong chromium plated die-cast cases with nylon sides, attractively shaped to fit into the hand. The snow-white tape blades are concaved for rigidity, but are also remarkably flexible enabling circumference of pipes etc., to be measured accurately. A wide range of graduations is available, clearly marked in black to give maximum legibility, even in poor light. Both rules have 2in. (51mm) wide cases and sliding tips to the tape, making it possible to take accurate internal and external measurements.

Retail prices: " Sixty ", 8/3.; " Sixty-Six ", 12/6.

Vapour from Paper Stops Rust

A REMARKABLE paper which keeps rust at bay is now being retailed in 5/- packets called " Banrust ".

The paper gives off a vapour which prevents rust forming on iron or steel parts stored within 18 inches of its surface (even if they are left wet).

Rust has been the handyman's enemy for so long that such a simple method of prevention may sound too good to be true. The fact is that " Banrust " under the name Stace V.P.I. has been used successfully in industry for several years.

Only now, after being thoroughly proved under really tough conditions—for example the packaging for export of knocked down car body panels shipped thousands of miles under really damp, humid conditions—has the paper been made available for retail sale.

V.P.I. stands for Vapour Phase Inhibitor, a chemical developed by Shell International. Leonard Stace Limited of Cheltenham, one of the few firms in this country licensed to produce V.P.I. papers, coats the chemical on to brown, waxed paper and it is sheets of this paper that can now be bought.

The remarkable feature of V.P.I. paper is that it constantly gives off a vapour which effectively prevents rust or corrosion forming on any iron or steel parts within 18 inches of the paper's surface, i.e., the parts to be protected do not even need to touch or be wrapped in the paper provided they are no further from it than this. Neither is it necessary to exclude air or moisture; in the most humid atmosphere (even the salty sea air) articles remain rust-free for months on end without the necessity for oiling or greasing.

The life of the chemical action of the paper depends upon the degree of enclosure or the movement of air around the articles under protection. In a tightly closed toolbox one piece of " Banrust " has been known to protect the entire contents from rust for as long as five years. On the other hand, for instance, a piece draped over a lawnmower in the garage, where air is free to circulate would probably last for the whole of the winter season.

Waterproofing Leather

NO one likes wet feet and as well as being uncomfortable you are more prone to colds.

You can, however, take precautions by waterproofing your shoes with a special Kiwi polish called Wet-Pruf. It is something rather more than a shoe polish as waterproofing is its main object and polishing an additional feature.

Special ingredients are incorporated to keep the leather soft and make the surface repel water. Various types of waxes are included for polishing and some are specially treated to increase their capacity to form a surface film and gloss.

Occasional use is usually sufficient, but more frequent applications are required if you are continuously in bad weather or wet conditions. Wet-Pruf is made in Neutral, Brown, and in Black. A tin costs 1/3., a little more than normal polish.

A MECHANICAL TEACHING MACHINE

(Continued from page 392)

The paddle works the trip mechanism for the bar. Washers at the ends keep the split an even width along its length. The ends of the paper rolls are pushed into this opening so that, when the handle is turned, the paper is rolled up and the paddle rotates, tripping the release mechanism.

The roller is held in place by metal rods through clearance holes in the box sides. On to one rod can be soldered the handle. At the handle end, inside the box, there is a rachet so that the handle can only turn clockwise. This ensures the correct direction of rotation, but it can be dispensed with if thought an unnecessary refinement.

Trip Mechanism

This mechanism is of the simplest possible design (Fig. 7) for the amateur to construct.

The paddle protrudes from the rotating bar about 1in. When the bar is rotated the trip hinge is pushed to the right by the paddle, thus releasing the shutter mechanism. The shutter then is assisted back to its working position by the return spring at the end of the shutter handle (Fig. 5).

Paper Rolls

Question and correct answer are on the same roll and can be made from 8in. broad paper. A few foolscap sheets joined together can be used. For the pupil's answer roll the paper is 4 to 4½in. broad. If this breadth is not easily obtainable then a shiny surfaced toilet roll can be used as a substitute.

A HOME CHARGING PLANT

(Continued from page 400)

The Circuit

The theoretical circuit diagram is shown in Fig. 3. As an added precaution a fuse in fuse holder might be included between the switch and the mains. If readers substitute a metal chassis, or cover of sheet metal an earth connection to the metal would of course be necessary.

