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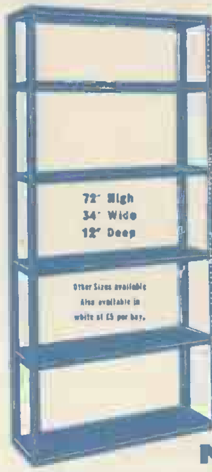

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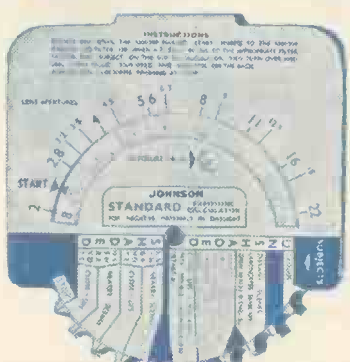

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CONTENTS

CONTRIBUTIONS

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

FAIR COMMENT

BRITISH STANDARDS INSTITUTION

ONE of our many young readers wrote to us recently and asked what a number meant when it was prefixed by the letters B.S. and applied to a material like steel. He mentioned that he had seen this many times applied to metals and thought it was a manufacturer's type number. When he saw the same prefix applied to marine plywood, he wondered a little but when it turned up again with reference to an interior sprung mattress, he thought it was time to get the whole business sorted out.

Many of our engineering readers will already know that this coding is the mark of the British Standards Institution and indicates that the product on which it is carried is made to a certain predetermined standard. It is not, however, merely an indication of quality.

By definition, the British Standards Institution is recognised by industry as well as the Government, as an organisation devoted to the preparation of standards, applicable throughout the whole of the U.K. and for the allocation, under licence, of certification marks, giving assurance of compliance with British Standards. These may be applied to dimensions, methods of use or codes of practice, terms and definitions, methods of testing and sampling and standards to permit assessment of fitness for purpose.

Viscount Hailsham, Lord President of the Council and Minister for Science, when opening the Seventh Standards Engineer's Conference recently, told delegates:

"An efficient economy requires standards—partly in order to achieve savings by the elimination of unnecessary variety and partly in order to reduce waste and danger by preventing the production of sub-standard goods.

"Opinions might differ as to how far and in what manner national standards should be compulsory," he went on. "Whatever view we take on this, it is clear that they cannot simply be imposed from without, whether by Government or by any other external force. They must result from discussion between representatives of the producer and the user; they must be a blend of scientific knowledge and industrial and commercial experience; and they must be expressed clearly and intelligibly."

Stressing the need to revise existing standards, as well as to produce new ones, Lord Hailsham said: "Old standards which have become obsolete are, or can be, as dangerous to industry as no standard at all. It is essential that our standards should be a real incentive to adopt what is best in current engineering practice and not a means of tolerating the mediocre or the worse than mediocre."

These comments on the aims and purpose of the B.S.I. give a very good idea of the work the body carries out and the point particularly worth emphasising is that standards are set only after considerable discussion between the B.S.I., the producer and the user.

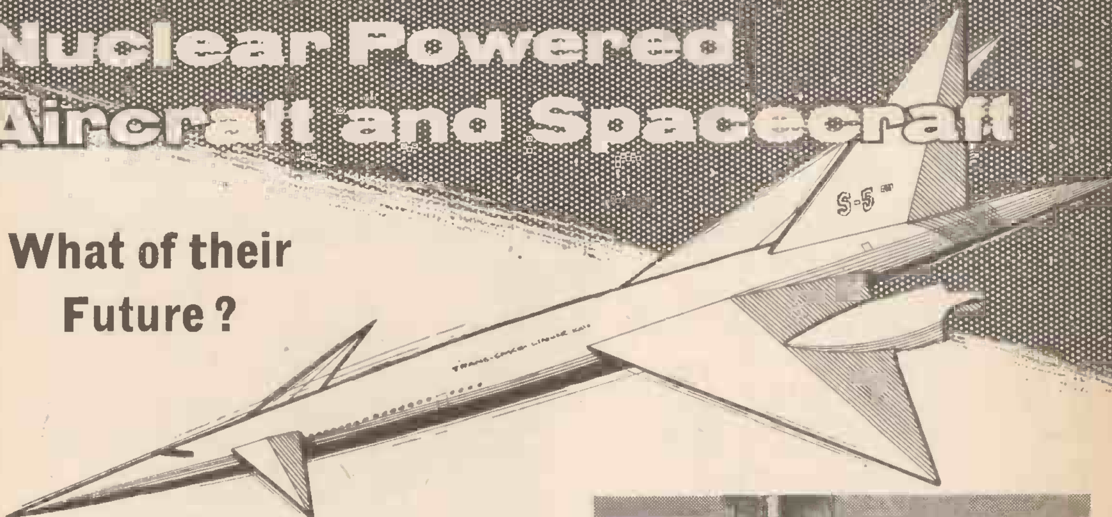
The conference was a lively one and the freedom with which the delegates commented on the work done by the Institution would seem to a guarantee that unrealistic standards will never be tolerated.

The conference served to underline the ever increasing interest of industry in standards and many useful conclusions were reached which may influence the future activities of the B.S.I. One of these emphasised the necessity to keep British Standards in line with international practice—a view which we heartily endorse, particularly having regard to Britain's possible future membership of the European Common Market.

The August, 1961, issue will be published on July 28th, 1961. Order it now!

Nuclear Powered Aircraft and Spacecraft

What of their Future?



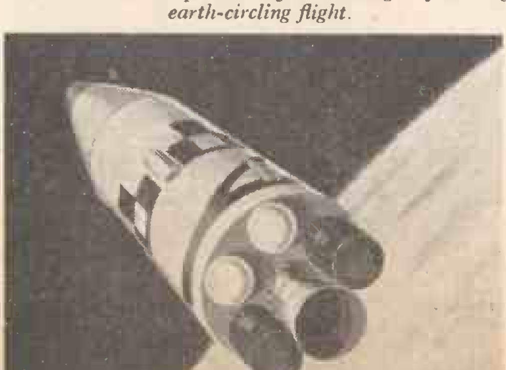
SINCE the end of World War II great advances have been made in the deployment of nuclear power for peaceful purposes. It is now being used on land, on sea and under the sea, but it has not so far made its début as a power plant for aircraft. The intensive study which has been put into the subject during the past ten years has, however, brought the day when the first nuclear-powered aircraft flies very much nearer. This will, of course, be a research aircraft and its design is already finalised. Its appearance can be seen from the cover design prepared by one of our artists and the aircraft will be known as the Convair NX-2. It has not yet been decided what type of nuclear power plant will be installed but the choice is likely to be between two types which are being developed in parallel; they are the General Electric direct-cycle and the Pratt and Whitney indirect cycle. The airframe requirements for these two plants are considerably at variance and the Convair NX-2 is therefore a very versatile compromise capable of flying with either or both power units.

The unusual configuration is designed to keep the crew space as far away from the power plant as possible as this helps to cut down the weight of shielding required and helps in isolating the reactor unit when installing and taking down. It is also possible with this configuration to install various types of power unit without modifying the basic aircraft.

The Biggest Problem

This is likely to be the matching of the nuclear engine to the airframe and a great number of critical

U.S. artist visualises a Discoverer type satellite with two SNAP-1-A generators attached to its blunt end. The two devices would provide 250W. during a year long earth-circling flight.



A technician prepares the SNAP 1-A atomic generator for electrical tests at The Martin Company in Baltimore. The odd-looking device, studded with caps marking the location of 277 thermocouples, is 34in. long and 24in. in dia.

During construction of SNAP 1-A, Martin Company technicians drill holes for thermocouples and channels for electrical connections in the device's insulation.

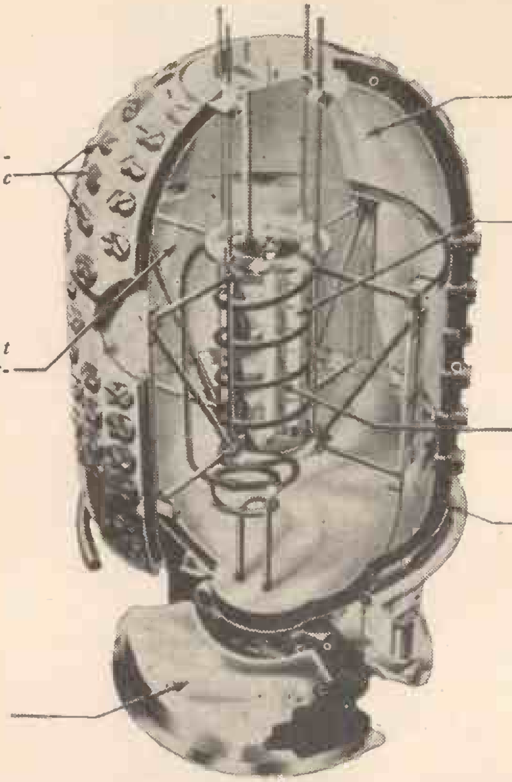
factors are at present under consideration. Such things as shielding weight, reactor wall temperature, free flow area ratio of the heat source, turbine inlet temperature, optimum altitude and component efficiency all have their effect.

Another point to be taken into account is the effect of radiation on components and materials. Oils and hydraulic fluids can take on a jelly consistency, glass can fog and tyres can harden until they shatter on impact like glass. These complications are, however, well on the way to being solved.

The Ultimate

The nuclear aircraft of the future is envisaged as being a high-altitude supersonic plane capable of flights lasting several days. Although it is fully realised that such an aircraft is still many years away, even in the form of a flying testbed like the NX-2, the U.S. Airforce is already conducting nuclear flight experiments in a special simulator.

The Convair NX-2 which is designed to be the first hesitant step towards a new generation of aircraft is already imprinted with a look of the future. How will it develop? Along the lines of the Lockheed supersonic liner sketched in the heading perhaps. Who knows? In ten years time, however, we should be well on the way to finding out.



A cutaway drawing of the SNAP 1-A atomic generator shows the outer thermocouple studded metal container and the device's inner construction. During the ground-handling prior to launching, the hollow interior of SNAP 1-A can be filled with liquid mercury, which acts as a radiation shield. The mercury would be drained out moments before lift-off to reduce weight.

Nuclear-powered Space Ships

In the field of space research too the atomic energy angle has not been neglected. Several new developments have been reported in the utilisation of atomic devices. The programme in which this work has been carried out is known as SNAP—Systems for Nuclear Auxiliary Power—and the aim is to select from several designs a power source sturdy enough to operate for at least a year without attention in the rigorous conditions of outer space. SNAP power is intended to be used in long-lived instrumented satellites to observe weather conditions and to send television programmes around the world; to transmit information from space to earth and eventually to aid interplanetary travel.

One device, SNAP 1-A is at present being tested. Heat emitted by a radioisotope is converted into 125W. of electric power inside an egg-shaped container 34in. long and 24in. dia., weighing 175lb. SNAP 1-A was designed and built by the Martin Company of Baltimore and, as can be seen from the photographs, 277 screwheaded caps of thermocouples stud its outer metal surface.

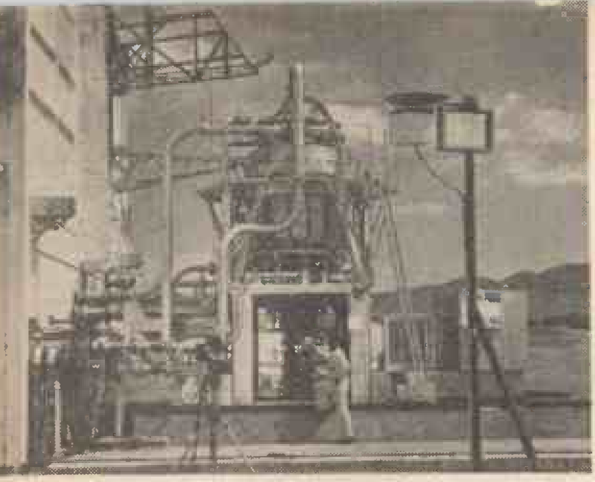
There are no moving parts inside the device. A capsule made from pellets of the radioisotope Cerium 144 is at the centre and this material decays slowly, producing heat which raises the temperature of the inner ends of the thermo-electric elements. The elements' outer ends remain cool and the difference in temperature between opposite ends produces a small electric current in each pair of thermocouples.

To prevent radiation escaping the Cerium 144 pellets are tightly sealed and insulated. If the satellite carrying rocket, due to some failure or miscalculation, did not reach orbital velocity, precautions have been taken to ensure that the radioisotope would not be released. After being successfully put into orbit, the fuel capsule is intended to burn up and be entirely destroyed on re-entry into the atmosphere.

During testing, the fuel capsule will not be installed inside the satellite until the rest of the system is known to be satisfactory. Liquid mercury will then be used to fill SNAP 1-A and act as a radiation shield during final ground handling tests prior to launching. The mercury will be drained off just before firing.

Generator output is kept constant by a special device. It is arranged at the beginning of the operation for the Cerium 144 to give off too much heat and for a temperature sensitive shutter to allow some of the heat to leak out. As the radioisotope decays and the heat it emits decreases, the shutter will close gradually, thus keeping the electricity output constant.

What are the advantages of the system over solar



A close-up of the U.S. Atomic Energy Commission's "Kiwi-A-Prime" nuclear reactor, the Commission's second reactor made to test the feasibility of nuclear propulsion for space vehicles.

cells? Well, firstly it operates independently of the sun and is able to produce power while in the shadow of the earth; it also is unaffected by the impact of micrometeorites. Additionally the chance of anything going wrong is reduced by there being no moving parts.

A Compact Reactor

In the same programme, another device—a compact reactor—is able to generate electricity without moving parts. This is SNAP-10. Tests are at present being carried out on a 7in. high and 7in. dia. experimental nuclear core for this reactor. It has a volume of ½ cu. ft. and weighs under 200lb. The firm responsible for designing and building the core are Atomics International and criticality was achieved about a year ago. Tests are continuing at an Atomic Energy Commission facility in the Santa Susana mountains in California.

A thermoelectric conversion device is included in the complete SNAP-10 system which generates some 300W. Heat from the reactor is passed through thermocouples surrounding the core. Excess heat passes on to the fins and thence by radiation into the atmosphere.

The fuel and moderator used in the experimental core is a homogeneous mixture of Uranium 235 and zirconium hydride. Beryllium heat conduction and reflector units are used. The device is divided into two identical units which are brought together by remote control to achieve a sustained chain reaction. Each of the halves is built up with alternate layers of fuel-moderator discs and circular conduction plates within a reflector.

A Larger Reactor

Thirty kilowatts of electricity continuously for about a year is the production schedule for a larger reactor, known as SNAP-8, being developed by Aerojet-General Corporation and Atomics International who are responsible for the conversion system and the reactor respectively. All-up weight, including reactor and shielding will be 1,500lb. and it is expected to be ready in about five years.

The major components of SNAP-10 include in addition to the reactor a heat-to-electricity conversion system similar to most electricity generating systems and including a boiler.

The reactor will heat a closed loop of liquid metal. This loop will pass through a boiler, through which a second loop containing mercury will also pass. Loop 1 will heat Loop 2, vaporising the mercury. In turn, the vaporised mercury will drive a turbine powering a generator which will produce electricity. After the mercury goes through the turbine it will be passed through a series of tubes forming a radiator several hundred square feet in area and the cooling effect will change the mercury from vapour back to liquid. The mercury will then continue through the closed loop under pressure to repeat the cycle.

After the launch of any SNAP device, the critical periods of flight will be over water and any falling nuclear device or components will be heavy enough to sink immediately. Since the materials have very low solubility in water and a high resistance to salt water corrosion, there should not be any appreciable solution in the sea until the activity level of the fuel and fission products is within acceptable limits.

The reactor will be shielded effectively to keep reactor radiation from damaging the system and the spacecraft around it.

A spacecraft weighing several tons will eventually house SNAP-8, the generating system being turned on after the ship achieves orbital velocity. A dual version, using a single reactor could eventually be sent up in a 15-ton Saturn-boosted spacecraft.

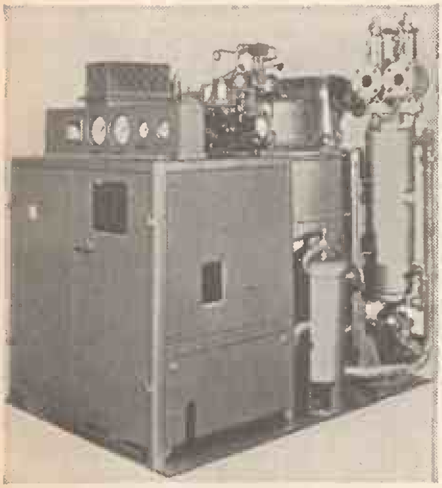
These are just two more uses being found for atomic energy. Will it, we wonder, ever completely replace conventional fuels?

A technician examining one half of the nuclear core of SNAP-10, a compact reactor to generate electricity for space vehicles. In test operations, which have already been carried out, the two halves of the core are brought together to attain nuclear fission.

SCIENCE NOTES

The Stone-Vapor Boiler

DESCRIBED by the makers as a forced circulation single pass coiled water tube boiler without drums or headers, this unit is the modern substitute for the conventional solid fuel boiler. It is compact and highly suitable for use on mobile equipment and widely used in industrial, marine and diesel locomotive installations all over the world. It is simple to install and is completely automatic in operation.



The Stone-Vapor boiler.

A three-cylinder positive displacement feed pump delivers water to several sets of coiled tubing, connected in series. A down-fired air atomised oil burner evaporates 90 per cent. of the water passing through the coils. Unevaporated water carries any scale forming sludge through the coils at high velocity into a steam separator where the carryover water and sludge settle out in a sump. Steam of over 99 per cent. quality flows out of the steam outlet non-return stop valve.

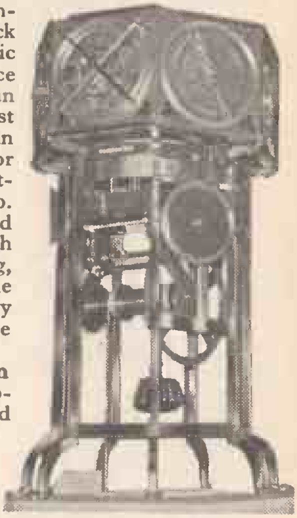
Further information is available from J. Stone and Co. (Deptford) Ltd., Arklow Road, London, S.E.14.

British Equipment in U.S. Space Research

WHEN Commander Alan Shepard returned from his trip into space, the task of locating his capsule was made easier by a piece of British equipment. This was used too in locating chimpanzee Ham and monkeys Able and Baker. The device is an Ultra SARAH beacon, a small radio transmitter of the type which has saved the lives of many airmen forced to land in the sea.

