Practical

MECHANICS

DECEMBER 1960

1'6

INSIDE

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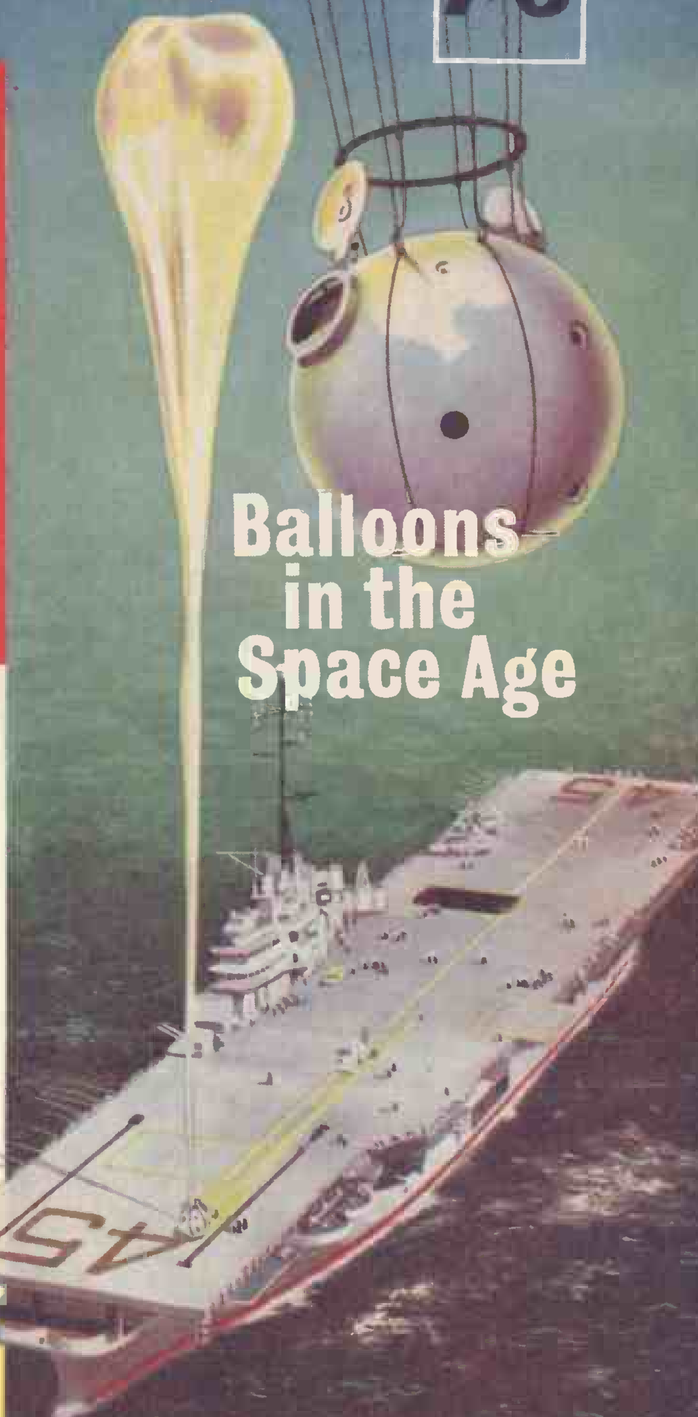

Balloons in the Space Age

Practical
MECHANICS

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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

THE END OF THE LINE ?

THE Ministry of Transport is currently facing two problems, both of which have recently received considerable publicity. The problems are road congestion and the inability of the railways to show a profit. Attempts have been made recently to solve the road congestion by the building of new motor roads and to put the railways back on their feet large capital grants for the modernisation programme have been made. Neither scheme has been a spectacular success. The new motor roads being built are woefully inadequate to cope with the rapidly increasing number of vehicles and the railways show every sign of continuing to make a loss. Is there any solution? Well, a report recently published by the Railway Conversion League claims to have the complete answer. It is nothing less than to scrap the whole of the present railway system and convert the existing permanent way into roads.

The report suggests that the widely held opinion that railways are indispensable because of the volume of passenger and goods traffic they convey is a fallacy and figures are quoted to back up the statement. For example an analysis of published figures shows that a certain stretch of line has a goods train carrying 146 tons of freight passing along it every 2½ hours and a passenger train carrying 89 passengers every 1¼ hours. If the line were converted to road traffic, it would require six medium or three large lorries per hour to carry the freight and two small or one large bus to carry the passengers, i.e. between four and eight vehicles per hour. Incidentally roads can carry up to about 2,000 vehicles per hour.

The flow of office workers into London was analysed in the same way and it was found that to cope with rush hour travel, 114 60-seater buses per hour would be needed—and everyone would have a seat! Compare this figure with the 2,000 vehicles per hour possible and it will be seen that there is plenty of room for other traffic. The introduction of a number of fast motor roads into London and the conversion of existing railway bridges over the Thames would be of immense benefit.

And what of parking? The report again quotes actual figures. Railway property within 2½ miles of Charing Cross alone totals 600 acres and the total area of sidings, etc. (some 40,000 acres) at present being used by the railways would be sufficient to accommodate every motor vehicle in the country.

Experts have vouched for the practicability of the scheme from the engineering standpoint and have estimated that it could be brought to completion within ten years. Where several tracks are laid, dual carriageway motor roads could be built; normal twin tracks would convert to a 30ft. wide highway, narrowing to 24ft. at the tunnels. Using existing permanent way and widening where necessary would of course be far cheaper than building the roads from scratch and would eliminate the difficulties of buying the land on which to build the road and finding a practicable route. The railways are already publicly owned so that work could begin immediately.

It has been said for some time now that something drastic must be done if Britain's transport is not to grind to a tangled halt within the next ten years. Here is a solution which is bold, imaginative and practical. It may not be the final solution but it is the first plan which even begins to get to grips with the problem.

The January, 1961, issue will be published on Dec. 30th. Order it now!

making a Shadowgraph Show

This could have equal success at home or in a small hall

USING cardboard cut-outs to supplement shadowgraphs made by the hands alone, a whole new range of effects is possible. Red Riding Hood and the Wolf is an example taken from the author's own shadow show and runs 10 minutes. The complete programme takes half an hour and is made up of two such plays with an interlude of famous faces. These faces are made with hands plus cardboard cut-out hats and accessories—Churchill's hat and cigar and Charlie Chaplin's bowler and cane are examples.

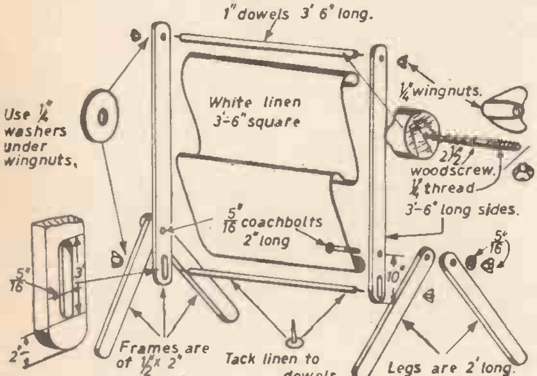


Fig. 1.—The shadowgraph screen.

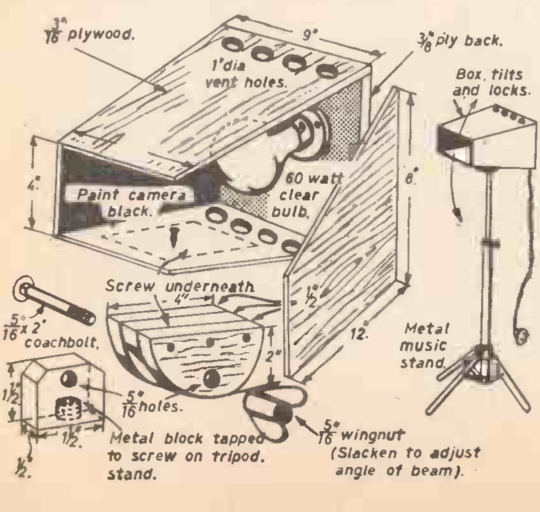


Fig. 2. (Left)—Dimensions of lamp housing of the beam projector.

Making the Shadowgraph Screen

The screen assembly is a very light affair and packs down into a roll only 3ft. 6in. long. Side members and legs are of planed timber 2in. × ½in. section with sides 3ft. 6in. long and the legs 2ft. Cut 3in. long slots in the bottoms of the screen frames and drill the other holes as shown in Fig. 1. After rounding off all the ends of the pieces, the legs can be attached to each frame side with 5/16in. dia. coachbolts.

The screen support dowels are pieces of smooth 1in. rod. Two broomstick handles are ideal and these have woodscrews driven into each end. The woodscrew heads are sawn off and the remaining shank of each screw is threaded ¼in. B.S.W. to take suitable wingnuts. A 3ft. 6in. white linen square is tacked to the dowels, then the screen can be assembled into the side frames by first tightening the top dowel into the upper holes and then positioning the bottom roller in the frame slots and locking with wingnuts. The slots give the necessary amount of adjustment to ensure a tight, crease-free screen.

Beam Projector

Lamp housing of the beam projector (Fig. 2) is constructed from plywood 3/16in. thick for the box sides and ⅜in. for the back. Top and bottom faces of the box measure 6in. × 9in. × 12in. while the two sides are 4in. × 8in. × 12in. Before fastening with tacks and glue, four 1in. dia. ventilation holes are drilled or fretsawn immediately above the lamp position and four holes below at the broad end of the box.

A 60W. unfrosted bulb is mounted in the centre of the back, using a standard bayonet-type socket. The wire flex passes through a hole in the back of the projector for connection to a 2in. plug. Obviously, the smaller the light source, the sharper the shadow, so choose a bulb with a small filament. At one time, the author used a 24W. car headlamp bulb plugged into the car battery with satisfactory results.

The tilt head for the projector is built up from ½in. plywood. There are two semi-circular pieces with a middle distance spacer. This unit is screwed to the underside of the box and a coachbolt with wingnut passes through a drilled hole in the sides of the tilt head and through a metal block that is attached to a metal music stand tripod. Drill and tap the metal block to screw on to the stand.

The beam projector is thus fully adjustable for height and angle of beam and can be locked in any position. Finish the projector by painting the body with flat camera black inside and out.

The set-up for projection is shown in Fig. 3

Red Riding Hood Shadowgraphs

All the shadowgraph cut-outs are made from thin white card. Since the cut-outs have to be picked up quickly in semi-darkness it is an advantage to leave the cardboard unpainted.

Red Riding Hood's head shape is marked out on a piece of card 4½in. × 3½in. (Fig. 4). Draw a grid of lightly pencilled ½in. squares on the card and copy the head outline from the sketch. The basket measures 3½in. × 3in. overall and is cut out as shown. A fish, loaf and banana—each 3in. long—are marked and cut to complete this figure.

During the play, Red Riding Hood is made by both right and left hand but the method of holding and working is identical. Head is gripped behind the thumb and the basket is held in the outstretched first and second finger tips, third and little fingers are bent into the palm of the hand. In the opening scene, Red Riding Hood is made by the right hand and the left hand takes the fish, loaf and banana—one by one—and apparently loads them into the basket.

Several figures illustrate the forest scene (Fig. 5) and three of these are cardboard cut-outs. The tree stands 9in. high and has a maximum width of 6in. Sun and bird are cut-outs mounted on thin wire holders. The wires are attached with gummed cardboard strips and have loops at the other ends. In working, the wires are held below the shadow line so the holding fingers do not show on the screen.

Butterfly and rabbit are fairly easy to make using the hands only. First and little fingers are extended to make the rabbit's ears while the thumb curls round the other fingers to form the nose. For the butterfly, hold the hands as indicated with palms towards the light. Flex the fingers to make the shadow wings flutter.

The wolf is presented in two forms. One form is a plain hand shadow with right thumb upraised and first finger crooked back to make nose and eye. The little finger opens and closes to simulate the mouth. Later, the addition of spectacles and mob cap turn the wolf into a resemblance of Red Riding Hood's Grandma.

Make the cap and spectacles from cardboard to the sizes given. (See Fig. 7.) Note how the mob cap is held behind the lowered thumb and the glasses clipped under the tip of the first finger.

House in the Wood

This is made from a piece of card 9in. × 10in. (Fig. 8). There is a holding tab so that the shadow can be projected on the screen without showing fingers. Door and windows are cut right out and there is a central chimney stack. It is designed for holding in the left hand.

Of sufficient size to contain the wolf's shadow, the bed is from a card piece measuring 6in. × 8in. (Fig. 8). It has two lugs for holding and is complete with pillow and big brass knobs.

The woodsman's head is marked on card measur-

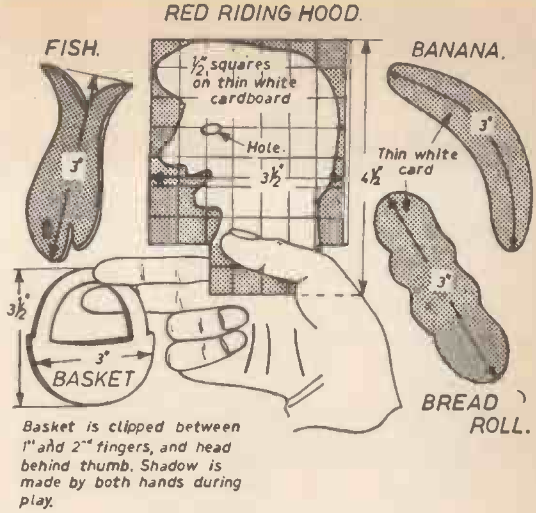


Fig. 4.—Making and working Red Riding Hood with basket and contents.

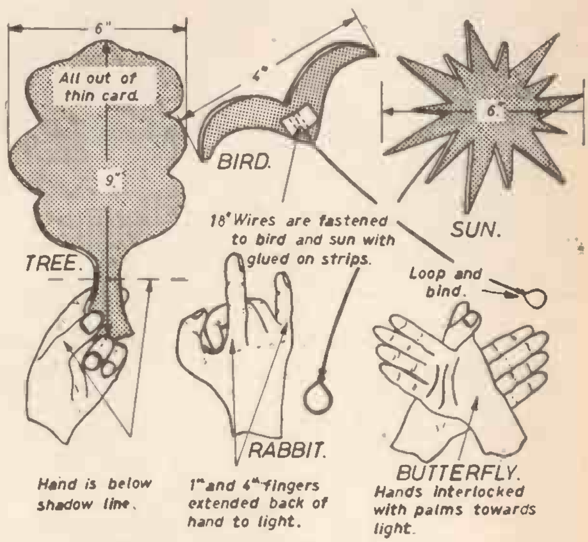
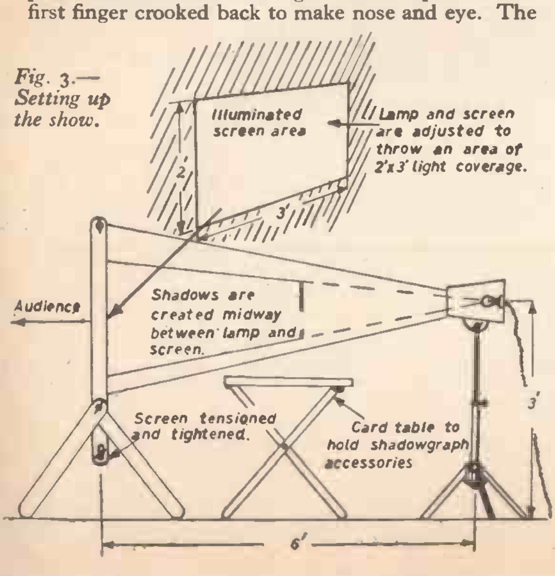


Fig. 5.—Details of the forest scene.

Fig. 3.—Setting up the show.



ing 5½in. × 4½in. He wears a top hat and carries an axe (Fig. 6). This figure is made in the left hand and works from the left-hand side of the screen. By bending and straightening the first and second fingers, the axe is made to work in chopping motion as the woodsman attacks the wolf in the final scene.

The cut-outs are laid in order of working on the card table and after use should be replaced in the same order. Action of the shadow play can be heightened by cutting rapidly from scene to scene—motion picture technique—and it is essential that the cut-outs can be found without fumbling as they are required.

Presenting the Shadowgraph Show

Red Riding Hood appears from right-hand edge of screen (as viewed by the operator). Her arm is outstretched but she is not carrying the basket.

Commentary

" Red Riding Hood has decided to visit her Grandma who lives by herself in a house in the forest. Here is Red Riding Hood's basket which we load with bread, fish and banana! "

The left hand places the basket in Red Riding Hood's hand and then the three articles are lowered one by one into the basket. The shadows of the quite large articles going into the relatively small basket looks very amusing.

" The little girl sets off on her journey across the sun-lit plain." Here, the figure is moved slowly across the screen and the sun cut-out manipulated. " But as she nears the forest the sky is darkened by the lofty trees." Tree cut-out is substituted for the sun. " A bird screeches and swoops down from the branches making the girl halt in terror." Tree is exchanged for the wired bird figure.

" Red Riding Hood sees a friendly rabbit peeping at her from the bushes." Left hand makes this shadowgraph then reproduces the tree. " We see Red Riding Hood vanish into the thick forest and wish for her safety . . . but only a butterfly flutters by! " The tree and Red Riding Hood are withdrawn from the screen then both hands make the butterfly.

" Deep in the forest something stirred . . . and Mr. Wolf lurked behind a tree! " Tree shown in left hand—wolf made by right hand. Tree is withdrawn and replaced by Red Riding Hood made by the left hand this time. " The wolf follows the little girl

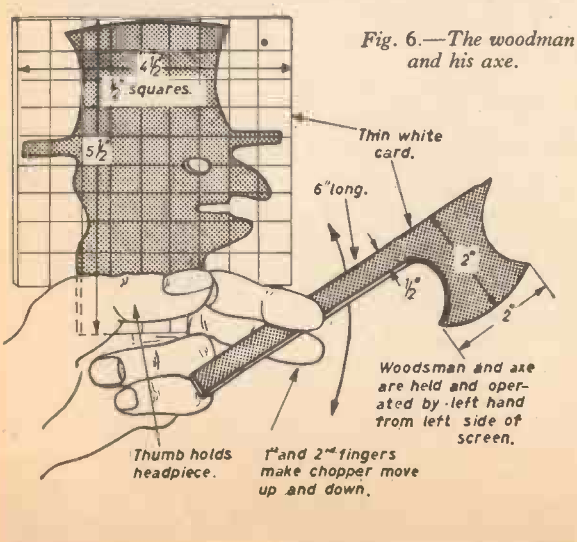


Fig. 6.—The woodman and his axe.

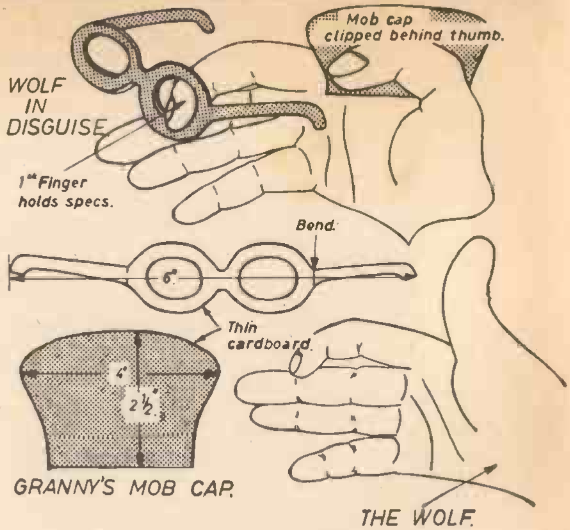


Fig. 7.—The shadow wolf and accessories.

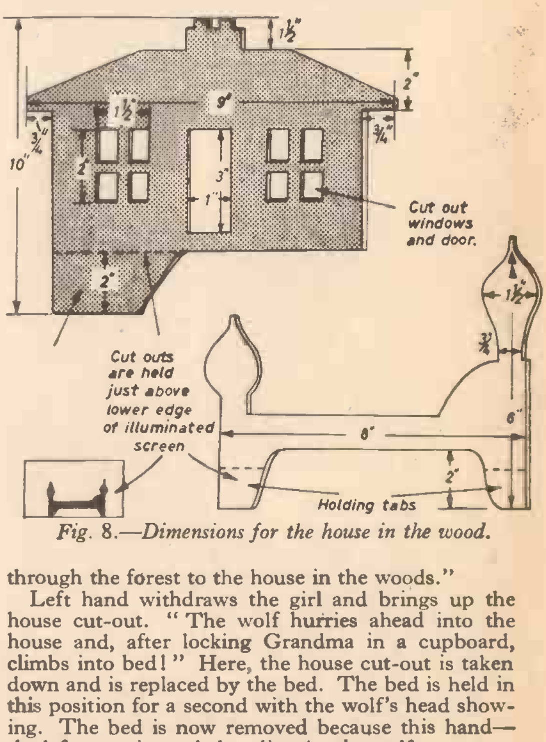


Fig. 8.—Dimensions for the house in the wood.

through the forest to the house in the woods."

Left hand withdraws the girl and brings up the house cut-out. " The wolf hurries ahead into the house and, after locking Grandma in a cupboard, climbs into bed! " Here, the house cut-out is taken down and is replaced by the bed. The bed is held in this position for a second with the wolf's head showing. The bed is now removed because this hand—the left one—is needed to disguise the wolf.

" The wolf put on Grandma's cap and spectacles . . . like this! " The left hand brings up the cap and places it on the wolf's head. Then the glasses are clipped on to the wolf's nose. " And the wolf waited for Red Riding Hood to open the door! Here she comes."

The girl with her basket is brought on with the left hand and the two figures are brought face to face in the centre of the screen.

Red Riding Hood speaks: "Oh Grandma . . . what big eyes you have! "

Wolf: " All the better to see you with! "

Red Riding Hood: " And what big teeth you have! "

(*Continued on page* 126)

Fig. 1.—Aerial view of Skyhook on the flight deck of the support aircraft carrier U.S.S. Valley Forge. (Photo: U.S. Navy).

Balloons in the Space Age

By P. Banbury

THE balloon is still superior to the aeroplane and the rocket for many types of research and for routine measurement of the atmosphere. A manned balloon can fly higher than any true aeroplane, and a balloon carrying only scientific apparatus or small "life specimens," can go nearly half as high again. Not only can it reach great heights but it can stay at maximum altitude for hours or even days, instead of for the fleeting moment that a rocket boosted aeroplane spends at the top of its climb.

The balloon is the perfect flying laboratory. At maximum height it has no speed relative to the atmosphere, and instruments suffer from no position error, frictional heating or vibration. Apparatus of almost any shape and weighing over a ton can be lifted. Most of the phenomena can be observed, recorded and transmitted without man's aid, but if the scientist has to go up himself he can carry on his work in relative comfort and leisure.

The balloon has been associated with research since the days of Montgolfier and Charles, and a recent Nobel prize was awarded for research done with their aid.

Meteorologists depend on balloons for the weight, movement, temperature and humidity of the atmosphere. Aeroplanes depend on the meteorologist. Balloons measure cosmic radiation for scientists and man-made radiation for the good of humanity. They investigate airborne bacteria, spore distribution, the nature of sunlight and clouds and many other things. Figs. 5 and 6 show a cosmic ray research balloon.

Atmospheric Pressure

The sport balloon operates up to about 20,000ft. and the modern research balloon rises to between 60,000ft. and 140,000ft. The design problems are basically the same but their magnitude is vastly increased by the greater altitudes. The biggest single factor is the decrease in atmospheric pressure with heights, as shown in simplified form in Fig. 2.

The pressure of gas inside the balloon always tries to equal the pressure of the atmosphere outside. To do this the gas must expand as the balloon rises. Were there no fall in temperature, the expansion would be 10 times at 50,000ft., 100 times at 100,000ft. and 1,000 times at 150,000ft. The effect of the cold at high altitudes is to reduce the ratios to 7·5, 75 and 750. As the gas pressure builds up inside the envelope three things can happen—1. The balloon bursts. 2. Gas is allowed to escape, either through the valve or through the open "neck," until pressure is equal. 3. The balloon expands. None of these things need happen if the envelope is only partially filled at take-off, leaving room for the gas to expand.

The Radio Sonde

The simplest solution is the expanding rubber radio sonde balloon (Fig. 4). This is about 6ft. dia. (100 cu. ft.) and carries a parachute, radar reflector and a box of recording and transmitting instruments (the sonde) which measure air density and humidity. The whole load weighs about 5lb. Ground radar tracks the reflector to find the speed and direction of the

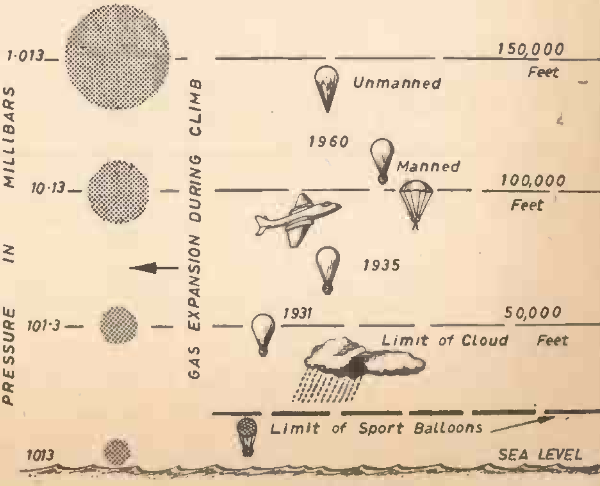


Fig. 2.—Demonstrating the decrease in atmospheric pressure with heights.

Fig. 3.—A balloon pressure cabin. (Photo by courtesy of Director of the Science Museum, London.)

wind at various heights. The balloon usually bursts at 60,000ft. though some reach 100,000ft., having expanded to about 30ft. dia. The sonde parachutes to earth.

Balloon Train

A more sophisticated apparatus is the balloon train (Fig. 4) used for cosmic ray investigation. About 10 balloons of 5ft. dia., 60 cu. ft. volume, are spaced out on a line. Two of them are filled so as to burst early at around 50,000ft. and slow down the climb in the final stage to give time for observation. At maximum height two more balloons burst and start the remainder on a slow descent with the instruments. These have already reported by radio but are recovered if possible. The flight takes between six and twelve hours.