Rectification

In the prototype simple half-wave rectification was used, which is really all that is necessary for charging purposes. These metal rectifiers are of two major types, high voltage work, consisting of a large number of rectifying washers in series and low voltage work, consisting of larger but fewer rectifying washers. Both types are usually assembled with the discs in combined series and parallel arrangements. A single rectifying unit is shown in Fig. 4A. Connections can be made via the cooling fins and it is possible to get varying amperage by actual connection variation. Fig. 4B is the simple half wave rectification, which as will be noticed is the same as Fig. 3, minus the additions of ammeter, neon indicator and photo lamp. A full-wave rectifying arrangement is shown in Fig. 4C. A simple half-wave circuit with a wander plug for selecting voltage tappings can be seen in Fig. 4D. The reader might like to try an arrangement such as this for selecting a particular voltage. Tapping points could go to sockets in the sloping panel. It is wise to check the voltage and amperages before connecting an accumulator. If the terminals are incorrect as to polarity, then the meters will just kick erratically and the markings will have to be reversed.

MATHEMATICAL CROSSWORD SOLUTION

(See page 419)

(1) 2	(2) 1	(3) 6	(4) 5	(5) 3
(6) 1	6	8	1	4
(7) 0	9	9	(8) 4	1
(9) 5	3	2	4	5
(10) 4	2	1	0	8

PUZZLE CORNER

The Four Aces

IF four people are to draw one card from anywhere in the pack, what is the chance that each will draw an ace?

Answer

When the first person draws, the chance is one in thirteen. The second person has only 51 cards to choose from and there are only three aces left, so his chance is three in fifty-one. The third's chance is one in twenty-five, and the fourth's one in forty-nine. The combined chances are, therefore:

$$\frac{1}{13} \times \frac{1}{17} \times \frac{1}{25} \times \frac{1}{49} = \frac{1}{268,725}$$

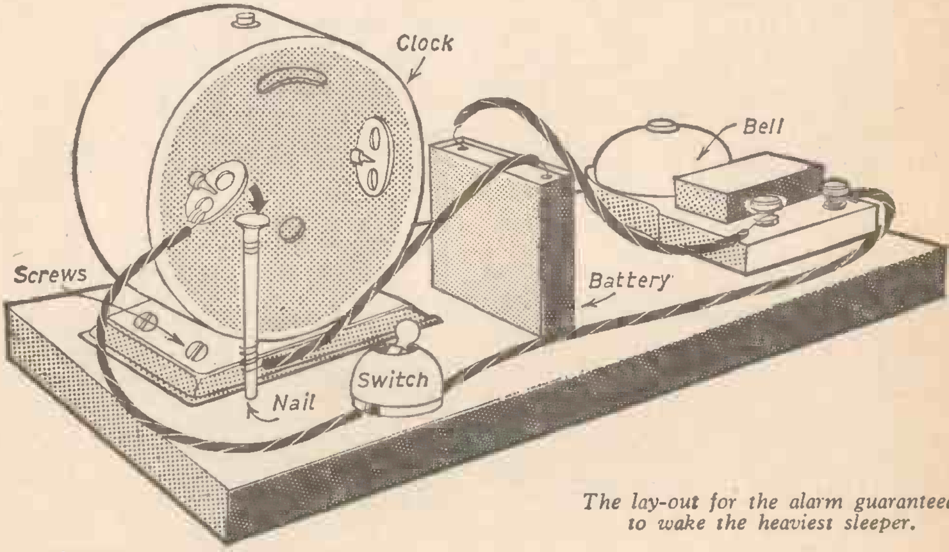
AN ELECTRIC ALARM

By BERNARD GILLESPIE

Alarm Clock Conversion

THE author of this article is a schoolboy and being a heavy sleeper found the ordinary clockwork alarm did not waken him, he decided therefore to adapt it to operate an electric bell and the directions for doing this are given in the following text and diagram.

First screw the clock to a suitable wooden base. Drive a nail into the base close enough to the clock to stop the alarm winder from making a complete turn. Attach a wire to the alarm winder, then take it through a switch to an electric bell. A second wire goes from the nail to either side of a battery and then to a second bell terminal. To set the alarm, turn the winder half a turn, just out of contact with the nail.



The lay-out for the alarm guaranteed to wake the heaviest sleeper.