World's First Astronomical Clock

PROBABLY the most complex mechanical clock ever to be shown to the public was on view at the Science Museum recently. It is an exact copy of a clock first designed and built by John Dondi, an Italian Professor of Logic, Medicine and Astronomy, some 600 years ago. Dondi's clock, all in brass and bronze, silver and gilt, with finely cut teeth and gearing, was built at a time when the standard clock was of clumsy forged iron and built by the local blacksmith.



The astronomical clock.

The reproduction shown on the right was built by horological author H. Alan Lloyd in conjunction with the firm of Thwaites & Reed Ltd. The clock indicates the hour, continuous indication and recording of minutes, rising and setting of the sun, daily length of daylight, Dominical letter, fixed feasts of the Church, day of the month, annual calendar wheel, conversion of mean to sideral time, perpetual calendar for Easter, trajectories of the five planets, elliptical trajectory of the moon and dial of the nodes.

Deepest Well

THE Rasidpur-2 oil-well being drilled in the Sylhet district of Pakistan has reached a depth of 15,000ft. or nearly three miles. This is the deepest well ever drilled in the East.

New Anaesthetics Control

SHELL Laboratories and the Royal College of Surgeons have co-operated to produce equipment for analysing a patient's breath in half a minute, using the new technique of gas chromatography. Basically a minute sample of the mixture of gases to be analysed (patient's breath) is injected into one end of a long tube containing special chemicals and emerges at the other end as separated gases, which can be quickly identified and measured. The apparatus can be seen in the photograph below.

(Below) The new breath analysis apparatus.

Raising the

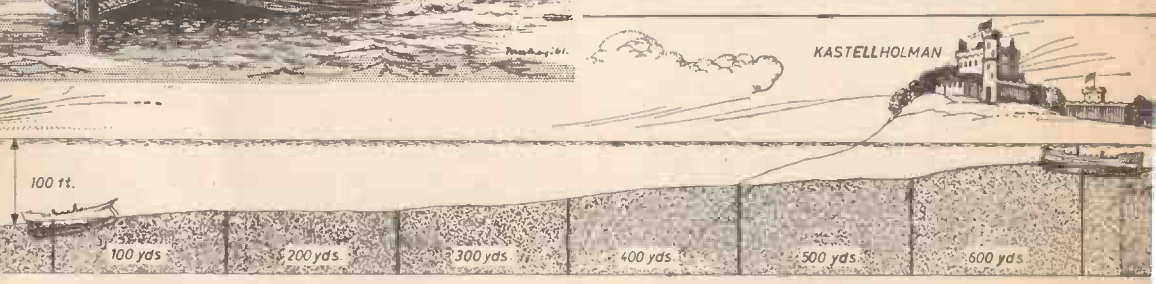
H.S.M.S. *Vasa* was built as part of a plan to strengthen the Swedish navy by order of King Gustavus Adolphus. She was probably launched in 1627 at the Royal Dockyard which was then situated opposite the Royal Palace. Her armament was formidable and comprised 64 cannon, of which 48 were 24-pounders, eight 3-pounders, two 1-pounders and six mortars. They were all bronze and had a total weight of about 80 tons. She probably had a crew of about 130 and a detachment of about 300 soldiers. Although there are no drawings available, she probably resembled the vessel drawn in Fig. 1.

On August 10th, 1628, with all her arms, ballast, stores and crew aboard she lay at the waterside Royal Palace ready to begin her maiden voyage. It was a Sunday afternoon, sunny, with a light breeze blowing from SSW. She was warped from her berth and moved slowly downstream, her sails were set and a crowd, which had turned out to see Sweden's mightiest warship, cheered her on her way.

Off the isle of Beckholmen in the harbour a sudden

Fig. 1 (Left).—" Stora Kronan," built in Stockholm in 1668, will give an impression of " Vasa's " original appearance.

Fig. 2 (Below).—The journey to shallower water.



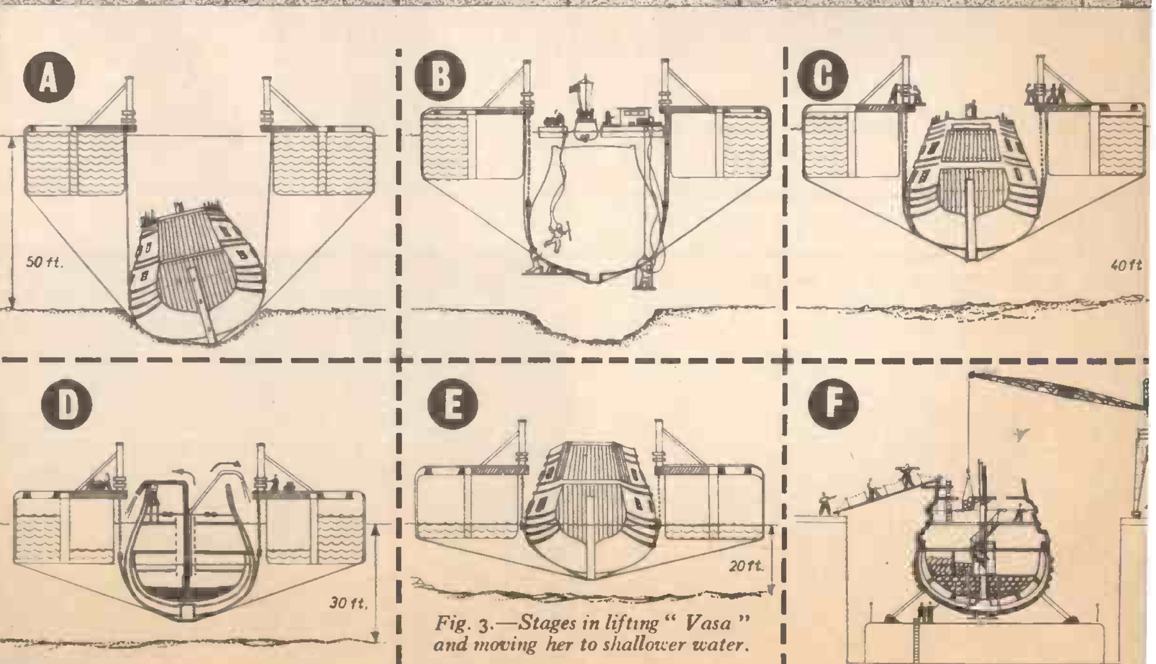


Fig. 3.—Stages in lifting " Vasa " and moving her to shallower water.

'VASA'

squall hit the *Vasa* and she heeled over to port. The wind was not strong enough to pull the sheets through their blocks and the captain ordered all cannon to be hauled to windward to counter the list. But it was too late. The lower cannon ports, which were open, dipped below the surface, the sea flooded in and the *Vasa* sank.

A Court of Enquiry set up later did not blame either captain or crew and general opinion seems to have been that the ship was well built but unstable. Her hull was too narrow and her bottom too sharp and there was not enough room for ballast. Had there been more room, however, the extra weight of ballast would have brought the lower gun-ports below the water level, so it would definitely seem that the design was at fault.

Attempts at salvage followed immediately and although most of the guns were eventually brought to the surface, all attempts to raise the *Vasa* failed, although an English engineer did manage to put her on an even keel. Finally all attempts at salvage were abandoned.

The Wreck Discovered

An amateur marine archeologist, Mr. A. Franzen, began looking for the *Vasa* in 1954 and two years later he was still searching. Then one day he fished up a piece of blackened oak. He contacted the Naval Diving School and a few weeks later master diver

Fig. 6.—One of the Flygt submersible pumps being lowered into place.

Edvin Falting found himself standing beside the looming black hull of the *Vasa*.

She was reported to be lying on an even keel in 110ft. of water in a well protected part of the harbour. A committee was formed which, in 1958, recommended that an attempt at salvage be made. Support was quickly received from H.M. King Gustaf Adolf and the Wallenberg Foundation. The Neptune Salvage Company offered to do the lifting free of charge and the Navy decided to incorporate the underwater work into its training scheme for divers. Interest was widespread as the salvage of the *Vasa* would provide an immense fund of knowledge about the construction

(*Concluded on page 499*)

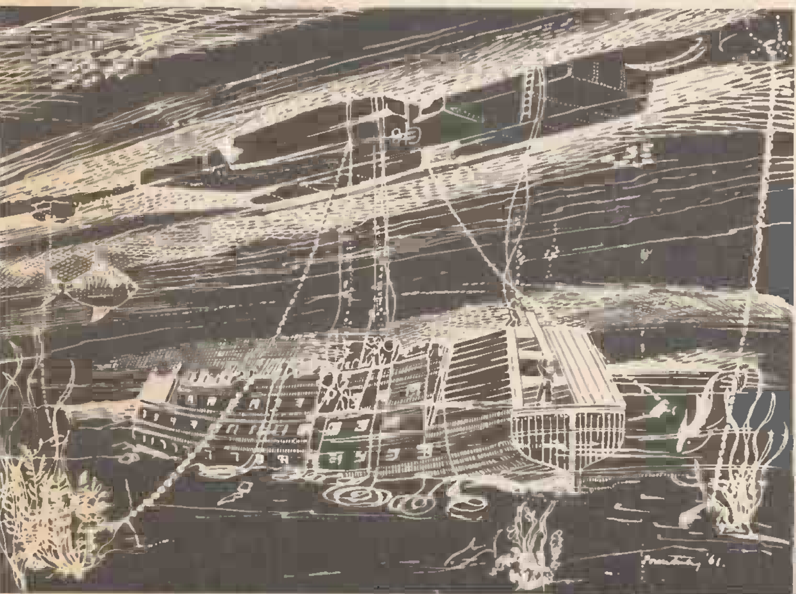


Fig. 4 (Left).—An artist's impression of divers strengthening the hull.

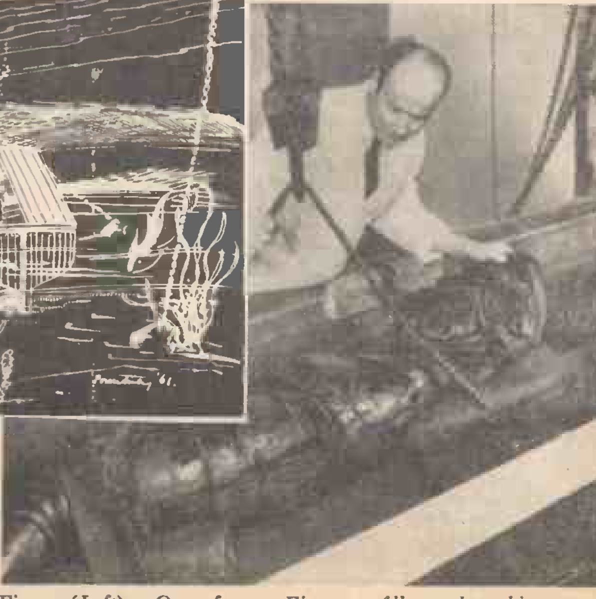


Fig. 5 (Left).—One of the many fine pieces of carving salvaged being inspected by Chief Diver Per Edvin Falting.

Fig. 7.—All wooden objects are being preserved with etylenpolyglykol, a soluble wax-like substance which replaces water in the wood and prevents cracking.

L.B.S.C's 3½in. Gauge

EVENING STAR

Part 5 Quartering the Wheels and Building the Pony Truck

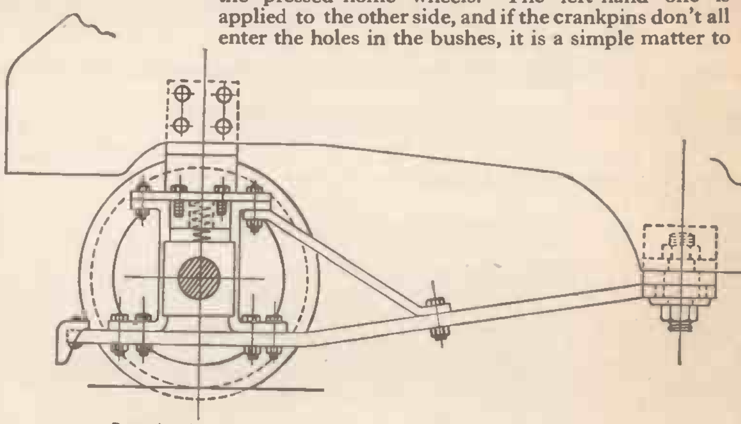
THE crankpins on one side of the engine are set at right angles to those on the other—known as "quartering" in the railway shops—and those on the right-hand side should lead. That is, when they are on front centre, nearest to the front of the engine, those on the left side should be at the highest point of revolution, or top centre. Various folk have devised weird and wonderful gadgets for setting the pins correctly, but there isn't the slightest need for them. All you require are a scribing-block or surface gauge, a try-square, and a "straight eye." The way to use them is shown in Fig. 24.

The driving wheel on one side should be already pressed on the axle, as mentioned previously. Push the axle through the axleboxes, and put the other driving wheel on the axle as far as it will go without pressing, setting the crankpins as near to right angles as you can get them "by eye." Take out the hornstay screws, lift out the whole assembly, and stand it on something dead flat and true. I use a surface plate, but the lathe bed, or the saddle, would do. Put a short piece of $\frac{1}{16}$in. silver-steel, or a drill shank (anything straight will do) in the oil duct, letting it project so that its end is level with the end of the crankpin. Fix up the wheels so that they can't roll; a block of wood or metal at each side would do the trick, or you could rest the axle in the groove of a vee-block.

Now set the pressed-on wheel with its crank on bottom centre. Test with the try-square as shown; the edge of the blade should pass exactly across the middle of the crankpin and the bit of steel in the oil duct. Set the needle of the scribing-block to the centre of the axle, tighten the screws so that the needle can't accidentally shift, then apply it to the other crankpin, adjusting the wheel on the axle to bring the centre of the crankpin to coincide with the point of the needle. That is all there is to it. When the two wheels are set as shown in Fig. 24 they are correctly quartered, and the second one can be pressed home.

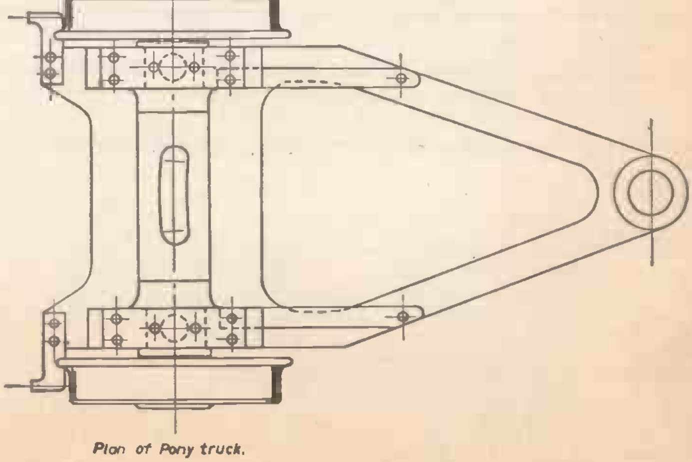
Nothing to be alarmed at in that job, is there? assembly can then be put back in the frame. The

Inspector Meticulous would probably tell you to set the other four pairs of wheels in the same way, but I know a trick worth two of that. I just push the axles through their respective boxes from the right-hand side, one wheel being pressed on each, and put the remaining wheels on as far as they will go without pressing. The pump and lubricator eccentrics are put on their respective axles as they are pushed through the boxes. All the crankpins are set as near as possible to right angles "by eye." The right-hand coupling-rod is then placed over the crankpins on the pressed-home wheels. The left-hand one is applied to the other side, and if the crankpins don't all enter the holes in the bushes, it is a simple matter to



Pony truck erected.

Fig. 25.—Side, plan and front views of the assembled pony truck.



Plan of Pony truck.

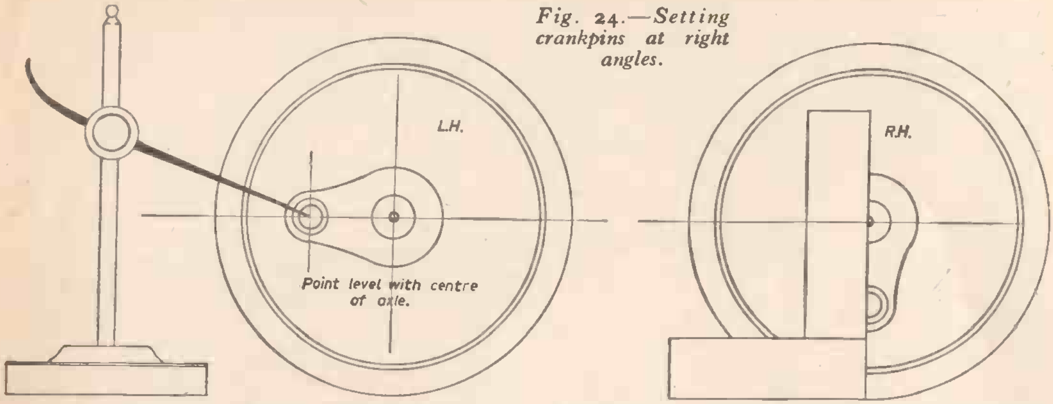
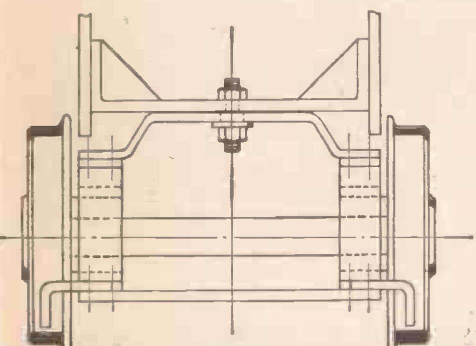


Fig. 24.—Setting crankpins at right angles.

adjust the wheels until they do. When both rods are on, and the wheels turn freely without binding anywhere, the rest of the wheels can be pressed right home.

The rods can then be erected, the first and second bosses being prevented from coming off by washers in the recesses, secured by $\frac{1}{8}$in. or 5 BA countersunk screws. To make the washers, chuck a piece of $\frac{1}{2}$in. round mild steel, face, centre, drill No. 30 to about $\frac{1}{4}$in. depth, countersink with No. 2 drill, and part off a $\frac{1}{16}$in. slice. The fourth and fifth bosses only need commercial nuts and washers. The driving bosses require no fixing, as the big-ends of the connecting-rods prevent them straying. Note—all the bushes



Front elevation.

must be quite free on the pins; on tight places anywhere. The whole ten wheels should spin freely by just turning the driving crankpin by hand, with the wheels off the bench, and the axleboxes in running position with bits of $\frac{1}{8}$in. square rod between axleboxes and hornstays.