To reach 100,000ft. the balloons must expand to six times their original diameter (an ordinary rubber band has this degree of stretch). Careful ground handling is necessary so that the envelope does not lose any of its elasticity due to cold or damage, and the balloons may have to be boiled before launching. Such balloons are perfect within their limits but no material will expand sufficiently to go much above 100,000ft., and seamless balloons can only be made in small sizes as yet.

In 1937 Professor J. F. Piccard began experimenting with large numbers of linked small balloons which he hoped would carry him to an altitude of 20 miles (Fig. 4). He reached 10,000ft. below 98 balloons tethered in two clusters. Individual balloons could be detached to control lift and the whole top cluster let go on landing. This " aerostat " Pleiades I was accidentally destroyed and the war ended plans for Pleiades II.

Modern Balloons for Big Loads

The modern method of carrying man or heavy equipment to great altitudes is by the big balloons called " Moby Dicks " or " Skyhooks " in the U.S.A. These may be 200ft. dia. and 10,000,000 cu. ft. capacity. The envelope is only fractionally filled with gas (helium in the United States) at take-off and hangs in great folds. Only 100,000 cu. ft. may be needed to support the load at sea level, but it will have expanded 75 times at 100,000ft. Lift of either hydrogen or helium is approximately 70lb. per 1,000 cu. ft. at sea level, 7lb. per 1,000 cu. ft. at 50,000ft., 0·7lb. at 100,000ft. and 0·07lb. at 150,000ft. In practice considerably more than the exact fraction is put in during inflation for various practical reasons and the surplus is wasted during the flight.

A balloon is extremely simple, light and cheap because the stresses are very low. The difference in pressure between the gas inside the envelope and the atmosphere outside is small and the weight of the " pay load " and its cabin or container relatively low, 500-2,000lb., according to the research undertaken.

Modern balloon envelopes are made of Polythene film 0·001in. thick, weighing 1 oz. per sq. yd. For comparison, the weight of the rubber-covered fabric envelope of the early " stratosphere balloons " such as that of Professor A. Piccard in 1930, was nearly 5 oz. per sq. yd. The net, a notorious collector of rain, ice and snow, is no longer used, and the load is now directly attached to the envelope.

The pressure cabin for human observers or life specimens is also light and simple. It is of the ideal spherical shape and is not subjected to the vibration fatigues or bending loads of its aeroplane counterpart. (See Fig. 3).

With the necessity of only fractionally filling the envelope and without a net to restrain the bulging bag, a new filling technique is used. The envelope, empty and pleated is laid out down wind and the gas introduced into the crown. In this state the balloon looks and acts like a gigantic whale, hence the nickname " Moby Dick." The filling operation may take up to nine hours.

Launching " Skyhooks "

The United States Navy, which calls them " Skyhooks " (from project " Skyhook ") has launched many giant balloons from aircraft carriers. The ship manoeuvres to reduce the wind speed to nil and the balloon rises up straight from the deck. In Fig. 1 there is still a lot more to come, lying between rollers on the deck. Not every launching is successful.

Early this year two " Skyhooks " of 10,000,000 cu. ft. were launched from U.S.N. *Valley Forge*. Each

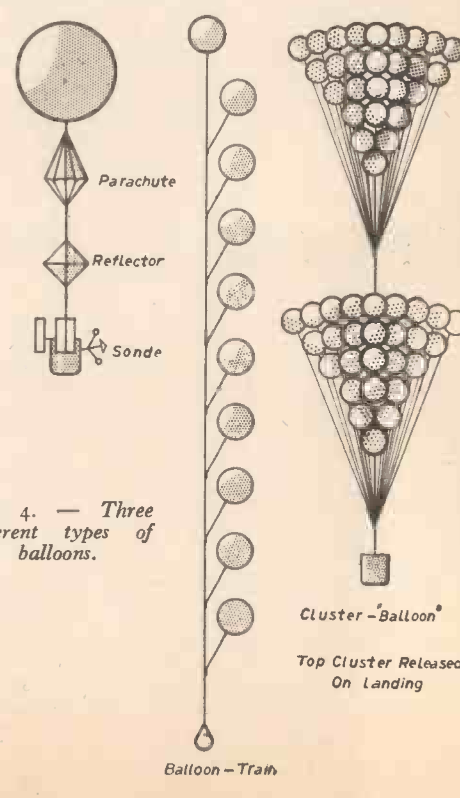


Fig. 4. — Three different types of balloons.

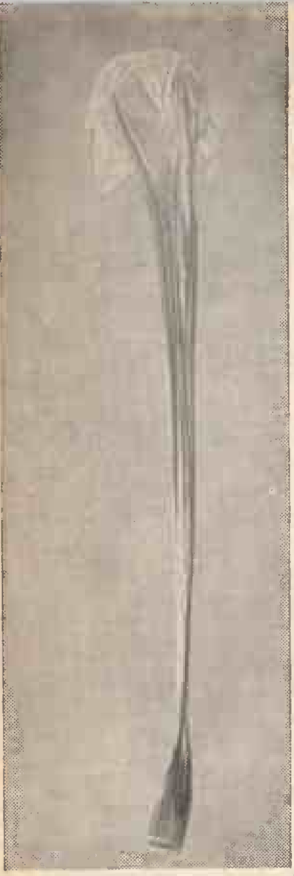


Fig. 5.—A British cosmic ray research balloon immediately after release. (Bristol University photo).

carried an 8ft. high stack of emulsion weighing 2,000lb., for the detection of cosmic radiation. They drifted for 48 hours at 90,000-100,000ft. while the film was exposed. Gas was valved by radio command from the carrier and the balloon and film recovered. These flights were part of I.C.E.F., International Co-operation Emulsion Flights. The United Kingdom's contribution is provided by Bristol University which has launched a great number of large Polythene balloons.

Higher and Higher

On August 19-20, 1957 (note double date) Capt. (now Lt.-Col.) D. G. Simons, U.S.A.F. established an absolute height record for all classes of aircraft by ascending to 101,490ft. Aeroplanes have since rocketed themselves higher, but only for short-lived arcs in the sky.

On August 16 this year Capt. Kittinger, U.S.A.F. set up a new height record of 103,000ft. before returning to earth by parachute! Here is the balloon assisting in yet another branch of research, and one directly connected with space travel, namely emergency escape from space vehicles. A series of such descents is planned and the balloon is obviously much the simplest way of getting the parachutist up to his starting height. The substitution of a pressure suit for a pressure cabin saves a lot of weight, and Capt. Kittinger's balloon was a small one by " Moby Dick " standards.

The balloon's ability to remain at great altitude has been used to test man's reactions to long periods of " solitary confinement " in the empty sky 20 miles above the earth.

Next year the American authorities intend to use a balloon to carry 500lb. of conventional explosive to 24 miles for an experimental detonation.

One attempt has been made in the U.S.A. to use a balloon as the first stage of a space vehicle. A rocket was hoisted to a great height beneath a giant balloon and then fired through it by remote control. This attempt was a failure, but high altitude meteorological rockets were fired this way as part of the International Geophysical Year programme.

A 6,000,000 cu. ft. balloon recently launched by the United States Navy refused to come down below 65,000ft., and the carrier's fighters were unable to get high enough to shoot it down!

Wind speeds of over 300 m.p.h. are frequently recorded at such heights and some balloons have been blown from America to Europe. Such balloons, briefly seen drifting high in some fast airstream and glinting in the sun, are sometimes reported as flying saucers.

In the Future

The two-hundredth anniversary of the balloon falls due in 1983, and it seems likely that as many balloons will be ascending then as now. Helium, the safe but rare gas, now only available in quantity to the United States, may become a cheap by-product of thermonuclear power stations. The plastics industry may discover a high stretch film and a technique for moulding it into a large seamless envelope.

But a far more exciting development has been suggested in Russia recently. (Soviet scientists were in the forefront with stratosphere balloons in the 1930s so that their position in the vanguard of the outward probe is no new thing.) This new Russian idea is suggested by Professor Pokrovsky, and was reported in the *Aeroplane* recently. It is to shoot a large packaged balloon by rocket to a height of 300 miles. There it would inflate itself into the form of a gigantic telescope, lenses being already positioned in the package.

The " balloon " would now be given a negative electrical charge to enable it to float in the earth's positive magnetic field. Television cameras would photograph the heavens with perfect clarity from above the atmosphere and transmit to earth.

Such is the present performance and future prospect of the balloon, abandoned 50 years ago as obsolete, but now seen as the tool of the meteorologist, the observation platform of the scientist, and having a part to play in the journey into space.

Fig. 6.—British cosmic ray research balloon ready for launching. (Bristol University photo).

NO DANGER OF SHOCK OR FIRE

FAIRY

By E. H. Worth

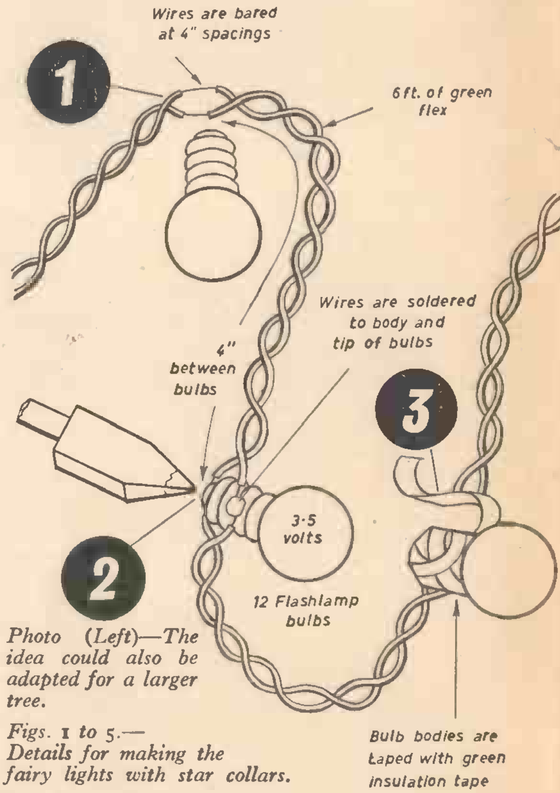


Photo (Left)—The idea could also be adapted for a larger tree.

Figs. 1 to 5.—Details for making the fairy lights with star collars.

Fig. 6.—The Base.

THIS set of low-voltage, battery-operated Christmas tree fairy lights was devised and constructed so that the fully decorated tree could be carried from room to room and switched on as desired. Absence of trailing leads coupled with a 4½V. bell battery supply means that there is no danger of fire or electrical shock—hazards always present when fairy lights are plugged directly into the mains.

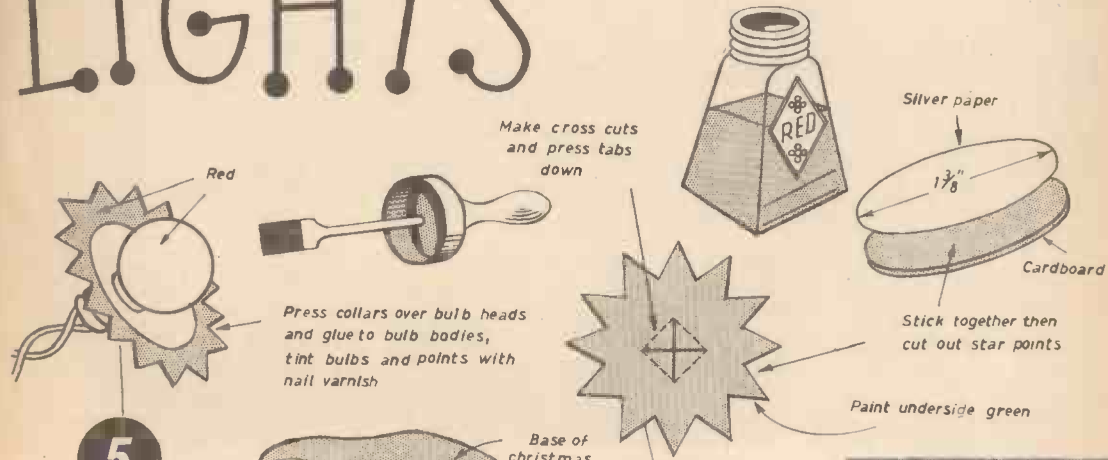
A 4½V. dry-cell battery costing 2s. 9d. lasts the Christmas week—if care is taken not to leave the lights on unnecessarily. The small switch on the side of the battery box is conveniently placed for operating the set and the tree is made extra safe from toppling over because the box with its greater area and weight is screwed and glued to the base of the Christmas tree.

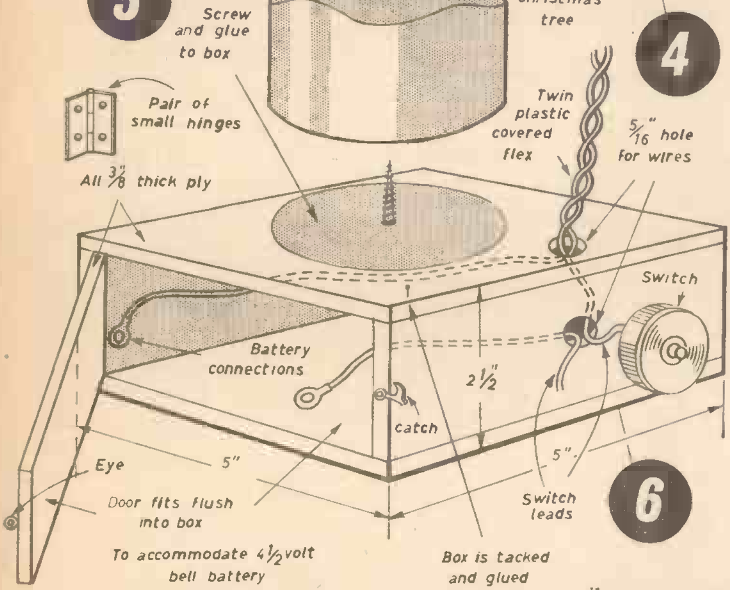
The String of Fairy Lights

Twelve flashlamp bulbs of 3·5V. each are soldered to a length of green plastic-covered twin flex at 4in. spacings (Figs. 1 to 6). The author's Christmas tree is 3ft. high on its battery box base and a 6ft. length of twin flex is used for all the wiring, including the switch and battery feeds.

The wires are bared at 4in. intervals, starting from the farthest end of the flex—not the battery end of the wire. Use a sharp penknife and cut away the plastic coverings of the twin leads as shown in Fig. 1. Soldering the bulbs to the wires is quite easy providing a suitable cored solder is used and the bulbs

WITH THESE BATTERY OPERATED LIGHTS





are held steady by a second person (Fig. 2). One wire is soldered to the body and the other to the tip of the bulb. A solder blob on each wire is all that is required for a sound fastening.

When all the bulbs are in position on the wire, the bodies and soldered connections are neatened and insulated with strips of narrow, green adhesive tape. The bulbs must be insulated or they might be shorted out by metallic tinsel decoration on the Christmas tree (Fig. 3). Wrap enough tape round each bulb body to cover but do not make them too bulky.

Star collars for the lights are cut from discs of silver paper—or silver foil—and cardboard. The discs are $1\frac{3}{8}$in. dia. and after cutting out, are stuck together (Fig. 4). Use a good adhesive to ensure a good bond.

Snip the star points—about a dozen will make a good effect—and make a cross cut with a sharp knife through the centre of each collar. Each cut should be as long as the bulb heads are wide so that after pressing the tabs down, the collars can be eased over the bulb heads. Dab a spot of glue on each tab to fix the collars securely. Fig. 5 shows this operation and also includes the method of tinting bulbs and

(*Concluded on page* 154)

A Short Conjuring Act

Described by E. W. Alan

WHEN you toss a pack of playing cards into the air they will quickly scatter down again, and if you try to stand a drinking glass upon the ceiling, or suspend a bottle in mid-air without any visible means of support, trouble will surely follow. However with the aid of a few easily made devices, you can defy the law of gravity and gain for yourself the reputation of being a worker of miracles. Three different effects will be described and you may present these individually, or together as a magical routine complete in itself.

The "Bewitched Pack"

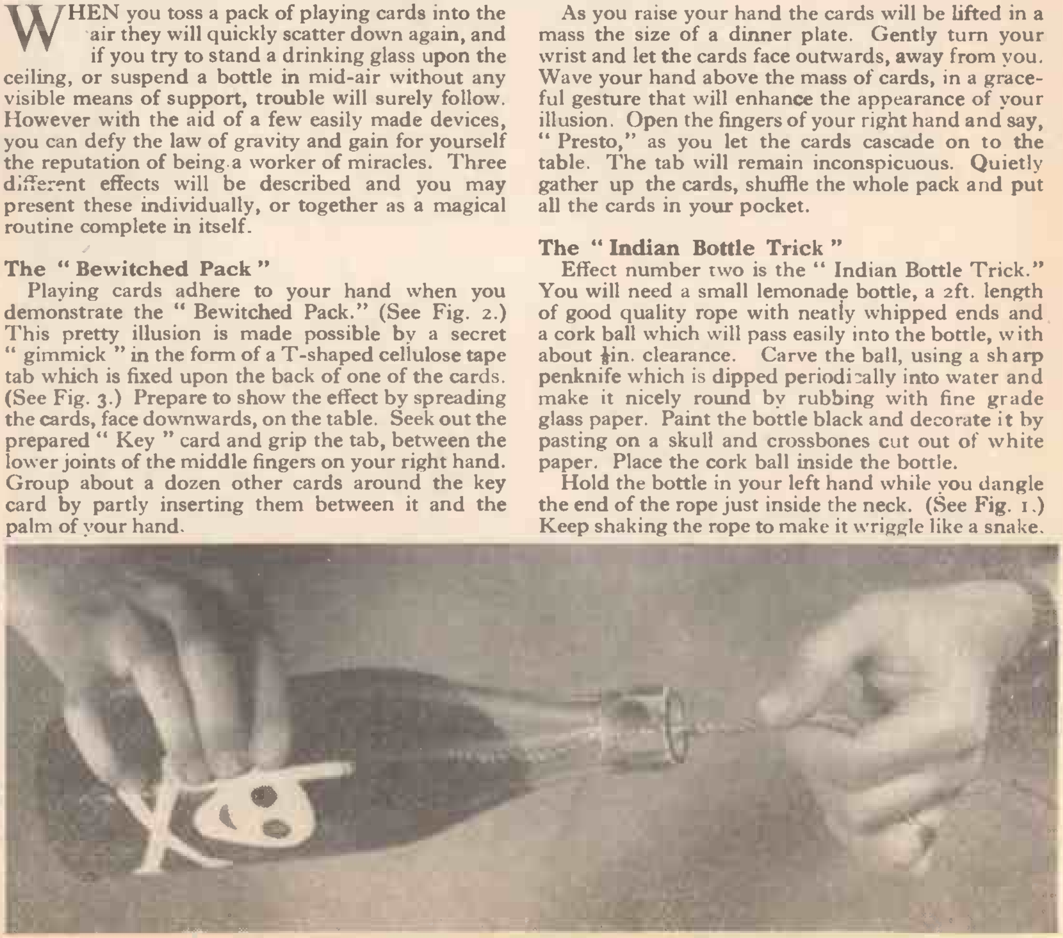
Playing cards adhere to your hand when you demonstrate the "Bewitched Pack." (See Fig. 2.) This pretty illusion is made possible by a secret "gimmick" in the form of a T-shaped cellulose tape tab which is fixed upon the back of one of the cards. (See Fig. 3.) Prepare to show the effect by spreading the cards, face downwards, on the table. Seek out the prepared "Key" card and grip the tab, between the lower joints of the middle fingers on your right hand. Group about a dozen other cards around the key card by partly inserting them between it and the palm of your hand.

As you raise your hand the cards will be lifted in a mass the size of a dinner plate. Gently turn your wrist and let the cards face outwards, away from you. Wave your hand above the mass of cards, in a graceful gesture that will enhance the appearance of your illusion. Open the fingers of your right hand and say, "Presto," as you let the cards cascade on to the table. The tab will remain inconspicuous. Quietly gather up the cards, shuffle the whole pack and put all the cards in your pocket.

The "Indian Bottle Trick"

Effect number two is the "Indian Bottle Trick." You will need a small lemonade bottle, a 2ft. length of good quality rope with neatly whipped ends and a cork ball which will pass easily into the bottle, with about ⅛in. clearance. Carve the ball, using a sharp penknife which is dipped periodically into water and make it nicely round by rubbing with fine grade glass paper. Paint the bottle black and decorate it by pasting on a skull and crossbones cut out of white paper. Place the cork ball inside the bottle.

Hold the bottle in your left hand while you dangle the end of the rope just inside the neck. (See Fig. 1.) Keep shaking the rope to make it wriggle like a snake.



Grip the neck of the bottle and the rope together and turn the bottle upside down. When you release hold of the rope it will dangle down as if hanging unsupported. This will happen because the cork ball will cause the rope to jam the neck. Now turn your apparatus over again, slowly, and let the bottle swing in a circle from the end of the rope. Finally, push the end of the rope into the bottle a trifle, in order to release the cork ball, and pull the rope clear.

Fling the rope out to your audience, for, examination, whilst you deftly invert the bottle and " steal " away the cork ball. When the rope is returned to you, hand out the bottle and use the rope to conceal the cork ball to the rear of your table.

" Crazy Tumblers "

A pair of transparent plastic drinking tumblers refuse to obey the law of gravity and cling tightly to the underside of a large book when you perform the " Crazy Tumblers." Begin by constructing a little dumbell shaped gimmick, using two small beads and a length of strong, thin string. (See Fig. 4.) Trap the beads, 1in. apart, upon a short piece of the string by tying large knots. Trim away the loose ends of string and slip the gimmick half way along inside the hem of a gentleman's white handkerchief. Also provide yourself with a book such as a child's annual, two plastic tumblers and two 18in. lengths of ribbon, one red and the other blue.

Before you commence the trick the book, tumblers, ribbons and handkerchief will be grouped tidily upon the table. Pick up the handkerchief and hold it up casually before wrapping it around the book. The hem containing the gimmick must lie across the middle of the book. Invert the tumblers and place them upon the handkerchief close together so that their adjacent rims each stand over one of the beads. Tuck a ribbon under each tumbler, but let the ends of the ribbons protrude slightly. (See Fig. 5.) Hold the covered book by placing your right thumb between the tumblers and putting your fingers underneath the book. Press down on your thumb and feel how the rims of the tumblers will be tightly gripped between your thumb and the respective beads.

Request the assistance of a lady and let her sit upon a chair, facing the audience, while you hold the book and tumblers above her. There will be scope for laughter as you slowly turn everything over and the tumblers hang suspended from the book, above the lady's head! Allow your assistant to reach upwards and pull the ribbons out from beneath the tumblers, then thank her and hold out the apparatus to the audience and let two different persons remove the tumblers. There will be many theories expressed as to how you accomplished the illusion, but the real solution will remain a mystery.

Practice Makes Perfect

Now that you have learned the secrets of three highly entertaining conjuring tricks practice the mechanics of them until every move becomes second nature to you, then pause to reflect upon how you can best present them to an audience. Think out some amusing patter to suit your own personality and recommence practising the tricks whilst co-ordinating words with body movements and manipulation of the apparatus. You may or may not refer to Newton or the late Professor Einstein, but whatever you say avoid saying too much, and aim to keep your audience interested throughout your performance.

Fig. 2.—(Above). Demonstrating the " Bewitched Pack."

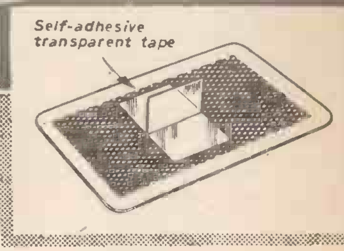
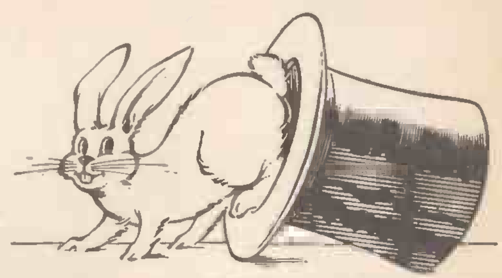


Fig. 3.—(Right). The T-shaped tab fixed on the back of a card.



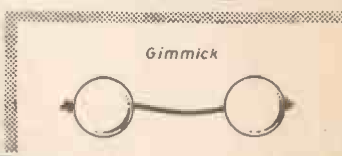
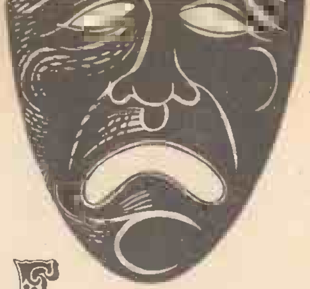


Fig. 4.—(Right). Two small beads joined by a length of thin string.

Fig. 5.—(Below). Invert the tumblers and place them close together.

Fig. 1.—(Left). The " Indian Bottle Trick " being performed.



MODEL THEATRE PERFORMANCE

By
C. C. Somerville

Some ideas for making full use of a model theatre

MANY people have a model stage and for those who have not, an article on the construction of a model stage appeared in PRACTICAL MECHANICS, March 1960, together with some details of its utility in the planning and design of live stage productions. The following is to aid readers in obtaining full use from their theatre.

Actual performances can be given on the model stage and since Robert Louis Stevenson first described the joys of the "Penny Plain and Twopence Coloured" performance countless adults and children have experienced the thrill of presenting plays in miniature. Today there flourishes a society, The British Model Theatre Guild, which has its headquarters in London and members all over the country.

The old "Juvenile Drama" characters were flat drawings printed on cardboard which the enthusiast cut out and coloured, or if he could afford the extra penny then he could buy the sheets already hand coloured. Though many people still use the flat cut-out actor, the modern trend is to use three-dimensional figures and the construction of these will be described in this article.

The ultimate aim of the model theatre enthusiast must be to create a complete theatre in miniature: scenery, stage properties, costumes and lighting must be convincing representations of the real thing. Having built the theatre, the next job is to decide on the production and build the necessary scenery and characters.

Characters

The basic material used in the construction of the tiny actors is either plastic wood or "Barbola Paste," both of which can be modelled like modelling clay and set hard. Barbola is perhaps the best since its weight gives extra solidity. It has a smooth consistency capable of very fine modelling and there is no shrinkage or distortion when drying. Initially a soft wire armature is constructed to the correct height and position of the figure (Fig. 1) and mounted on a circular base of either clear Perspex or plywood. The figures should be about 3in. high if they are to be used in the Practical Mechanics model theatre.