A SIMPLE TIME SWITCH FOR THE TROPICAL AQUARIUM

(Concluded from page 420)

The box must be deep enough so that a lid can be screwed on and long enough so that the arms can be positioned. The box must also be wide enough so that the cam unit can revolve without interference. A hole is cut in the back of the box exposing the key so that the clockwork can be rewound. Having mounted the clock inside the box, a wooden block must be made. The height of the block is the same as that of the height of the cams from the bottom of the box and is shaped as shown in Fig. 2. Screw the two arms in position, bearing in mind that the arm which carries the contact screw runs on the large cam and attach a length of wire to each screw. Hook the long spring through the two holes in the arm which carries the contact screw and the smaller spring is to be hooked through the two holes in the plain arm. Hook the other end of the springs on to the two eye screws which are screwed into the block, see Fig. 2. These should be screwed in until sufficient tension is loaded on the springs. It is important that the two eye screws and the springs *do not* come into contact with each other. A piece of insulating material can be placed between them if desired. Locate the arms on top of the cams and screw the block inside the box. A hole must be drilled in each end of the box and the wire pushed through. Screw a lid on to the box as a safety precaution and the time switch is complete.

SALES AND WANTS

The pre-paid charge for small advertisements is 9d. per word, with box number 1/6 extra (minimum order 9/-). Advertisements, together with remittance, should be sent to the Advertisement Director, PRACTICAL MECHANICS, Tower House, Southampton Street, London, W.C.2.

COURSES

LOUGHBOROUGH COLLEGE OF TECHNOLOGY

Loughborough, Leicestershire

COURSES IN AUTOMOBILE ENGINEERING and AUTOMOTIVE TECHNOLOGY

The Department of Aeronautical and Automobile Engineering invites applications for the above four year courses commencing in September 1962.

The course in Automobile Engineering is a college diploma course offering General Engineering with an automobile engineering or maintenance and distribution bias (the former qualifying for an honours diploma). Candidates must possess at least four different G.C.E. subjects at "O" level, including English; and maths. or physics at "A" level.

The course in Automotive Technology is a new sandwich course which integrates honours degree academic work with practical and industrial training. Students can be either college or industry based and must possess at least five different G.C.E. subjects including English at "O" level and maths and physics at "A" level. Alternatively a very good O.N.C. entrance standard will be considered.

The department has recently moved to new buildings on the College campus and is rapidly extending its facilities. The College will be entirely residential by September, 1962, and offers exceptional recreational and extra-curricular activities.

For further information and application forms apply to the Academic Registrar.

RADIO

RADIO, TELEVISION Service Sheets. All types valves. S.A.E. list. JOHN GILBERT RADIO, 20 Extension, Shepherd's Bush Market, London W12. SHE 3052.

EDUCATIONAL

"HOW AND WHY" of Radio and Electronics made easy by a new non-maths, practical way. Postal instructions based on hosts of experiments and equipment building carried out at home. New courses bring enjoyment as well as knowledge of this fascinating subject. Free brochure from Dept 12. PM, RADIOSTRUCTOR, Reading.

POSTAL TUITION in Technical Drawing, tracing and blueprint reading. Drawing and Design in wood or metalwork for handicraft Teachers Examinations. Details from C. PANNELL, 145 The Crossway, Portchester, Hants.

ELECTRONICS!

Key to YOUR Future?
An exciting career—a new Hobby—
Your own spare or full-time BUSINESS?

New experimental course includes big kits for building test gear and complete AM/VHF receiver.

FREE BROCHURE FROM **RADIOSTRUCTOR**

DEPT. E80, READING, BERKS.

SITUATIONS VACANT

A.M.I.Mech.E., A.M.Brit.I.A.E., City and Guilds, G.C.E., etc., bring high pay and security. "No pass—no fee" terms. Over 95% successes. For details of exams and courses in all branches of Engineering, Building, Electronics, etc., write for 148-page handbook, free. B.I.E.T. (Dept 967B), London, W8.

SKILLED PRACTICAL Engineers and Craftsmen are eligible for associate membership of The Institute of Engineers, Practical, 118 Westwood Park, London, SE23. Write for details.

PHOTOGRAPHY

PHOTO ENLARGER, Castings and Bellows 35/- per set. S.A.E. for details. V. J. COTTLE, 84a Chaplin Road, Easton, Bristol 5.

PROJECTORS. Home Assembly Kits, all types and sizes and Stereo from £6/2/6. Fan Base Kit, £3/7/6. Opticals, Screens. S.A.E. MARSHALL, SMITH LTD., 64 Norwich Avenue, Bournemouth.

MODEL PARTS

"EVENING STAR" in $3\frac{1}{2}$" G.

"Wilwau" is completely up to date with the castings for L.B.S.C.'s fine loco. S.A.E. with enquiries appreciated.