The Pony Truck

The pony truck on the full-size engine is a complicated box of tricks consisting of bars, plates, brackets, angles and what-have-you, secured by a multitude of bolts and nuts. It would be hopeless to reproduce it as a working proposition in $3\frac{1}{2}$in. gauge; so what I have done is to scheme out a simpler arrangement which bears a family likeness to its big relation, but which is easy to construct, and will stand up to the job; see Fig. 25. It consists of a steel frame on which the horns are mounted; these are bent from steel strip, and held in place by a cross-bearer at the top. Ordinary axleboxes with overhead springs are fitted to the horns. No side-control springs are needed as the friction between the cross-bearer and the underside of the bolster prevents " hunting " at speed on a straight road, while allowing ample freedom to slide sideways on curves. As big sister's pony simply bristles with nuts and bolts, I've shown the little pony with similar adornments; but if I build the engine myself (I live in hopes!) I shall either use iron rivets, or get busy with my old friends the oxy-acetylene torch and a Sifbronze rod.

Making the Frame

A piece of $\frac{1}{8}$in. mild steel plate $6\frac{7}{8}$in. long and $3\frac{1}{8}$in. wide is needed for the baseplate or frame. Mark it out to the dimensions shown in Fig. 26, and saw and file to outline. The triangular hole can be cut by drilling holes all around, breaking out the piece, and cleaning with a file, or it can be cut out with a piercing-saw (glorified fretsaw) in the same way as a kiddy cuts out the bits of a jigsaw puzzle. That useful tool known as an Abrafile will also make short work of it. As a matter of fact, the hole needn't be cut at all by anybody who doesn't worry about appearance. To bend the frame, grip it in the vice at the places indicated, and hit the projecting part with a mallet, or what railway shopmen call a " bacon-rind hammer "; that is, one with hide insets at each end of the head. I always use one, as it leaves no mark on the work. Drill a $\frac{9}{16}$in. hole at the apex, and fit a bronze bush to it as shown. After bushing the coupling-rods, you won't need detailed instructions for *that* little job!

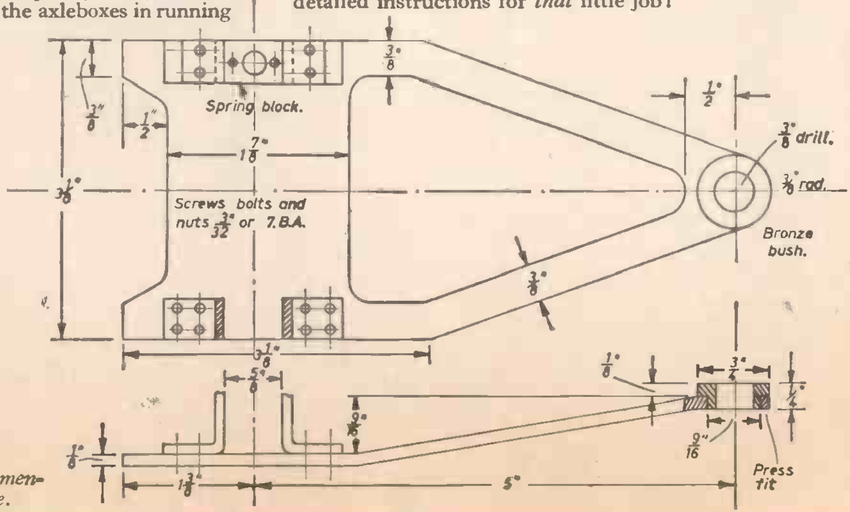


Fig. 26.—Details and dimensions of the pony frame.

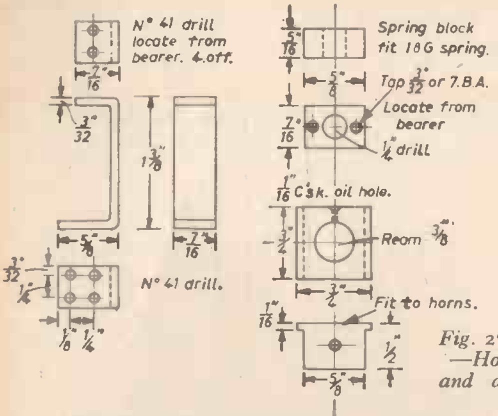


Fig. 27 (left).—Horncheek and axlebox.

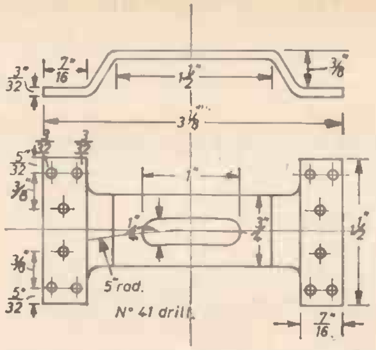
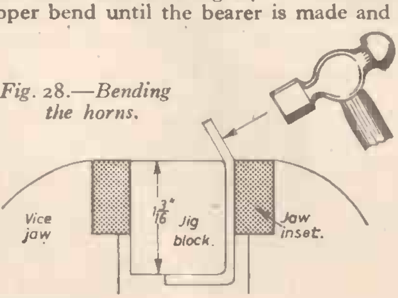


Fig. 29 (left).—Details and dimensions of the pony bearer.

The Horncheeks

Four $2\frac{1}{2}$in. lengths of $\frac{7}{16}$in. × $\frac{3}{32}$in. mild strip will be required for the horncheeks, shown in Fig. 27. Bend each at a right angle at $\frac{5}{8}$in. from one end; a job easily done in the bench vice. The second bend is made at $1\frac{3}{16}$in. from the first; and as all four must be exactly alike, bend them over a jig. This is just a piece of steel bar about $\frac{1}{2}$in. × 1in., and cut to the length mentioned. Take the sharp edge off the ends. Rest the jig on the lower bend, and grip in the bench vice as shown in Fig. 28. If the upper end is then beaten down on to the jig, the four horns will all be the same height, which is essential. Trim the upper bend to $\frac{7}{16}$in. length, and drill four No. 41 holes in the bottom bend as shown in Fig. 27. Leave the holes in the upper bend until the bearer is made and fitted.

Fig. 28.—Bending the horns.



The Axleboxes

These can be made either from drawn bronze or gunmetal bar of $\frac{1}{2}$in. × $\frac{3}{4}$in. section, or from cast bar. As they are machined up in exactly the same way as the main axleboxes, there is no need to go through the ritual again; but note from Fig. 27 that they have flanges on one side only. Take care to drill and ream the holes dead square with the faces.

Ordinary brass rod, or mild steel rod, of $\frac{5}{16}$in. × $\frac{7}{16}$in. section, can be used for the spring blocks. Grip the rod in the four-jaw chuck, and part off two $\frac{5}{8}$in. lengths. Drill a $\frac{1}{4}$in. hole through the middle of each, as shown.

The Bearer

This can be made from a piece of $1\frac{1}{2}$in. × $\frac{3}{32}$in. mild steel approximately $3\frac{3}{4}$in. long. Mark out as shown, in Fig. 29, then saw out the two side pieces to leave a $\frac{3}{4}$in. centre, after which the bearer can be bent to shape in the bench vice, using a bit of $\frac{3}{8}$in. square bar as a gauge to get both bends equal. Trim the ends to bring the overall width to $3\frac{1}{8}$in. and drill the No. 41 screwholes as shown. Be careful when marking out the curved slot; the radius of the centre-line should be struck out first, through the centre of the bearer, and then the slot can be marked off by lines at each side. To cut the slot, just drill a few $\frac{7}{32}$in. holes along the centre-line, run them into a slot with a round file, and finish to size with a half-round file. A piece of $\frac{1}{4}$in. round steel should slide easily from one end to the other. An exact fit doesn't matter, as the pony is controlled by the king pin; the slot merely limits the sideplay.

Wheels and Axle

The pony wheels are $2\frac{1}{4}$in. dia. on treads, with $\frac{1}{8}$in. flanges, and are turned in exactly the same way as described for the coupled wheels; so repetition is not necessary. Same applies to the axles, which are turned

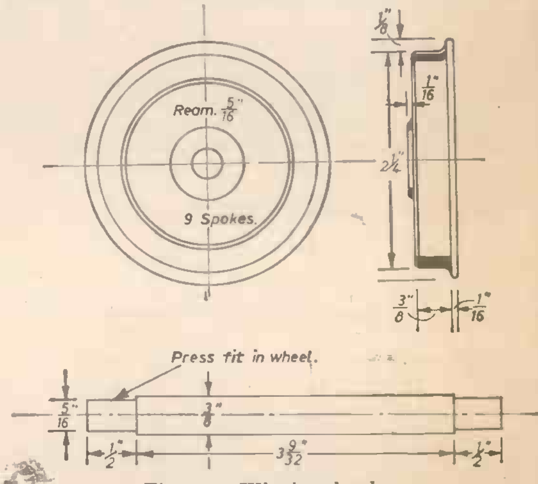


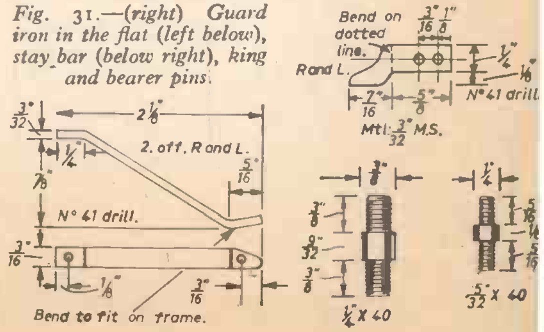
Fig. 30.—Wheel and axle.

from $\frac{3}{8}$in. round mild or silver-steel rod, to the dimensions shown in Fig. 30. Oil ducts are not required in the pony axle, as you can poke the spout of an oil feeder between the wheel spokes, and put a drop down the oil holes on top of the axleboxes.

The king pin (Fig. 31) is also turned from $\frac{3}{8}$in. round steel held in the chuck. Face the end, turn down $\frac{3}{8}$in. length to $\frac{1}{4}$in. dia. and screw $\frac{1}{4}$in. × 40. Part off at $\frac{9}{32}$in. from the shoulder, reverse in chuck and repeat turning and screwing operation on the other end. The bearer pin is turned in the same way, from $\frac{1}{4}$in. round rod to the dimensions shown in

(*Continued on page* 498)

Fig. 31.—(right) Guard iron in the flat (left below), stay bar (below right), king and bearer pins.



A CAMERA TRIPOD with BALL & SOCKET HEAD

By

G. R. Gilbert

Fig. 1.—The completed tripod and head in use.

THE tripod shown in Figs. 1 and 3 is adjustable in height from 2ft. to 4ft. Cut from a plank of well-seasoned ½in. thick timber (from second-hand furniture perhaps) six strips ⅝in. wide and 2ft. long. Plane and sandpaper them smooth.

Make the clips, which hold the legs together and allow them to extend, from $\frac{1}{16}$in. mild steel (Fig. 2). The upper clip (see sketch) should be bent to allow the legs to slide easily, but without any excessive play. The lower clip is made large enough to take the small brass pads which prevent the clamping screws from digging into the wood.

For the tripod head, cut from ⅛in. sheet brass a disc 1¾in. dia. and drill and tap a hole in its centre ¼in. Whit. This is the thread in the tripod bush of most modern cameras.

The three pieces which form the housing for the legs are ⅝in. wide and are bent at 120 deg. To hold these parts together for silver soldering, use a ¼in. Whit. bolt in the centre hole of the disc, a large washer and a locking nut.

The 2 B.A. screws that join the legs at the head should be fitted with self-locking nuts and tightened sufficiently to prevent the legs moving on their own. The screws which clamp the legs at the right extension are short with knurled or wing type heads. A short length of ¼in. Whit. screw soldered into the centre hole of the disc completes the tripod.

The Ball and Socket Head

Brass is the best material to use. Turn up the shape shown in Fig. 2, the centre being bored out to ¾in. except for the top end which is radiused down to $\frac{7}{16}$in. The ball can be turned from brass or a ⅝in. dia. ball bearing used. To soften the latter, heat it to a

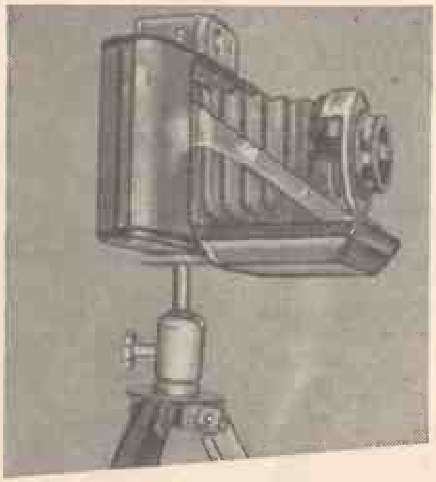


Fig. 3.—A further view of the head in use.

bright red and allow it to cool slowly. Drill and tap a $\frac{5}{16}$in. hole in the ball and into this screw and silver solder a 1½in. long pillar of $\frac{5}{16}$in. dia. rod. This has a ⅜in. long shoulder turned on its upper end and is tapped ¼in. Whit.

The centre plug is turned to slide in the outer shell and has a 45 deg. groove turned in it ¾in. from the shoulder at the base. The outer shell is drilled and tapped to take a ¼in. Whit. screw with a knurled head and a 45 deg. point to coincide with the groove. Tightening the screw should lift the plug and clamp the ball; if it does not, adjust the height of the plug by soldering on brass discs. The hole in the bottom of the plug is tapped ¼in. Whit.

At one point at the top of the outer shell, a $\frac{5}{16}$in. wide slot is cut to allow the stem to move to the horizontal position.

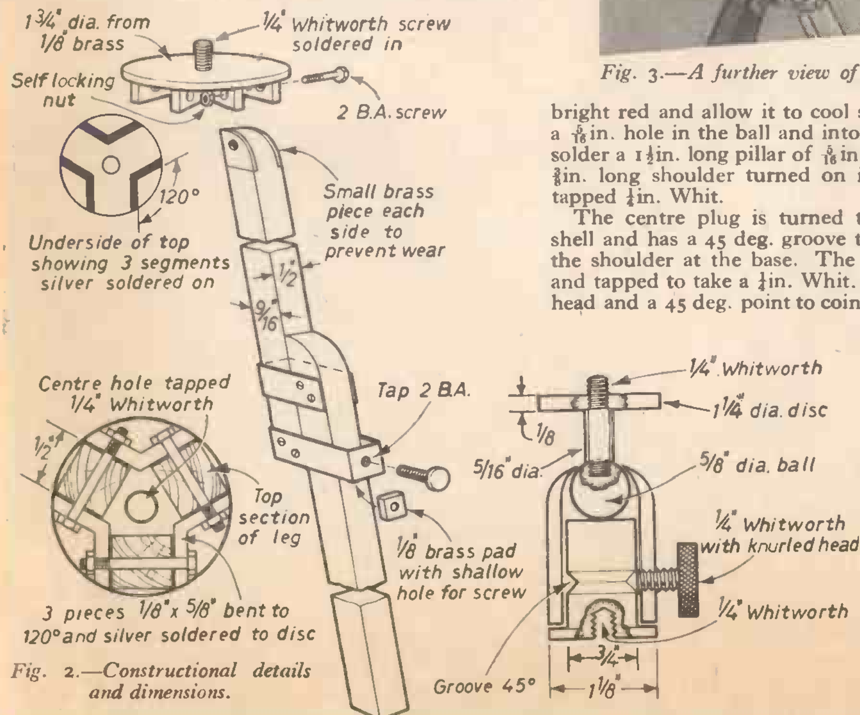
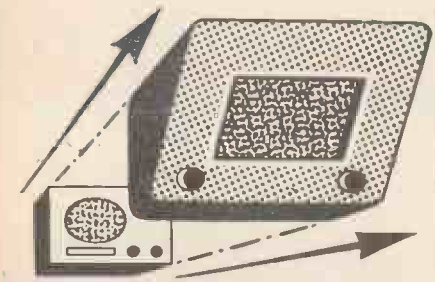


Fig. 2.—Constructional details and dimensions.



EXTENSION SPEAKERS

Part 17 in the Automatic House Series

by E. V. King

GENERALLY extension speakers *must* be permanent magnet types. The type which uses an electro-magnet (field winding) will NOT do for an extension without special wiring.

An old T.V., radio or gramophone speaker, provided it is equipped with a permanent magnet, will suit. Test for magnetism by holding a piece of iron (say a nail) near the centre piece at the rear.

The extension speaker must match the output "impedance" of the set (usually about 3Ω). The extension speaker may be bought alone, on a baffle board, or in a cabinet.

In general buy an 8in. P.M. speaker with an impedance of 3Ω and mount in a box 10 or 12in. square. Suitable surplus speakers are advertised in this magazine from time to time at about 8/- each.

Checking Impedance

Connect a flash lamp bulb in series with a 3 or 4V. battery as shown in Fig. 151. The radio is disconnected from the mains. If the lamp lights the system required is of low impedance if the lamp does not light it is of high impedance. This article deals in the first instance with low impedance systems.

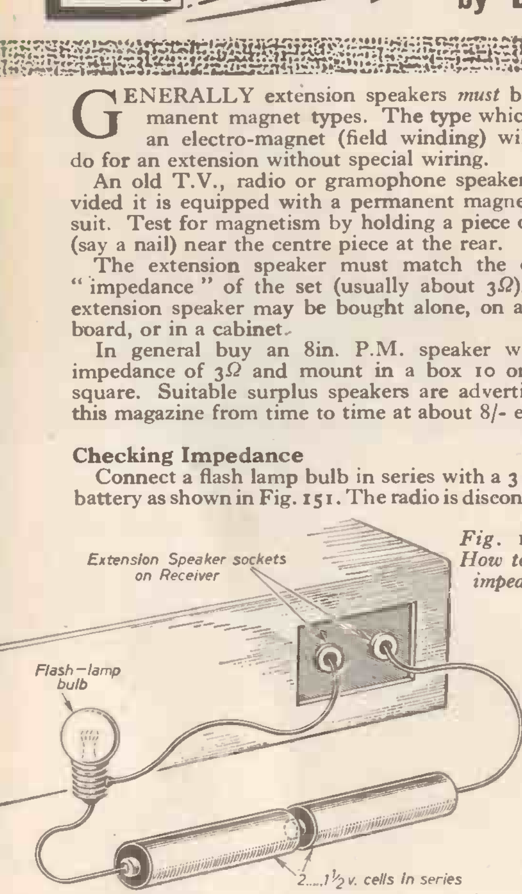
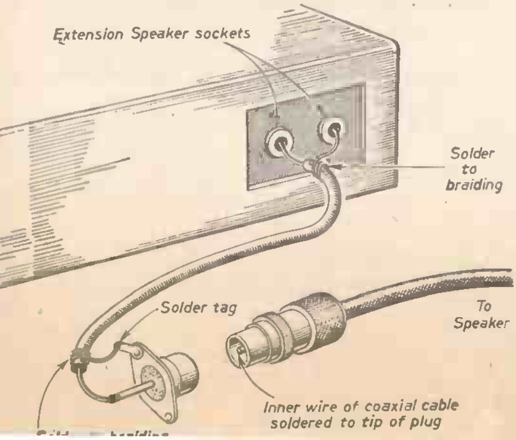


Fig. 151.—How to check impedance.