Around the wire armature the character is then roughly modelled in the paste. Male characters require more finish than do the women since these latter can often be dressed with crêpe paper, which is easily worked and gives a wonderfully realistic imitation of fabric. In the case of the men much can be done with modelling and painting. Figs. 2 and 3 show the modelled character and the final result. This figure was designed to take part in a Spanish scene. His trousers are painted on whereas his shirt sleeves and bolero were fashioned from crêpe paper.

Operating the "Actors"

The method of operating these characters is usually by means of a "slider" of some description. Fig. 4 illustrates the type used with the old flat characters, whereas the one in Fig. 5 is an elaboration suitable for use with three-dimensional figures and which allows them to turn around. Basically it consists of a strip of celluloid on the end of which is mounted a Perspex pulley. This is turned by a double thread running to a similar arrangement at the other end of the strip. This type of controller is very useful since, if desired, several characters may be mounted on the same strip and operated in unison (Fig. 6).

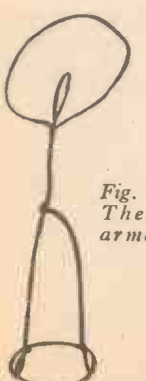


Fig. 1.—The wire armature.

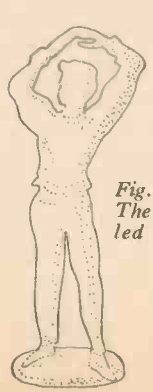


Fig. 2.—The modelled figure.

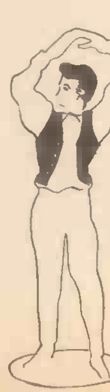


Fig 3.—The completed character.

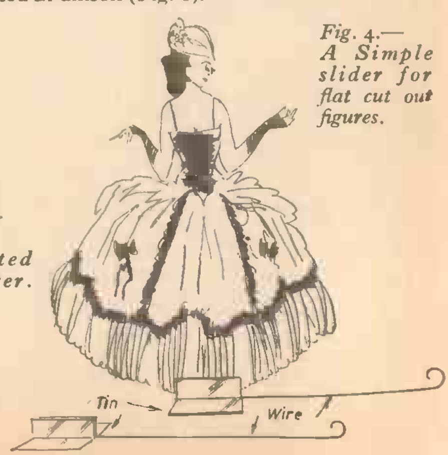


Fig. 4.—A Simple slider for flat cut out figures.

Another ingenious method of moving the characters around the stage is to mount them on small button magnets. They are then moved by a duplicate magnet under the stage. In this way no operating mechanism is visible. Should you like to experiment with this method your stage will require a little elaboration. The actual stage floor will have to be made double thickness with a gap between to allow movement of the understage magnet and its guiding rod. The construction of these is shown in Fig. 7, which also illustrates the stage arrangements.

Type of Show

The scope for model theatre production is quite wide although it is doubtful whether straight plays are ever very successful. I feel that pantomime, revue, musical comedy and operetta offer the most scope for splendid scenic design with limited movement which are characteristics of this type of theatrical. Due to its small scale scenery can be very elaborate and with the lighting system described with the stage, quite spectacular effects can be achieved.

A model theatre and characters can bring unlimited enjoyment to an imaginative child, but this does not mean that this can be considered a childish art. In fact many of our leading men of the theatre take an active interest in this form of drama. A few years ago an elaborate production was performed on a model stage in London. The script was written especially for the occasion by J. B. Priestley, the scenery and characters designed by one of our leading scenic artists, Doris Zinkeisen, and Sir Ralph Richardson took a leading role in the production. The play, which was an 18th-century story of a highwayman and a captain home from the wars to claim his inheritance, called *High Toby*, was performed at Heal's Mansard Gallery.

Whatever productions you decide to stage, take as much trouble as is possible over their smooth running. Do not plan elaborate settings following one after the other which entail boring intervals, and make sure that your helpers, if you have any, know exactly what they have to do. Plan all entrances and exists and have the characters ready in the wings in the correct order. Leave nothing to chance and remember to rehearse and rehearse—that is the only secret of a good production. The world of the stage, whether in model form or the real thing, is, *par excellence*, a world of glamour, but this world is only created by hard work.

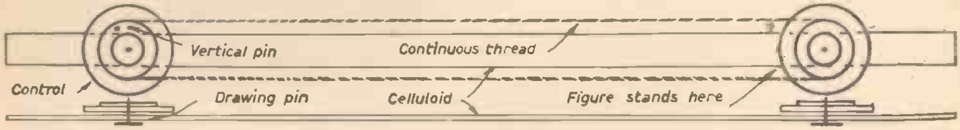
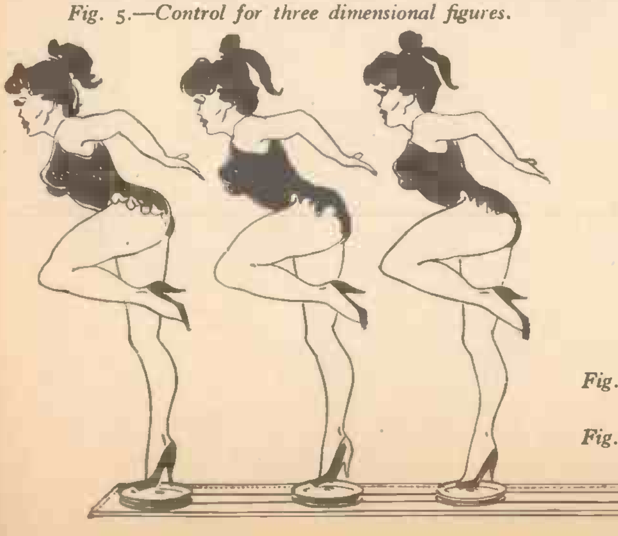


Fig. 5.—Control for three dimensional figures.



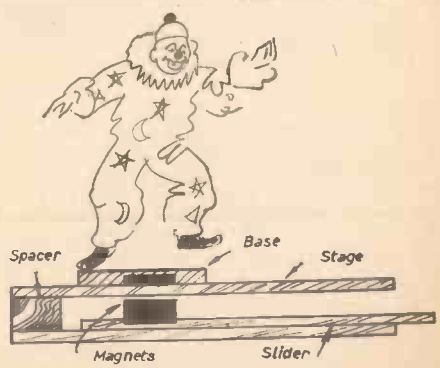


Fig. 6.—(Left) Several characters can be mounted on the pulley type controller.

Fig. 7.—(Above) The magnetic system of control.

Double Dovetails

THE wedge form of a dovetail prevents any movement in one direction. Two dovetails in opposite directions, preventing movement in either direction would appear to be an impossibility! Below are shown two forms of the same problem and in each case two solid blocks of wood are securely double-dovetailed together. Put the problem to your Christmas guests and ask them to work out how the two pieces could ever have been assembled.

The actual shape of the blocks is shown in Fig. 2. No details are given for the construction but anyone reasonably proficient in woodwork could make them without difficulty. Dimensions are not important provided the approximate proportions are adhered to.

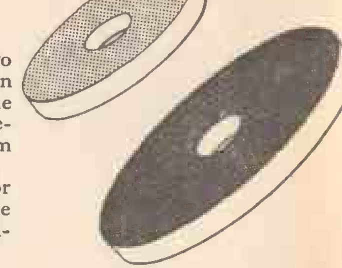


Fig. 1.—Two double dovetails puzzles.

Some Puzzles for you to ?

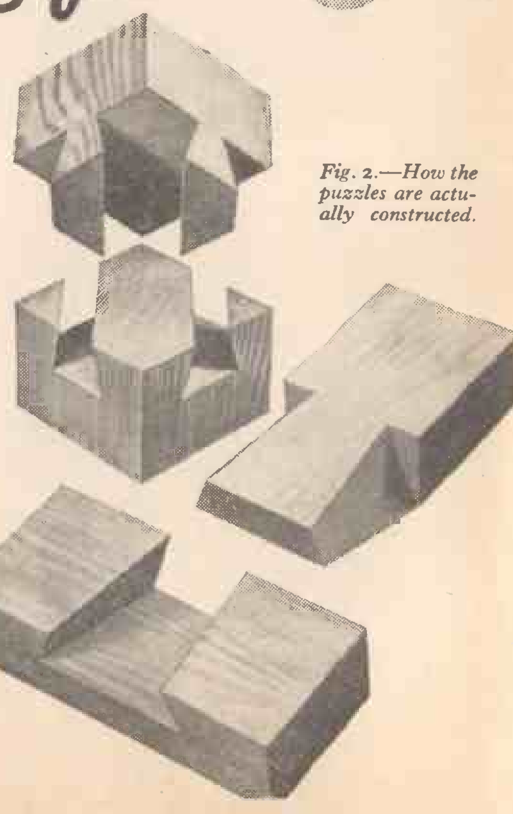


Fig. 2.—How the puzzles are actually constructed.

Slipped Discs

THIS might well be described as a toy for grown-ups. Fig. 3 shows a wooden stand on which are three upright pegs; the former can be of plywood (about 9½in. × 4in. × ⅜in.) and the pegs of ⅜in. dowels 3in. long. The four discs should be ½in. plywood and are 1in., 1½in., 2in. and 2½in. dia. respectively. None of these measurements is critical and the discs can be of any material provided they are easy to handle quickly and are of increasing diameters.

Method of Using

Having the four discs on one of the pegs, largest at the bottom working up to the smallest at the top, the problem is to shift the pile from one peg to another by a succession of steps, at each stage moving one disc only and never at any time placing a larger disc over a smaller one. All three pegs may, of course, be used.

Count the steps as you make them and see if you can complete the change in less than 24 moves.

The Locked Heart Puzzle

HERE is an attractive cardboard novelty that can be made up in quarter of an hour. The parts are best cut out of coloured cardboard, but scraps

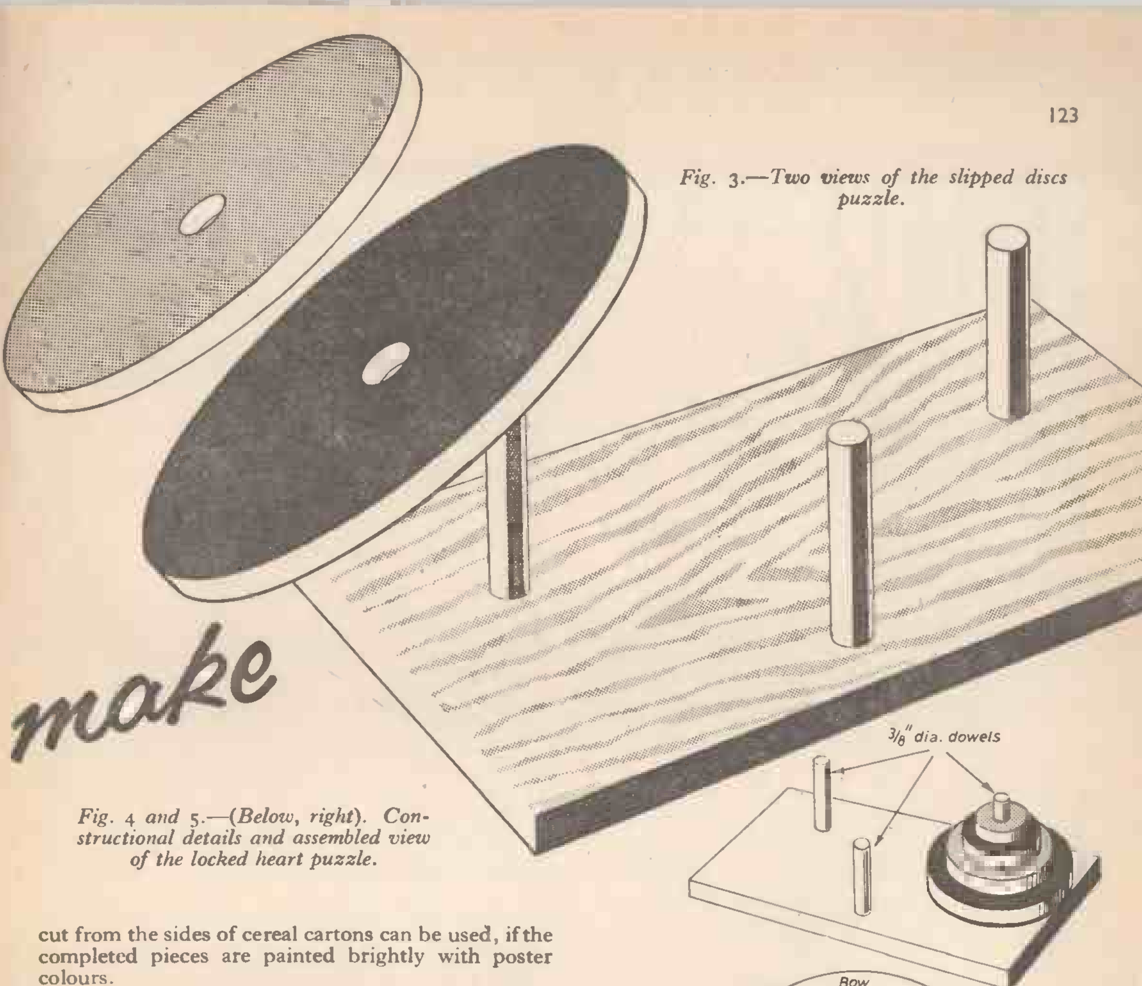


Fig. 3.—Two views of the slipped discs puzzle.

make

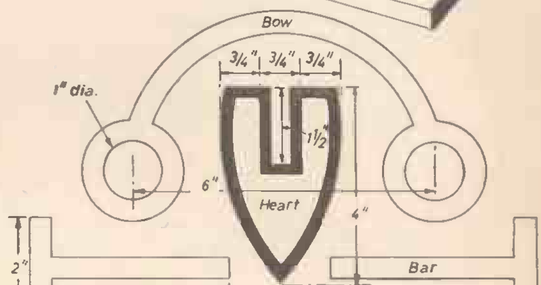
Fig. 4 and 5.—(Below, right). Constructional details and assembled view of the locked heart puzzle.

cut from the sides of cereal cartons can be used, if the completed pieces are painted brightly with poster colours.

Copying and Cutting the Shapes

Copy the four shapes shown in Fig. 4, upon the cardboard, using a ruler and compasses. The holes in the " bow " should be 1in. in diameter and the two holes themselves are 6in. apart. The two halves of the " bar " are 4in. long and the end pieces are 2in. tall. The " heart " measures 4in. from top to bottom and each of the three " loops " are ¾in. wide. The middle loop must be at least 1½in. deep.

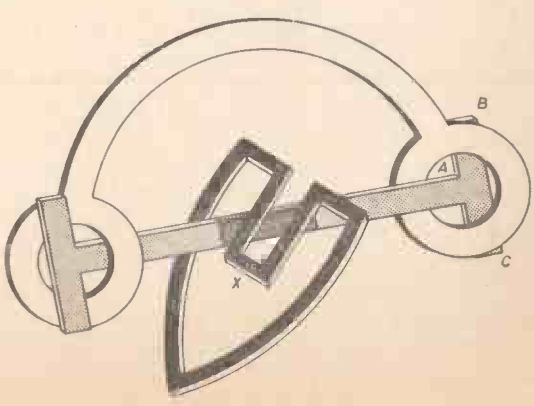
Cut out the shapes neatly and assemble them to resemble Fig. 5. First pass the half bars through the holes in the bow. Thread the heart on to one half bar and then join the two parts of the bar together with cellulose tape or a strip of gummed paper. The problem is how to remove the heart from the bar without damaging any of the pieces.



The Solution

Refer to Fig. 5. Pass loop (X) behind the bar and through hole (A). Then pass the loop over (B) and down over (C) before releasing the heart by pushing the loop out through (A). Reverse the moves to put the apparatus together again.

Hand the puzzle to a friend and challenge him to free the heart in say, half a minute. Even if the puzzle presents no great difficulty, it will be sure to arouse interest. The design is based upon an old wire puzzle and, if you wish, you can make the various parts with strong wire.



SCIENCE NOTES

A SERIES of units, designed to demonstrate the fundamental electrodynamical principles and the working principles of electromagnetic instruments has been designed to aid science teachers by Messrs. Griffin and George, Ealing Road, Alperton, Wembley, Middlesex. All working parts, wires and connections are visible. Slotted bases and clearly marked terminals facilitate linking together.

Instant Standby Power

POWER failure is always troublesome, but such failure of the generating sets producing the power for the radar defence chain could be a catastrophe. So that their defences should never be "powerless", the U.S. Airforce base at Thule, Greenland has installed a $1¼ million power package capable of detecting an interruption in the power supply and coming into full operation within 8-30 seconds.

New Computer

UNDER development at Manchester University, the Ferranti Atlas electronic digital computer will be the ultimate in present generation digital computers. It will operate at very nearly the speed of light, 1,000 times faster than the first commercially available computer of ten years ago and 100 times faster than Europe's present fastest computer. One millionth of a second is all the time taken to add and four millionths are required for multiplication. Atlas is expected to pioneer such work as proving theorems for mathematicians, analysing alternative designs for large engineering projects, linear programming, rocketry and orbit calculations.

Ultrasonic Healing

SOUND vibration far too high to be detectable by the human ear and known as ultrasonic vibration has been used with success to heal wounds, clear up infected sinuses, relieve arthritic pain, treat acute asthma and to relieve pain arising from amputations, scars etc.

Radio Telescope Range

THE radio telescope at Jodrell bank, said Professor Lovell recently, has tracked a radio source six billion light years away. It was moving away at about half the speed of light.

New Atom Smasher

IT has been reported that work has been started on a new 70 billion electron volt accelerator in Russia. This machine would when completed be more than twice as powerful as any now in use.

Tides Calculated

SCIENTISTS have been puzzled for centuries by the theoretical determination of the tides of the world and attempts have been made in the past to produce a mathematical formula corresponding to actual tide movement. Now Professor Chaim Leib Pekeris, head of the department of applied mathematics at the Weizmann Institute of Science, Israel, aided by mathematical computers has produced a theoretical solution for the height of the tide at any port in the world that corresponds with actual measurement.

BOOKS *Received*

"Steel" by Frederick E. Dean. 140 pages. Price 9s. 6d. net. Published by Frederick Muller, Ltd.

THIS is another book in the "Mechanical Age Library" series and its pages contain a concise account of the developments which led up to present-day steel making practice. This is followed by an account of the entire procedure of steel making, from mining the ore to the final processes.

"Strange World of the Moon" by V. A. Firsoff. 226 pages. Price 25s. net. Published by Hutchinson & Co. (Publishers) Ltd.

THE name V. A. Firsoff, M.A., F.R.A.S. is well known to regular readers of this journal for the many articles on astronomy and allied subjects he has written in the past. Perhaps the most outstanding aspect of his work is its originality and it is this quality which strikes the reader of *Strange World of the Moon* most forcibly. The author turns a questioning eye on even the most firmly established concepts about the moon and in non-scientific language investigates the properties of lunar rocks and the atmosphere and origin of the moon. The ever-popular question of whether life exists is also discussed. Some of the arguments postulated can only be maintained mathematically and an appendix has been included so that nothing too complicated need interrupt the main part of the book. A number of photographs and drawings, many of them original, are included.

Elementary Engineering Mechanics by Eugene George Key. 457 pages. Price 44s. net. Available in Britain from Chapman and Hall.

THIS book contains all the essential elements of statics and dynamics and their application to engineering problems. The reader needs only a basic knowledge of algebra and plane geometry; trigonometry is explained by the author. The book is divided into two parts, Statics and Dynamics. The book is profusely illustrated with line drawings and there are some photographs.

"Power Tools as a Pastime" by John Christopher. 128 pages. Price 15s. net. Published by Souvenir Press Ltd.

THOSE who already own or are intending to buy one of the many home workshops built up round a power drill may find this book of interest. It is partly a review of the various types of drill power unit available and also includes descriptions of the different types of accessory available and their use.

A table top Bowling Alley

This game could provide some amusement for the guests at your Christmas Party

THIS game, which appeals to old and young alike, has had a revival of popularity of late; it is simple to construct and its cost is relatively small. The size may vary considerably provided proportions are maintained; these generally accepted are that the table should be about six times as long and twice as wide as the skittles are high, and that when positioned on the table their centres should be distant half their height.

The model being described is 4ft. long × 16in. wide. The skittles are 7½in. high and were bought at a local toy shop for 5s. The board rests comfortably on the dining-table and takes up practically no room when not in use, being stood against the wall. The ball guide is detachable and the skittles and balls have been boxed.

The Table

This is best made of ⅜in. or ½in. plywood and is edged with 1½in. × ⅜in. hardwood which may be butt-jointed as shown or mitred. Note that the circles which form a guide when positioning the skittles are merely marked on the table surface; they are not cut at all. Indian ink and a pair of compasses are all that are required, but mark out in pencil first and check up for accuracy. Later, the table will require to be drilled with a ⅜in. hole to accommodate the dowel on the ball guide which allows it to be directional but at the same time prevents it being brought closer to the skittles than it should be. The surface of the table may either be painted (say, dark green) or varnished, but perfect smoothness must be maintained. A refinement is to fit rubber feet to the underside or line it with green baize.

The Ball Guide

The function of this piece of apparatus is to give to the balls the necessary impetus and to serve, to a certain extent, as an aimer. It can be made in many ways but the simplest, and as efficient as any other, is as shown in Figs. 3 and 4. It consists of two pieces of shaped ⅛in. hardboard, 15in. long and 12in. high,

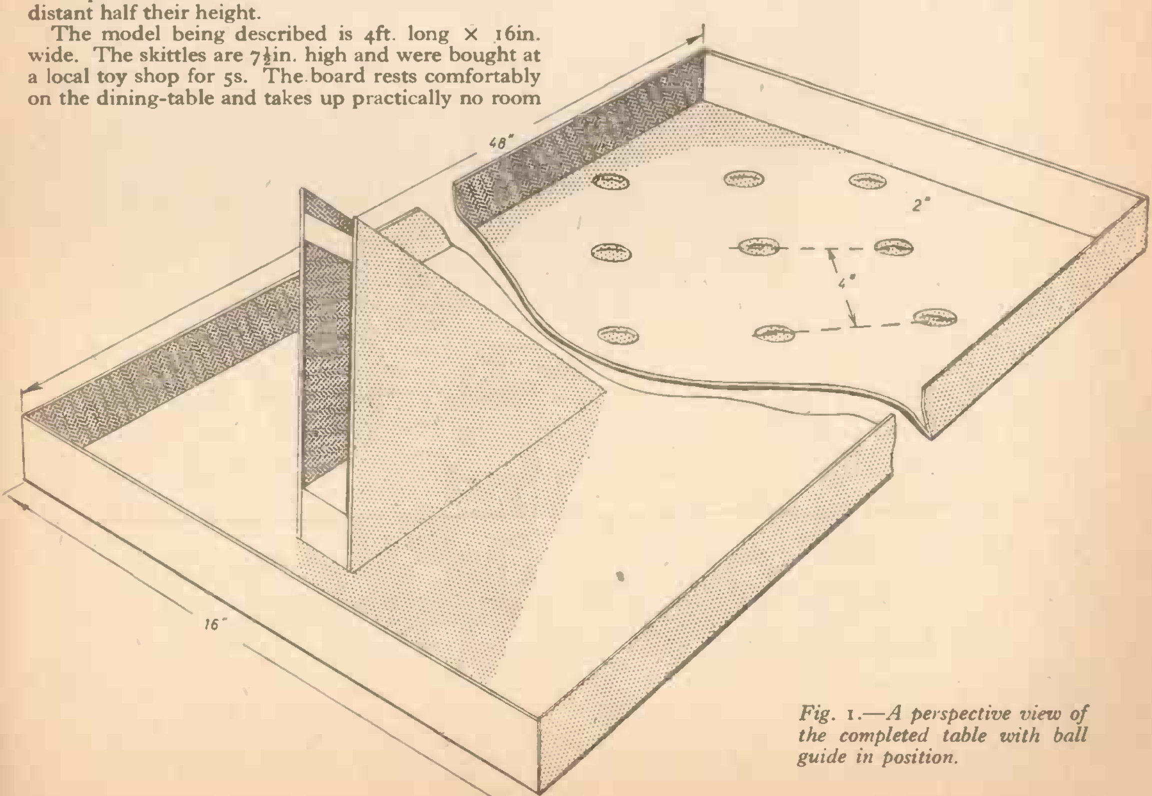
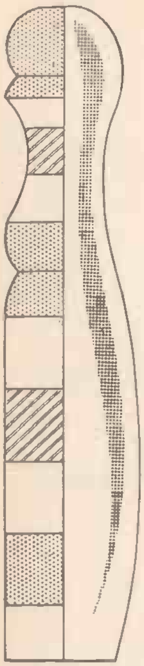


Fig. 1.—A perspective view of the completed table with ball guide in position.



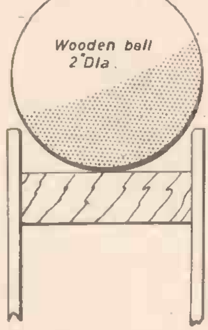


Fig. 2.—Two suggested shapes for skittles. Dotted shading—red; barred shading—blue; remainder white.

Fig. 3 (Above).—Back view of the ball guide.

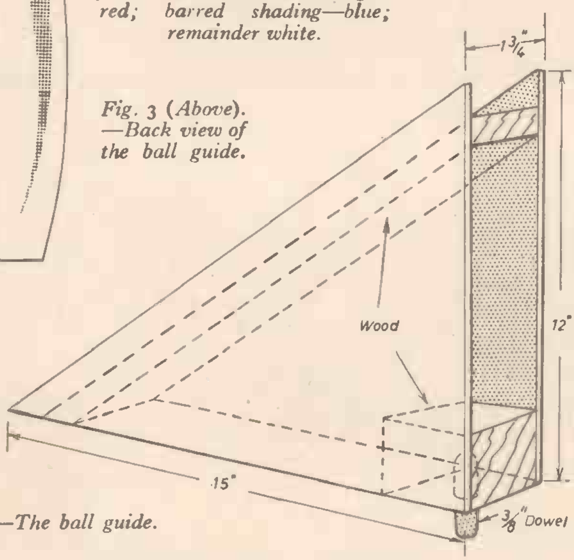


Fig. 4.—The ball guide.

the two corners being joined to form a right-angled triangle; the two can be made from one piece by cutting diagonally. They are separated by a 1¾in. × 1¾in. block at the right-angle, and by a 19in. length of 1¾in. × ½in. running ⅛in. below the sloped edges; this gives a channel in which the ball can roll and is plainly shown in Fig. 3. Into the centre of the bottom block is bored a ⅜in. hole, ⅜in. deep to carry a 1¼in. length of ⅜in. dowelling, rounded at the lower end. The hardboard sides should be glued, pinned or screwed to the separators. This can also be painted for the sake of appearance, but do not paint the exposed part of the dowel since it requires to be a reasonably easy and frictionless fit in the hole bored in the table. This hole may now be drilled and should be positioned in the centre of the table 1½in. from the back edge; thus, the guide is free to move a certain distance either to the right or left for directing the run of the ball but cannot be moved forward.