W. K. Waugh, 31 Hillfoot Drive, Bearsden, Nr. Glasgow. Bea 2985

HOBBIES

NEWTONIAN TELESCOPE making. 6in., 8½in., 11¼in Glass discs. Grinding Kits. Aluminised Parabolic Mirrors. Optical flats. Ramsden eyepieces. Barlow lenses. S.A.E. for list. L. J. MAYS, 20 Clover Road, Timperley Altrincham. Cheshire.

WATCHMAKERS

WATCH PARTS

FOR ALL makes of Watches, Tools, Instructional books, etc., Special Kits for beginners; send 6d. for "Super Bargain Catalogue": T. G. LOADER (Dept. B). WATCHMAKERS' MAIL ORDER SERVICE. Milestone Road, Carterton, Oxford.

BALANCE STAFFS

72 Named and Boxed friction fitting, only 8/6 box.

Free list of tools, materials, bracelets, watches, clocks, etc.

J. J. LAWSON
95 GODWIN ST., BRADFORD, 1.
Phone: 32075

NEW WATCHES, watch movements, Watchmakers' tools and materials, instructional books, etc. at unbeatable prices. Also watch repairs undertaken. Send 1/- for Bumper Bargain Catalogue. THE WATCHMAKERS SUPPLY COMPANY, "Time House," Carterton, Oxford.

PLIERS

SQUARE NOSE, SNIPE NOSE, ROUND NOSE or SIDE CUTTERS 12/6 Pair

Send for FREE lists now of Watch Materials, Tools, Bracelets, Straps and Watches to:

J. J. LAWSON
95 Godwin Street, Bradford, 1
Tel. 32075

WOODWORKING

ANGLIAN RANGE—Saw Spindles. 10in. R/F Sawbenches, 6in. and 8in. Planers, 6in. Sawplanes and Woodworking Lathes. Send 6d. postage for brochures and price list to the East Anglian Trading Company, 5 Guardian Road, Norwich, Norfolk. NOR 55A.

WOOD LATHES, clearance offer. brand new 3½in. x 18in., send £4/19/6 or S.A.E. Details NEWBOULT & THORP LTD., Bridgegate, Retford.

PATENTS

PATENTING SERVICES, Advice Qualified agent. C. L. BROWNE, 114 Greenhayes Avenue, Banstead, Surrey.

ELECTRICAL

ALL TYPES of Electrical Goods at extremely competitive prices, e.g., 5 amp Twin Cable, 35/- 100 yards. Lampholders 7/- doz. 5ft Battens 49/-. Quality and immediate dispatch guaranteed. Request list. JAYLOW SUPPLIES, 93 Fairholt Road, London N16. (Tel: Stamford Hill 4384.)

BRAND NEW
BROOK ELECTRIC MOTORS

Single Phase	1/3 h.p. 1,500 r.p.m.	£7 13 9
	1/2 h.p. 1,500 r.p.m.	£10 7 6
H.P. TERMS	3/4 h.p. 3,000 r.p.m.	£10 7 6
AVAILABLE	3/4 h.p. 1,500 r.p.m.	£11 16 9
	1 h.p. 3,000 r.p.m.	£11 16 9

Fully guaranteed by makers, approval against cash. Carriage paid mainland. State voltage.

P. BLOOD & CO.
ARCH STREET, RUGELEY, STAFFS.

SMALL ELECTRIC CIRCULATING PUMPS

for hot or cold water, fish tanks, ornamental fountains, waterfalls, milk cooling, greenhouse watering, pot washers, etc., comprising 120 watt unshrouded type, shaded pole, A.C. motor, coupled to centrifugal die-cast pump. Output 250 g.p.h. Maximum head 6 feet, 220/250 volts. Silent continuous running. New Price £3.3.0. Post paid.

H. MIDDLETON, 639 ABBEYDALE RD., SHEFFIELD, 7.

TOOLS

SAVE POUNDS
AT OUR NEW
TOOL BAR

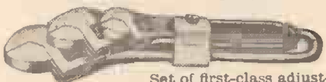
AN EXTRA HAND

10" adjustable grip wrench with an automatic self locking tension release. Leaves both hands free. Makes so many awkward jobs easier. High grade—heavy duty tool. OUR PRICE **7/6** p. & p. 2/-.

Set of Chrome Vanadium RING SPANNERS !

fits 6 nut and bolt sizes ¼"-1" Whitworth and six nut and bolt sizes 3/16"-7/16" B.S.F. (also available in A/F and Metric). Worth 25/-. OUR PRICE **10/6** p. & p. 2/-.