Fig. 152.—(Below) Using a co-axial cable, plugs and sockets for wiring extension speakers.



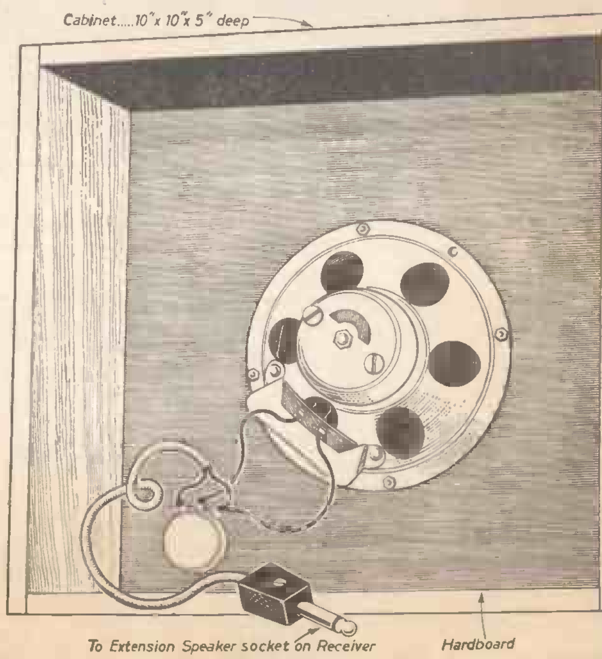
" Adding " Extension Speaker Sockets.

Where no provision is made for an external speaker, unplug from the mains and remove the back. If the speaker is closely examined there may be only two leads going to it, two other leads may be joined to them and taken to a socket in the back of the set.

If however, more than two leads go to the speaker the latter is of the Energised Type with an electro magnetic coil and special care is needed or 300 to 400V. of H.T. may be tapped in lieu of the speech coil leads. Examine the speaker more closely and find the two leads which eventually connect to the actual " cone " of the speaker (Fig. 153.) These leads may be very thin and dust covered, but once found may be traced through to two solder tags. Leads from here may then be connected to the sockets. Verify that no H.T. has been fed to the sockets, by wiring a lead temporarily from the metal chassis and " sparking " it on the extension sockets. No sparks at all should be obtained with the volume down low.

Test the extension speaker by wiring it to the extension sockets. If the speaker is not in a cabinet

Fig. 153.—(Below) Inside view of a suitable cabinet wired with an extension speaker and internal separate volume control.



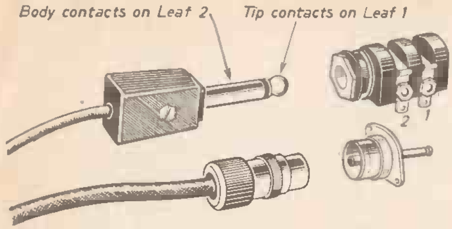


Fig. 154.—The special type of Post Office jack plug and socket used in many of the systems to be described. Also a co-axial plug and socket which is an alternative.

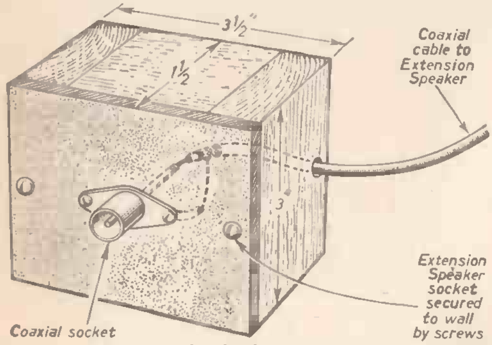


Fig. 155.—A very simple form of extension speaker socket fitted in a box for screwing to the wall.

lay it down cone towards the bench or damage may be done on low powerful notes.

It may however be connected to a flash-lamp battery and as the connection is made or broken the cone should be seen to pull in or push out and a clicking noise will be heard. The cone can be VERY GENTLY pushed in at the centre to make sure that it is quite free.

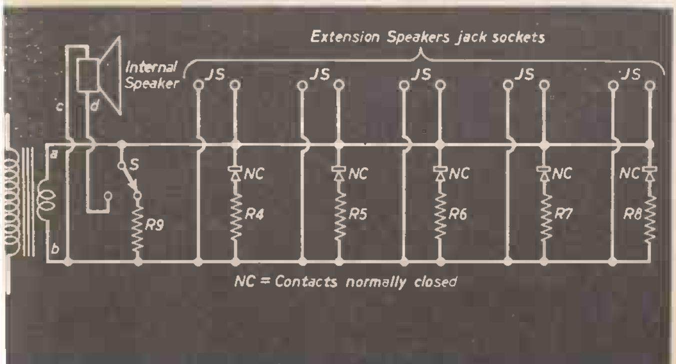
The Speaker Mounting

The speaker MUST be mounted on a board, known as a baffle, or in a cabinet. Generally the larger these items are the better the reproduction. A suitable cabinet easily made and decorated to tone with any room is shown in Fig. 153. The dimensions will suit a 5 or 8in. speaker. The frame is made up of four pieces of ½in. stuff pinned as shown. The front is of hard-board with a hole cut in it to suit the speaker.

Baffles

A flat baffle is a convenient and easy mounting method. It is made of hardboard measuring 12in. × 10in. or larger. The edges are strengthened by pinning on lengths of 2in. × 1in. softwood or by using special tray moulding, obtainable at " do it yourself " stores.

Fig. 156.—A system giving almost constant volume as speakers are inserted or removed from circuit. The internal speaker switching may be omitted if required.



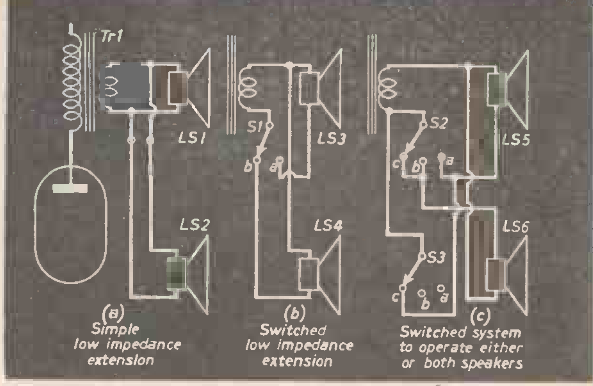


Fig. 157.—Various extension speaker systems. Tr1 is the transistor or valve output transformer. Loudspeakers 1, 3 and 5 are the original ones, 2, 4 and 6 are extensions. S2 and S3 are ganged.

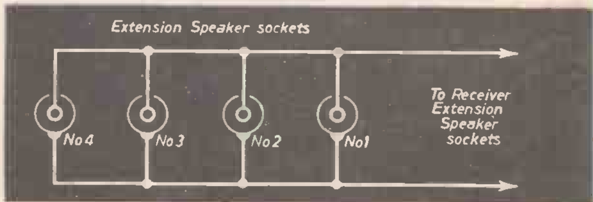


Fig. 158.—Four sockets wired in parallel for a simple system. Some precautions are necessary.

Protection of the Cone Against Damage

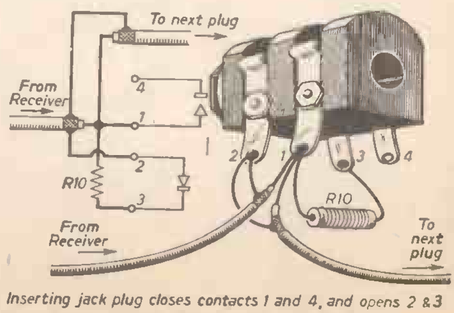
Most speakers will stand the full volume obtained by the ordinary radio set without mechanical harm, however, if they are used with over about 4 or 5W. of power they may be permanently damaged. Great care must be exercised never to bring the speaker near iron or steel filings.

Really good mechanical protection from outside is given by using expanded metal (obtainable from Messrs. Lasky's Radio Ltd., 42 Tottenham Court Road, London, W.1) or by fitting small wooden battens across the front of the speaker hole.

Dust is kept out by placing a layer of cloth between the front baffle and the speaker (i.e. just behind the expanded metal). Additional help in keeping dust out is given by covering the magnet assembly in a cloth bag which may also be part of the dust cover already mentioned.

Wiring

Use twin plastic covered flex wire or co-axial television cable for distances of up to 25ft. For longer distances heavier cable (low resistance) such as 15A. mains cable or 600Ω line transformers should be used. These will be mentioned later.



Inserting jack plug closes contacts 1 and 4, and opens 2 & 3

Fig. 159.—How the system of Fig. 156 is wired up in a practical manner. See also Fig. 154. (Left) Theoretical wiring plan.

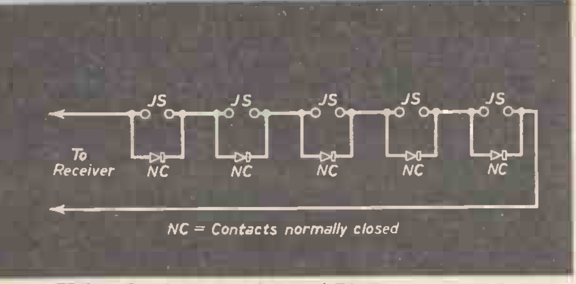


Fig. 160.—A simple series speaker system using normally closed jack sockets.

Using Sockets, Jacks and Plugs

It is possible to wire the system to a jack or co-axial socket so that the speaker may be plugged in as required. Such a system is shown in Fig. 152 where television co-axial sockets are used. Three or four may be mounted in different rooms. No harm can be done to the radio, but the volume of each will drop as more speakers are plugged in.

A suitable mounting is shown in Fig. 155. It is made up of 2in. × 1in. or similar wood with a small hardboard top about 3½in. square. The co-axial plug is mounted on the panel with a solder tag underneath as shown in Figs. 152 and 155. The box is fixed to the wall using Rawlplugs or asbestos plugging and long wood screws. Make sure the screws do not pierce the cable. The wires may be inserted in channels chiselled out of the plaster of the wall. The channels being filled with plaster or Alabastine afterwards. No danger is involved in this as would be the case with mains leads.

Using Jack Sockets

The sockets so far used are rather fragile. A more costly but better method is to use Post Office type jacks. One type is shown in Fig. 154. The plug and socket is obtainable from Messrs. Home Radio Ltd., 187 London Road, Mitcham and should be ordered

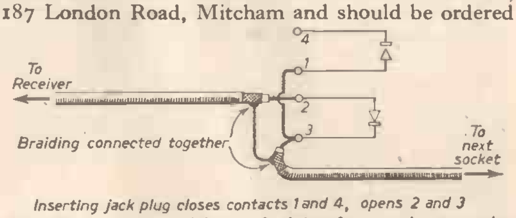


Fig. 161.—A special form of wiring for a series extension system as in Fig. 160.

with one pair of n/o contacts and one of n/c. On arrival the reader should scratch numbers on the plastic body to correspond with Fig. 159. Make sure also that the contacts which touch normally are doing so and also check the others which make when the plug is inserted.

Direct Connection Methods

The simplest arrangement is shown theoretically in Fig. 157a. Boxes made as in Fig. 155 may be used on the wall and connected with wire or co-axial cable as shown (Fig. 158). The speaker is then plugged in as required. If the jack sockets and plugs are used the wires go only to tags 1 and 2 of Figs. 154 and 159. The other tags are not used in a simple system.

Switching Speakers

Fig. 157b shows how the system may be adapted so that you may use either the main radio speaker or the extension. A small throw-over toggle switch may be mounted on the back of the radio. If this system is used the extension must be permanently in circuit, or a jack socket fitted with tags 1 and 3 joined with a wire as well as the other connections. Similar arrangements are seen in Fig. 159.

Fig. 157c shows how you can arrange a two-pole three-way switch to give *either* main radio speaker, external speaker or both speakers. The remarks above also apply.

Using a Number of Extension Speakers

A number of extension speakers may be wired as in Fig. 158. If used as shown the radio must always drive ONE speaker (i.e. its own) or any number. The volume will be less when more are added.

A better idea is to fit jack sockets with connections as shown in Figs. 154 and 159. The wiring of each actual socket will be as in Fig. 159. Co-axial cable is shown. The cable is split at each box, the braiding being tinned and joined again. Both inner ends connect to tag 1, the braiding through a piece of wire to tag 2. A resistor R 10, etc., is fitted between contacts 3 and 1. This puts the resistance in circuit if the speaker is removed. Thus there is NO loss in volume as additional speakers are inserted. The values for R4, 5, 6, 7, 8, etc. will all be the same and about 4 or 5Ω each, i.e. about 8in. of 32g Nickel/Chrome wire wound round an old radio resistor of value more than 10Ω.

If a 15Ω output transformer is fitted in the radio the results with a series system (Fig. 162) will be somewhat better, but this is by no means necessary.

Series System of Wiring

A number of speakers may be wired in series. Generally the limit will be five of 3Ω impedance. They are wired as in Fig. 160. If fitted with plugs, shorting contacts must be wired (i.e. 1 and 3 are joined). The volume will alter either up or down as more speakers are inserted A fault will cause all the speakers to mute.

The wiring of each plug is shown in Fig. 161. In the last socket of the line, the braiding will be joined to tag No. 1.

Better Fidelity System

If the series system is used with the wiring of Fig. 162 at each plug point the correct load is presented always and the quality will be better. There will also be no difference in volume as speakers are inserted or removed from circuit. The circuit of Fig. 161 is used but the resistor is fitted between contacts 1 and 3 in lieu of the wire loop. It should consist of 6in. of 32g Ni/Cr wire as mentioned already.

(To be continued)

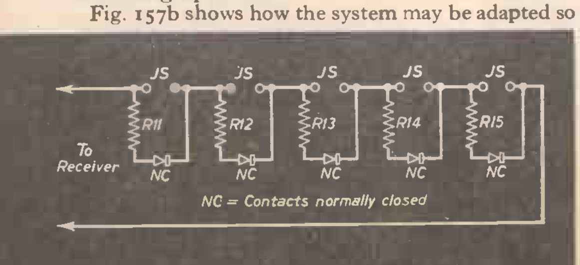


Fig. 162.—An improved series system, which requires some knowledge of radio as another transformer is required in the receiver for perfect operation.

CLOSED CIRCUIT TELEVISION

Applications of this medium have extended far beyond the entertainment industry and will undoubtedly spread even further. The photographs on this page will perhaps point some of the ways that future expansion will take.

THE photograph above was taken during a science lesson at Hayes Grammar School and in addition to the usual science laboratory equipment, it will be noticed that TV cameras, lighting and a monitor screen are also installed. The lesson is in fact being televised and transmitted to Barnhill Secondary Modern School two miles away. In the photograph on the right the lesson can be seen being received on a high definition 27in. screen and being monitored by the Barnhill school teacher.

This teaching aid is being tested by High Definition Television Ltd., a company of the Pye Group. Two Pye industrial television cameras are used, one positioned directly opposite the teacher to televise his desk and the blackboard and another (further left in the picture) for enlarging small objects and to give close-up views of experiments.

In the Hospital

In the photograph on the right a cardiologist at Hammersmith Hospital is examining a patient's heart under X-ray control. The equipment which can be seen is an EMI Electronics closed circuit TV camera fitted to a Siemens electron-optical image intensifier and the picture is displayed on a high definition monitor screen in the X-ray room and elsewhere. Use of TV means easier and quicker diagnosis of illness for the patient and radiologist and enables examinations to take place in a lighted room.

A further use for closed-circuit TV has been found in the new branch of Coutts Bank where senior personnel use it to inspect ledger accounts, kept in the ledger room, without leaving their desks.

Perhaps the days of the "Television telephone" are nearer than we think.

A BATTERY FLASH

B. C. Macdonald gives full

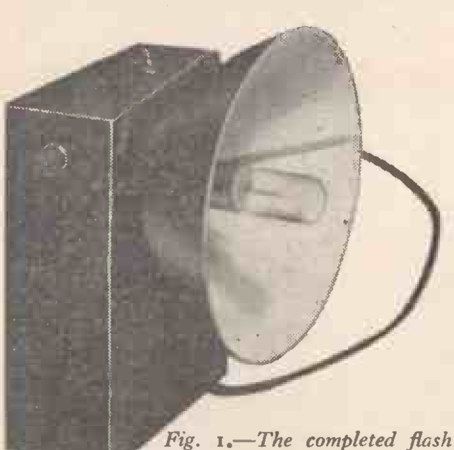


Fig. 1.—The completed flash gun.

THE gun, shown in Fig. 1, is designed to take two kinds of flashbulb, the larger and more powerful bulb fitted with a bayonet cap, and the smaller more popular capless bulb. To enable this dual purpose to be served, it is fitted with a Philips capless adapter. Incorporated in the adapter is a device for ejecting spent bulbs so that these can be removed easily and without burning the fingers. The gun also has a test circuit so that if a faulty flash bulb is encountered, the gun can be checked quickly.

The Casing

The case of the gun is made of plywood, and once the various parts have been cut to the dimensions shown in Fig. 2 assembly is simple, using glue and panel pins. The pin heads should be punched slightly below the surface of the wood and the depressions formed filled with a mixture of glue and sawdust. Finally, the whole is smoothed with fine glass paper. The S.C.C. bulb holder is mounted on a piece of wood ⅞in. × 1in. × ½in. by means of screws, and the wood is then glued to the rear panel of the case. If a bulb holder of different length to that quoted is used, the ⅞in. dimension may need to be altered. The holder should project ⅜in. through the front panel. Note that the holder and the attached wood must be fitted to the case before the front panel is fixed in position. The holder is of the type used in many car and motorcycle tail and head lamps with a centre contact fitting, and possibly such a lamp holder could be adapted, but the one used is of Bulgin make and is fitted with a fixing bracket.

As it is difficult to drill holes in thin plywood without splitting, the hole for the bulb in the front panel and the hole in the top should first be made with a ¼in. drill and afterwards widened out to size with a red hot poker or metal bar. In this way holes with smooth edges may be obtained. The hole for the push switch must be counterbored on the inside halfway ($\frac{3}{16}$in.) through the wood to allow the switch to be fixed.