The Skittles

These can be bought at most toy shops or may be turned on the lathe. Fig. 2 gives two suggested profiles. Both are 7½in. high and have a base dia. of 1⅛in. The bought skittles are quite ornate being painted alternately white, red, white, blue, etc. The skittle on the right is usually of one colour. Note, if turning them in the lathe, the bases are slightly hollowed to ensure firmness when standing on the table.

The two balls supplied with the skittles were found to be 1¾in. dia. and, in the writer's opinion, are not quite heavy enough unless thrown, which they should not be. Also, three balls make for a better game since practice has shown that it is rarely possible to knock down more than five or six skittles with only two attempts. Accordingly, three 2in. dia. balls were bought at the local hobbies shop and painted white. If a ball larger or smaller than 2in. dia. is used, it will be necessary to alter the width of the separators when constructing the ball guides.

A box to hold the skittles and the balls should be made—if not purchased already boxed—but it is felt that no constructional details are necessary; any form of lidded box will do. Alternatively, the box may be made to house the ball guide as well, and it will be found that the skittles can be conveniently packed into the hollow guide and the whole boxed quite neatly.

The Rules

These should be somewhat elastic and are best arrived at by trial and error. For example, it is usual that pins knocked down remain where they fall until the player has sent up the last ball; but in practice a skittle may well fall across the width of the table and thus almost completely block access to the others except by an attempt to "cannon" from one of the sides. This, in itself, is not easy to do, and the weight of the ball is not sufficient to build up the necessary impetus for such shots to be 100 per cent. practicable. On the other hand, removal of fallen skittles may make the game too easy, particularly if three balls are employed.

By and large, a three-ball game with the skittles left where they fall will offer the most hazards and call for more cunning play. There is no reason, of course, why the size of the balls should not be increased to, say, 2½in. or even 3in.

SHADOWGRAPH SHOW

(*Concluded from page* 112)

Wolf: "All the better to eat you with!"

The girl's voice is high pitched . . . Mr. Wolf growls. The cap and spectacles fall off the wolf as he shakes his head and pounces on Red Riding Hood. She lets fall her basket and exits off the left side of the screen. And is replaced by the woodsman with his axe!

Woodsman: "Ah ha Mr. Wolf! At last I've caught you . . . come here and fight!" They fight all over the screen with the woodsman hacking away with the axe until the wolf is dead. The right hand goes down as the dead wolf and returns as Red Riding Hood to thank the woodsman.

Red Riding Hood: "At last the wolf is dead . . . and we can go and let Grandma out of the cupboard!"

Winking Fairy Lights...

Numerous readers have asked us to describe this gadget

THIS apparatus is extremely useful for making and breaking electric circuits at fixed intervals and is particularly adapted to your Christmas Tree and similar decorative features, shop window lighting (after closing hours) and electric signs.

Parts Required

These are a wooden base 6in. × 3in. × 1in.; an ebonite block 1in. × ⅜in. × ½in.; a brass block 1in. × ½in. × ¼in.; a small quantity of insulated **Eureka** resistance wire, gauge 30; one strip of copper and one of tin, each 4in. long × ⅛in. wide; two brass terminals; a 4 BA brass screw 1 in. long; and a few wood screws. The strips of copper and tin should both be very thin.

Fig. 1 furnishes a perspective view of the completed apparatus, which is assembled as follows: The two metal strips are neatly soldered together at each end for a distance of not more than ⅛in., i.e. sufficient to hold them firmly together but to allow free play between them throughout almost all their length. A hole is drilled in one end which is fastened to the ebonite block. To the other end is soldered the bared end of the insulated resistance wire which is then carefully wound around the strips to the far end where it is bared and fixed under the base of the brass terminal. Note that although the illustration shows the wire as being wound in loose coils (for the sake of clarity) it is really wound closely, with the turns touching.

Four holes are drilled in the brass block—two for fixing to the base, one for the second terminal, and the other tapped for the 4 BA adjusting screw. This latter should be drilled with a No. 28 or a 9/64 in. drill and then threaded. A ⅜in. hole is bored in the underside of the base to a depth of about ¼in. in order to permit of easy adjustment of the screw. Note that the end of this screw should be carefully ground or filed to a sharp point so that make and break may be instantaneous.

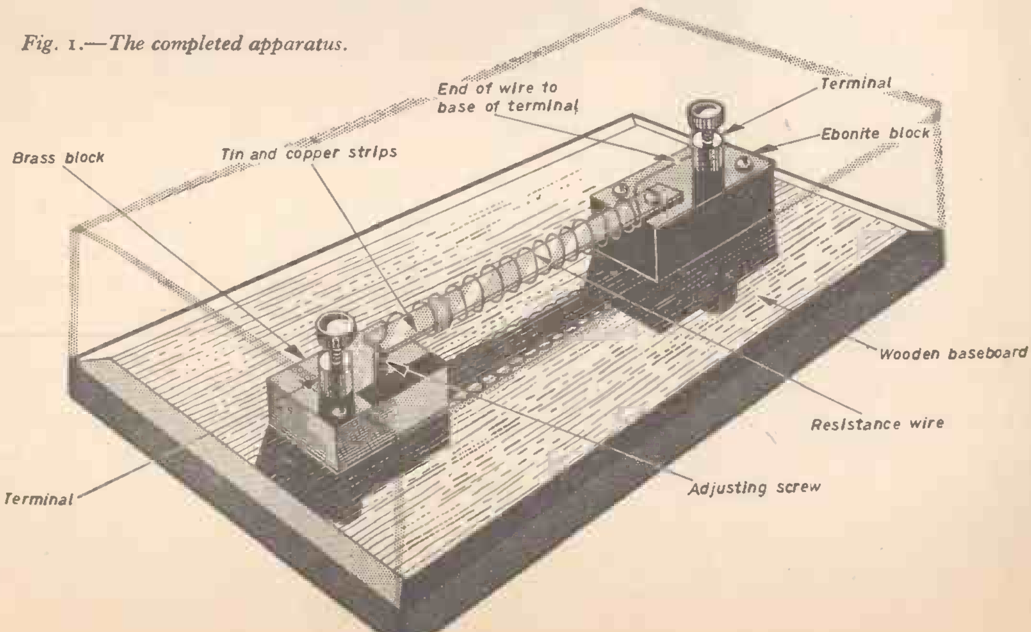
Wiring

The apparatus is wired in series with the mains and its action is that when the current is switched on it flows through the resistance wire to the contact or adjusting screw and thus to the second terminal. This terminal is wired to one side of the lamp or lamps (holder(s), the other side running to the mains.

Working Principle

The flow of electricity heats the resistance wire which in turn heats the strips thus causing them to expand. But since copper picks up more heat than tin, the strip curls upwards (the copper strip being at the bottom) thus separating the free end from the adjusting screw. The current flow is therefore broken. When the strip consequently cools, it straightens out again and thus re-establishes electrical contact and the strips begin to heat up again. The frequency of interruption can be regulated within reasonable limits by varying the height of the adjustment screw. Note that the apparatus should be shrouded or enclosed in some form of box so that live contacts are not exposed.

Fig. 1.—The completed apparatus.



home-made CHEMICAL LABORATORY APPARATUS

Part 4

By K. Given

Equipment for making hydrogen

Commercial thistle funnel and homemade substitute

IT is now proposed to deal with the apparatus necessary to study the preparation and testing of hydrogen, lightest and simplest of all gases. The apparatus is shown in Fig. 27. A bottle may be used in lieu of the flask since no heating is required. The gas collection can be as stated, with alternatives, under preparation of oxygen and the only new part required is the thistle funnel.

Thistle Funnels

A very suitable substitute can be made as shown in Fig. 26. A bottle which has been used to make, say, a gas jar is used. The top is ground down to avoid sharp edges and fitted with a bored cork and tube. Always keep glass tubes thoroughly wet when trying to work them through rubber and never leave them in the rubber longer than necessary or they will stick.

Another type of funnel also suitable for use in place of a thistle funnel may be made from a tube cut from a small medicine bottle or part of a fluorescent tube. Cut the tube with the wire cutter and wash out the " powder " without letting it contact the hands. The cork (if not rubber) should be soaked in water before use. If used with strong acids the cork (when dry) should be painted with hot candle grease.

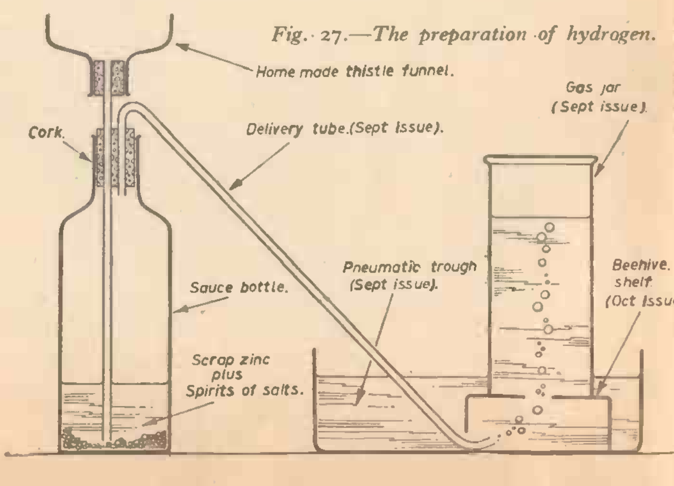
Experimental Details

Granulated zinc is placed in the flask. If none is available collect zinc scraps from old torch batteries, off cuts of " larder " zinc from ironmongers, chimney flashings, or soakers from builders merchants and plumbers. Heat them to a red heat in a tin can and when molten pour into a bucket of cold water. The result will be " granulated " zinc (see Fig. 28).

A dilute acid is then poured on to the zinc through the thistle funnel, the tube of which must reach nearly to the bottom of the flask.

Hydrochloric acid is obtainable cheaply and readily from most ironmongers under the title " Spirits of Salt". It should be diluted with two or three volumes of water. Inexperienced

Fig. 27.—The preparation of hydrogen.



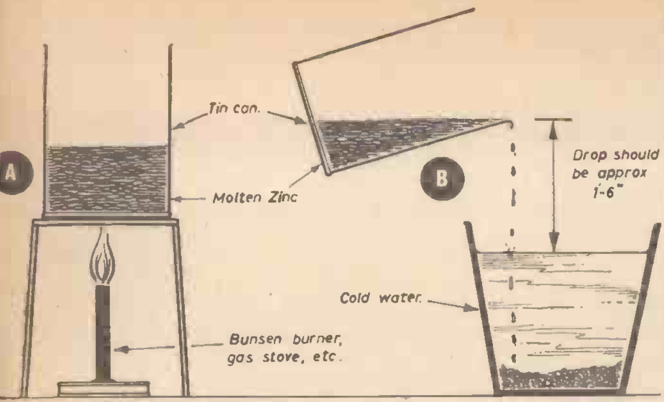


Fig. 28.—The preparation of granulated zinc.

readers should purchase " Spirits " or use dilute sulphuric acid obtainable from garages as the electrolyte for car batteries. Concentrated sulphuric acid is not suitable and diluting it can be dangerous.

Other acids will only evolve hydrogen at a slow rate, and as experiments, are not spectacular.

Suggested Experiments with Hydrogen

1. Apply a light to the first jar. An explosion results.
2. Apply a light to the last jar collected. It burns with a pale blue flame.
3. Try pouring the gas upwards into an empty jar (Fig. 30), and test with a light.
4. Fill a balloon with hydrogen (Fig. 32). Do *not* give such a balloon to children where there is any possibility of fire.
5. Hang two jars on a beam of wood, carefully balanced as shown in Fig. 29. Pour some hydrogen upwards into one jar. The beam will no longer balance.
6. Try burning substances in it.
7. After at least five jars have been collected (2,500 c.c. or more, with a flask or bottle of 500 c.c. or less) fit a jet. Apply a light. The hydrogen burns at the jet. If a cold body is brought near, water is produced.

DO NOT do this if the necessary numbers of jars have not been collected or an explosion of the flask or bottle of acid will result. (See Fig. 31*a*). For added safety wrap the flask in sacking.

Fig. 31*b* and *c* shows how to make the jet from ordinary glass tubing.

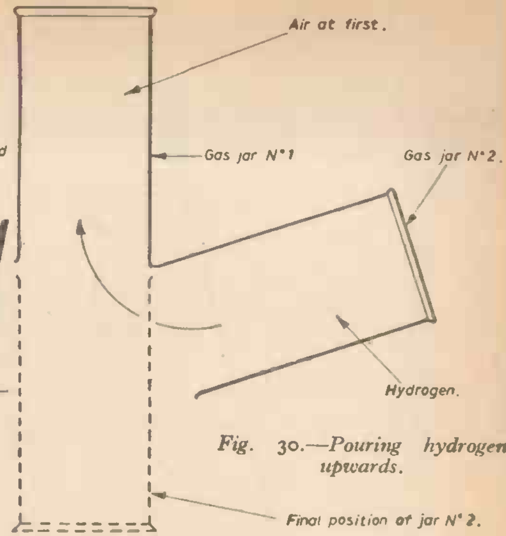


Fig. 30.—Pouring hydrogen upwards.

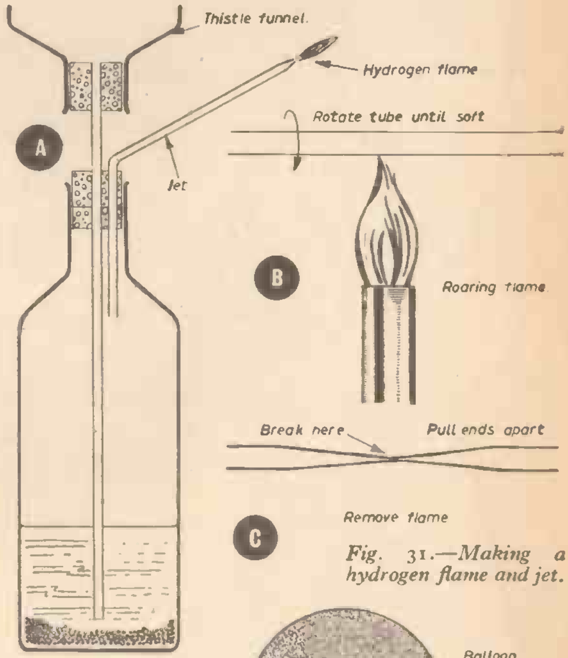


Fig. 31.—Making a hydrogen flame and jet.

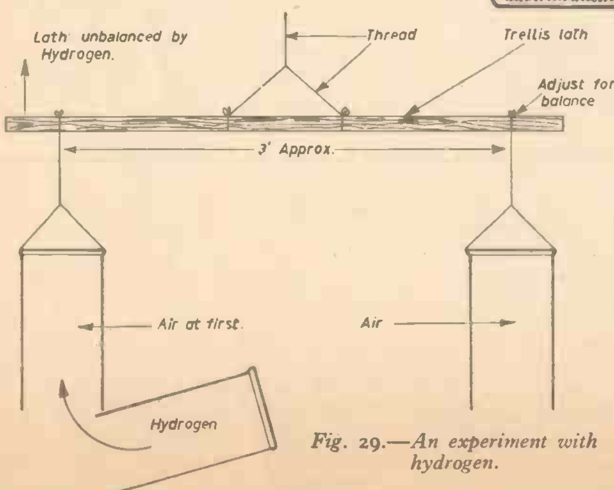


Fig. 29.—An experiment with hydrogen.

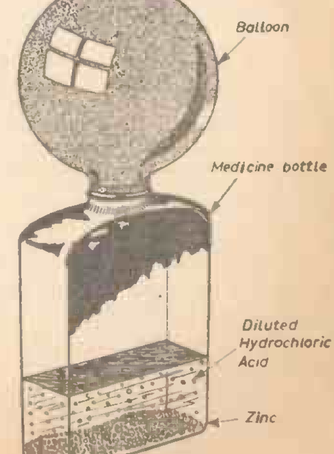


Fig. 32.—Filling a balloon with hydrogen.

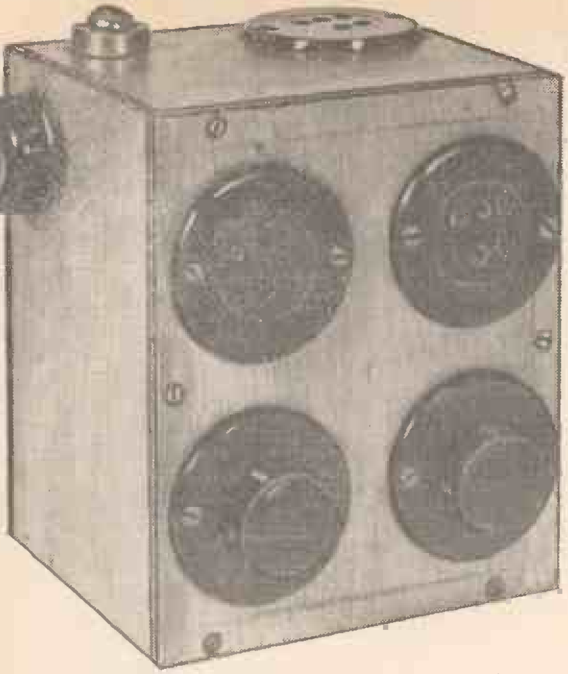


Fig. 1.—The prototype power pack.

Electrolytic capacitator—250 μf.
Plugs and sockets or Jackplugs—5 plugs and 5 sockets.
Switch or button.
6V. 0·04A. Cycle rear lamp.

A panel indication cover, as shown in Fig. 1, although not strictly necessary may be added as a refinement.

Component values will depend upon the number of flashbulb outlets required and, also length of flex connecting power pack to bulbs. The values quoted will operate with certainty through 100ft. of flex.

Unless self-closing Jackplugs are used it will be necessary to obtain three extra plugs for the four output sockets. Each of the three plugs are wired between the two pins to act as " Shorting plugs ". As the bulbs are wired in series, the remaining three sockets must be bridged should only one lead be required. If two lamps are used two sockets will require bridging, etc. The shorting plugs are also required along with the test bulb to test continuity.

Circuit Operation

Within seconds of the flashbulb being placed

Power Pack for Multiple Flash

Construction is described by J. K. Tallant

WITH the advent of capless flashbulbs, multiple-flash has become an attractive and cheaper proposition.

The power pack described in this article can be made by the average handyman quite cheaply, actual cost depending upon whether new or government surplus materials are used.

The circuit employed is of the battery-capacitor type ensuring positive firings to be made over a long period. Drain on the battery is extremely low, therefore, it has a life almost equivalent to shelf life.

A test light has been incorporated to ensure continuity of flashbulb circuit—an indispensable aid when long leads and valuable colour film are used.

The case may be any size or shape, no measurements are given as these are best left to individual requirements. Readers may think that the unit shown in Fig. 1 is unnecessarily large, but the power pack was made especially for industrial photography, and foundries, etc., are no place for " Kid Glove " equipment.

Circuit and Components

The circuit is self-explanatory and as the components may be wired in any order no difficulty should be encountered. However, a word of warning, it is essential to observe correct polarity of the condenser and battery, as can be seen from Fig. 2. Actual wiring of the author's unit is shown in Fig. 3.

Components required:
Battery—30V. hearing aid type.
Resistor—2,500-5,000 Ω.

in the holders the condenser becomes charged with the voltage given by the battery. When the shutter is fired the circuit is closed and the condenser discharges through the bulbs. When the bulbs have fired the circuit is broken and the condenser remains empty until bulbs are inserted. The reason for the resistor in circuit is to prevent the battery being short circuited when the camera shutter makes contact.

Testing and Fault Finding

The flash lead continuity test bulb is wired across the condenser. When the button or switch controlling this bulb is depressed a charge will be released through the bulb causing it to light

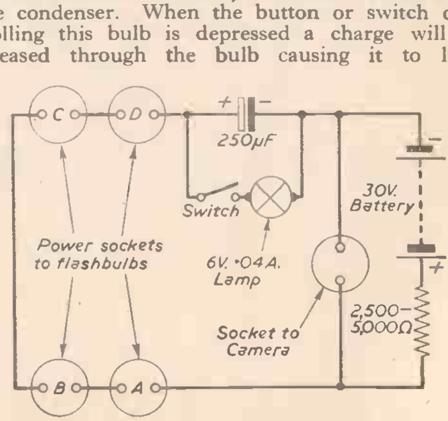


Fig. 2.—The theoretical circuit.

momentarily. This is, of course, providing that the circuit is complete.

In practice the following procedure is well worth carrying out:

1 Place lamps in holders at required positions.
2 Plug leads from lamps into power pack.
3 Connect firing lead to *camera* and then to power pack.

All that remains now is to depress the test button and the bulb should flash once, indicating that circuit is complete and exposure may be made.

However, should the bulb fail to light, the fault may be eliminated to one lead instead of all leads being suspect. Remove one lead at a time and replace with a shorting plug (in the case of self-closing Jacks this is of course unnecessary). Each time this is done depress the test button. When the bulb lights the lead which has been removed from the unit contains the fault. It is then relatively simple to trace.

On the few occasions that the unit has failed to function (during three years) the fault has been due to faulty flashbulb (one occasion) and incorrect insertion of flashbulbs in holders.

Although the above may seem a complicated procedure, in practice it takes only about 30 seconds to test all leads.

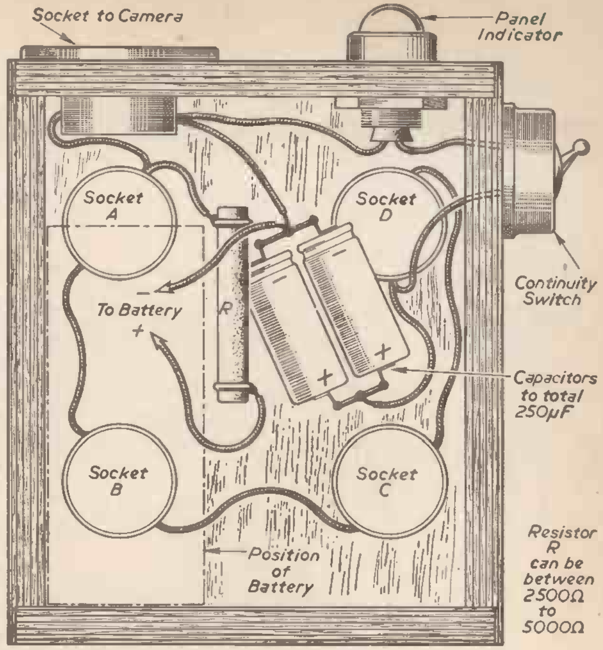


Fig. 3.—Point to point wiring diagram.

Synchronisation of Shutters

SYNCHRONISATION of the camera shutter to fire a flash bulb at the right moment extends the scope of the camera by an immense degree.

There are several types of synchronisation. The simplest is the " X " type, where contact to the bulb is made at the moment when the blades are fully open. This type of synchronisation is only effective at slow speeds . . . preferably 1/25 sec. As contact is made the bulb does not reach its peak illumination instantly: there is a delay of about 0·005 sec. before any light is emitted. The light builds up in intensity reaching its " peak " after about 0·015 sec., and the period for which useful light is emitted is about 0·015 sec.

The entire cycle can thus be completed, during the time when the lens is uncovered, only when a slow speed is used.

Where it is needed to " freeze " motion by means of a high shutter speed it is necessary for the contact to be made before the shutter blades are fully open, thus making sure that the peak of the flash comes at a moment when the blades are fully open. This type of synchronisation is referred to as " M " class.

With electronic flash there is no measureable delay in reaching the peak intensity, and the duration of the flash is so very short that " X " synchronisation is always required. Most modern shutters are so designed as to offer both classes of synchronisation, except in the cheaper grades.

Focal plane shutters can be very effectively synchronised, but because of the comparatively long time before the exposure is complete over all the negative a special " long burning " bulb, the " F/P." class, must be used.

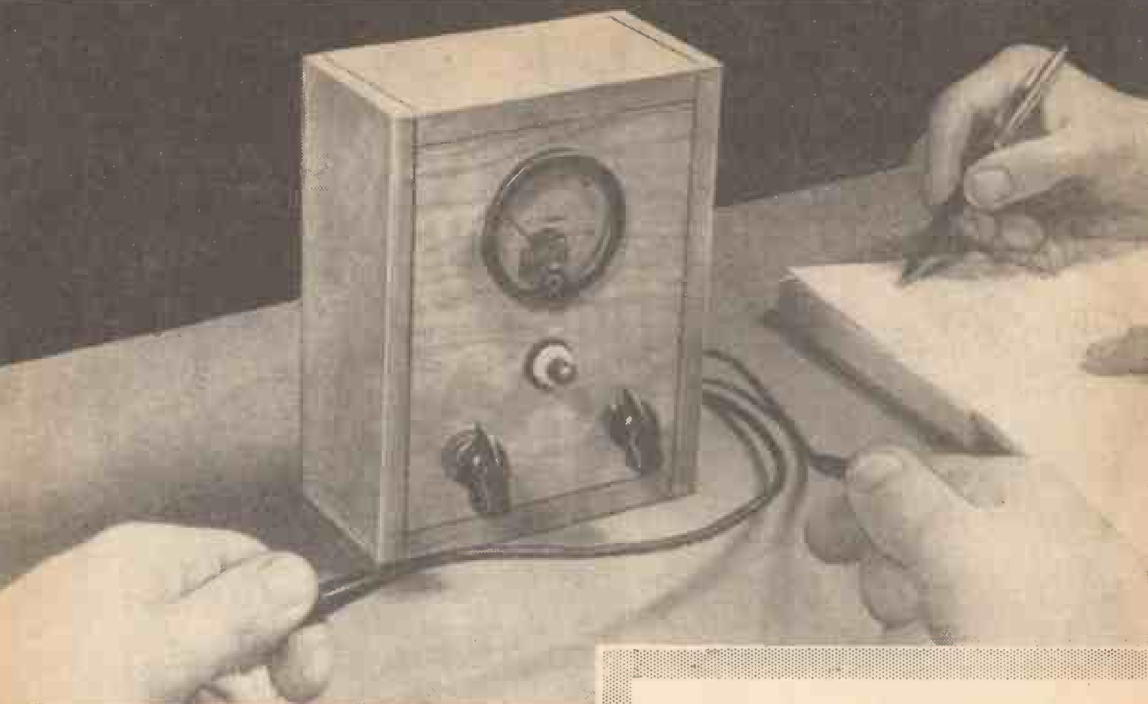
PUZZLE CORNER

FIVE families reside in five bungalows built on a straight line, each being 100 yards from its neighbour. At 100 yards from the last bungalow is a well from which the occupant of bungalow "A"—who went to the well each morning to fill his bucket—undertook to collect an empty bucket from each of the other bungalows and deliver full ones. He could not carry more than two buckets at a time, either

full or empty. Assuming he took the shortest route, what distance do you estimate he had to walk in order to supply himself and all his neighbours with water in this manner ?