WRENCHES 3 FOR THE PRICE OF ONE



Set of first-class adjustable Wrenches—4", 6" & 8" sizes. Today's value 37/6. OUR PRICE **17/6** p. & p. 1/6.

Lists of all our tools are available on request

J. D. SWAIN Ltd
(Dept. PMC 2)
47 Goldhawk Road, London, W.12.

TOOLS
(continued)

BRAND NEW
TOOLS AT BARGAIN PRICES

50 Sets Hand Reamers, Parallel. One each size, 3/16, 7/32, 1/4, 9/32, 5/16, 11/32, 3/8, 13/32, 7/16". Price 28/6 per set.

5,000 New Files, not recuts, best quality, Precision Needle Files, 6 ass., price 4/6. 4" hand files, 6 assorted, price 5/-. 6" hand files, 6 assorted, price 7/6.

1,000 Circular Split Dies, Standard, BSF or Whitworth sizes 9/16, 5/8, 3/4, 7/8, 1" x 2-1/4" O.D. Price 30/- per set. Diestocks 15/-.

500 Circular Split Dies, Standard, BSF or Whitworth sizes 1/2, 7/16, 3/8, 5/16, 1/4 x 1" O.D. Price 12/- per set. Diestocks 7/-.

100 Sets B.A., Cir/St Dies 13/16" O.D. Sizes 2, 3, 4, 5, 6, 8 and 10 B.A. Price 15/- set.

200 Goodell-Pratt 18" Steel Rules, marked 4 edges, 1/8", 1/16", 1/32", 1/64", 1" wide x 1/16" thick. Worth 20/-. Price 7/6 each.

"Sturtevant" Torque Wrenches, 1/2" square drive, 0–100 foot/lbs. Price 65/-.

60 B.A. Socket Sets, 9/32" sq. dr., 0–8 B.A. with tee bar and 3" ext. Price 15/6.

50 Sets Whitworth Hex. Die Nuts, sizes 1/2, 5/8, 3/4, 7/8, 1". Price 15/- set.

Barn Tool Boxes, heavy gauge, length 19", 8" x 8", fitted tray. Price 38/6.

HSS 45° Angle Milling Cutters, 1" hole. Price 17/6 each.

HSS Metal Slitting Saws, 4" dia. 4 assorted widths, 1" hole for 20/-. Ditto 2-3/4" diam., 1" hole, 4 for 9/-. Ditto up to 2-1/2" diam. 6 for 10/-.

30 Knurling Tools, 2-wheel floating head. Price 25/-.

45 Drilling M/C Vices, capacity 2½". Price 25/-.

80 Sets Left Hand B.S.F. Taps and Dies. 2 taps one die each size 1/4, 5/16, 3/8". Price 12/6 a set.

Please add 1/6 on orders under 40/- towards postage.

MONEY REFUNDED IF NOT SATISFIED

A. E. KING
152 Halfway Street, Sidcup, Kent

HOME BOAT BUILDING

FULLY PREFABRICATED Kits to assemble a Boat at home, for two-bert Cabin Cruisers, fast runabouts, canoes, prams. Enterprise SigneT sailing dinghies. Leaflets from: WYVERN BOATS (WESSEX) LTD., Milbourne Port, Sherborne.

BROMLEY BOATS, Kits, Mahogany, Silver Spruce, American Boat plans. 3d. list. Southlands Road, Bromley, Kent.

MISCELLANEOUS

"LITON" PHOTOELECTRIC CONSTRUCTION MANUAL

10 interesting **PHOTOELECTRIC PROJECTS** fully described with building plans and circuit diagrams which can be easily made by amateurs from standard components. Hints on the use of photocells and phototransistors. A mine of practical information for the experimenter. All units available also built and tested.

1. Battery burglar alarm. **Kit 65/-.**
2. Mains burglar alarm.
3. Light saver.
4. Customer announcer.
5. Simple garage door opener.
6. Photoelectric counter. Price (2-6) **Kit £4.12.6. Built £5.10.0.**
7. Long range infra-red mains alarm.
8. "MIRA" Miniature infra-red battery alarm. Total consumption 0.2 watt.
9. Motorised garage door opener.
10. Door opener with electronic lock.