Mounting the Clips

The capacitor, resistor and battery clips are mounted on two $\frac{3}{16}$in. plywood panels, each measuring 1¾in. × 2½in., made to slide easily into the case. Fig. 3 shows manner of assembly. The capacitor is fixed to the wood panel by passing the wire ends through the wood, and cutting them off to leave about ½in. projecting; the wires are then bent down on to the panel. Small L-shaped brass clips are required on the battery panel, and these may be made from $\frac{5}{16}$in. wide spring brass strips, and fixed with 6 B.A. nuts and bolts. The nuts should be on the battery side of the panel and a solder tag should be placed under the head of each bolt. Ordinary plastic-covered twisted lighting flex, the strands being unwound, is suitable for wiring up the components. The wire ends of the resistor are each cut to about ⅜in. long and the connecting flex soldered to them. The flex will hold the resistor in position without any other fixing. A piece of linen tape, about ¾in. × 4in. has one end glued to the rear of the battery panel, and on top of this a piece of cardboard will be needed to lift the battery clip fixing screw heads clear of the capacitor. The pieces of connecting flex pass through holes drilled in the plywood panel. Strips of cardboard, or better, $\frac{1}{16}$in. thick paxolin sheet are cut to the interior width of the

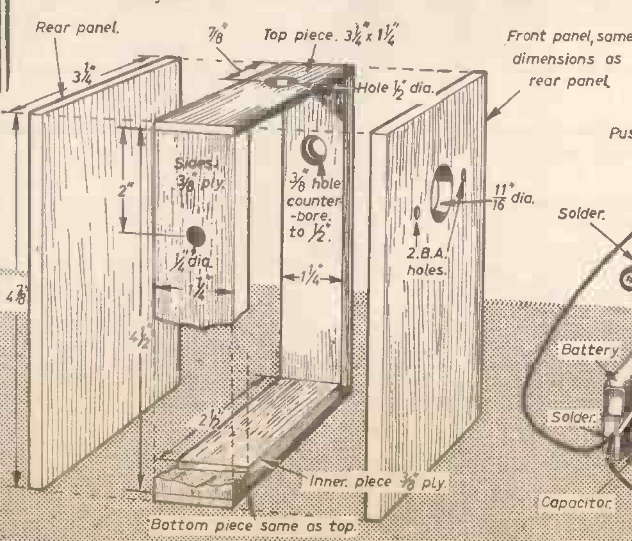


Fig. 2.—(Extreme left) Dimensions for the casing.

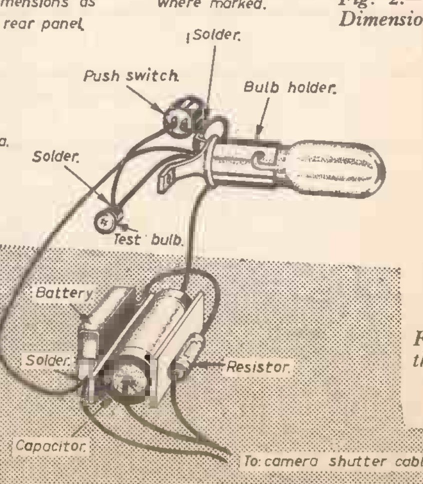


Fig. 3.—How the components are wired.

CAPACITOR GUN

constructional details.

case (2½in.) and slightly wider than the diameter of the capacitor. These are to provide rests for the sides of the battery panel. It is vital that the capacitor should be connected to the battery correctly. One end of the capacitor is coloured red and also one side of the battery; these must be connected together, through the resistor, as shown in Fig. 3. Mark the battery panel to ensure correct battery fitting.

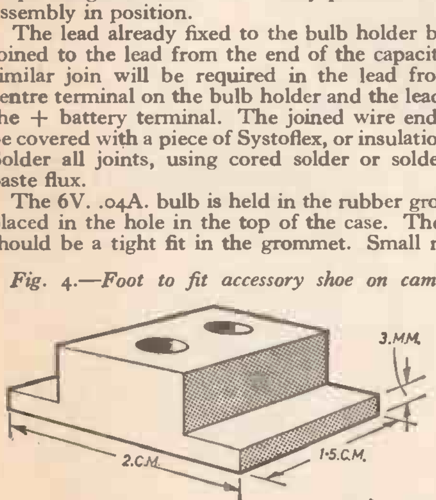
Inserting Components

Insert the assembled components into the case, the battery being in position with the linen tape threaded underneath. The purpose of the tape is to make removal of the battery easy. Simply pulling the end of the tape will lift the battery out. Fold the free end of the tape on top of the battery and fit the bottom of the case. Place the case upright on the table and press the top panel (on which the resistor is mounted) down to consolidate the component assembly. Take two square match sticks with the heads removed, and glue these to the inside of the side panels of the case so as to touch the sides of the panel on which the resistance is mounted. These woods are to act as stops. Carefully slide the components out so as not to disturb the woods just fixed. When the glue is set re-insert the component assembly and press down against the stops, the card or paxolin rests for the battery panel being in position. Two more wood stops are glued above the battery panel to hold the assembly in position.

The lead already fixed to the bulb holder body is joined to the lead from the end of the capacitor. A similar join will be required in the lead from the centre terminal on the bulb holder and the lead from the + battery terminal. The joined wire ends may be covered with a piece of Systoflex, or insulation tape Solder all joints, using cored solder or solder and paste flux.

The 6V. .04A. bulb is held in the rubber grommet placed in the hole in the top of the case. The bulb should be a tight fit in the grommet. Small rubber

Fig. 4.—Foot to fit accessory shoe on camera.



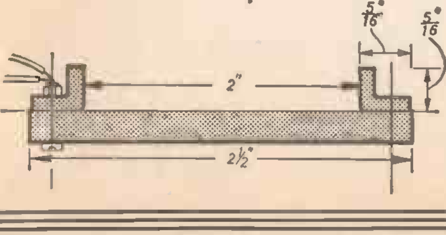


Fig. 5.—Battery panel with clips fitted.

Components required

- 1 100 µF. electrolytic capacitor, 30 to 50V. working.
- 1 2,300 to 3,000Ω resistor, ½W.
- 1 Press type switch (Bulgin No. M.P.1)
- 1 Bulb holder (Bulgin No. S.C.C.3 with B type bracket).
- 1 Deaf aid 22½V. battery (Type No. B122).
- 1 Test bulb, 6V., .04A., M.E.S. fitting from your radio dealer.
- 1 Philips capless adapter and flash lead from any large photographic dealer.

grommets are also required in the holes in the side panels, and as it is not easy to obtain grommets suitable for panels as thick as ⅜in. it is necessary to cut one of the rims off the side panel grommets so that these may be inserted in the holes and fixed with rubber adhesive.

The Reflector

A small aluminium or plastic bowl may be used, preferably thermo-setting (hard) plastic. Suitable measurements for the bowl would be roughly 2in. across the base and 4in. across the mouth with a depth of 2½in. or less. A hot (not red hot) poker or tapered metal bar will make the centre hole in a plastic bowl easily and without risk of cracking. The two 2 B.A. fixing screw holes are best made with a hot piece of wire. Make them in the bowl before making them in the case.

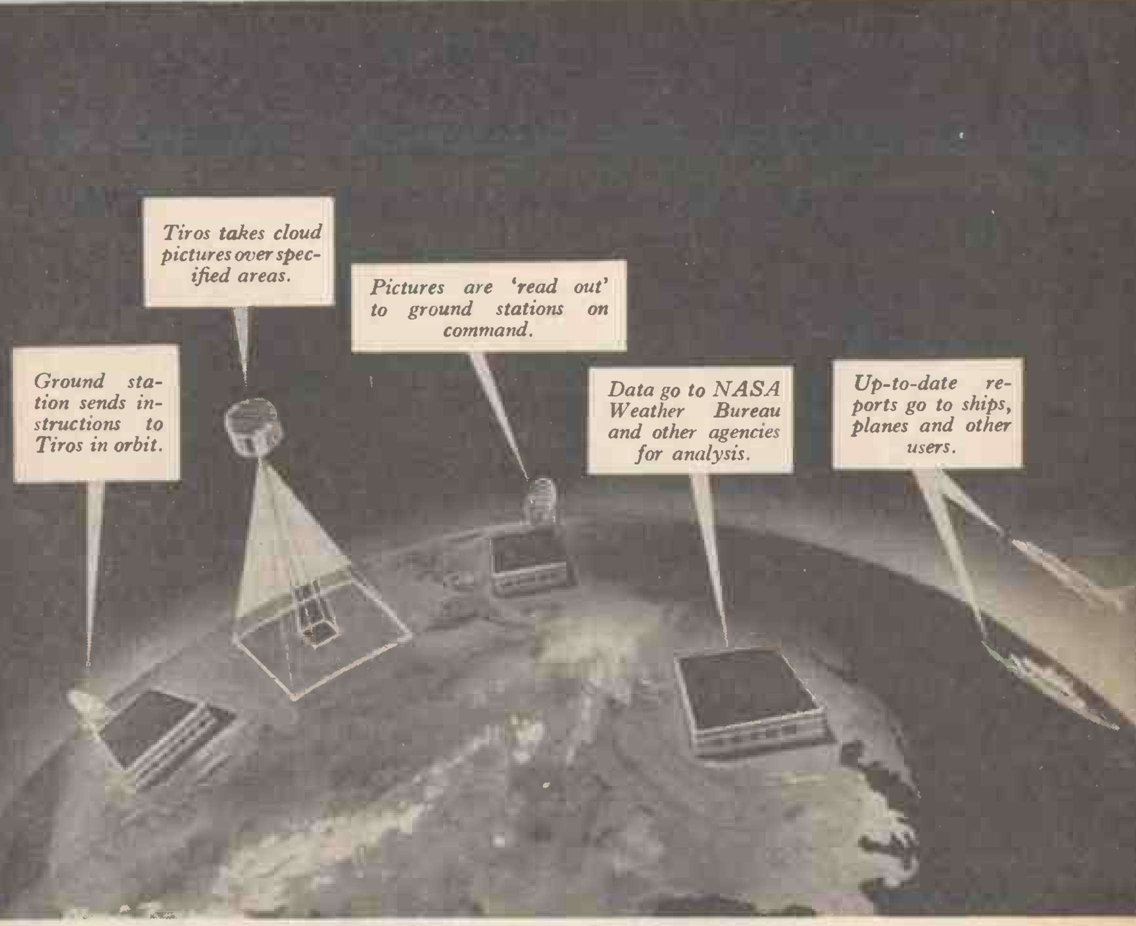
The foot on the bottom of the case, for engaging with the accessory shoe on the camera (Fig. 4) may be made from aluminium. If not solid, it may be made up from pieces of 16 s.w.g. sheet, two thicknesses for the bottom part and three or four for the narrow top part. Two wood screws hold the foot in position.

It is important that the bottom be a good tight fit in the case. If slack, it may be made tight by sticking a piece of cloth or paper on the ends that enter the case, not the sides. The bottom may be screwed on by brass screws passing through the sides.

A good finish for the case may be obtained by giving it several coats of black leather paint.

Testing

To check the gun, plug the lead into the camera socket, press the button on the side of the gun and after about two to three seconds, still keeping the button pressed, operate the shutter. The test bulb should flash; not brilliantly, but distinctly. No flash bulb must be in the holder during the test. The gun should not be operated close to the face. Note that an unfired bulb should not be allowed to remain in the gun for a long time or the battery will run down.



The major orbital and ground elements of the Tiros II television-infrared weather observation system.

Meteorological Satellites

By D. S. C. Fraser

TIROS II—the American satellite that went into orbit on 23rd November, 1960—sent back pictures and information to help scientists in many countries to improve weather forecasting.

Fourteen nations co-operated in the experiment. They received orbital data, pictures of cloud cover and information from the satellite's battery of infrared sensors which measured earth and cloud temperatures. In turn, weather agencies sent to the United States conventional meteorological data obtained by ground-based instruments. Such co-operative efforts could lead to better weather forecasting all round the world, in addition to providing new knowledge of the origin and mechanisms of weather.

Tiros II, shaped like a drum, looked like its predecessor, Tiros I, which earlier last year pioneered practical weather-forecasting satellites by transmitting nearly 23,000 useful pictures. Tiros II was, however, scientifically superior in several ways and carried additional equipment in the shape of the seven infrared sensors.

Tiros II measured 42in. × 19in. and weighed 280 lb.—10 lb. more than Tiros I. It is still travelling round the earth about once every 100 minutes at a 48 deg. inclination to the equator, and will eventually pass over most of the populated area of the globe, although it has now ceased transmitting weather nformation.

Power from the Sun

The top and the sides of the satellite are covered with 9,620 solar cells that supplied energy to 62 chemical batteries. These in turn, powered the experiments and the five transmitters aboard.

Tiros II had a wide-angle and a narrow-angle camera to photograph cloud formations. Each was about the size of a tumbler. The narrow angle camera took pictures of an area about 75 miles wide: the other covered an area about 800 miles wide.

Stations at Fort Monmouth in New Jersey and San Nicolas Island in California received pictures "on command" from the satellite. In addition, they programmed the satellite to take pictures at pre-selected places. The stations had also the option "reading out" pictures directly as they were taken, or they could order the satellite to store the pictures, 32 at a time, on tape, for relay later.

Tiros II emobodied a simple system that enables ground observers to shift its angle in space

Tiros II is mounted in a special test machine to check the function of the magnetic stabilization system under conditions similar to those in outer space.

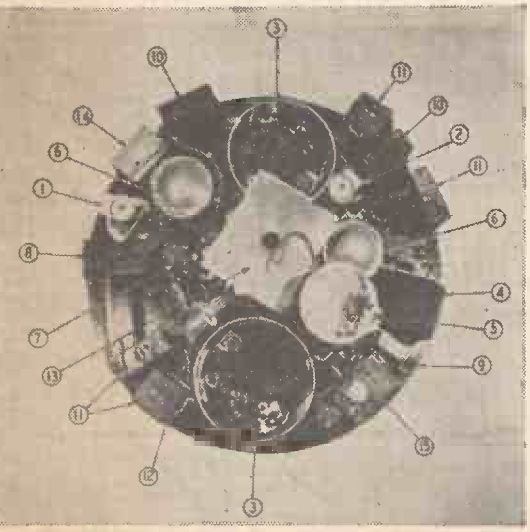
by remote control for improved picture coverage.

In this orientation system, developed by Radio Corporation of America, the effect of the earth's magnetic field in space is used to alter the attitude of the satellite upon command, without the need for special propulsion devices such as rocket motors or compressed gas jets.

The new system follows studies by RCA and Government scientists of an unexpected gradual shift in the attitude of the first Tiros satellite under the influence of the magnetic field surrounding the earth. In the first Tiros, these magnetic forces caused the satellite to tilt gradually away from the predicted position of its axis in space.

Test Cage Used

In Tiros II, the forces were harnessed by a technique in which a controllable magnetic field was generated around the satellite itself by a coil of wires round the lower sides of the vehicle. Interacting with the earth's magnetic field, this gave ground observers an invisible "hand" with which to tilt



(Left): The Tiros II satellite from directly above shows instrumentation: (1) Wide angle TV camera; (2) Narrow angle TV camera; (3) TV tape recorders, (4) Infrared system five channel radiometer; (5) Infrared system electronics; (6) Electronic clocks for timing sequence of operations: (7) Relays for magnet stabilization system controlling satellite's attitude; (8) Control box for electronic systems; (9) Infrared horizon scanner; (10) Electronics circuits for cameras; (11) Electronics circuits for TV tape recorders; (12) Telemetry switches; (13) Antenna diplexer (covering storage batteries); (14) Automatic signal generator; (15) Fuse board and current regulator.

the satellite on command in order to obtain a more advantageous angle for the sensors and the solar power supply. In developing the technique, engineers devised a large spherical test "cage" in which the complete satellite was placed and rotated in a magnetic and solar environment similar to that in space.

Both Tiros I and Tiros II were experimental devices, and had useful lives of between two and three months. Tiros II will, however, go on orbiting for many years yet, although it has stopped transmitting information.

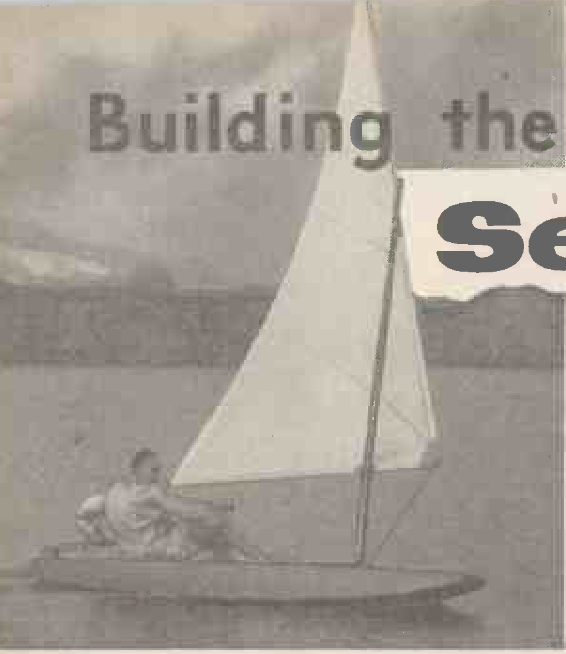
The success of the two Tiros satellites has undoubtedly given a fillip to the U.S. Weather Bureau plans for an advanced type of weather satellite to be put into orbit in the summer of 1962 for global weather forecasting.

Tiros II was launched from Cape Canaveral by a 92ft. Delta rocket.

Tiros II is positioned for calibration tests of its two cameras. The lens of the wide angle camera protrudes from the base plate of the satellite at upper right. Through the opening in the centre of the large calibration scale appears a smaller scale for measurements of the narrow angle camera.

Building the SeaSkate

by R.W.T. Bradley



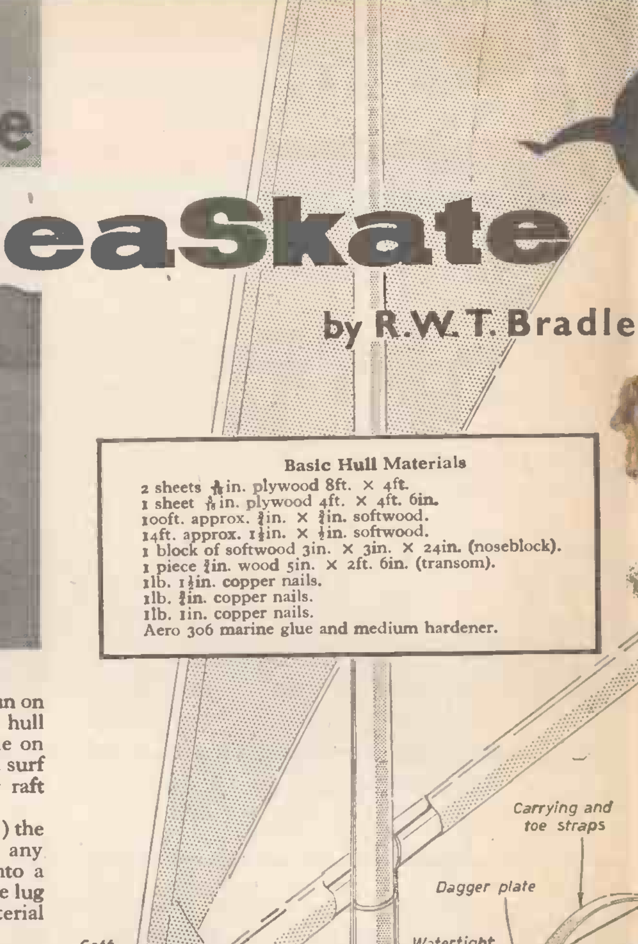


Fig. 1.—*Cutaway perspective view showing general construction and rigging details.*

Fig. 2.—*Centre-board box details. This will be described next month.*

Basic Hull Materials

2 sheets 3/16in. plywood 8ft. × 4ft.
1 sheet 3/16in. plywood 4ft. × 4ft. 6in.
100ft. approx. 3/4in. × 3/4in. softwood.
14ft. approx. 1½in. × ½in. softwood.
1 block of softwood 3in. × 3in. × 24in. (noseblock).
1 piece 3/4in. wood 5in. × 2ft. 6in. (transom).
1lb. 1½in. copper nails.
1lb. 3/4in. copper nails.
1lb. 1in. copper nails.
Aero 306 marine glue and medium hardener.