Answer

The distance is 1,800 yards. He collects buckets from A and B, fills them at the well and takes them back to C. He then takes empty buckets from C and D, fills them, and takes them back to E. From E he takes the empty bucket, fills it, carries it back to E and takes the two full buckets left at E and leaves one at D and the other at C. Collecting the two full buckets left at C he delivers one at B and the other to himself at A.



THIS detector is neither expensive nor difficult to build. Most of the components could be removed from an old radio or TV chassis, but a few valuable pieces such as the meter or valve may be obtained on the surplus market at moderate cost. The complete assembly was constructed by the author for less than three guineas using surplus materials.

Although the name Lie Detector is used in the title, the instrument may be used to detect changes in blood pressure, muscle tension and so on. In fact if any changes occur in the skin, such as sweating, expansion or contraction, the unit will record them.

Many people associate the words "Lie grim process of extracting the truth from on the same plane as the 3rd Degree an one described here has no such sinister could prove a great success at your Christ you start measuring the attraction betwee or better still a girl and her boyfriend, th fast and furious.

Have Fun with a Lie Detecto

B
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M de

It is this factor that allows the unit to be used as a lie-detector. When the subject is emotionally disturbed, as when lying or worrying, he or she perspires slightly, thus causing a change in the electrical resistance of the skin. This causes a change in the electronic circuit and it functions accordingly.

As the circuit is so simple, great results cannot possibly be expected. The operator must be prepared to have patience to practice with the controls, to gain experience in confident operation of the instrument. A lot of fun may be had at social gatherings or parties, using the detector for practical joking.

After a while experiments can be carried out to improve methods. Also new applications for the device may be found in the process. Of course it could be used on a more serious basis, for demonstrative psychology, but no degree of accuracy can be guaranteed as the circuit has not been used under ideal conditions for this purpose.

The Electronic Circuit

Refer to Fig. 1. When the power is connected and the mains switch turned on, thermionic emission occurs in the Z77 in the usual way. This electron stream is controlled by introducing a negative potential between the control grid "i.e. G1" and the cathode. This voltage is supplied by cells B1 and B2 which are connected in series with the resistance network, which in turn is regulated by S2. When R5 is used in conjunction with S2, complete control of this negative voltage is at hand. The operator sets the grid voltage to practically *zero*. The subject under test is then asked to hold the test prods. If good contact is made between both prods and the subject, a minor current change takes place in the grid circuit. This small change is amplified by the Z77 about 60 to 70 times, causing the meter in the anode circuit to fluctuate.

The Power Circuit

The power unit employed is one of the simplest available as it must be accommodated in a confined space. The A.C. current from the transformer is rectified by MR1 which is a contacted cooled type of half wave rectifier used to a great extent in modern circuitry. Capacitors C1 and C2 are 8-10 μF electrolytic types used for H.T. smoothing. They should be at least 450V. A.C. working. R1 acts as an H.T. choke and anode load resistor, about 1W. will do. Specifications for all components are given in the component list (page 134) and diagrams.

Constructional Details

A box 4½in. × 4½in. × 7in. will be required to house the set. It should be of some kind of insulative material or preferably wood (Fig. 6). No metal chassis is used. A paxolin or wooden base is utilised (Fig. 5), as this eliminates the possibilities of electric shock, if an H.T. short developed. A suggested wiring scheme is illustrated in Figs. 3 and 4.

Assemble all the components except the front panel and meter and when firmly fixed in position, begin wiring from the A.C. input, working through the circuit, testing each solder joint for reliability. All wiring should be well insulated, 18 s.w.g. p.v.c. coated solid copper wire being ideal for this type of circuitry. The meter and front panel (Fig. 2) may be attached when the wiring is complete. After checking the wiring against Figs. 1 and 4, the instrument is ready for use.

The Test Prods

These should be made from 3in. or 4in. nails. After filing the sharp points off, a few feet of copper stranded wire can be soldered on to this blunt end. The solder joint is covered with a sleeve made of strong P.V.C. coating. Your local electrical contractor will supply you with a few scraps of P.V.C. covered wire to enable you to carry out this latter step. See Fig. 8 for illustrated details.

To obtain best results with the unit, the test prods must be cleaned with fine emery cloth at least every

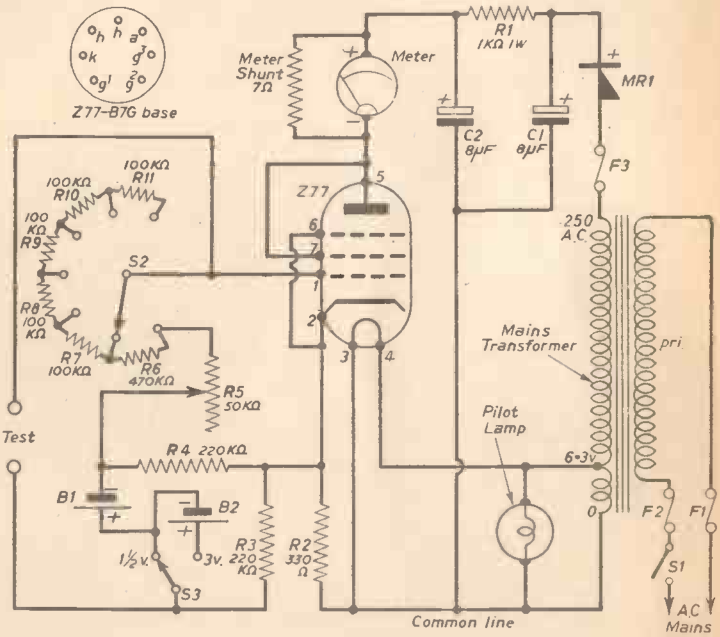

Fig. 1.—Theoretical circuit and valve base details.

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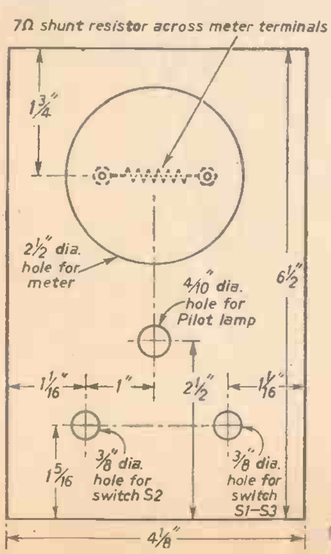
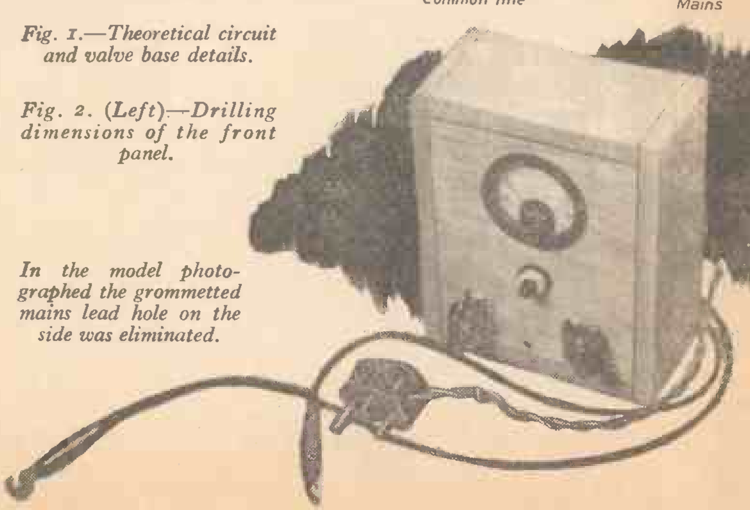


Fig. 2. (Left)—Drilling dimensions of the front panel.



In the model photographed the grommetted mains lead hole on the side was eliminated.

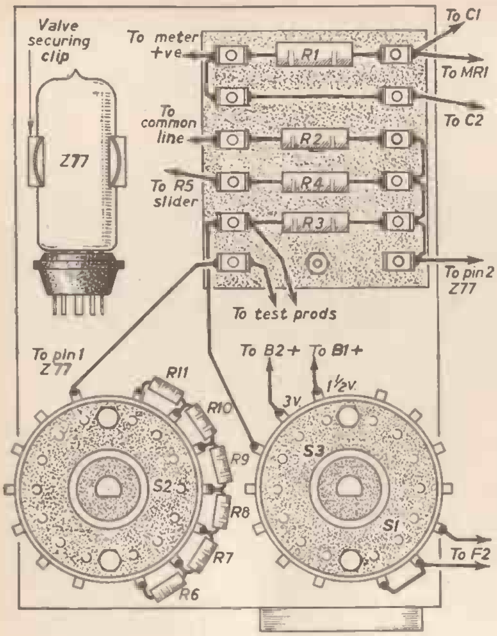


Fig. 3.—Wiring the actual lie detector.

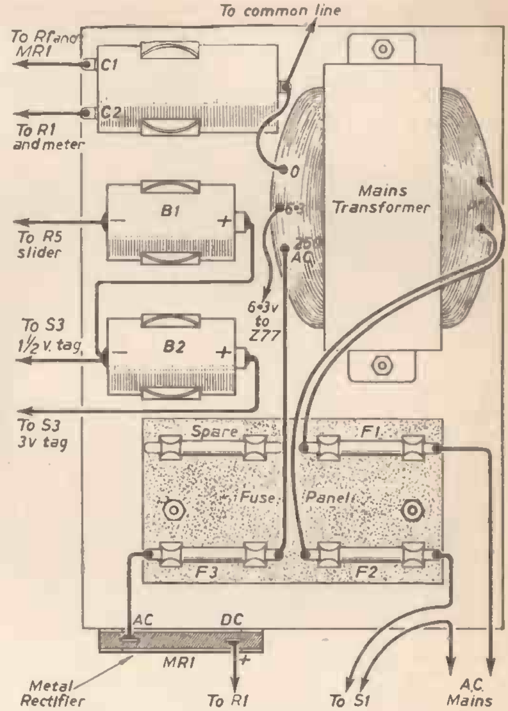


Fig. 4. (Above right)—Point to point wiring of the power pack.

Lie Detector CONTINUED

COMPONENTS LIST

1—Z77, 8D3, EF91, 6AM6 or equivalent valve.
1—B7G valve base.
1—2-pole 3-way rotaty switch.
1—1 pole 7-way rotary switch.
1—5 mA. F.S.D. meter (2½in. or 3in. type).
4—¾in. condenser clips.
2—1½V. cells (A Bijou torch battery cut in two).
1—8 × 8 μF. electrolytic condenser.
1—Midget 0-250V. 6·3V. mains transformer.
1—7Ω shunt (wirewound if possible).
4—Fuse holders (cartridge type).
4—250 mA. fuses (cartridge type).
1—Pilot lamp holder with lens.
1—M.E.S. 6·3V. 0·3A. lamp.
1—50 kΩ midget variable potentiometer.
2—220 kΩ ½W. resistors.
1—330 Ω ½W. resistors.
1—1 kΩ 1W. resistor.
5—100 kΩ ¼W. resistors.
1—470 kΩ ¼W. resistor.
1—Piece Paxolin 6½in. × 4½in. × ⅛in.
1—Piece Paxolin 5in. × 3½in. × ⅛in.
1—Metal rectifier (type 18RA 1-1-8-1) contact cooled.
1—6-way tag board.
1—Handle for case.
3—Pointer knobs.
1—Wooden box 7in. × 4½in. × 4½in.
4—Rubber feet.
1—Small brass hinge.
1—Small angle bracket to fit MR1.
Grommets, screws, nuts, bolts, wire, solder, etc.

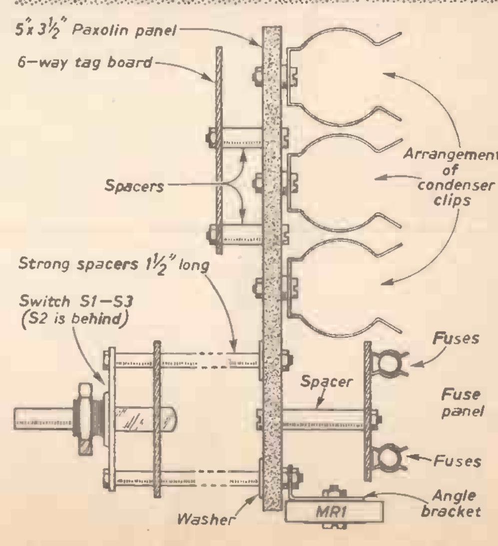


Fig. 5. (Right)—End view of paxolin panel showing method of mounting components.

fortnight if it is used regularly. It is also advisable to leave the heads on the nails, as this will result in the prods having no sharp edges.

Simple Tests

Before commencing any of the tests always ask the subject to wash his or her hands 10 minutes before the test starts. (This is to remove all excess sweat and grease which could give a false impression of the detector's capabilities.)

For the first test, switch on the unit and leave it running for at least three and a half minutes to allow the valve to reach a steady temperature. After allowing it to warm up, rotate the grid voltage regulator (S2) until the milliameter reads full scale deflection (F.S.D.). If F.S.D. cannot be obtained it is probably due to the "bias" voltage being too low. This is easily remedied by turning S3 clockwise to its middle position (Fig. 3). It will be necessary to short the hand prods together for this test. If the meter corresponds to the control switching then the unit is now functioning.

For the second test, control R5 should be turned to minimum. First obtain F.S.D. on the milliameter and wipe the prods with a clean dry rag. You may now try the test for different skin resistances on a number of subjects.

Make sure that they have all washed their hands, then ask them, each in turn to hold the prods, one in each hand until the pointer of the meter stops rising. Record the readings of the meter before and after each test on a piece of paper and notice the vast differences of the various people. In general higher readings will be noted with child subjects or women as they have softer skin which makes better electrical contact and it is usually of a smaller resistance.

If the last two tests were successfully carried out you can have some fun with the third. This will give you some idea about how to go about using your detector to its best advantage. The next time you go to a party, ask a young man and a girl to come and test their feelings for one another. Probably they will blush slightly (all the better) but will consent to try the test. After explaining how to hold the prods ask the rest of the company to note the reading on the scale before beginning. Now ask the man to hold one of the prods and the lady the other. When they are holding the prods tightly tell them to give each other the biggest kiss they can. Some of these results will amaze you. When their lips meet the pointer will rise indicating the amount of perspiration. This of course is just a practical joke and does not indicate the amount of emotional disturbance between two people. If one of the subjects is a little bashful he might blush and sweat, making the pointer rise higher and thus causing himself greater embarrassment. These three tests will give you some idea of the sensitivity of the detector.

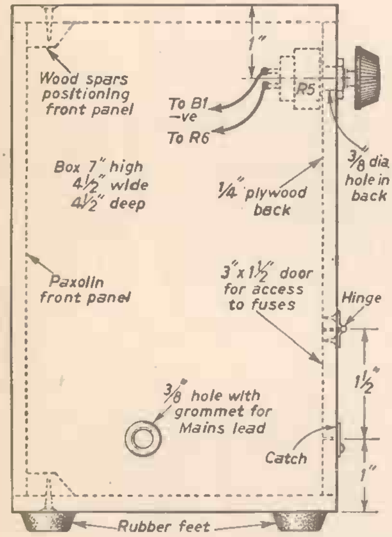


Fig. 6.—Side view of the cabinet showing fuse access door, grommeted hole for mains lead and cabinet construction.

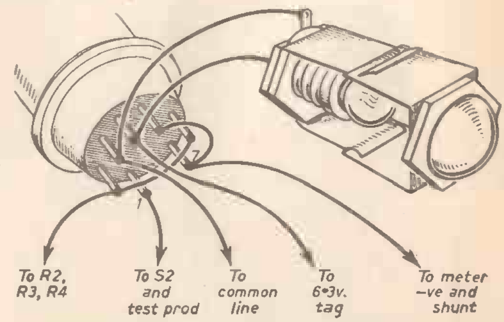


Fig. 7. (Right)—Valve pin connections and method of mounting pilot lamp.

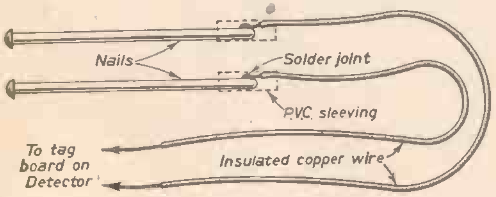
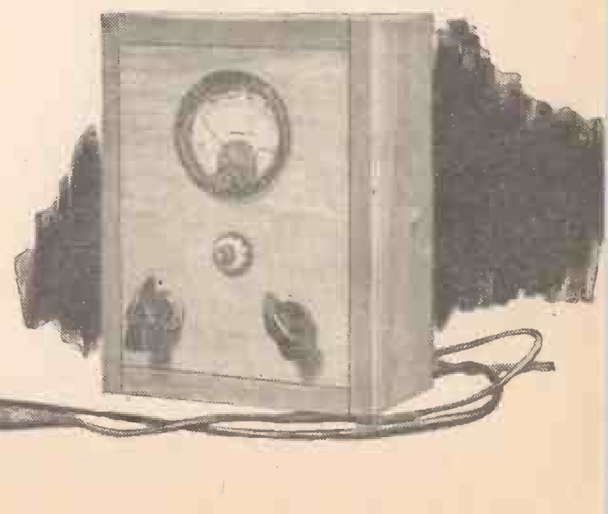


Fig. 8.—Details of the test prods.



AUTOMATIC OPENING & CLOSING OF DOORS

PART 10 of our Automatic House Series by E. V. KING

THE idea of opening and closing doors automatically has for many years been used in industry but its use in the home has not been common. For home construction an external motor seems the easiest method and a suitable mechanism is that once used for lowering the heavy flood lights of aircraft. Two were purchased for trials: one was unit S137 from Messrs. Milligans, Liverpool 3, and the other from Messrs. H. English, Hutton, Brentwood. The price of each complete unit is around 25s. and there are other sources of supply.

Description of the System

A 24V. D.C. motor drives a sprocket via a worm drive. This sprocket is geared down to drive another sprocket with a high torque. The second sprocket is used to drive a sector pivoted so that it makes a movement over 80 deg. When the sector is " out " it holds the door closed, when the sector is " in " the door is held open. This is shown in Figs. 81, 82, 83 and 85.

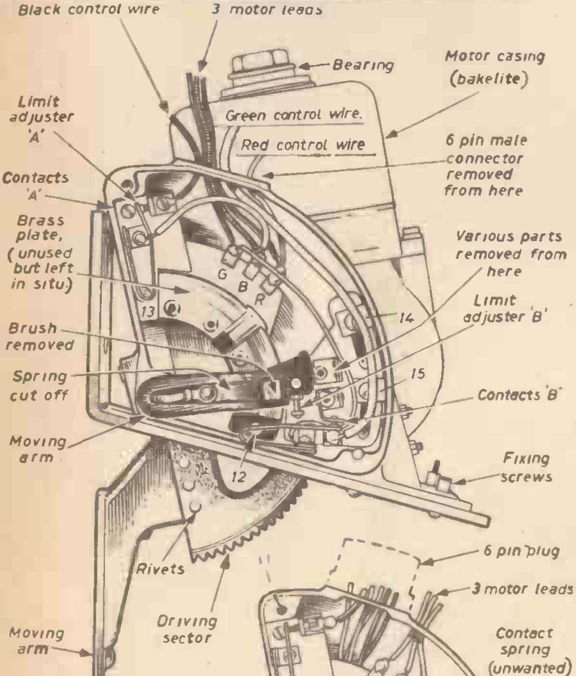
The motor, worm, sprockets and sector are all mounted in working order in the landing lamp unit. It is necessary to arrange limit cut outs to stop the motor when it has opened or closed the doors and to make a few alterations to the unit

The Reversible Motor

The motor circuit is shown in Fig. 87. The red tag (or lead) goes through a solenoid to one brush, through the commutator and armature coils to the other brush and then through whichever of the two fields is connected. Note that the fields are wound opposite ways, causing reversing. Wired as shown to a D.C. supply and a simple throwover switch of the toggle type, the door would open or close as required (limit switches *must* be arranged).

The Magnetic Brake

The internal brake plunger may be removed. If a good 24V. D.C. at 2A. is available leave the brake alone. If the supply is low in voltage, remove the plunger by taking off the cap fixing screws. The cover is shown in Fig. 85. If the cap is not screwed on some tags will have to be bent to remove it. Refit the cap afterwards to keep moisture out.



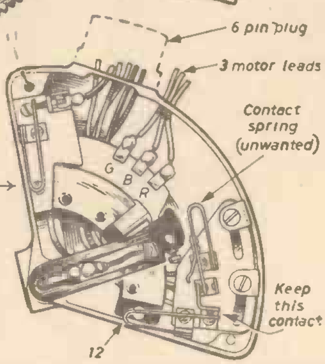
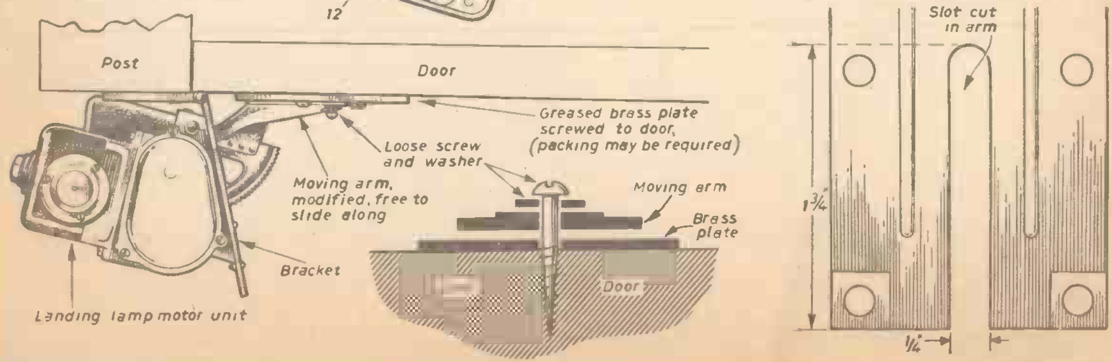


Fig. 82.—(Above) Inside limit switch cover (modified). Fig. 81—(Right) The motor with arm and wiring before modification.

Fig. 83.—(Below) Top view as mounted on door post and details of modification to moving arm.



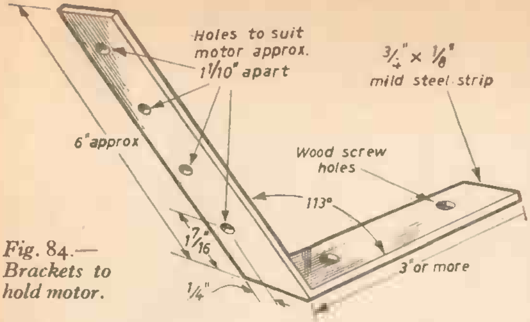


Fig. 84.—Brackets to hold motor.

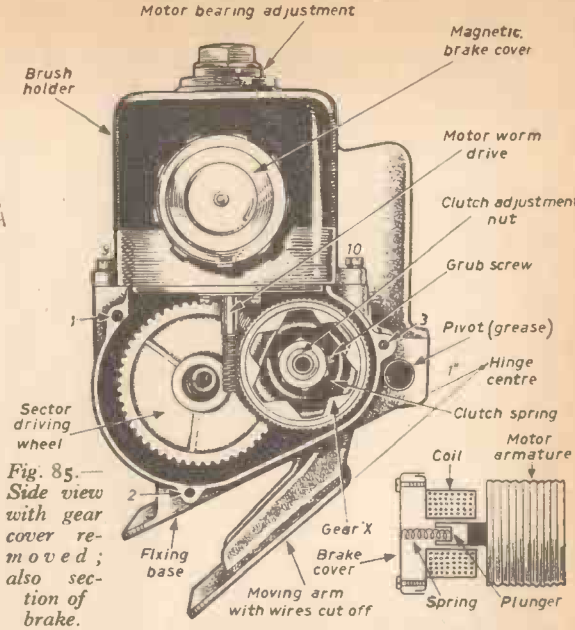


Fig. 85.—Side view with gear cover removed; also section of brake.

The Safety Clutch

Doors fitted for mechanical electrical operation should not be hand operated. However, a stranger might damage the mechanism, so a " safety sliding " device is needed. If the gear cover on the brake side of the unit is removed, a large nut fitted to the sprocket meshing with the worm (Fig. 85) will be seen. This may be loosened as required so that the springs do not grip strongly and the door will give freely even when pushed against the working of the motor. Do not loosen off the clutch more than necessary, or wear will take place. Should the sector jam over one way at any time remove the gear meshing with the worm by pulling it outwards (see Fig. 85). Should the door be required for manual operation at any time follow the same procedure.

Wiring and Limit Switches

Switches of the micro-type operated through compression or leaf springs could be fitted to shut off the motor when the door is fully open or closed. When open, the door must shut off at about 85 deg. or there is a chance of the sector jamming. If the Bakelite cover is removed by undoing two screws (as shown in Figs. 81 and 82) readers will see a moving arm which moves over with the door and sector (seen in Fig. 82). It is arranged that when this arm moves over to the limit of travel either way it pushes some contacts open and shuts down the motor. Only one field circuit at a time is cut out so that the other circuit can be completed by the manual switch.