If you are interested in electronics or electro-mechanical gadgets send 1/- stamp for the 24-page publication illustrated. **"ST. JOHN'S RADIO," Jews Row, London, S.W.18.**

MISCELLANEOUS
Continued

SPRINGS, PRESSWORK. Immediate capacity available. ADWIN SPRING LTD., 33 Elwell Street, West Bromwich. Phone Tipton 1473.

AQUALUNG AND COMPRESSOR Equipment, Ballraces and Miscellaneous items. Lists 3d. PRYCE, 157 Malden Road, Cheam, Surrey.

FIX IT. Why scrap it? Repairs to anything mechanical. Parts for obsolete machinery. No job too small. Inventors' Models. WELLWORTH PRODUCTS, Ramsbottom, Bury, Lancs.

BRIANT & LANE, Experimental, Prototype and General Engineering, Brazing and Welding.—19 Foyle Rd., Tottenham, London N17. Tel: TOTtenham 9088.

FOR SALE

ASTRO TELESCOPE making. Standard Ramsden Push-in Eye-pieces, ¼in., ½in., ⅔in. focus, 35/-; with R.A.S. thread, 42/6 each. S.A.E. list. Object Glasses, Newtonian Mirrors, Diagonal Mounts, Focusing Mounts, Altazimuth Mountings and Tripods for refractors and reflectors. W. BURNET, Grand Sluice, Boston, Lincs.

HYPODERMIC SYRINGES, brand new 2c.c. Sima, excellent for oiling etc., 4/9d. each. Also needles, sizes 12, 17 and 18 at 4/- per dozen. G. ROGER SMITH, 16 Clyde Street, Liverpool 20.

8mm. double-run film. 25ft. lengths fast pan (29° sch) or slow pan (27° sch) not process paid, not spooled, 6/6 each. 16mm. ex-government film manufacture date 1957/58, 300ft. tins containing 6 x 50ft. rolls, 30/- each plus 1/6 post. This film is slow pan and can be successfully reversed. Single rolls of 50ft. ditto 6/- ea. plus 6d. post.

Brand new **Dallmeyer 4in. projection** lenses especially designed for 35mm. transparency projectors, but will cover up to 2¼in. square, original price £7, only £3, post 1/6.

2in. **Bi-Convex Glass Condensers,** 2/6 each, post 6d. Epidiascopes from £20 each.

Ex A.M. G45 **Gun Camera,** 24 volt, 2in. fixed focus lens 50ft. magazine loading, complete with magazine, new £2.15.0., ditto used £2. Both post 2/6.

Brand new Kodak (ex Admiralty) 7 x 50 Prismatic Telescopes, focusing in fitted wooden case with binocular eyepiece, fitted filters, cost over £50: due to another huge purchase, lower than ever price, £4.10s. each, carriage 5/-.

Brand new (ex A.M.) 12 volt 25 amp batteries. These are R.A.F. general purpose lead acid accumulators, and are similar in construction to normal car battery. Very suitable for cars and vans, will start any vehicle. Never been filled and in original tropical packing. First charge instructions included, cost about £10, only £2.10.0, each, carriage 5/-.

All Metal Projector Stands, Lightweight, fold flat when not in use. Model 1. Height 3ft. Table 20 x 13in. Grade 1 £4, Grade 2 £2.10.0. Both plus 7/6 carr. Model 2. As above but height variable between 2ft. 9in. and 3ft. 3in. Platform 21 x 13in. Grade 1 £5, Grade 2 £3. Both carr. 7/6. All are in good condition, used but paintwork is very good on Grade 1 models.

Ex **R.A.F. Aerial Film.** 9¼in. x 300ft. Pan, £3. 160ft., 35/-, 5¼in. x 47ft., 3/-, 24ft., 5/-. Ideal for cutting to smaller sizes. Perfect condition. Post 1/6.

Ex A.M. **GGS Mark 3 Recorder Camera.** 16mm. made by Specto. Latest model with three shutter speeds, 2 or 16 f.p.s. bloomed 1½in. lens F1.9 with iris to F.16, 24 volt 50ft. magazine loading, complete with magazine in original tropical packing, absolutely brand new, only £5, post 2/6. Ditto used £3.10s., post 2/6.

All goods supplied on 14-day money back guarantee.

R. SANKEY, Regal Cinema, ATHERSTONE, WARWICKS. *Tel.: Atherstone* 2220 3210.

Continued on page 431

YOUR *Queries* ANSWERED

RULES

Our Panel of Experts will answer your Query only if you comply with the rules given below.