SEASKATE is a craft designed for family fun on summer days by the sea. Its lightweight hull and simple rig make it easily transportable on the car top. It is unsinkable and can be used as a surf boat with a double-ended paddle, a swimming raft or a really fast surf sailer.

As will be seen from our large drawing (Fig. 1) the hull is square in section and does not involve any tricky angles in the making, the mast drops into a socket and does not need stays, the sail is a simple lug and can be made of almost any lightweight material by the feminine side of the family.

The approximate total cost works out at about £24, this includes buying the sail and using all new materials, but many savings can be made, i.e. the use of tempered hardboard instead of marine-ply for the hull, timber you already have by you for the framing, bamboo poles for the gaff and boom and, of course, the main saving, making the sail yourself from Egyptian cotton or other lightweight fabric.

Following the general practice with this type of craft the hull was made plain and foot-straps were attached to the deck to allow the helmsman to counterbalance the craft, but after trials it was decided to cut a small cockpit between stations 5 and 6. This has proved most satisfactory and gives just enough foot purchase to allow a rapid change of seat position to port or starboard. This detail does not appear in some of the early constructional pictures but is included in the constructional description.

Marking Out

Set out on your 3/16in. plywood sheets, the deck, sides and bottom pieces as shown in Fig. 6. This should be done most carefully, taking the measurements from the plans (Fig. 5).

Butt the edges of the ply as shown and fix with cellulose tape. Using the edge of the ply as a datum set out the centre-line of the top deck at 1ft. 4½in. from the edge. Mark off the station centre-lines across at right angles and then the centre-line-to-gunwale distances. This will give the main profile points, which should be connected by bending one of the 3/4in. square gunwale strips and marking a strong

LENGTH .... 11′ 6″
BEAM .... 2′ 8″
DEPTH .... 10″
SAIL AREA .... 58 sq. ft.

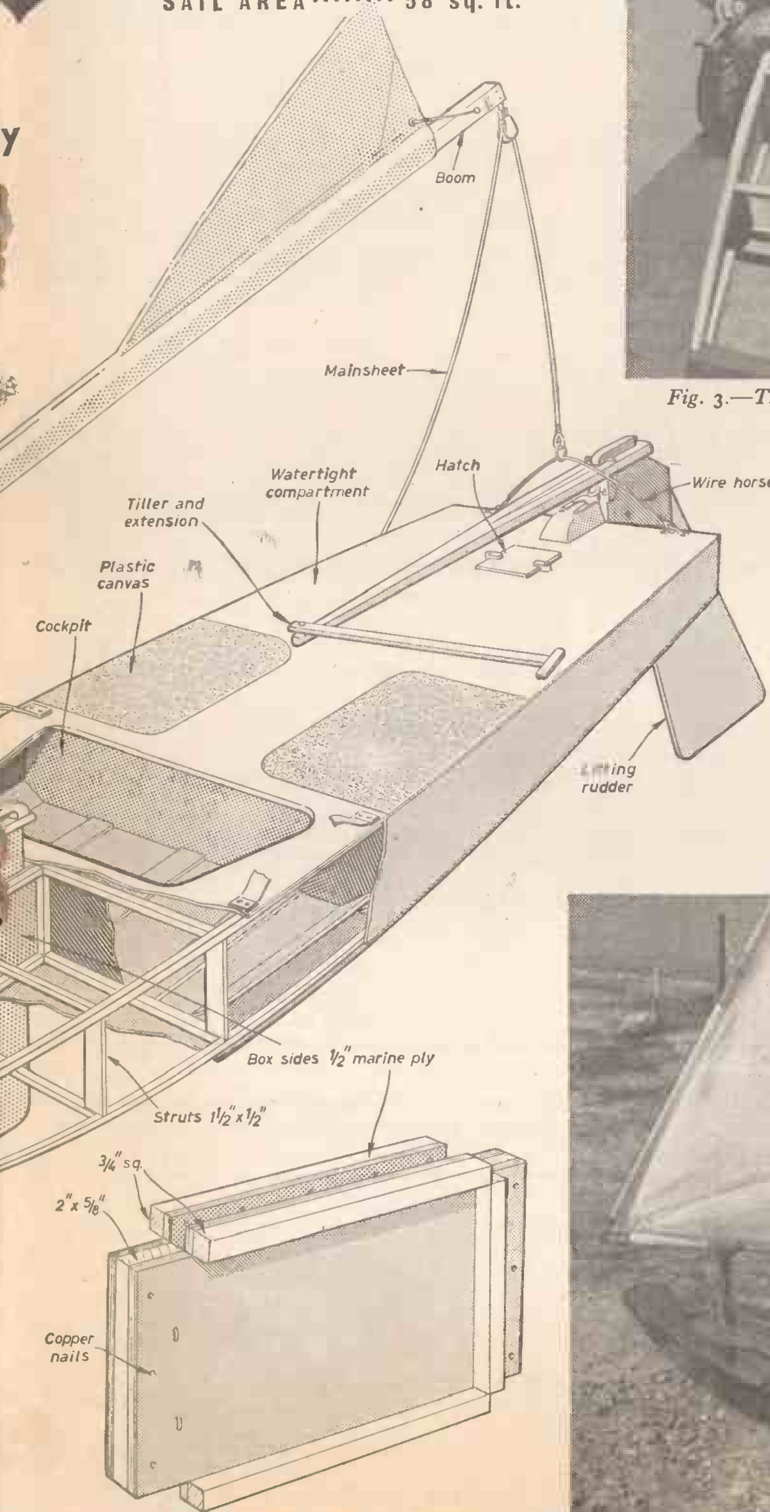
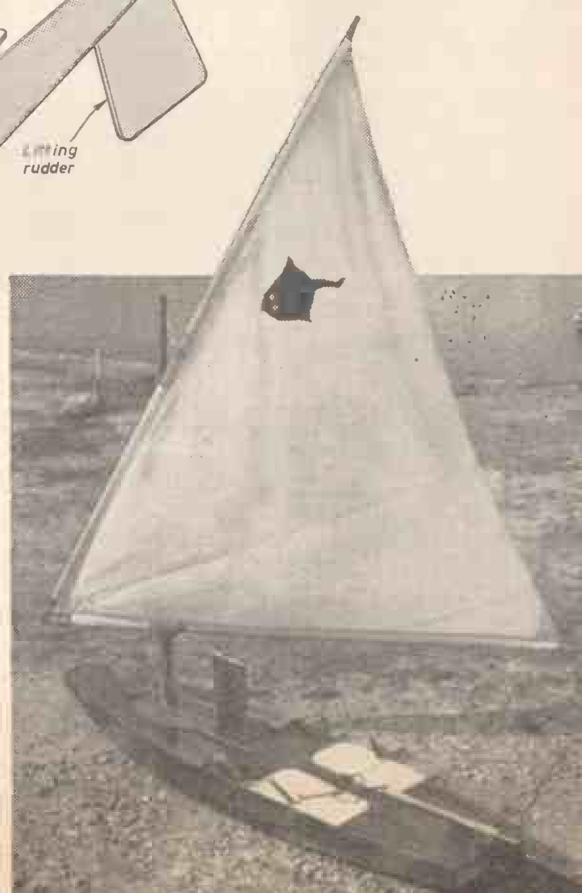


Fig. 3.—The last of the framing members go into place.

Fig. 4 (Below).—The prototype "Seaskate" before the cockpit was added.



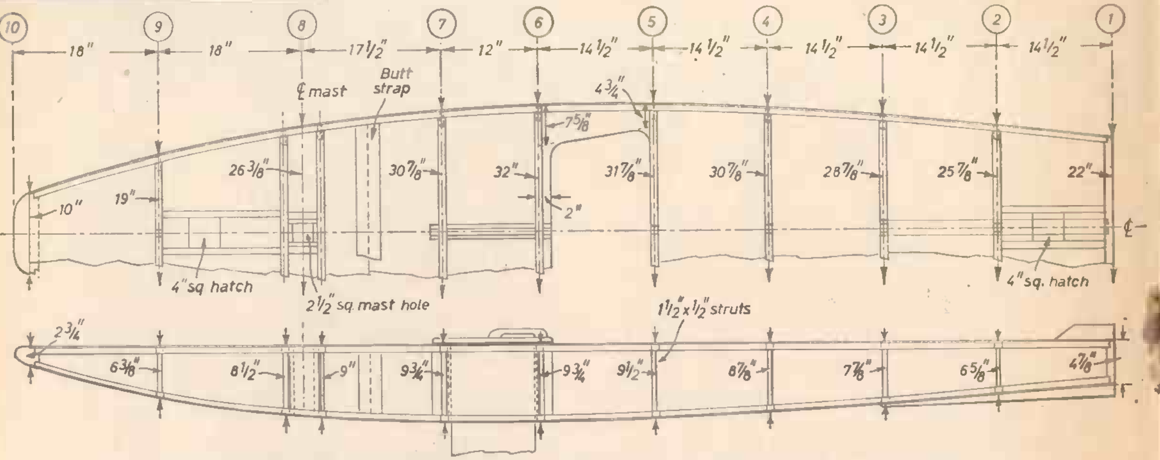


Fig. 5.—Plan and side elevation showing all framing, centre-board box and mast box.

pencil line. Two pairs of hands will be needed here.

Mark out the side sections using the same method and making allowance for slight additional length caused by the curved sides. This length can be obtained by running string along the line of the top deck edge.

On the second sheet mark out the side pieces and bottom profile and once again leave additional length to allow for the curve of the bottom. Set out only the main width and length of the latter. The sheet can be laid on the framework later and scribed off.

The Deck

Cut out the main top deck section cutting as close to the curved scribed line as possible, but leaving a little fullness across the bow and stern for subsequent trimming. Plane the butting edges to a good butt and they are ready to be joined together to make a complete deck, using the 3in. wide deck joint strip. Place this in position along the centre-line of the butt and cut the ends 1in. in from the deck edge. It should now be glued, using Aero 306 marine glue and clinch nailed to the deck sections. Use four rows of 1in. nails at 2in. centres, nailing through from the top, the top being at this stage the side of the sheets without station markings (see Fig. 8).

The term " clinch " means to bend over the point of the nail and drive it back in on itself, when it has passed through the two sheets of ply (see inset).

Whilst the deck section is setting, cut out the side sections complete with their joint strips and join as above to form complete lengths.

If a little heat has been applied to the deck butt it should now be set and the hatches, cockpit, mast and centre-board slots can be marked and cut out. This is done with a sharp-pointed knife and steel ruler with the ply laid on a firm base. Plane the gunwale edges to the scribed line.

The Framework

This is mainly of ¾in. sq. stuff and the first pieces to be cut are those across the underside of the deck. Cut to a line scribed 1in. in from the deck edge and along the centre lines of the various stations. These should then be glued and nailed with ¾in. nails at 3in. centres to the deck underside (see Fig. 9).

A good flat floor is now needed. Garage floors are often far from that so work on the prototype was allowed on the lounge floor (but no mess mind!). Here were glued and nailed into place the ¾in. square gunwale strips and other deck reinforcing members (Fig. 10). The whole was then weighted down with radios, coal buckets, etc., to ensure a nice flat deck on drying.

Back in the workshop the now flat rigid top deck is supported on saw horses or boxes at working height. Sight along the ends and adjust these supports to prevent any tendency to sag.

Adding the Sides

By now the hull side planks will be set. Lightly nail back-to-back to the edge of the bench and plane the straight edges to a true line. After separation glue and nail to the gunwale framing at the edges of the top deck, commencing nailing amidships and working out to bow and stern. Don't be mean with your glue, these joints must be good and watertight.

The form of the hull is now taking shape and the bottom chine ¾in. sq. strip can be added. As can be seen from Fig. 12, lots of small clamps were used. This was followed by nailing (¾in. nails again) at 3in. centres. Leave the ends long, they will be trimmed at

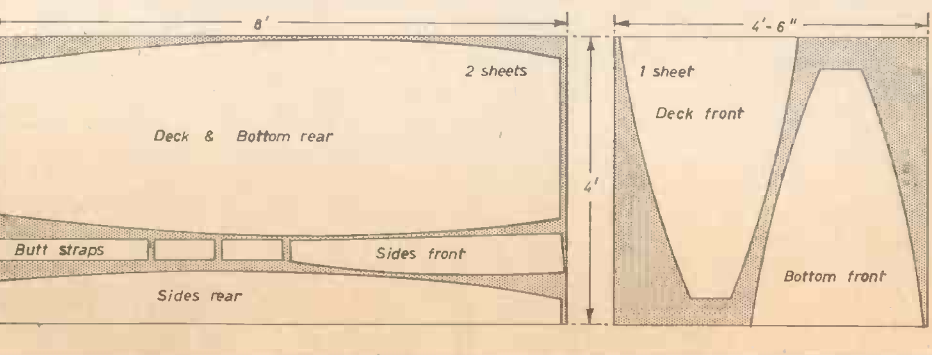
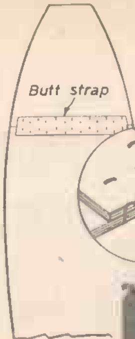


Fig. 6 (Left).—Cutting diagram for the three main sheets of $\frac{3}{16}$in. marine plywood.

Fig. 7 (Right).—Transom details.

Fig. 8 (Right).—Using a butt strap to join the two halves of the deck.

Fig. 9 (Extreme right).—The first frame members in position.



a later date. After setting, plane the ply sides flush with the strip. It is a good idea during the setting time to cut 3 or 4 of the bottom cross members and press into place to ensure that the sides set vertically.

Nose Block

A solid piece was not available, so it was made up in two parts, glued and nailed together, rebated on the the top and bottom back edges and cut at the corners to locate into the chine and gunwale strips (Fig. 11). The leading edge of the deck must be planed to fit its respective rebate in the nose block. This is then well glued and nailed into position through the ply sides and deck. After setting work to finished shape (Fig. 14).

Transom

Now turn to the stern and trim the deck and sides square and vertical, cutting the chine and gunwale strips ½in. back from the ply edges at the ends. Cut the transom board from ¾in. thick material, jointing out the corners to fit the chine strips. Glue and nail into position through the outer ply sides (Fig. 7).

Work along the hull, fitting in the bottom cross members. Cut these exactly the same length as those for the deck and glue and nail into position using 1½in. nails driven in through the ply sides and frame members; see Fig. 3. Another pair of hands here holding a weight at the other side helps a lot. Do not fix the cross members at stations 6 and 7 as if you do you will be unable to get the centre-board box in later.

The vertical side members come next and these are 1½in. × ½in. stuff. The edges that fit against the ply sides will need angle planing for those frames towards the bow and stern. A single nail through the ply sides should serve to locate these till set. This is followed by the fitting of the ¾in. sq. central verticals along the middle of the hull, as shown in Fig. 15. As will also be seen from this picture a 1½in. × ¾in. strip is jointed into the transom and frames 2 and 3. This is to reinforce the bottom ply to take the skeg. Also fitted are the block against the transom and one on the underside of the deck to support the rudder fittings. The holes seen in this picture in the transom are for drainage, are ¾in. in diameter and positioned ¼in. up from the bottom edge. The operation shown in Fig. 15 is that of cutting V-shaped notches into the frames about ¼in. deep to provide drain holes throughout the length of the hull. This completes the basic hull and next month we shall deal with the centre-board box, mast box, cockpit, mast, spars and sails.

Fig. 10 (Right).—A good flat floor is needed for the fixing of gunwale strips.

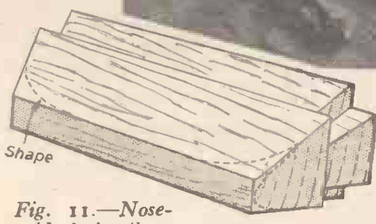


Fig. 11.—Nose-block details.

Fig. 12 (Right).—Adding the sides.

Fig. 13 (Below).—Noseblock in position.

Fig. 14 (Right).—Fairing off the nose-block.

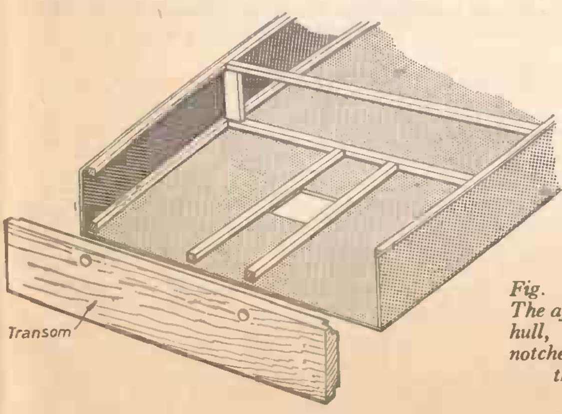


Fig. 15 (Right).—The aft section of the hull, showing drain notches being cut in the frames.

Fig. 1.—The complete unit.

BUILD THIS

WEATHER FORECASTER

using a Govt. surplus air pressure switch

By E. W. Monarch

THIS simple device, shown in Figs. 1 and 2, will show changes of air pressure of about ¾in. of Mercury and is used to show the last big pressure change by the glowing of one of two lamps.

When the left hand lamp is glowing the last big change in pressure was from high to low and there is a good chance of rain coming, alternatively the right hand lamp shows a change from low to high with good chances of dry weather.

Parts Required

A large aneroid capsule with eight or nine concertina type segments.

A suitable capsule is obtainable from surplus altitude switches. Messrs. A. T. Sallis, 93 North Road, Brighton, Sussex can supply these as list No. 215. See Figs. 3 and 4.

Softwood and hardwood for the case.