Fig. 81 shows the wiring as it is and Fig. 82 as required. Proceed as follows:

1. Cut away with tinsnips unwanted contact spring shown in Fig. 81.
2. Undo screws 14 and 15 in Fig. 82. Remove the Bakelite board and cut all wires away. Replace as before.
3. Undo screws 11, 12 and 13 of Fig. 81. Carefully lift the Bakelite panel and cut off all wires fixed to it except the three coloured wires leading through a hole to the motor. Replace Bakelite and screws as before.
4. Bring in three coloured control leads capable of taking a good 2A. Solder the red one to the tag marked " R." Solder the green one to the fixed contact " B " of Fig. 82. Solder the black or blue one to the fixed contact " A."
5. Solder a lead from the " B " tag to the *moving contact* " A."
6. Solder a lead from the " G " tag to the *moving contact* " B."
7. Make sure that the leads allow free travel of the moving arm and test the mechanism as follows.

Test of Wiring and Unit

Take the control wires coming out of the unit and attach the red one to one side of a 24V. D.C. supply. Now put the green one to the other side of the supply.

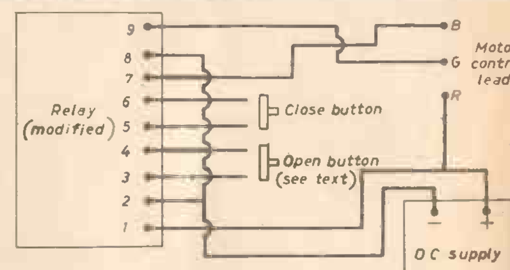


Fig. 86.—Push button auto door control.

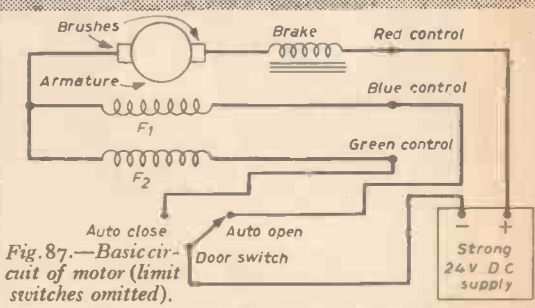


Fig. 87.—Basic circuit of motor (limit switches omitted).

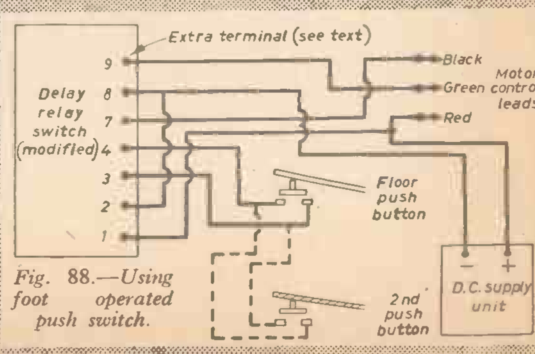


Fig. 88.—Using foot operated push switch.

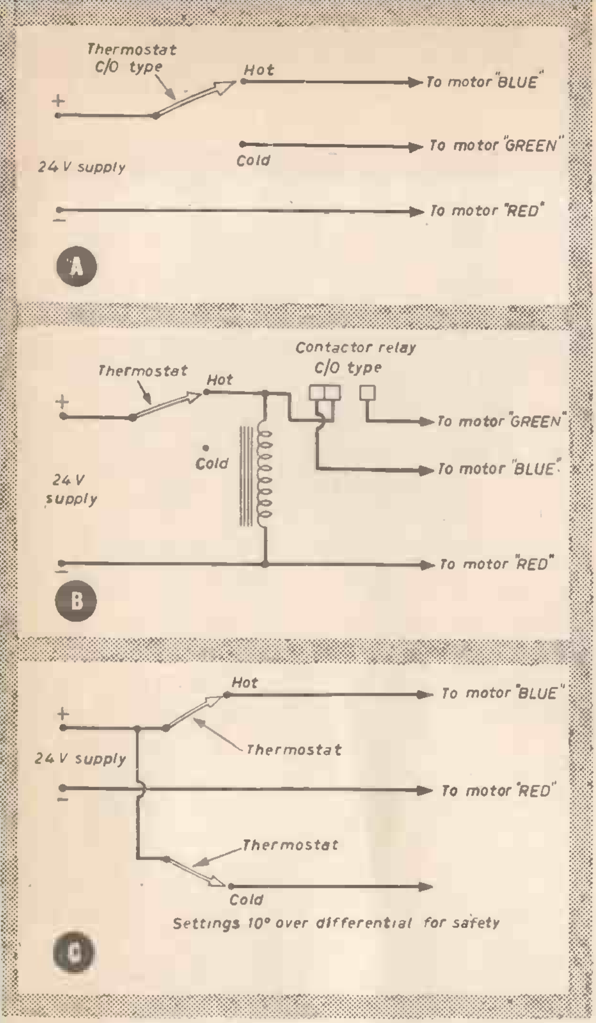


Fig. 89.—(*Left*) *Greenhouse automatic ventilation.* (*A*) *Circuit where thermostat will take 2A. D.C.* (*B*) *Circuit where thermostat will not pass 2A. D.C.* (*C*) *Circuit using two adjustable thermostats.*

The motor should commence to move the arm until it touches and moves over contacts " B." The motor then stops. If the black wire is now used in lieu of the green one the motor will go the other way until the arm pushes over contacts " A " and shuts off. If the motor jams at the end of travel the brake may not be working; this does not matter, as when used on a door mechanical stops will be fitted to prevent "overtravel " by momentum or the limit contacts "A" and " B " need adjusting. When testing, replace covers. For very long life anti-sparking resisters and condensers may be arranged across the limit points.

The complete simplest external and internal circuit is shown in Fig. 87. The switch may be any single pole throwover type capable of dealing with 2A. D.C. inductive load. Suitable types are Bulgin S.601/PD or Crabtree 3100. Whatever system is to be installed it should be wired up and tested on the bench before any attempt is made to attach the mechanism to the door.

Door Post Fixing

Fig. 83 shows the motor as viewed from on top when fitted to a door post. Two brackets are made up of ¾in. × ⅛in. mild steel strip approximately to the dimensions of Fig. 84. The angle must be correct and the first fixing hole 1 1/16 in. from the extreme bottom of the angle. The brackets are bolted to the fixing " Base " of Fig. 85 using the small B.A. screws provided in the motor. No tapping, etc., is required. Notice that it is necessary to drill the holes in the brackets off centre or the moving arm will jam on opening. This can be seen in Fig. 84 and heading photo.

When the brackets have been fitted to the motor, true them up if necessary and remove them. Fix them to the door post with the edge of the bracket exactly under the hinge centre pins, using wood screws or long bolts and nuts. Attach the motor to the brackets again. Test to make sure no fouling occurs. When doing this remove gear " X " Fig. 85.

Spring Return Method of Operation

The moving arm is *not* fixed to the door. A brass plate about 1/16 in. thick and measuring 5 × 2½in. is fixed to the door and greased so that the moving arm comes in contact with it all through its travel.

Any convenient method of opening the door by means of springs or gravity may be used and the motor will close it by force. On reversal the door will follow the moving arm back of its own accord. Suitable springs are obtainable from ironmongers.

Positive Open/Close Method

This method is the most efficient. The moving arm *cannot* be fixed to the door because the centre of the hinge line is not in line with the true centre of the moving arm. To overcome this trouble cut a ¼in. slot down the centre of the moving arm (see Fig. 85). A small wood screw or nut and bolt with a washer is then fitted into the door and in the slot of the arm (Fig. 83). Thus the arm holds the door open or closed, but at the same time the screw allows the arm and brass plate on the door to slide relative to one another.

Slight packing may be necessary under the brass plate. Verify that the motor *does* " cut out " at the end of its travel, as it is possible to fit it a few degrees out so that the door jams tight and the motor is still trying to " close it more." This would result in a burnt out armature or field. Likewise allow the door to open and make sure the motor " cuts out."

Outside Operation

The motor is perfectly safe as only 24V. is used. It is best to have one side of the supply earthed. The unit is not waterproof and it should be well lubricated with grease (except the armature bearings) and enclosed in a zinc box or a polythene bag if used outside. The moving arm and toothed sector should be well greased at regular intervals.

Where doors can swing too far open, stops must be fitted or a high wind might damage the motor. In winds of gale force large doors should be helped by hand or damage to the gears might result, especially if the clutch has not been loosened.

Push Button Control of Doors

The switching system already mentioned is satisfactory for cupboards, etc., where two switches for operation are not required. A better system is to use two-button control each side of the door. Fig. 86 shows this system. The latching relay already described in the May issue is fitted with an additional contact so that the contact No. 8 touches contact No. 7 when normal and contacts another one, No. 9, when energised (i.e. c/o contacts are required).

When wired up as shown, if button (Open) is pressed momentarily, the relay is set and the change over points in relay (terminals 7, 8 and 9) set the motor driving one way. If the other button is pressed, the latch is lifted, relay goes normal and c/o contacts reverse the motor. The door stays open or closed as long as required, being controlled by the limit switches. The door *cannot* be set at intermediate positions. Two more push buttons may be fitted on the other side of the door, they are also wired to 3 and 4, and 5 and 6. Table lamp type push switches are *not* suitable.

Push Button Pad Operation

A push button operates a change-over relay which is thermally delayed in becoming normal again. Thus the door opens and remains open for a predetermined period before closing. The time delay switches already mentioned could be used. None of these simple home-made systems is suited for really heavy traffic, or the delay period might not be long enough for people to pass (i.e. when the thermal delay system gets too warm through not being static long enough). For the automatic home they are quite suitable.

Fig. 88 shows how the delayed relay of Fig. 24 (June issue) may be used for door control. The contacts " Y " connected to terminals 7 and 8 need to be fitted with another point so that 8 touches 7 when normal and 9 touches 7 when energised. That is c/o contacts are required, and one more terminal, No. 9.

In Figs. 86 and 88 the switch is a "push for contact" type which releases when the pressure is removed. Burgess micro switch type BR is suitable and will give at least 100,000 operations without trouble. Another switch, the other side of the door, may be wired in parallel to the one already mentioned.

If the delayed relay unit is constructed with a controllable delay readers may set this as required. The author finds that a delay of 5 to 10 seconds is suitable. Any of the delay units described in the May 1960 issue, may be used in this circuit provided they are fitted with c/o contacts for the 7 and 8 terminals.

Photo-operation

Fig. 88, just explained, is well suited to light ray control. A light-operated switch worked by a gas filled photo-tube will be explained later and the switch terminals may be connected to the leads going to 3 and 4 terminals in lieu of the foot pad. Anyone interrupting the beam will cause the doors to open, remain open for a few seconds, and then close again.

Bolting Automatic Doors

Outside doors must be bolted or high winds would result in gear damage. Normal bolting can be used, but if the motor is switched to " open " while the door is bolted damage will be caused. Any of the methods described may be used for bolting the door automatically. A small micro-switch can be made to pull in a bolt at the moment the door is absolutely closed, details of mounting were described under "cupboard lighting." See also Figs. 4, 5 and 6 (April issue) and Fig. 74 (October issue).

Opening of the bolt may be such that the solenoid is energised when the switch is set to " open." This works well as long as the bolt is " snappy " in its action otherwise it is best to fit a delay unit (already described) in the motor circuit. In this case putting the switch to " open " pulls out the bolt and some ten seconds or so later the door opens.

Greenhouse Ventilation

The motor is ideal for use in the greenhouse for opening and closing ventilators. It is powerful and will work quite a number at a time. It can be set to open and close the ventilators at certain times by a time clock (see July issue), or by a preset temperature controlled thermostat. Thermostats will be dealt with later. A thermostat of the type that comes ON when the temperature rises and changes over to another contact (also ON) when it falls is required. Alternatively a normal thermostat can be wired to a change-over relay to operate the ventilation motor, or two thermostats can be used. See Figs. 89a, b and c.

Feeding of Chickens, etc.

The motor will also open a " hopper " in the poultry run, etc., at the touch of a switch, or by a time clock arrangement. It can also be made to close poultry house doors as darkness falls by a solar dial clock or photo-switch (to be described). This is especially useful where foxes are around and the owner is away late.

Automatic Control of Coke Boilers

If a thermostat is fitted in or on a hot water tank it can be arranged to open the air supply under a boiler or to alter the damper setting, the former method being most suitable. When the temperature in the tank drops, contact is made and the motor opens the air flap. When the water is hot the thermostat changes over contacts and the motor closes the flap. An air bleed can be arranged and most likely a relay operation system will be necessary as in Fig. 90.

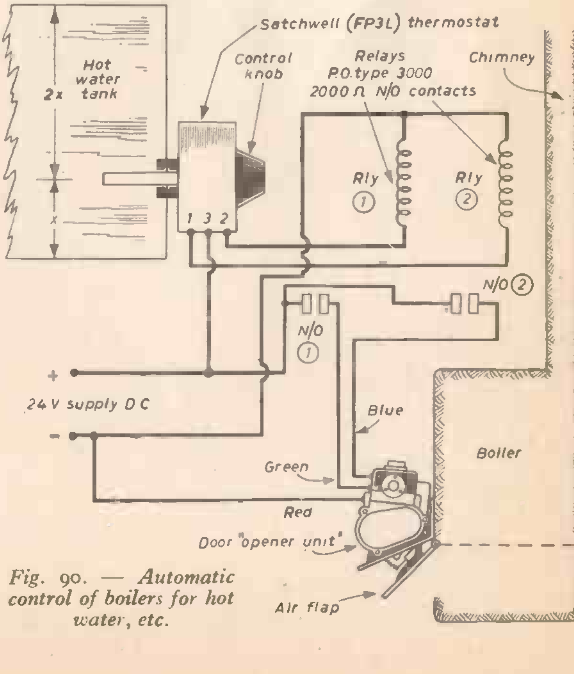


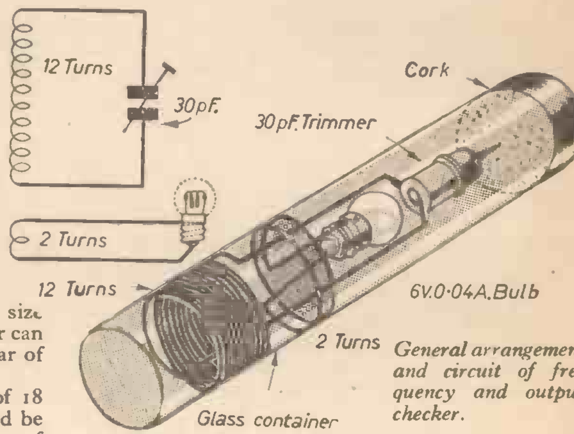
Fig. 90. — Automatic control of boilers for hot water, etc.

One of the most useful accessories for the model control enthusiast is

A Frequency and Output Checker

F. G. Rayer describes how to make one

WHEN using a model control transmitter it is necessary to set it in the permitted band. As changes to the aerial, etc., can modify tuning, some means of checking the frequency should be employed. The output checker described here can be used for this purpose, and is easily carried in the pocket. It is constructed in a sealed glass container so that handling it will not cause any change in frequency setting. The container also prevents any accidental contact with the transmitter tuning coil, which is usually wired to the high tension circuit.



General arrangement and circuit of frequency and output checker.

The glass container used was approximately ⅞in. dia. internally, and 3¾in. long. The exact size is not important, provided coil, bulb and trimmer can be accommodated, with a tightly fitted cork clear of the trimmer. A test tube would be suitable.

For the tuned portion of the coil, 12 turns of 18 s.w.g. enamelled wire are used. The wire should be pulled straight, and the turns wound on an object of such diameter that the coil will be a push fit inside the glass tube. The ends of the winding are bent so that they pass up the tube to the trimmer, short pieces of insulated sleeving being added. The 6V. 0·04A bulb is soldered directly to a 2-turn winding. Insulated, single strand connecting wire may be used for this coil.

After checking the coils for diameter, they are removed from the tube. The ends of the larger coil pass through the 2-turn loop, and are soldered to the tags of the air-spaced beehive trimmer. A test should then be made to see that the trimmer can be adjusted to give resonance on a 27 M/cs signal.

The actual diameter of the windings, and gauge of wire used, are of little importance, but if the tube is of rather different diameter from that specified, the number of turns on the larger winding may need modifying, to permit tuning to 27 M/cs.

The inside of the tube is then smeared with an adhesive such as Durofix, and the coils, bulb and trimmer, ready connected, are pushed in. The adhesive should cement the coils and bulb to the inside of the tube, and the cork should be left out so that the adhesive can harden.

Calibration and Transmitter Checking

A transmitter already tuned to the Model Control band may be used to provide a signal. An ebonite or paxolin tube or rod should be filed or cut so that it will engage with the trimmer. The coil end of the tube is then brought near the transmitter coil, and the trimmer is slowly rotated until the correct position is found, the bulb then lighting at maximum brilliance. The tube should then be moved to a little distance, so that the filament only just glows when the exact point of resonance is found on the trimmer. The trimmer is then sealed, and the cork inserted.

To put another transmitter on frequency, hold the tube near the transmitter coil, and tune the transmitter until the bulb lights, the tube always being kept as far from the transmitter coil as possible.

If the transmitter is so designed that the coil cannot be reached, a short length of insulated wire should be connected in series with the aerial. A one or two-turn loop is made in this wire, and the frequency checker is brought near this loop instead of near the transmitter coil.

The distance at which the checker can be held from the transmitter coil depends on the power of the equipment. With 2-valve battery transmitters, or other fairly powerful apparatus, care is necessary not to bring the checker too close to the anode coil, or the bulb may be blown.

Once adjusted, the checker will show at once if the transmitter is radiating, and set to the correct frequency.

A PIN TABLE BAGATELLE

By Eric Hawkesworth

A game for all the family

"ORBIT" is a pin-table type game requiring a fair amount of skill to attain high-scoring figures. The idea is to put as many balls into orbit—the central top-score ball cup—as possible, but first-, second- and third-stage rocket ball-cups pay off with an increasing number of points according to progress down the board.

However, balls can still miss all the rocket cups and return to base to register a score in the traps at the bottom of the table. Thus, every ball played, adds something to the total. Eight ¾in. dia. balls are used—either ball bearings or, as in the author's model, glass marbles are suitable—and they are fed semi-automatically at the push of a finger, from the magazine to the tee-off trough.

The table stands on three 1in. dia. legs at a convenient height and is smartly finished in a multi-colour scheme with name headboard for professional effect.

The Table Frame

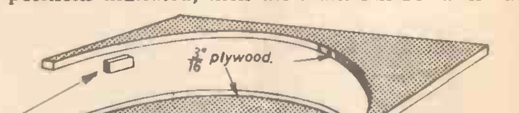
The outer frame is constructed of planed 3in. × ¾in. timber with the sides measuring 3ft. 6in. and the top and bottom cross ends 19½in. (Fig. 1). Glued and screwed butt joints are the method of assembly—two 1½in. long screws being used per joint. Screw up on a flat surface to ensure lateral alignment of the pieces.

A strong support frame is necessary for the play board if the balls are to run smoothly. This is built up mainly of 1in. square wood but the forward cross piece is 1½in. × 2in. in section while the one at the top of the table is 2in. × 2in. Fig. 1 shows how the support frame is half-jointed for strength and how it is fixed into the main outer frame with c/s. wood-screws.

Before fitting the play board, three 1in. dia. holes are drilled—one in the middle of the front cross beam and two in the back member—to take the legs. Glue the 3ft. 6in. × 18in. sheet of hardboard liberally to the support frame and use just a few small panel pins to hold the board down while the glue sets.

Two notches are cut into the side frames to accept the ends of the plywood arch which is sprung into position as shown. This arch is a strip of $\frac{3}{16}$in. plywood 1in. wide by 27in. long. Ends should fit snugly into the notches to give a smooth lead-in to the balls as they are propelled up the guide trough.

Glue two small wood blocks behind the arch in the positions indicated, then the mask can be sawn out



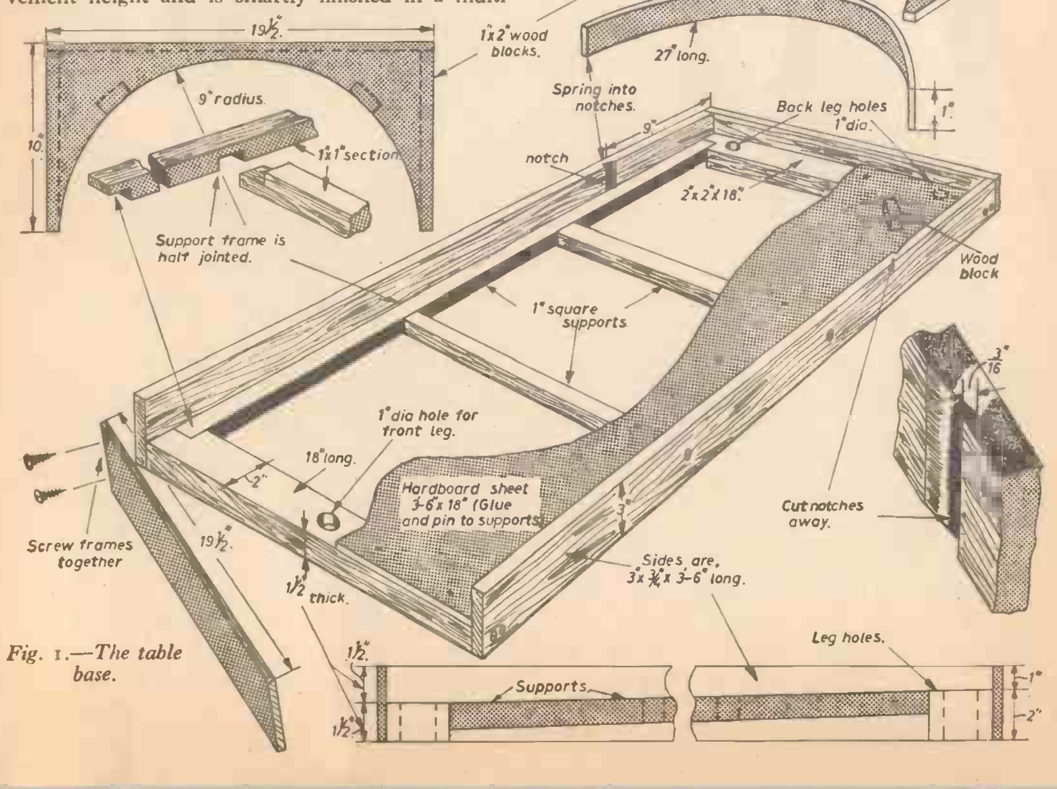


Fig. 1.—The table base.

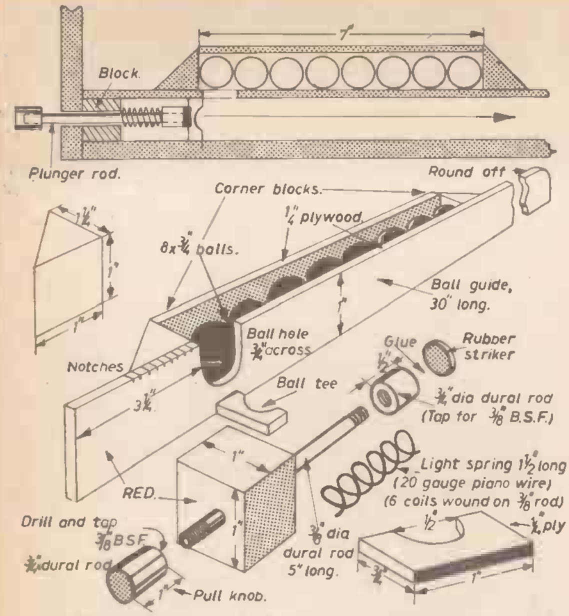


Fig. 2.—The striker mechanism and ball magazine.

of a piece of thin ply measuring 10in. × 19½in. Pencil a 9in. radius semi-circle from the centre of one edge of the board then carefully fret this out. The waste piece is put to one side because it is used to make the headboard later on.

Tack and glue the mask over the top end of the table where it should be a good fit round the edges and along the curve of the arch.

Striker Mechanism and Ball Magazine

Make the ball guide-trough from a 1in. wide strip of ¼in. ply 30in. long. Saw the ball feed hole out of the strip at a point 3¼in. from the bottom end (Fig. 2). The ball magazine is simply a 7in. strip of the ¼in. ply glued to the guide strip via a couple of triangular shaped wood blocks.

Assemble the magazine and guide to the table by fixing a 1in. cube block of hardwood between the guide and frame. A ⅜in. dia. hole is carefully drilled through the end frame and through the centre of the 1in. block to take the plunger spindle of the striker.

The spindle is a 5in. length of ⅜in. dia. dural rod. Both ends are screwed to a distance of ½in. with ⅜in. B.S.F. to take the knob and striker head which are made from short lengths of ¾in. dia. dural rod. A rubber disc—cut from a piece of car inner tube—is glued to the striker knob as shown. After winding up a light coil spring on a ⅜in. dia. bar, the complete striker can be assembled into the frame.

A ball tee is sawn from ½in. ply and this is glued into the guide adjacent to the ball hole and just above the tip of the striker knob. Balls should push easily through the slot from the magazine and fall on to the ball tee.

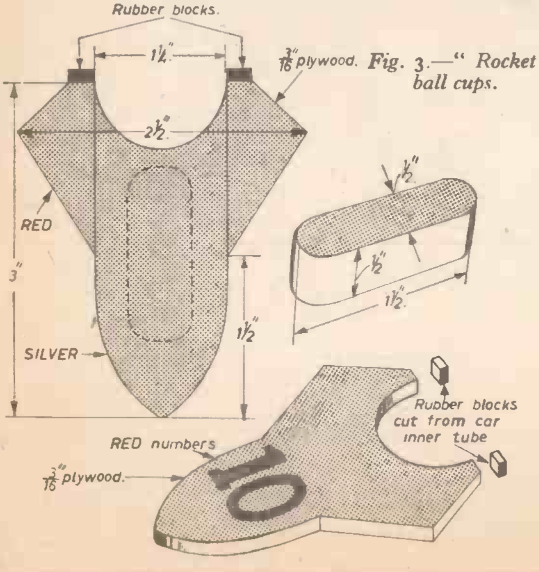


Fig. 3.—" Rocket " ball cups.