A stamped addressed envelope, a sixpenny crossed postal order, and the query coupon from the current issue which appears at the foot of next page, must be enclosed with every letter containing a query. Every query and drawing which is sent must bear the name and address of the reader. Send your queries to the Editor, PRACTICAL MECHANICS, Geo. Newnes Ltd., Tower House, Southampton Street, Strand, London W.C.2.

Removing Heat Mark

I HAVE a natural walnut veneered coffee table which has a white bloom on one part, caused by the heat of a teapot penetrating a tray. Can you please advise me how to remove this mark?—S. Short (Surrey).

SET the surface perfectly vertical, then with a rag damped with methylated spirit wipe over the damaged area. Set this alight at the bottom—the flame will quickly run up the surface and go out. This procedure should make the mark disappear. If it is unsuccessful repeat the treatment. Restore the gloss, which will be slightly dull, with Brasso.

Mineral Salts Problem

AS a result of an unpleasant smell in two rooms of my bungalow, I removed the floorboards and found that some parts of the wall and brick support for the floorboard joists were covered with a white furry deposit like mould. Could you please tell me how to eliminate this and has it anything to do with the unpleasant smell?—J. Wright (Lancs).

THE white furry deposit you have found on your brickwork below floor level is in all probability an efflorescence of mineral salts. These salts may be derived from either the ground or from the brickwork. It is not easy to prevent this from happening, particularly if the ground water contains the salts in solution. However, providing there is no evidence of such trouble above damp-proof course level it is unlikely to lead to any real problem, but we should point out that some disintegration of the paintwork can take place where bricks are heavily attacked.

With regard to the unpleasant smell, this may be due to pockets of stagnant air beneath floorboards and it is essential to provide adequate cross-ventilation beneath the floor. The addition of ventilators beneath the floor in the area where the smell is strongest may well help to overcome the problem.

Coal Consumption of Engine

I BELIEVE there is a method of finding out the coal consumption of a steam engine from diagrams. Could you please tell me how this is achieved?—L. Skellern (Sheffield).

THERE is no simple way of finding out the coal consumption of a steam engine from diagrams and data. The only reliable way is by actual test.

You should consult D. K. Clark's work on "The Steam Engine", a treatise in four volumes, which you could probably borrow from the reference department of one of the public libraries in Sheffield. In that you would find a considerable amount of information on the estimated coal consumption of various types of engines and boilers, including the Musgrave tandem compound and the Lancashire boiler. However, there are so many factors which would have to be taken into account for a specific job that even the most complicated calculation would be unreliable.

The load on the engine will vary, consequently the steam consumption will also vary. Welsh, Yorkshire, Nottingham, Derby, Kent and other varieties of coal all contain a differing amount of heat units. The friction between the engine and the machinery that it drives—that is, in the transmission—is seldom constant; a tight bearing or a fault in lubrication would have effect on the coal consumption. The temperature and velocity of the air over the top of the boiler chimney and the skill (or otherwise) of the fireman would affect the amount of coal consumed.

If it were possible to calculate coal consumption there would have been no need for the locomotive testing plants at Rugby and Swindon; and even there it was found that the amount of coal consumed for a given power output on the stand was entirely different to the consumption when the engine was out on the road running a train.

Bubble Tubes

I WISH to make some bubble tubes, similar to Christmas bubble lights, but not attached to lamps. Could you advise me as to the most suitable method of producing these and how to colour them?—D. Lewis (London, N.W.9).

A VERY satisfactory method of operating bubble tubes is to arrange the base of the tube (or group of tubes) to project into a metal box containing an electric lamp. This produces heat for the reaction as well as projecting a certain amount of light up the tubes.

An alternative method is to pass the base of the tube (or tubes) through the cork of a vacuum flask filled with hot water. This will operate for several hours.

A self-contained electric tube can be made containing a small internal heating spiral below the glass hat. The spiral may be made from fairly fine nichrome wire, as used in a soldering iron heater. If an oxy-coal gas flame is available then Pyrex glass should be used with tungsten "seal-in" wires. With soft glass, copper seal-in wires may be used, but these must be hammered flat into the form of a ribbon where passing through the glass.

In either case the "lead-in" wires should first be well oxydised in a flame and then have a bead of glass fused on to them. The inner ends should then be cleaned and the nichrome spiral may be brazed or spot welded to them. The glass beads are finally sealed into holes blown in the main tube. It is essential that the spiral be lower than the lower edge of the glass hat.

A simple method of construction is to wind a nichrome spiral on to the outside of the tube base. The glass should be covered by a single layer of paper, secured by shellac varnish. The wire may then be tightly wound on the paper and secured with a further layer of paper with a thread binding, the whole being treated with shellac.