Mild steel strip. About 2ft. of ⅛in. and 1in.

Four valve springs from a small car engine. Those used in the prototype were from an old Austin Seven, obtainable at almost any garage.

Two 5in. *Wire nails.*

S2. *Micro switch.* Burgess Type BR or similar. Change-over contacts. Messrs. Burgess Products Ltd., Dukes Way, Gateshead-upon-Tyne.

S1. *Table Lamp Switch.* Arcolectric Type S.308.

B1 and B2. *Low Voltage Signal Lamps.* Arcolectric S.L.82. Obtainable from Messrs. Arcolectric (Switches) Ltd., Central Avenue, West Molesey, Surrey.

Tr1. *Standard Speaker Transformer* or a 6V. filament transformer. MTF1 from Messrs. A. T. Sallis would suit.

The case

This may be of any material, but if of metal it must be properly earthed to the green mains lead. A suggested wooden cabinet is shown in Figs. 1 and 2. Two pieces of deal as in Fig. 2 are required, the rest is made up of hardboard pinned in place, the front panel being screwed.

Obtaining the Aneroid Capsule

Refer to Figs. 3 and 4. Remove the two metal locking clips labelled 2 and 4. Clamp the body 3 tightly in a vice and with a cold chisel and hammer, attempt to unscrew the portion 1 by knocking round in the conventional way. Similarly try and unscrew the portion 5 in the same way.

In the prototype the portion 5 was thus easily removed but 1 could not be moved. Resort had to be made to very careful cutting with a hack-saw round the portion shown dotted (Fig. 4). In the event of portion 5 not moving, cut round it too at the dotted line. When 5 is removed take out all the contacting gear; this is not required.

The fixing stem of the capsule 8 with its nut is required and will come away complete with the capsule. Careful cutting with a hack-saw down the container 3 may be necessary. It is **most important** that the capsule is not damaged when hack-sawing the container. Even a small air leak will render it useless. The rod attached to the other end of the capsule is broken off. It is very hard and cannot be cut by a hack-saw.

Aneroid Capsule Frame

Three parts are required to be cut from mild steel about ¾ or 1in. × ⅛in. to the dimensions given in Fig. 6. The strip X is fixed to the capsule fixing stud, packing with washers if the thread does not go far enough down. The strips Y and Z are mounted on the broken off piece of the capsule. The arrangement is seen in Fig. 2. Small nuts and bolts fix the piece Z to Y. The flange on the broken-off piece of the capsule is thus locked between Y and Z.

A large nail is soldered in at each end of X (Figs. 2 and 6) and two valve springs are fitted over each nail. The nails are quite free to slide in and out of the piece Y (Figs. 2 and 6).

The springs should now have stretched out the capsule (formerly completely squashed up by air pressure) to a length of about 3¾in. The bellows will now respond to even small changes in air pressure.

The Switch Frame

This is made of 1in. or similar M.S. strip and is shown in Fig. 6. The dimensions are critical to within ⅛in. A small double bracket as shown is also required for the micro switch. A small brass nut is soldered over a hole as shown and a screw inserted to serve as an adjuster.

Mounting the Parts.

The nut holding piece X (Fig. 2) on the capsule is undone so that the stud may be inserted through X of Fig. 6. The nut is then replaced so that the aneroid unit is within the frame as seen in Fig. 2. Now mount the micro switch and with the adjusting screw fix it so that the operating plunger is just resting on the end of the broken steel dowel. Try gently easing the bellows in or out and the micro switch should be heard to operate. Oil the nails, and the valve springs with light machine oil.

The frame is now screwed down firmly to the base of the cabinet (Fig. 2).

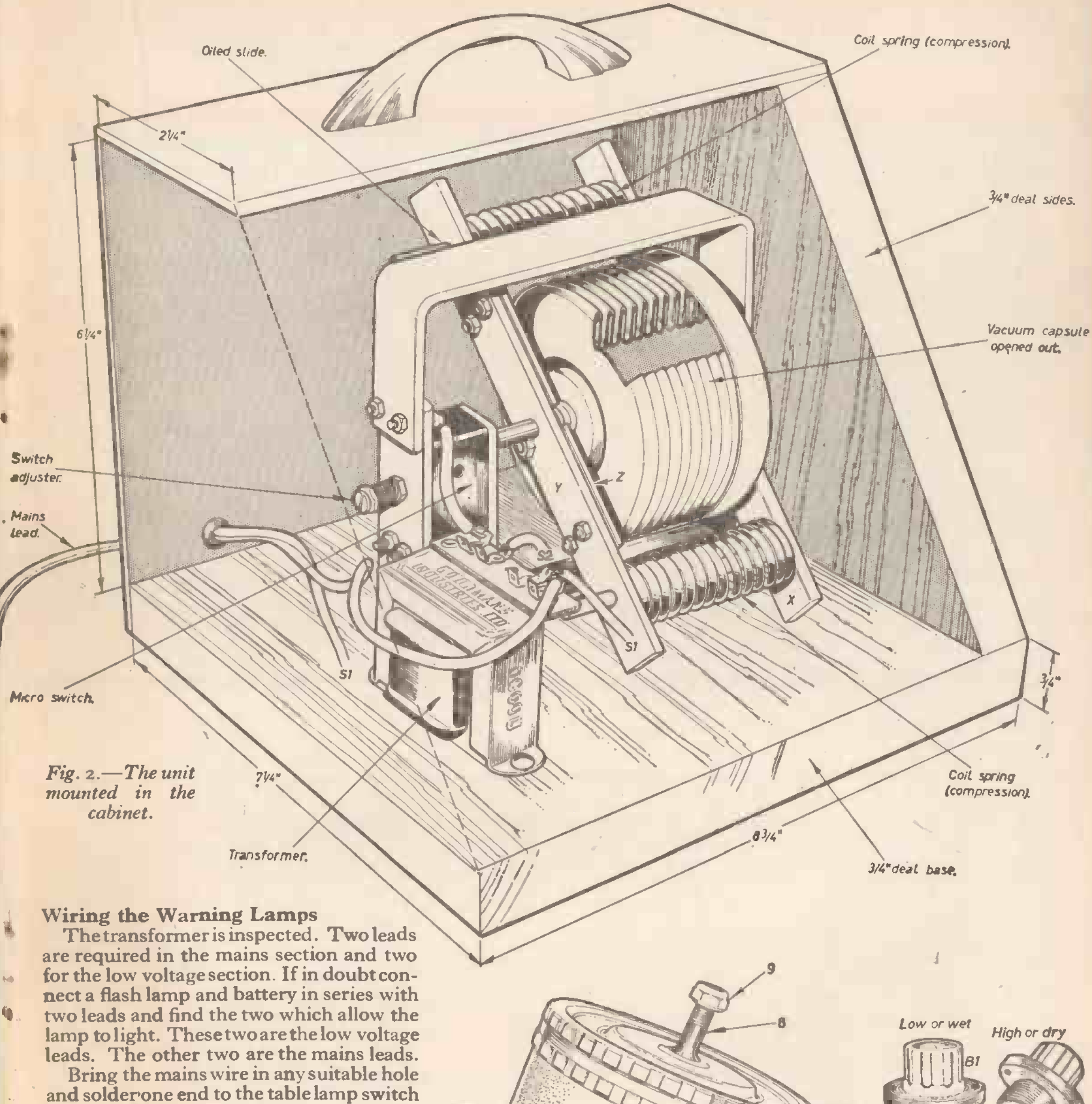


Fig. 2.—*The unit mounted in the cabinet.*

Wiring the Warning Lamps

The transformer is inspected. Two leads are required in the mains section and two for the low voltage section. If in doubt connect a flash lamp and battery in series with two leads and find the two which allow the lamp to light. These two are the low voltage leads. The other two are the mains leads.

Bring the mains wire in any suitable hole and solder one end to the table lamp switch and the other to the transformer. Make sure the lead cannot be pulled away by tying a

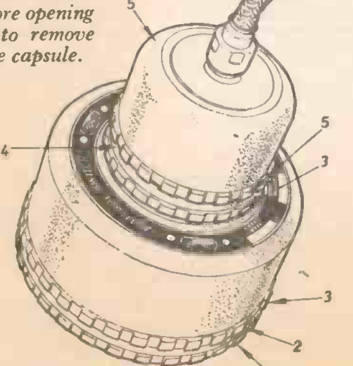


Fig. 3.—*The height switch before opening up to remove the capsule.*

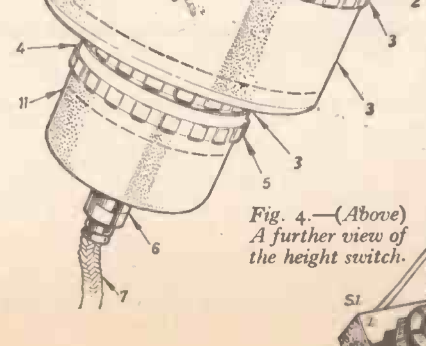


Fig. 4.—*(Above) A further view of the height switch.*

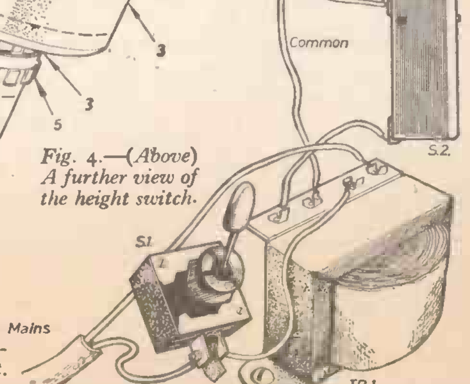


Fig. 5.—*Typical practical layout of circuit.*

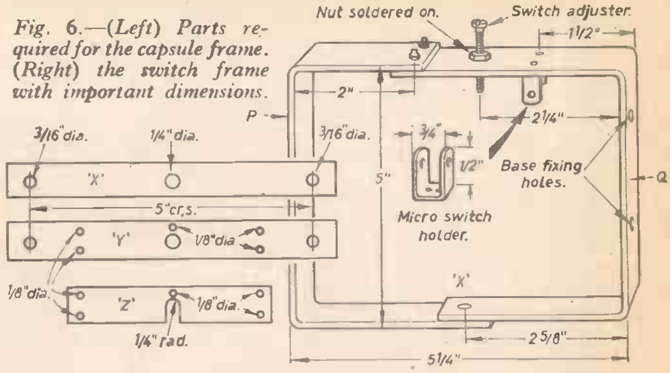


Fig. 6.—(Left) Parts required for the capsule frame. (Right) the switch frame with important dimensions.

knot in it or fixing with staples. Connect the switch to the other lead of the transformer (See Fig. 5).

Connect the low voltage side to the micro switch common terminal as shown (Fig. 5), and the other side to one signal lamp and on to the next one. Connect the other tag of each signal lamp to the vacant terminals on the micro switch. The micro-switch terminals are ready marked by moulding in the base.

Setting the Instrument

In ordinary locations at about Sea Level, wait until the air pressure is about 30in. This may be done by consulting a local Technical School, Meteorological Station or the Television Weather Charts. Adjust as nearly as possible so that the lamps are " on the change " by means of the adjusting screw. Leave the unit so that the " dry " lamp is on, but only just. The slightest fall in pressure will then cause the aneroid capsule to expand and operate the microswitch, changing over the lamp circuit.

People living on high ground may set the instrument as explained provided they have a fairly local television report, the barometric lines on the diagrams televised usually cover most areas. If the instrument is used at a different height it will have to be re-set. The unit can be adapted for use with batteries.

" EVENING STAR " (*Concluded from page 482*).

Fig. 31. As $\frac{1}{4}$in. and $\frac{5}{32}$in. × 40 nuts are not made commercially, make those required from hexagon steel or brass rod; $\frac{3}{8}$in. for the king pin and $\frac{5}{16}$in. for the bearer pin. The hexagon rod can be held truly in the three-jaw. Face, centre, drill the larger one $\frac{7}{32}$in. and tap $\frac{1}{4}$in. × 40. Drill the smaller one No. 30 and tap $\frac{5}{32}$in. × 40. Chamfer the corners of the hexagon, and part off to $\frac{3}{16}$in. length.

The stay bars (Fig. 31) are merely pieces of $\frac{3}{16}$in. × $\frac{3}{32}$in. steel strip, bent to the shape shown, and drilled at the ends. The guard irons can also be cut from any odd bit of $\frac{3}{32}$in. steel of requisite size; offcuts kept in a box under the bench, come in mighty handy and save time. Saw and file to outline, bend as indicated, and drill the rivet holes.

Assembly and Erection

The leading horncheeks are set with the rubbing faces at 1 $\frac{1}{16}$in. from the front end of the pony frame, and flush with the sides, as shown in the plan drawing (Fig. 25). Set one in position, hold it there with a toolmakers' cramp, and drill the outer bolt holes through the frame with a No. 41 drill, using those in the horn foot as guides. Fix with $\frac{3}{32}$in. or 7 BA bolts, as shown in the elevation of the assembled pony truck. When locating the second one, be sure to keep it dead in line with the first. Then drill the other bolt holes, and put in the bolts. Another beginners' tip: broken ends of drills can be used to make extension drills for jobs like this. Chuck a piece of $\frac{3}{16}$in. round rod about 3in. long. Face, centre, and drill for about $\frac{1}{2}$in. depth with a drill a size smaller than the broken bit. Hold the latter tightly in the bench vice between two pieces of sheet copper, so that it won't get damaged, and have the broken end projecting. Drive the bit of brass rod on to it, and you have a useful gadget that can be held in the chuck of a hand brace or electric drill, and will reach into all kinds of tight places, see Fig. 32.

To locate the rear horncheeks, use the axleboxes themselves as spacers. Set the horncheek flush with the edge of the frame, and put the axlebox between it and the one already fixed, so that the box can slide easily between them, but without slackness. Clamp it in place, and then drill the bolt holes and bolt up as before.

Now set the bearer in place on top of the horncheeks, as shown in the front elevation. Clamp it in position with two small cramps, one at each side, holding the top bends of the front horncheeks to the underside of it. Drill the holes in the bends, using those in the bearer as guides, and bolt up. Shift the cramps to the back horncheeks, see that the axleboxes are free to move from top to bottom, and drill as before; but before bolting up, put the staybars in place. The inner bolt at each side goes through the end of the staybar as well as the bearer and horncheek bend, so that longer bolts will be needed. The lower ends of the staybars are bolted to the frame, as shown in the elevation of the pony truck erected.

To fit the spring blocks, put one in place at the top of the horns, put the axlebox in under it, then jam a wooden wedge or a piece of metal between. This will hold the spring block in place while a No. 41 drill is run through the holes in the bearer, to make countersinks on top of the block. Remove block, drill the countersinks No. 48, tap $\frac{3}{32}$in. or 7 BA, replace block and fix with two screws, as shown in the elevation (Fig. 25). The springs are wound up from 18-gauge tinned steel wire over a piece of $\frac{5}{32}$in. rod. Wind enough for two, cut off two $\frac{1}{2}$in. lengths, square off the ends against an emery-wheel, turn the pony upside down on the bench, drop the springs into the holes in the blocks, and insert the axleboxes. The springs should just start to compress when the boxes are in bottom position.

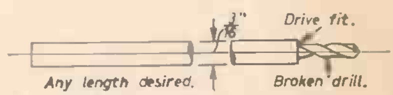


Fig. 32.—Extension drill.

Press one wheel on the axle, push the axle through the boxes, and press on the other wheel. The guard irons are riveted on with $\frac{3}{32}$in. rivets as shown, level with the centres of the wheel treads. Put the king and bearer pins in the holes in bolster and stay, and secure with nuts. The pony truck can then be put in place, and the nuts put on, with washers between them and the pony as shown. The pony truck should then be perfectly free to swing from side to side, to the amount allowed by the curved slot.

RAISING THE "VASA"

(*Continued from page* 479).

and outfitting of ships of that period. Very little is actually known on the subject.

Due to having rested in water that is very nearly fresh, the *Vasa* was found to be very well preserved, but it could not be known with any certainty whether she would stand the stresses and strains of being moved. It was planned to lift the vessel and move her still submerged to shallower water.

The work commenced by tunnels being dug beneath the hull. This was done by divers using a powerful water jet and a mud suction pump. See our artist's impression in Fig. 8. As the mud was cleared a large number of items of great archeological interest were discovered, including carvings, coins, cannon and mortars, human skeletons, wooden casks, etc. When the tunnelling was complete, 6in. steel cables were passed beneath and secured to two giant salvage pontoons. Then *Vasa* was lifted from her 15ft. grave and towed underwater to a point some 1,500 ft. away. This journey was accomplished in eighteen stages, the hulk being grounded between each (see Fig. 2).

During 1960 a great deal of work was carried out on the hull to make it watertight and reinforce it to enable the final lifting operation to be carried out. (Fig. 4). Pneumatic hammers and drills were used in the work of shuttering the many open gun ports and building up the stern with wooden supports. Drawing irons were used to strengthen the hull and these were drawn through four gun ports on each side and screw tightened on the outside of the hull. This can be seen in Figs. 4 and 10. An immense amount of caulking work had also to be completed.

Finally all was ready for the lifting operation. The cables that were used earlier were attached to the lifting pontoons, the pontoons were submerged by filling their ballast tanks with water and the cables were hauled taut (see A in Fig. 3).

Picture B of the lifting sequence shows the pontoons dewatered lifting the *Vasa* about 9ft. The ship was trimmed to overcome her list of 12 deg. Divers attached new lifting cables, each 9in. thick, to augment those used previously. The *Vasa* was then sunk into her depression again, then lifted 24ft. by means of hydraulic jacks. Divers then spent the next two weeks caulking the bottom of the vessel. The lifting pontoons were kept on an even keel during this period by filling their outer ballast tanks.

While the caulking and strengthening operations were in progress the *Vasa* was towed by stages to shallow water. Her deck line broke the surface for the first time during the third stage, Fig. 3 (C) and Fig. 9.

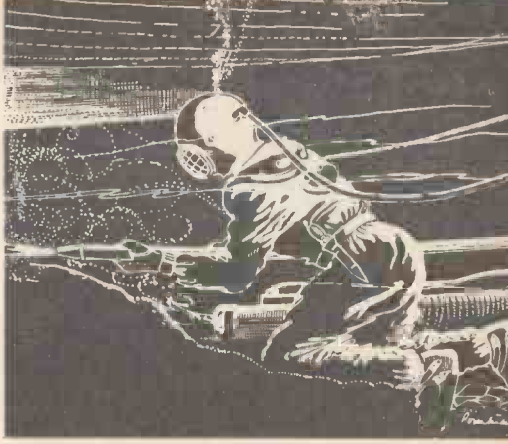


Fig. 8.—Tunnelling under the hull.