Rocket Ball Cup

Fourteen rocket ball cups are required and they are all cut to the shape and dimensions shown in Fig. 3. If one rocket shape is fretsawn out of a piece of 3in. × 2½in. ply, it can be used as a template to mark out the others. Note the small rubber blocks which are glued to the lips each side of the cup openings. Mount the shapes on pieces of ½in. square section wood with the ends suitably rounded.

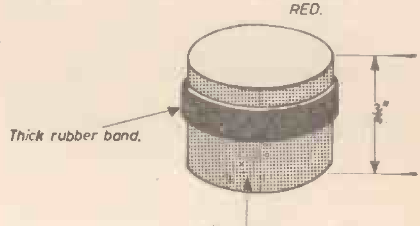


Fig. 4.—Dimensions of the bounce pegs.

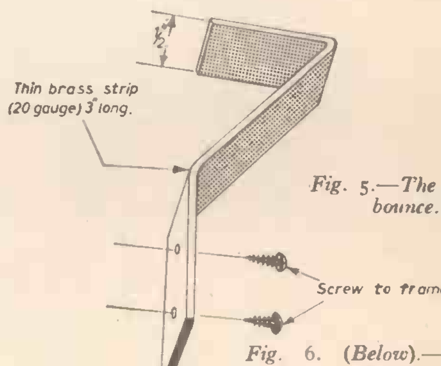
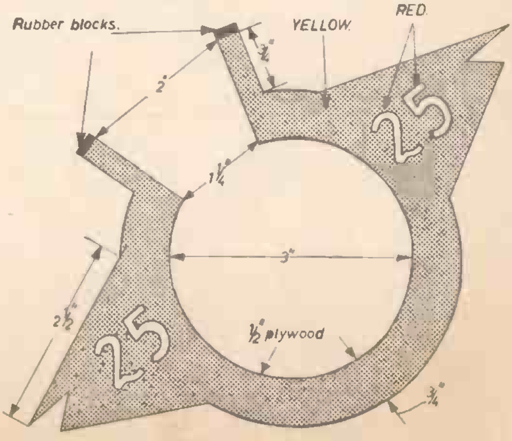


Fig. 5.—The spring bounce.

Fig. 6. (Below).— Top scoring " Orbit."



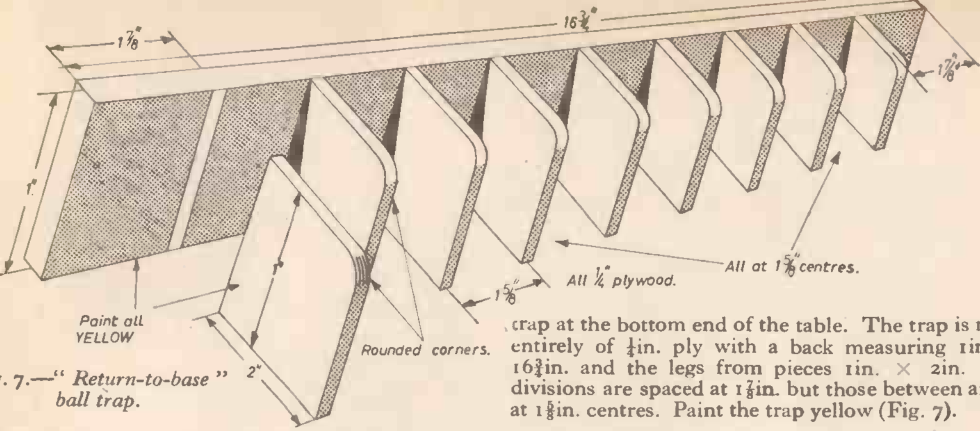


Fig. 7.—"Return-to-base" ball trap.

It is best to paint the rockets silver at this stage then the red score numbers can either be painted or transferred—$\frac{1}{2}$in. letters are fine—to the face of each cup. Five are marked with No. 10, five with No. 20 and the other four with No. 15.

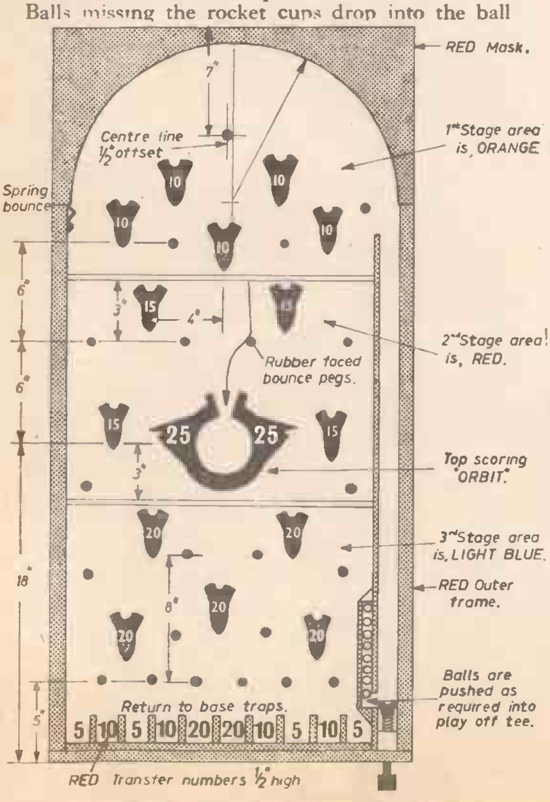
The bounce pegs (Fig. 4) are pieces of $\frac{3}{4}$in. dowel, $\frac{3}{4}$in. high and have thick rubber bands glued round near to the top of each peg. Twenty-two are required and should be painted red.

A spring bounce is bent up from a 3in. long strip of 20 gauge brass $\frac{1}{2}$in. wide (Fig. 5) and is screwed to the frame at the point where the balls come to the end of their run round the arch.

The top-score Orbit ball cup is sawn out of $\frac{1}{4}$in. plywood. Draw out two concentric circles—one 3in. dia. and the outer $4\frac{1}{2}$in. dia.—then pencil in the wings and opening to the dimensions given (Fig. 6). Complete by fixing the two rubber blocks and, after painting yellow, transfer the two sets of No. 25.

Return-To-Base Ball Trap

Balls missing the rocket cups drop into the ball trap at the bottom end of the table. The trap is made entirely of $\frac{1}{4}$in. ply with a back measuring 1in. × $16\frac{3}{4}$in. and the legs from pieces 1in. × 2in. End divisions are spaced at $1\frac{7}{8}$in. but those between are all at $1\frac{5}{8}$in. centres. Paint the trap yellow (Fig. 7).



Laying Out the Hazards

Before the various cups and pegs are added to the table, the play board should be painted with the three zone colours as shown in the layout diagram (Fig. 8). The board is sectioned into three with the areas orange, red and light blue in that order from top to bottom. Black lines divide each area.

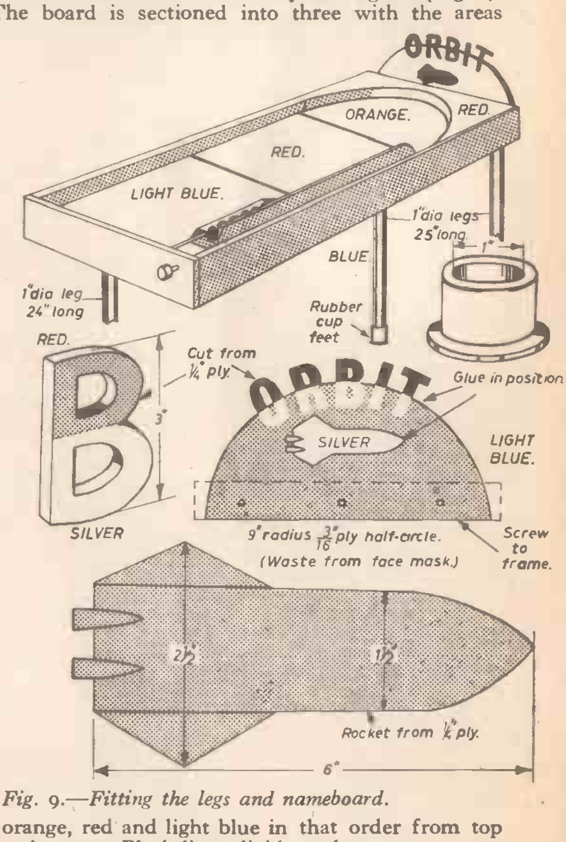


Fig. 9.—Fitting the legs and nameboard.

Use a contact adhesive to fix the hazards and no other fixing will be necessary. Dispose the ball cups, Orbit, bounce pegs and base trap as shown adhering to the given layout as closely as possible but aiming also at a neat, symmetrical appearance.

(Concluded on page 154)

Fig. 8. (Left)—Lay-out of the hazards.

Alan A. Ward introduces...

A TELEPATHY ACT

Try mystifying your Christmas guests

THE possibility or impossibility of thought transference from one person to another is a controversial topic which can be relied upon to provoke lively conversation and argument whenever it is raised. Entertaining demonstrations of telepathy, or other " psychic " powers always arouse great interest. The truth is that, though most of us are sceptical of anything which seems magical or supernatural, many people have a deep human desire to believe in miraculous things, even in these frankly scientific times. If you enjoy acting and have had some small experience as an amateur conjurer, you will be able to present a baffling display of telepathy which, if convincingly performed, will earn you a reputation for being a " mind reader " and mystic. You will need to work with an assistant, preferably a lady.

Technique

Here is the effect of your performance, as witnessed by your audience. After introducing your lady assistant, you talk briefly about such ideas as the physical nature of thoughts and the reality of thought transference between sympathetic minds. When these necessary preliminaries are over you call for a committee of two or three spectators and request them to escort your assistant to an adjoining room or behind a screen placed to the rear of the hall. As soon as your assistant is out of sight you go out into the audience holding a pack of cards. One spectator cuts the pack and three other persons take and retain a card from the lower half of the pack. Next, you ask for three volunteers who must each take an envelope and secretly seal therein a small personal object of " sentimental value." The envelopes are returned to a small tray which you place upon your table. Finally, another spectator is invited to select one of a series of diagrams which are drawn upon large cards.

You now stand to one side of the stage and notify your committee that the " experiments " have been prepared and ask would they kindly bring your assistant on to the stage. The lady is blindfolded and led to a chair in the middle of the stage. You command the three persons who chose cards to close their eyes and form mental pictures of their cards. Haltingly, your assistant names the values and suits of cards one and two, but she only succeeds in naming the value of the third card. When her eyes are uncovered she is already looking strained and tired. You let her rest a moment while you retrieve the cards from the three spectators, then hand her the tray of envelopes. As she tears open each envelope and holds up the enclosed object you call on the owner to concentrate deeply upon it. One by one the objects are returned to their correct owners. Finally, the lady takes a piece of chalk from the table and requests the whole audience to participate in thinking of the chosen diagram. You return to the table, where you silently pick up the diagram cards, and then hold them so that the selected drawing faces outwards towards the audience. Slowly your assistant sketches the diagram clearly upon the blackboard and your performance is concluded. If your acting has been well rehearsed and your subterfuges well executed, your audience will be in a state of tension which will now be relieved by a generous outburst of applause.

" Forcing " The Cards

Now for the three vital secrets that make the act possible. You must learn to force three cards. Decide with your assistant what these three cards shall be and place them upon the top of a packet of a dozen other cards. Place all of these, faces down, against the faces of the rest of the pack. (See Fig. 1.) Turn the whole pack over. When you take the cards into the audience be careful not to betray the pre-arrangement of the pack. It will be possible to shuffle the top half of the pack just before you leave the stage. Hold the cards in your left hand when you offer them to be cut. Ask the spectator to cut the pack somewhere near the centre. When the top portion of the pack has been removed, immediately drop your left hand to your side while you take back the top portion in your right hand. When next you lift the cards in your left hand, let the three force cards be uppermost. This can be managed easily if you turn over the cards as you step away to the next person. Let three other spectators remove the force cards and retain them. Replace the top half of the pack underneath the cards in your left hand. Casually show the face of the bottom card before placing the cards in your pocket.

Secret number two is subtly simple. The backs of the second and third envelopes are marked by minute creases upon their lower flaps. (See Fig. 2.) Thus the three envelopes will be readily identifiable. Also, the three " volunteers " are decided upon by your assistant and yourself before the show commences and it is merely up to you to persuade them to take the proper envelopes later on. Choose your innocent " stooges " from different parts of the hall. Surprising as it may seem, this daring procedure is not nearly so risky as it sounds.

The Diagrams

Fig. 3 illustrates the set of nine diagrams which you must draw in Indian ink upon rectangles of thick white cardboard which measures 6in. × 8in. Your assistant must learn the diagrams and their correct numbers. You can easily communicate the " test " diagram when you place the cards and chalk upon a certain part of the table which has previously been mentally divided up into nine " code " areas, as shown in figure three.

Study carefully the detailed account of the act, as given above, and apply your knowledge of the various techniques, where appropriate, in order to obtain a complete account of every move that you and your assistant must make. Pay attention to details of showmanship, such as your assistant's " inability " to discover the complete identity of the third playing card and her feigned " tiredness " later on. Invent some interesting patter which will be in accordance with the serious mood of your performance. It will be advisable to study a book about scientific research relating to telepathy in order to speak with confidence, and some authority, when you address your audience. *New Frontiers of the Mind*, by J. B. Rhine will be useful and interesting reading on the subject. You will be able to obtain a copy of the book at your local library.

Make sure that all your apparatus is neatly assembled before you begin and arrange for suitably mysterious music to be played at appropriate times during your performance. Try to wear evening dress. Rehearse your act thoroughly and present it as a " psychological entertainment." However, do not actually claim supernormal powers, but shrewdly let your audience make up their own minds.

Fig. 1.—Pre-arrangement of the cards. The three top cards are force cards.

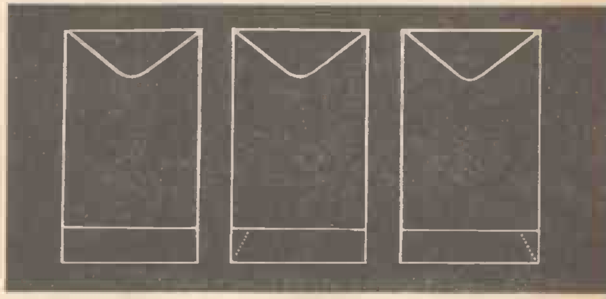
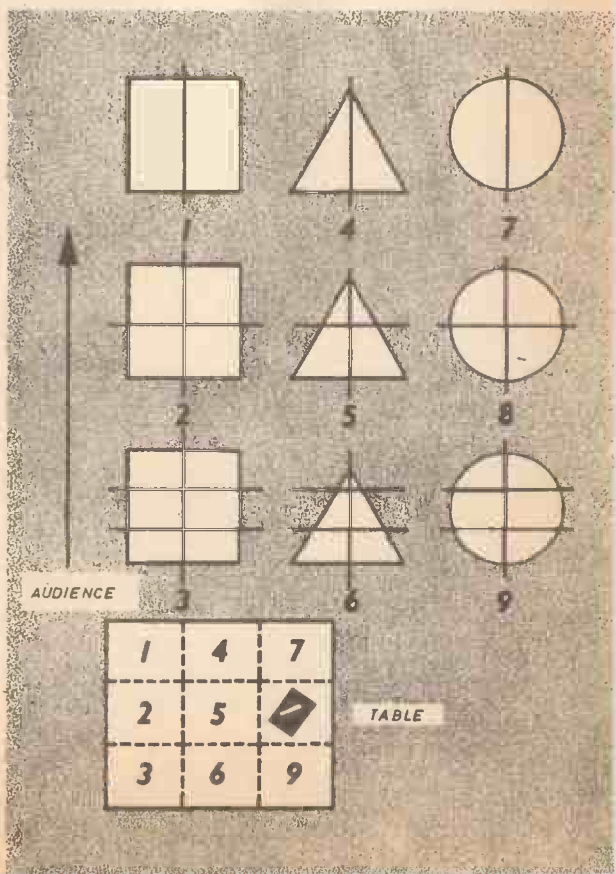


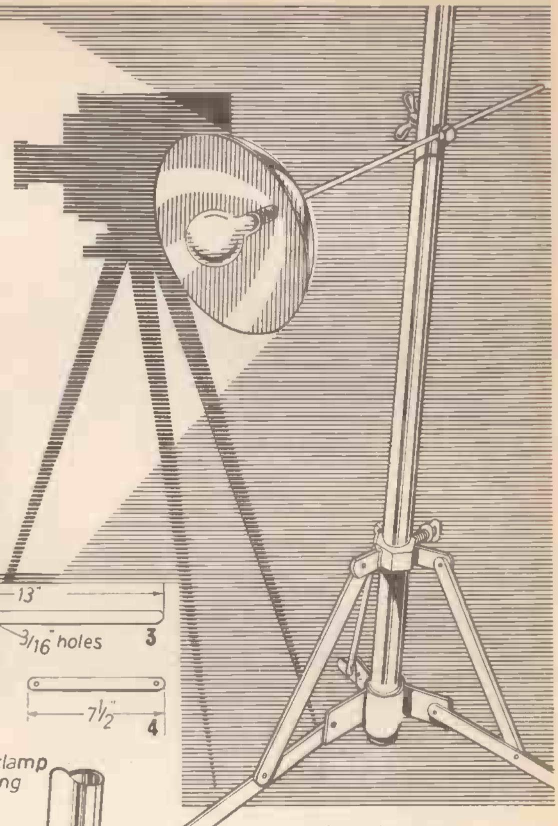
Fig. 2.—The backs of two of the envelopes are marked by creasing.

Fig. 3.—(Below). The nine diagrams to be drawn in Indian ink.



How to make a PHOTOGRAPHIC FLOODLIGHT STAND

By "Helios"



HERE is a convenient folding stand which will enable one or more floodlight reflectors to be held without the need of assistants.

The main pillar is a piece of $\frac{5}{8}$in. dia. light-weight electrical tubing 4ft. 3in. long. At distances of 3in., 12in. and 21in. from the top are drilled $\frac{11}{32}$in. holes to take the clamping screws for holding the reflectors (Fig. 1).

The clamping screws are $\frac{5}{16}$in. dia., 1¼in. long hexagon headed bolts with butterfly nuts. Near the head of each bolt is drilled a ⅛in. hole. The bolts are passed through the $\frac{11}{32}$in. holes in the metal tubing of the pillar as shown in Fig. 2 and the reflectors clamped on as shown in the sketch of the complete stand.

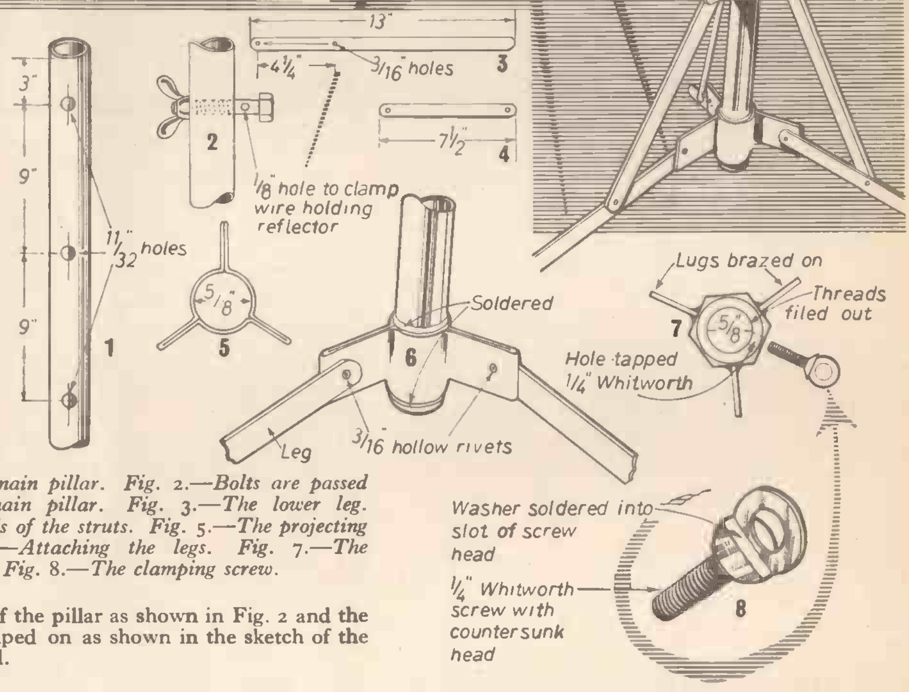


Fig. 1.—The main pillar. Fig. 2.—Bolts are passed through the main pillar. Fig. 3.—The lower leg. Fig. 4.—Details of the struts. Fig. 5.—The projecting lugs. Fig. 6.—Attaching the legs. Fig. 7.—The clamping ring. Fig. 8.—The clamping screw.

The Base

The base of the stand is of the folding "music desk" pattern. The lower legs are three pieces of iron 13in. long, ½in. wide by ⅛in. thick with $\frac{3}{16}$in. holes drilled near one end and at 4¼in. from the same end (Fig. 3).

The struts are three pieces of the same gauge iron 7½in. long with $\frac{3}{16}$in. holes drilled near each end (Fig. 4).

Take great care to get these holes drilled in exactly the same respective positions in each piece of iron, otherwise the stand will not fold up properly.

At the bottom end of the central pillar is soldered a ½in. wide strip of iron bent as in Fig. 5 to form three projecting lugs. A $\frac{3}{16}$in. hole is drilled through the centre of each lug and the legs attached by hollow brass rivets—the latter not hammered up tightly—so as to make hinge joints (Fig. 6).

The struts are similarly attached with rivets to the legs and to the clamping ring at their upper ends as can be seen from the heading sketch.

The clamping ring is made from a $\frac{5}{8}$in. nut with the threads filed out so as to be an easy sliding fit over the tubing (Fig. 7).

Three lugs made from ½in. × ⅛in. iron are brazed on at angles of 120 deg. A hole tapped ¼in. Whit. is drilled in the side of the nut wherein fits the clamping screw. The latter is made up from an ordinary ¼in. Whit. countersunk head screw with a flat washer soldered in the slot (Fig. 8).

More New FIXING KITS from RAWLPLUG

More and more handymen want to do their fixing jobs the professional way—drilling the hole with Metalide drill in a handbrace, inserting the Rawlplug and driving in the screw, tight—all in a matter of seconds with complete security. Here to meet the needs of these enterprising handymen are three kits—No. 8 ($\frac{1}{8}$), No. 10 ($\frac{3}{16}$), No. 12 ($\frac{1}{4}$) Metalide Drills with corresponding Rawlplugs and Screws. Ask your dealer now for a sight of these new kits which are your complete answer to every indoor and outdoor fixing job in solid masonry.

No 8	No 10	No 12
6/6	7/-	7/6

All purpose adhesive. Clear. Waterproof. Heatproof. Insulating. Handy tube 1/-, Large tubes 1/6d. DUROFIX is undoubtedly the finest value for money today. It has such a wide range of applications from simple woodwork repairs to fine china, porcelain and glassware that no home should be without a tube. Commercial tubes 5/-; $\frac{1}{2}$-lb. tins 2/9d.; 1-lb. tins 10/6d.

1/- & 1/6

Real wood in putty form. In dexterous fingers surprising things can be done with Rawlplug PLASTIC WOOD. Models can be made and coloured, intricate mouldings rebuilt, splits in wood made good and, what is more it will stick firmly to any non-greasy surface — metal, glass, vulcanite, plastic, earthenware, etc. Can be cut, planed and sanded to glass-smooth finish. Colours: Natural, Oak, Mahogany, Walnut. $\frac{1}{4}$-lb. tins 2/3; $\frac{1}{2}$-lb. tins 3/9; 1-lb. tins 6/6.

1/-

Animal glue of tremendous strength. This popular ready-to-use DUROGLUE is the handyman's friend. It can be used for that immediate need and replaced in the toolbox for another day. It is strong, reliable and for woodwork an ever ready aid to fixing and repairs. It is also suitable for many other materials but not for those washed in hot water. $\frac{1}{2}$-lb. tins 2/6; 1-lb. tins 4/9.

1/-

For quick easy repairs to metalware. This scientific preparation in paste form can be applied in a few seconds and dries in a few minutes. Metal utensils in the house, garage or garden can be put into good condition again by the intelligent use of Rawlplug PLASTIC METAL without heat or soldering iron. Not suitable for wireless or electrical connections.

10$\frac{1}{2}$D

Rawlplug DO-IT-YOURSELF OUTFIT

12/6

The handiest of handy outfits for the handyman

Here is a clever innovation from the Rawlplug Company. Seven popular Rawlplug products packed into one attractively printed box.
One handy box of No. 8 assorted Rawlplugs. One No. 8 Metalide Masonry drill in plastic container. One 1/6 tube Durofix. One tube Natural Plastic Wood. One tube Duroglue. One card fuse wire. Six No. 316 Rawlnuts (for making vibration-proof fixings to thin and hollow materials). One 64-page Rawlplug instructional handbook.
This assortment of Rawlplug products will find many uses in the home. Selling at 12/6 it makes an ideal present for the wife to buy for her husband or the handyman to buy for himself.
Rawlplug Do-it-Yourself Outfits are now in the shops, why not call in to your local Rawlplug dealer and ask to see one now?

DUROFAST

1/9

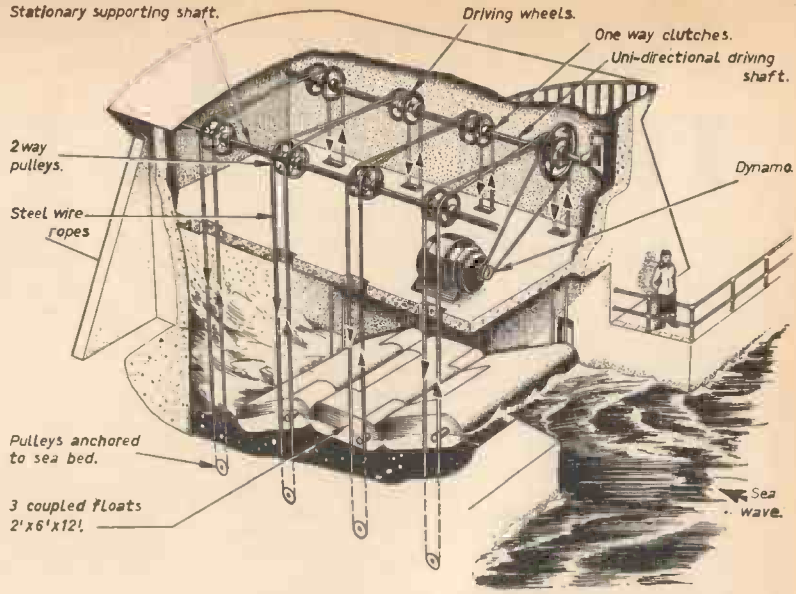
Durofast is the new contact adhesive by Rawlplug. It has absolutely amazing strength yet is so flexible you can even fix rubber soles to shoes with it. Durofast is ideal for fixing laminated plastics to cabinet tops and can also be used for fixing metal to metal or glass to metal, rubber and felt to wood, etc.