In all cases the heater should be limited to that portion of the tube which is below the "hat", the latter being retained by "dints" in the glass. These heaters are intended for low voltage and may conveniently be run in series with the lamps used for lighting.

The main fluid in bubble tubes is plain water, which may be coloured with methyl blue or almost any of the water-based dyes or inks.

The active fluid is normally carbon tetrachloride or chloroform. These liquids are volatile as well as having a density greater than water. Many spirit-soluble dyes may be used for colour but ballpen inks are probably the easiest to obtain.

Developing Ex-Government Film

CAN you please tell me the best method to use for developing ex-R.A.F. aerial film? I intend cutting it into small pieces to fit a miniature 3-D camera. Also can you tell me what colour safety light to use.—D. Hodgson (Derby).

ALL films for aerial photography, other than infra-red, are panchromatic. There is no "civilian" equivalent of the Government surplus film and no processing instructions have, therefore, been issued. However, handling does not vary from the normal routine associated with medium speed or fast panchromatic stock bought in branded packings. Should you wish to enlarge from the negatives produced on this film it would be advisable to employ a fine-grain developer. The Johnson product, Unitol, is suitable and it is supplied with a table giving times and temperatures for different types of films. We suggest you experiment by developing a small exposed strip of film rated at about 40 A.S.A. for the purpose of exposure but considered as Ilford FP3 for the purpose of development. Most surplus film is rather old and this system helps to compensate for the ageing effect. You will then be able to see from the resulting negatives whether the film speeds need adjustment. Use the following table to find the correction necessary:

Fault	Correction
High density and high contrast	Reduce exposure and reduce development
Low density and high contrast	Increase exposure and reduce development
High density and low contrast	Reduce exposure and increase development
Low density and Low contrast	Increase exposure and increase development

Negatives not needed for enlarging or only very slightly can be processed in an ordinary M.Q. developer such as Johnson M.Q., Ilford ID2 and ID34 or Kodak D61A. The remarks regarding rating, etc., already made hold good for these formulae.

If the developed film shows a mottled effect, which it may do due to age or bad storage, the addition of a developer-improver helps to eliminate the trouble. Johnson 142, Kodak Anti-Fog and P.A.C. Latitol are suitable.

Any safelight suitable for a panchromatic film can be used. The designations are Ilford GB No. 908, Kodak "Wratten" No. 3, Agfa No. 103, Ansco No. A3, Gevaert Gevinac No. X535 or Gevaert Gevalor No. X534. They should be used with a 25W pearl bulb at least 4ft. from the film. Philips also produce a suitable green-coloured bulb, No. PF744, which has the safelight built in to the bulb envelope.

FOR SALE
(continued)

NUTS, SCREWS & WASHERS. Mixed parcels of 432 parts, 2, 4 & 6-BA Steel in Round Head, Cheese Head or countersunk 7/-. Ditto Brass 9/-, 6, 8 & 10-BA ditto Steel 6/6, Brass 8/6. Also other sizes. Send for free list, over 140 interesting mixed lots and 3,500 "BOBPAKS" (1/- packs). K. R. WHISTON, Dept. SPM, New Mills, Stockport.

BLACKSMITHS PORTABLE FORGES!!! Brand new Government from £5/15/- carriage paid. Thousand bargains, catalogue free. GREENS, 439 Albert Street, Lytham.

WASHING MACHINE spares, new and second-hand. J. & D. ELLISON, Barkerhouse Road, Nelson.

MAKE a complete Oxy-Acetylene Welder from bits and pieces. New parts amount less than £1. Gas from chemicals. Ideal for home repairs, handicrafts e.g. glass and wire ornaments, etc. Send 2/6 for building instructions, diagrams, welding hints. "DRESDEENA," The Harrow Way, Basingstoke, Hants.

FREE Liquid Rubber Moulding Guide. Send S.A.E. P.P.S. 53 Foljambe Drive, Dalton, Rotherham.

Published about the 30th of each month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2, and Printed in England by Watmoughs Limited, Idle, Bradford; and London. Sole Agents for Australia and New Zealand—Gordon & Gotch (A/sia), Ltd. South Africa and Rhodesia—Central News Agency Ltd. East Africa: East African Standard Ltd. Subscription Rate (including postage): For one year: Inland 22s., Overseas 20s. 6d., Canada 19s. Registered for transmission by Canadian Magazine Post.