RAWLPLUGS

B698

THE RAWLPLUG COMPANY LIMITED, CROMWELL ROAD, LONDON, S.W.7

THE sea engine consists of a number of air tight floats coupled together in series and housed in a building consisting of a pair of parallel piers, surmounted by a power house. The floor of the power house must be above high water level and the approaches to the piers should be given a slight taper to accelerate the speed of the waves. Also the plant must be erected at a point on the seashore where the floats would still be seaborne at low tide. The floats are subjected to the rise and fall of the tides as well as the horizontal and vertical motion of the waves.



Harnessing Sea Power

By H. W. Neale

The floats are constrained to travel in a vertical direction only and each is tied into a separate circuit of steel wire rope at each side of the flat. The shape of the circuit is determined by wheels and pulleys placed at suitable locations, the purpose of which is to change the direction of motion of the rope strands.

One-way Clutch

The wheels and pulleys shown near the roof in the sketch operate in pairs in order to cope with the forward and return strands in the rope circuit. A single pulley on each side is anchored to the sea bed. The upper pair of pulleys on the left run freely on a stationary shaft, since they rotate in opposite directions. The upper pair of driving wheels on the right also rotate in opposite directions but each of them has a one-way clutch housed in its hub. These are keyed to a driving shaft which passes through them, the shaft being made common to all the floats in series.

The floats would be arranged approximately parallel to the seashore in order to meet the incoming waves broadside on and would be shaped more or less like a shallow box and lid. An axle would be attached to each side of a float and each would be made to slide up and down in a steel vertical channel embedded in the masonry of the piers, they would thus be prevented from horizontal motion.

In the rope circuit a pair of loops would be included which would be slipped over the axles, the float would consequently be tied into the rope circuit.

Starting at the axles, the strands would extend upwards and downwards in front and on each side of the float. The left-hand strand in front would descend and pass round the pulley anchored to the sea-bed to the rear, it would then ascend through the floor of the engine house to the *rear* pulley of the pair on the left near the roof. It would then pass over to the right side to the front driving wheel, then descend through the *front* to the axle on the right side of the flat. Meanwhile the front strand on the left would rise to the *front* pulley above, it would then cross over to the *rear* driving wheel on the right, then descend through the floor past the right side of float down to the pulley anchored in the sea bed round which it would pass, then upwards to the right axle. Evidently this arrangement will cause the strands above to cross in passing from side to side, consequently the rise or fall of the float would cause the pull in the strands on each side to be equal and in the same direction and the same applies to all the floats in the series.

The Driving Wheels

By following the direction of the arrows in the drawing it will be seen that a wheel in each pair of driving wheels on the shaft rotates always in the opposite direction to the other. Consequently the one-way clutch housed in one driving wheel will be driving, while the other is free wheeling and vice-versa. This causes uni-directional rotation of the shaft regardless of whether the motion of the float is up or down. From this it follows that the downward stroke as well as the upstroke of the float will contribute to the rotary output of the shaft. Consequently the latter could be put to useful purposes such as driving a dynamo, air compressor or water pump, etc.

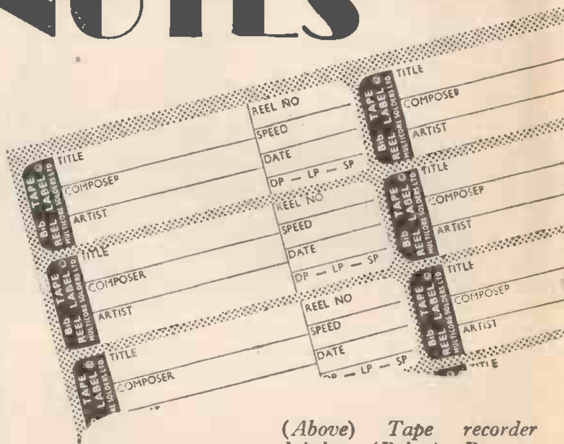
Coupling two adjacent floats could be accomplished by means of a number of broad strips of some resilient material such as rubber. This arrangement would act as a barrier to the passage of water up between the floats, the result would be that the floats in series would act like a blanket under which the waves would force their way. They would also suffer a reduction in size due to the compression caused by the floats, but since water is incompressible the tendency of the waves would be to expand. This would be resisted by the parallel sides of the piers, resulting in further acceleration of the speed of the waves.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

New Labels for Tape Recorder Enthusiasts

MULTICORE Solders Limited, of Maylands Avenue, Hemel Hempstead, have recently placed on the market a new Bib tape accessory. It is a self adhesive label for titling and identifying reels of recorded tape. An attractive two colour packet contains 24 printed labels mounted on a backing sheet so that the labels may be peeled off and used as required. The actual labels are shown on the right. The retail price is 2s. 6d. per packet.



(Above) Tape recorder labels. (Below) Bassett-Lowke "Trainsmaster."

New All-Purpose Lubricant

"LUBRI-JEL" is a new kind of jelly-lubricant that comes in a tube. Clear, clean to use, it is immune to rain or sea-water. Lubri-Jel is ideal for preventing rust and corosion forming on metal parts when laying-up motor-cycles or lawn-mowers, etc., for the winter. It can be used for lubricating locks, hinges and many other things. Lubri-Jel contains silicones, and therefore protects as well as lubricates. It costs 2s. 6d. from hardware stores, bicycle shops and motor accessory stores.

Trainsmaster 622

THIS is the only power control system designed exclusively for model railways. In use it gives the operator complete separate command of two trains at any time over a track divided into six control areas. Because of its extensive control range, Trainsmaster can be applied to any known 12-volt D.C. system and will ensure a maximum performance, irrespective of the individual motor efficiency. Each unit is supplied with a complete instruction sheet, with track diagrams illustrated in colour, showing clearly the method of applying Trainsmaster control to all the English proprietary systems in 'O' and 'OO' gauge, and with sufficient detailed and illustrated information to ensure that the newcomer to the hobby, without previous electrical instruction, could apply the six-area control to any layout. Trainsmaster 622 carries a 12 month guarantee, costs £9 9s. and is manufactured by Bassett-Lowke Ltd., of 18-25 Kingswell Street, Northampton.

(Left) B. & D. Modern Homes Kit. (Below) The Pano Map Rail.

Modern Homes Kit

SHOWN in the photograph on the right is Black and Decker's kit designed especially for the householder to aid him in those never ending odd jobs. It contains the D500 ¼in. drill, portable saw attachment, wire cup brush (rust removing, etc.), moulded rubber pad with sanding discs and lambswool bonnet. The price is £12 10s.

The "Pano" Map Rail

GEORGE Philip and Son Limited have obtained the agency for the "Pano" map rail. This is a suspension rail of light weight, made of aluminium and plastic, obtainable in lengths of 48in. It is attractively designed in a modern manner for hanging photographs, pictures, charts, etc., for display. A great advantage is that the wall is not damaged by the use of drawing-pins, adhesives, etc. Obtainable from 30-32 Fleet Street, London, E.C.4, it costs 37s. 6d. for a 48in. length. Packing and carriage is 3s. extra.

LETTERS TO *The Editor*

The Editor does not necessarily agree with the opinions expressed by correspondents

Steam Cars

SIR,—In your July issue there is a report of a very successful steam car actually on the road in America. To me this is great news, having seen, although not owned or driven, these fascinating vehicles and being for many years a regular reader of Bolsolver Bros. *Steam Car*.

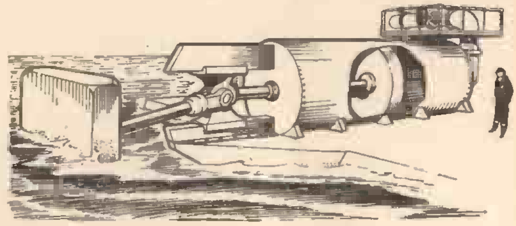
One often hears reports of steam cars, but no further development seems to take place and one wonders whether they are swallowed by the " Mighty Internal Combustion Monster " before they can get into production. As overproduction due to the inevitable saturation of the car market approaches, something new and attractive like a modern steam car might help to stimulate the market rather than depress it. Once the public experience the silent, smooth, elastic power of steam, they would soon become converted.—K. E. BURCA (Kent).

Power from Sea Waves

SIR,—Your Letchworth correspondent in the October issue proposes a rise and fall mechanism, but this is fundamentally contrary to the facts. Wave motion is circular, not up and down, and, in fact includes as much back and forward movement as the former. Additionally, the tides rising and falling add to the problem.

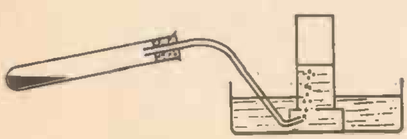
I consider that a mechanism similar to a " cylinder-to-wheel " transmission, in reverse, would be better adapted to pick up the power (see sketch). The resulting pressure and suction would need adapting to useful purposes, by means of valves, or it could work a horizontal rack and pinion.—A. H. POULTON (Norfolk).

(*See also " Harnessing Sea Power," page* 149.—*Ed.*)



Preparation of Oxygen

SIR,—We feel obliged to draw your attention to an error in your issue dated September 1960. The cover picture and diagram (Fig. 1, p. 540) of apparatus to prepare oxygen show a test tube with oxygen mixture, held at an incorrect angle. When this mixture melts there is every possibility of it sealing up the glass delivery tube with explosive results. Comments in the text that " the tube is tilted to stop water running back and cracking it " are not valid: no water is given off in this reaction. Finally, " the apparatus, typical of many a text book," has not been found in any book we have looked up. The angle of the tube should be as in the diagram below. Should the apparatus be set up as you suggest we can visualise serious accidents.—S. HEIGHTON, R. E. THORNTON, D.Phil (Oxon.).



The preparation of oxygen using potassium chlorate has always been accompanied with some possibility of accident if the manipulation is not carried out carefully.

Mr. E. V. King, Grade B Head of Science Dept. in a school of 655 pupils tells us that his third year pupils (14 years of age) all perform this experiment in groups of four (six groups in all), at one time. A demonstration is carried out first of all and warning given of the necessary precautions. The school concerned is noted in Surrey for the practical nature of the Science Dept. and teachers from other schools are sent by the County Inspectors to view the methods used. Not one single case of accident of an explosive or dangerous nature has ever taken place and in the example given (Prep. of Oxygen) the tube has always had a slight downward slope.

While water is not formed chemically in the reaction, if the Pot. Chlorate and Manganese Dioxide are not kept in ideal conditions they do absorb water. This can be proved by weighing before and after drying at a low temperature. At the same time, however careful and explicit one is, some experimenters will use wet or damp tubes. If the mixture is made up correctly the oxygen is given off before liquifaction takes place.

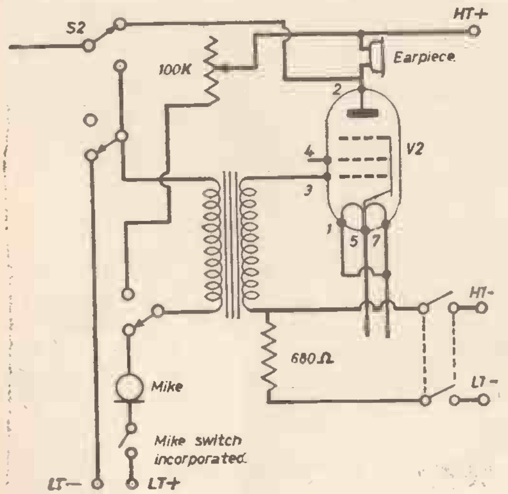
In this, and similar experiments such as the preparation of Ammonia from Ammonium Chloride and Slaked Lime there is always the possibility of a " plug " of powder sliding up or down the tube and blocking the delivery tube. This possibility is referred to in the text.

The use of impure Manganese Dioxide has been found to be the cause of many accidents in the Oxygen experiment. This matter has now been put right by the manufacturers of chemicals supplied to schools. The dioxide used for pottery work, etc., is not suitable.

Mr. E. V. King admits that most text books do give the tube a horizontal or backward slope. This does not necessarily mean the downward slope is not best, provided *the precautions he mentioned in the text are observed.*—ED.

10-Metre Walkie Talkie

SIR,—It may be of interest to P.M. readers who would like to construct the 10-metre Walkie Talkie published in the January 1960 issue that one need not make any alteration to the transformer if wired as shown below. The switch should be a 4-pole rotary and it is possible still to use a 3v. drive to the mike if required.—W. A. HARTLEY (Solihull).



A PIN TABLE BAGATELLE

(*Concluded from page 143*)

Finishing

Three 1in. dia. dowels are glued into the holes drilled in the support frame to make the legs. Front leg is 24in. long while the back ones are 25in. Dowels should be a tight fit before gluing then it will not be necessary to cross-pin them in the holes. Fit the leg ends with rubber feet as an anti-slip device.

Saw the letters ORBIT out of ¼in. ply after marking them 3in. high on the wood. Mount them half way off, half way on to the rim of the discarded plywood semi-circle left aside for making the headboard (Fig. 9). Saw out the plywood space-rocket motif from a piece of ply 6in. × 2½in. and glue this to the headboard too.

Complete the painting as follows:

Outer table frame red. Mask-top red. Headboard light blue with red and silver letters and silver rocket. Table legs blue.

In operation, a moderate spring tension on the striker should propel a ball onto the spring bounce and back in a loop halfway across the board's width. Cut a series of small cross notches on top of the ball guide to act as a tension scale and provide an indication of where the ball will go.

Built to the given instructions the table surface will have an inclination of 1in. from top to bottom—ample for a steady ball play. Adjust the angle of the spring bounce by further bending to obtain a good rebound if necessary and always ensure that the table is true i.e. on a good flat surface.

Anything over a 100 is good while 150 is excellent.

Hydrochloric Acid

SIR,—In answer to the query about removing scale from a kettle (September issue), you recommended the use of hydrochloric acid. Whilst I agree with the advice given, I cannot help feeling that you did not give sufficient emphasis to the fact that this chemical is very corrosive and poisonous and great care must be taken to avoid its contact with the skin. The kettle should also be thoroughly rinsed out with water several times before being used.—J. HENDRY (Caithness).

Battery-operated Fairy Lights

(*Concluded from page 117*)

star points, using nail varnish. Every other bulb was finished red and the ones between were done pearl. A single coat of varnish coloured the bulbs most effectively.

Finally, the fairy light string was completed by turning up all the points of the star collars and testing with a battery.

Making the Battery Box

The overall dimensions of the box are 5in. square × 2½in. high (Fig. 6); ⅜in. thick plywood was used throughout and the assembly was by glue and panel pins. It is important to have all the box edges well squared off when using this method of jointing.

One end of the base had a flush fitting door as shown, and this door is hinged via two small butts. A hook and eye catch retains the door in the shut position.

Before the box top is finally glued home, it is best to mount the Christmas tree to its centre by means of glue and a single 2in. woodscrew put through from the underside. Then the box is completed with the tree permanently mounted to its upper face.

Two $\frac{5}{16}$in. holes are drilled through the box for the fairy light wires. One hole is through the top and the other to bring the wires into the switch on the side of the box. Mount the small, low voltage switch over the hole after joining in the two wires as shown. The circuit is quite simple; one end of the fairy light flex goes directly to the battery terminal but the other wire is cut and tapped into the switch prior to connection with the other battery terminal. Solder two terminal ends to the battery wires and these can be trapped under the screw terminal connections of the bell battery.

The fairy lights are fastened to the tree branches by green thread, starting at the top and weaving the flex from one side to the other. Cover the base box with coloured paper and stick silver paper stars round the sides. Finish off with a layer of cottonwool snow.

YOU WILL NEED

	Cost
2 yd. of green plastic twin flex	8d.
12 flashlamp bulbs, 3·5V.	3s. od.
Solder and Insulation Tape	6d.
Silver Foil and Cardboard Discs	
Small Switch	1s. 6d.
Plywood: ⅜in. thick	1s. 6d.
2 pieces 5in. × 5in.	
2 pieces 5in. × 1⅞in.	
2 pieces 4¼in. × 1⅞in.	
Pair of small hinges, hook catch	1s. od.
4½V. dry-cell bell-battery	2s. 9d.

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

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156 St. John's Hill, S.W.11. Bat. 9838.

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FOR SALE (*Continued*)

ASTRO TELESCOPE MAKING.—Standard Ramsden Push-in Eyepieces, ¼in., ½in., ⅔in., focus, 35/-, with R.A.S. thread, 42/6 ea. S.A.E. list, Object Glasses, Newtonian Mirrors, Diagonal Mounts, Focusing Mounts, Tripods, Mountings and Terrestrial Telescopes.—W. Burnet, Grand Sluice, Boston, Lincs.

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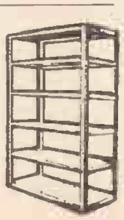

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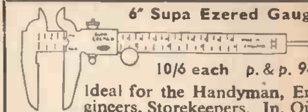

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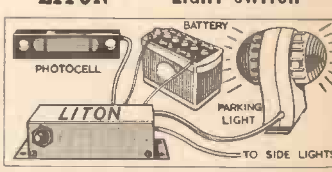

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(*Continued on page 159*)

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 this 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.

Transparent Glass Adhesive

I AM planning to paint the name of my house on a piece of glass and then stick another piece over the first to protect the name from the weather. Can you recommend an adhesive which is both transparent and durable?—T. F. Bird (Notts).

OBTAIN from Vinyl Products, Ltd., Butter Hill, Carshalton, Surrey, about one pint of a toluene solution of polybutyl methacrylate. This is a clear liquid which dries to a clear, transparent film. It is quite insoluble in water. It should be brushed or sprayed over the one glass surface, and the other surface gently brought into contact with it, care being taken to exclude the formation of air bubbles. The two glass sheets should be put away flat under slight pressure for three or four days. During this time, the solution will set into a clear film and will firmly cement the two glasses together. This solution has the advantage of not being affected by the weather. Alternatively, you could use any clear cellulose lacquer for the same purpose, but it would not be weatherproof round the edges.

Master Dimmer for Stage Lighting

WE are considering fitting a master dimmer to our stage switchboard (maximum load 7-8 kW). Rod elements for electric fires have been suggested to provide the resistance. Would these be satisfactory and can you suggest a suitable arrangement?—A. F. Taverner (Northampton).

YOU could use 1,000W. rod elements, each connected in series with a tumbler switch, all these elements being arranged so that they are connected in parallel with each other when the switches are closed, and in series with the lights. A 30A. switch should be connected in parallel with the elements and switches so that these can be completely short circuited when maximum brilliance is required.

With this arrangement you will, however, require a large number of elements to bring the lights up to full strength gradually. For instance if you use 24 elements in parallel on a load of 8kW. the voltage applied to the lights will only be about 75 per cent. of maximum with all the elements in use. For a given degree of control you could use fewer elements if, say, the first eight elements were rated for your mains voltage and the remaining elements rated for about half the mains voltage. Elements could be altered for half voltage rating by connecting both ends of each element to one terminal, and connecting the other terminal to a clip which makes good contact with the element wire in the centre of the element.

Burglar Alarm

IS there a type of burglar alarm contact which can be used on sash type windows and would not come into action until the window was opened more than about 9in.?—R. Hale (Dublin).

THIS problem could be solved by fitting in the window frame a micro switch which closes its contacts when the window is opened by more than the required amount. Assuming that the lower window is in the inner track you could fit a normally-open switch in the track of this window about 8in. above the top of the window when closed, or a normally-closed switch in the track of the window about 9in. from the bottom of the track. A normally-closed switch could be fitted in the track of the top (outer) window about 9in. from the top of the track.

The Burgess micro switch can be used for either purpose (Switch reference BRL). These are obtainable from Burgess Products Co., Micro Switch Division, Dukes Way, Team Valley, Gateshead 11.

Repolishing a Table Top

I RECENTLY bought a second hand gate-leg table and have removed the existing badly scratched cellulose and smoothed the whole top surface down to the bare wood. I applied wood stain and wax floor polish and obtained a pleasing finish (I dislike a high gloss) but there seems to be no resistance to heat; rings form almost immediately, even when cork mats are used. Can you help me please?—J. H. Duddell (Chelmsford).

ALL wax polishes and oil polishes are damp-resisting, but they will not resist heat effects. The only way in which you can get a heat-resisting surface is to use a synthetic-resin lacquer, as, for example, a bakelite lacquer (Bakelite, Ltd., 18 Grosvenor Gardens, London, S.W.1.), but this will tend to give the gloss which you dislike.

Assuming that you are satisfied with the present colour of the table top, there is no need to sandpaper it again. Dissolve one part of caustic soda in eight parts of warm water, mop on to the woodwork and then scrub it. The stain and polish can be then wiped away with a damp rag. Subsequently, the wood surface should be scrubbed with soap and water, and finally wiped over with strong vinegar in order to neutralise any trace of alkalinity remaining. A wipe with a damp cloth will finish the job, and the wood should then be allowed to dry out. The table should then be restained with an oak stain dissolved in methylated spirits. Two coats of stain can be given if the first is not intense enough. After the stain has dried out, rub raw linseed oil thoroughly and sparingly into the wood surface. Allow it to remain for three days, then, wipe it off, and apply a good wax polish. The surface will mark under heat influence, but the marks will usually disappear quite readily under further polishing. Further raw linseed oil can be applied sparingly from time to time.

Household floor polish is not suitable for this purpose. It is too soft, and is apt to heat-mark very badly. Any good wax polish specially prepared for furniture use will be suitable. Or, if you prefer, you can make up an excellent wax polish for yourself on the the lines given in reply to the next query.

Wax Polish for the Home Carpenter

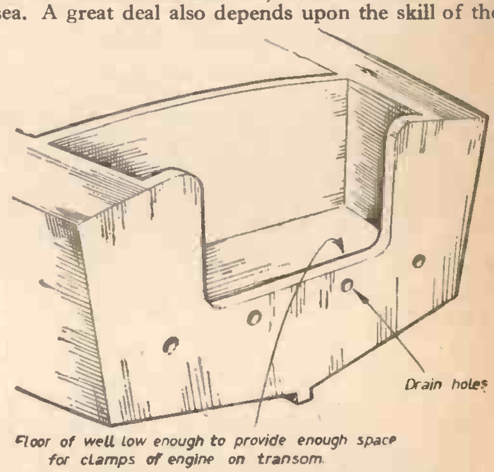
MY hobby is carpentry and most of the things I make are wax polished. Could you give me a formula for making my own polish?—V. Boyle (Crewe).

BY following the instructions below you can make a polish which will not fingermark and which is highly resistant to heat marking. Gently melt together equal parts of prime yellow Carnauba wax and refined beeswax. The mass of mixed wax thus obtained is gently melted, and to 30 parts of the molten wax thus obtained, 70 parts of white spirit are slowly stirred in, together with a few drops of perfume, such as pine oil or pine essence. The whole mass is well stirred and then poured into suitable tins or containers in which it is allowed to cool down. The product is used sparingly. It gives brilliant results, and marking troubles are reduced to a minimum, since Carnauba wax is the hardest and the most resistant of the natural waxes. It can be obtained from any firm of laboratory suppliers.

The P.M. Cabin Cruiser

WE anticipate using the P.M. Cabin Cruiser (recently described in P.M.), for deep-sea fishing and wonder whether it is suitable for sea-going.—H. Wernecke (S. Africa).

THE P.M. Cabin Cruiser was originally designed for inland waterways, hence the hard chine form of construction. For a sea-going craft a round or semi-round chine form of design is more usual. Having made this point it can be said that providing the state of the sea is suitable, the boat can be taken to sea. A great deal also depends upon the skill of the navigator and readers must take the craft to sea at their own risk. For sea-going the transom must be fitted with a self-draining well around the opening for the outboard motor so that a following wave does not swamp the craft. (See illustration.)



Sea-going transom with self-draining well

D.C. Motor as Dynamo

I WISH to drive a mains voltage compound wound D.C. motor with an A.C. motor so as to produce D.C. Are any modifications necessary?—R. A. Ward (Berks).

ASSUMING the motor has not lost its residual magnetism it should function as a dynamo when driven in the same direction as it ran when motoring. In order that the terminal voltage as a dynamo shall be approximately the same as the rated voltage as a motor the machine should be driven at a slightly greater speed than the motoring speed. Once this condition has been obtained the connections to the series field winding of a compound machine should be reversed to give correct compounding as a dynamo.

If the machine is fitted with interpoles the brush position should need no alteration. Otherwise the brushes may require shifting slightly in the direction of rotation to give good commutation.

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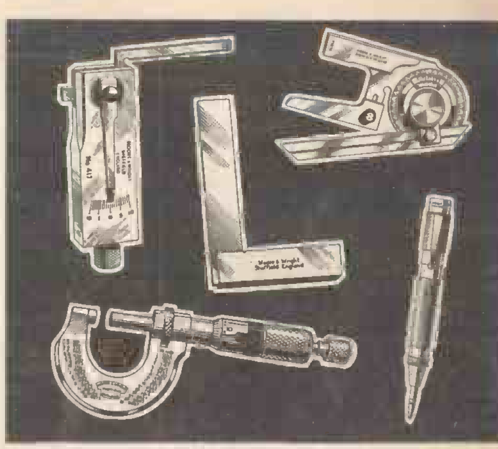

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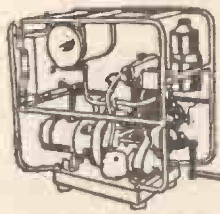

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GEAR PUMPS. Beautifully made. 5" x 5". 32/6. Post 3/-.

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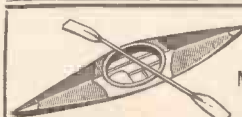

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