At the fourth stage (D) the *Vasa* was at a depth of 30 to 40ft. and the pumping operation began. Two submersible Flygt 56 h.p. pumps, one of which can be seen in Fig. 6, were placed fore and aft in specially arranged pumping pits and began shifting water from the hull interior. At the same time caulking and strengthening continued. As dewatering went on the *Vasa* floated higher and the weight on the cables lessened. The lifting pontoons were kept in correct trim by successive pumping of ballast water between the various tanks and the sea.

When the lowest gun ports were clear of the waterline the initial pumping stage was complete, but some continuous pumping was still necessary (E). Before docking all remaining work and scientific investigation will take place on a shallow and sheltered bank between Skeppsholmen and Kastellholmen.

Finally, *Vasa*, when all the water is out, will be towed to Gustav V's dock at Beckholmen and lifted on to a specially constructed pontoon (F). Here she will be prepared for the voyage to her final destination, the " Vasa Wharf " at Alkarret.

A museum is to be built round her on the pontoon and this building will have specially insulated walls and roof and will be equipped to maintain a controlled humidity. After 300 years in the sea, the *Vasa* must not be allowed to dry out too quickly, as her timbers would shrink and lose their shape. This humidity level will be reduced over the next six or seven years and then, when properly dried out, the *Vasa* will probably be moved to a permanent site on shore.

Fig. 9 (Left).—The " Vasa's " deck line breaks the surface for the first time.

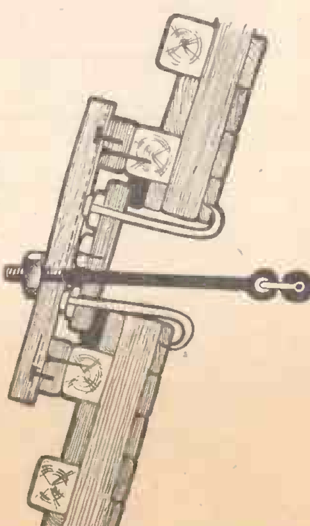
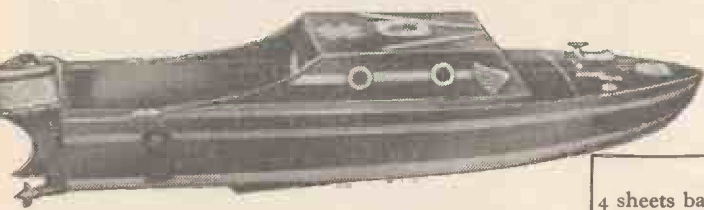


Fig. 10 (Right).—Drawing irons passed through four of the gun-ports were used to strengthen the hull.

A Model Outboard Launch



By Colin Read

By Colin Read

MATERIALS LIST
4 sheets balsa wood $\frac{1}{16}$in. × 3in. × 36in.
2 sheets balsa wood $\frac{1}{8}$in. × 3in. × 36in.
2 lengths balsa wood $\frac{1}{8}$in. × $\frac{1}{8}$in. × 36in.
1 block balsa wood 3in. × 3in. × 2½in.
1 sheet plywood $\frac{1}{16}$in. × 6in. × 3in.
1 sheet lightweight model span tissue.
¼ pint clear dope.
2 oz. jar red dope.
1 tube cement.
1 outboard motor (Selcol).
1 4½V. battery.
1 small piece of celluloid.
Fittings: 1¼in. steering wheel, 2in. lifebelt, a set of $\frac{5}{8}$in. portholes, a set of bollards and cleats and a twin siren.

BALSA wood is the main material used for this neat little craft and reference to the materials list will show that everything else required should be obtainable from the local stockist of model-makers' supplies.

Construction is commenced by cutting from $\frac{1}{8}$in. medium hard sheet balsa formers F1—5 and keel 1 (see Figs. 1 and 3). From $\frac{3}{32}$in. balsa cut the cabin sides and from $\frac{1}{16}$in. plywood cut formers F5A and F5B, cementing them either side of F5 to provide a firm engine mount. Cement formers 1 to 5 in place on the keel, K1, and leave until dry before adding the $\frac{1}{8}$in. × $\frac{1}{8}$in. side stringers. These are 18in. long and should be selected with an eye to equal strength. They are cemented in position using a good quality balsa adhesive to ensure watertight joints. Trim the stringers to conform with the hull outline and then cover with four pieces of $\frac{1}{16}$in. sheet balsa approximately 18in. long. Cement the two upper pieces first and when dry, trim to allow a smooth joint when the two lower pieces are added. These also will have to be trimmed a little to ensure a good joint at the keel.

Add the $\frac{1}{8}$in. × $\frac{1}{8}$in. spars and then cover the deck with $\frac{1}{16}$in. sheet (one piece each side) cutting out the rear portion as indicated on thed rawing. This piece can be used to sheet the interior at the rear. Rub down this assembly, using fine sandpaper.

Cabin Construction

Commence by cementing together the front window (built as Fig. 2) and the two sides; then add F3A and the roof of $\frac{1}{16}$in. sheet balsa. Sand with a fine sandpaper until a smooth finish is obtained.

Give the complete model two or three coats of (*Concluded on page 510*)

Fig. 2.—Attaching the engine to the boat.

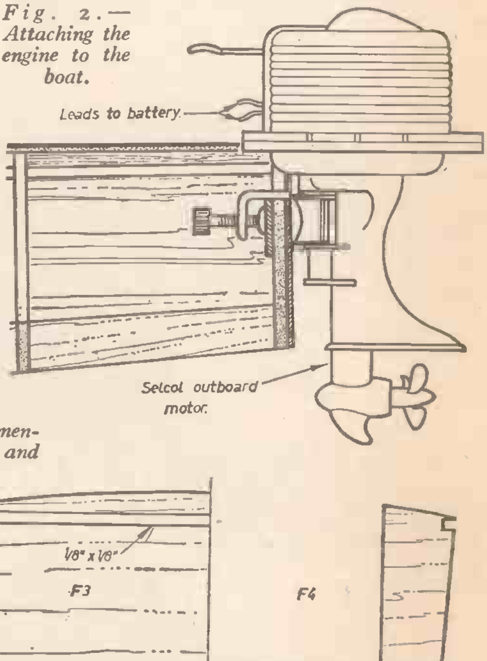
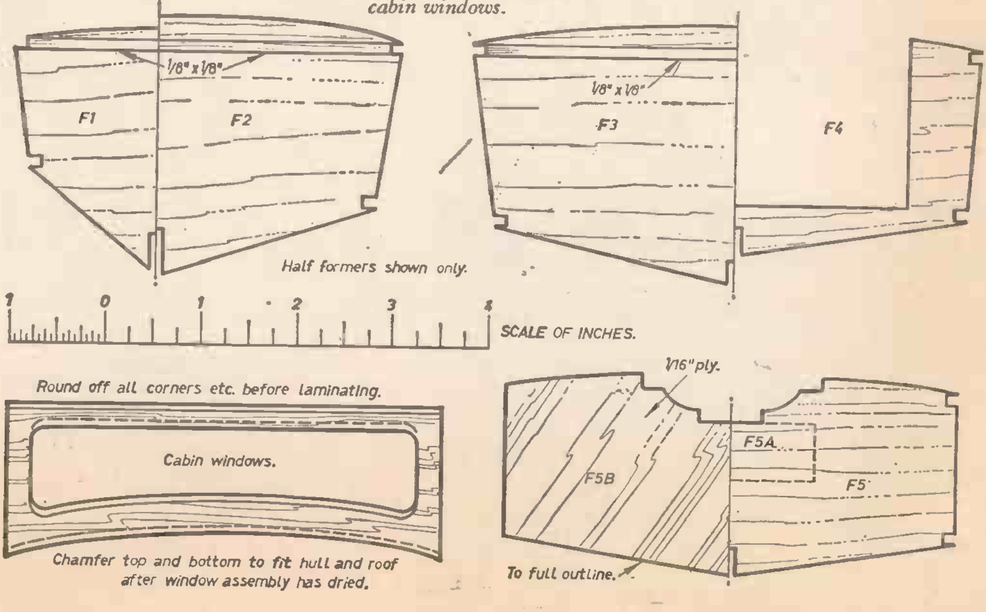


Fig. 1.—Details and dimensions of the formers and cabin windows.



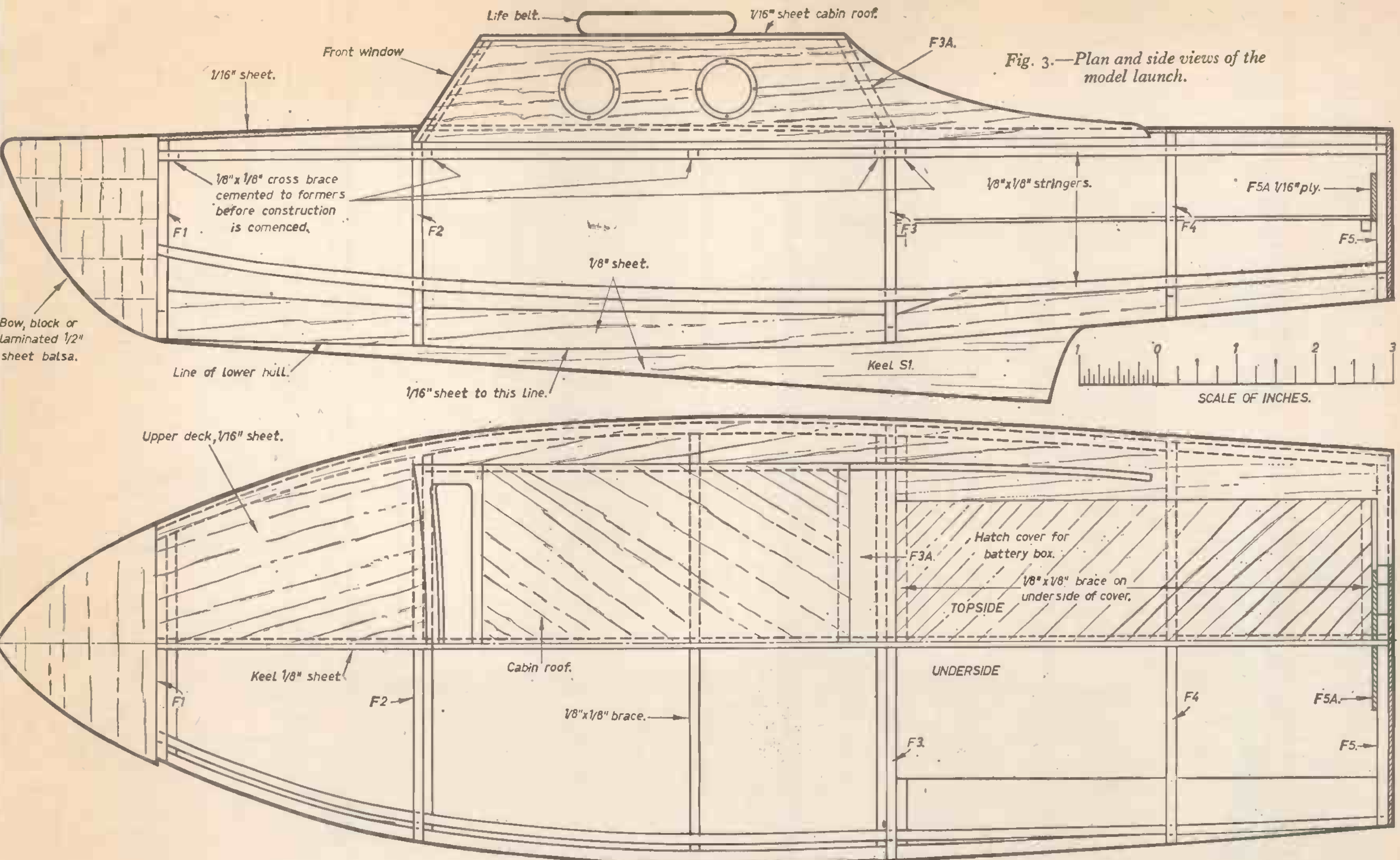


Fig. 3.—Plan and side views of the model launch.

home-made

CHEMICAL LABORATORY APPARATUS

By K. Given

Part 11—A Woulffe's Bottle, A Small Immersion Heater and a Test Tube Rack

IT is possible to prepare nitrogen from air with apparatus completely home-made. The normal apparatus is shown in Fig. 68. In lieu of the iron gas pipe and copper turnings a combustion tube of magnesium ribbon is very satisfactory.

All the parts have been described except the Woulffe's bottle and the aspirator.

A suitable aspirator is shown in Fig. 69. A large gallon lemonade jar or Winchester quart is drilled as described with a ½in. dia. hole at the bottom. The hole is fitted with a rubber bung, glass or copper tube, rubber tube and burette clip already described. In the preparation of nitrogen, water from the main is taken to the rubber tube and enters the bottle at the bottom thus forcing the air out at the top into the iron pipe. Fig. 69 shows how the apparatus may be used the other way round for producing suction or low pressure. The burette clip admits of very fine adjustment.

The Woulffe's Bottle

This is a bottle with more than two necks (see Fig. 70).

Most ordinary glass bottles may be made into quite serviceable Woulffe's type by drilling ½in. holes in the upper portions (see Fig 70). In order that the bungs may make a gas-tight joint, thicker glass bottles are preferable.

The apparatus fitted up as in Fig. 68 shows the Woulffe's bottle as a carbon dioxide absorber, the liquid is fairly strong caustic soda (sodium hydroxide) solution, this is very caustic and must be used with care. In addition to acting as a gas absorber the bottle gives a clear indication of the speed at which gas is passing and may always be used as an indicator in any " gas " circuit, provided the gas is not soluble.

Unusual Proof that air contains $\frac{1}{5}$ Oxygen and $\frac{4}{5}$ Nitrogen

Using the measuring cylinder already described mark off portions of the aspirator jar, and making sure gas passes very slowly through the bright red iron pipe, collect the gas left (nitrogen) in gas jars. Allow to cool to room temperature and with the aid of the measuring cylinder and water, measure the volume of gas obtained.

Readers will find that $\frac{1}{5}$ by volume has " disappeared," i.e. it has combined with the copper to form copper oxide. If a wrong result is obtained the following should be looked into:

1. Copper already oxidised.
2. Iron pipe not red hot.
3. Leaks somewhere in the piping, probably at position of bungs in the iron pipe.

Readers may prove that nitrogen has been obtained by plunging burning magnesium ribbon in a jar of gas using pliers. Both carbon dioxide and oxygen will support the combustion, but nitrogen puts the ribbon out at once.

A Small Immersion Heater

Often it is required to warm or boil some water and it is not convenient to light a burner, i.e. when ether has recently been used. The author found that most fluorescent tubes, when discarded still have at least one filament intact. These are very robust filaments com-

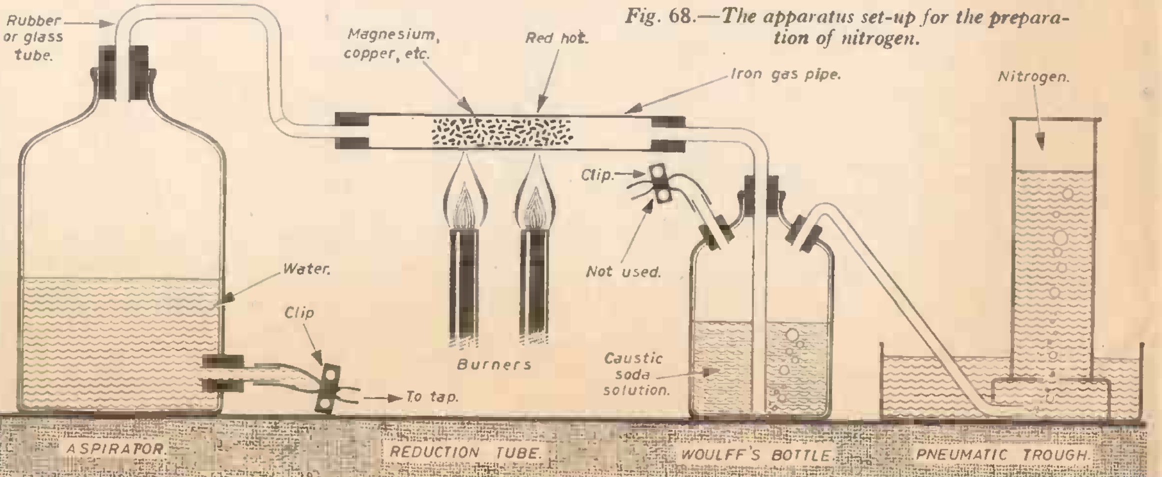


Fig. 68.—The apparatus set-up for the preparation of nitrogen.

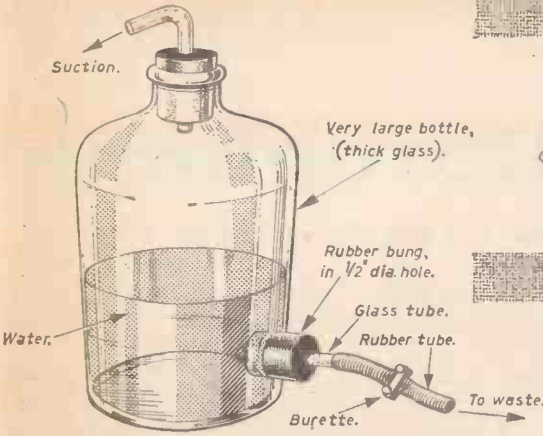


Fig. 69.—Details of the aspirator.

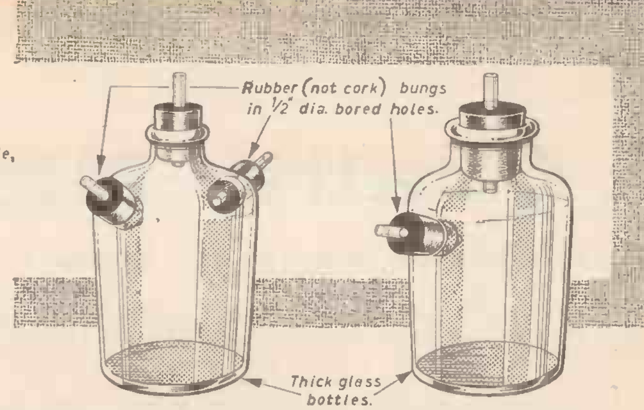


Fig. 70.—(Above) A home-made Woulffe's bottle and (above right) another useful bottle.

pared to lamp bulbs and experiment showed that when surrounded by water they will stand up to 12V.

An immersion heater made up using one of these tubes is shown in Fig. 71. It is made in the same way as the measuring cylinder but two wires are soldered to the lead contacts and wires are taken out through a rubber grommet to a 6V. or 12V. supply from a car battery or mains transformer. In the latter case earth one of the filament wires for added safety.

The immersion heater is no use if very pure water is required (some of the filament will contaminate the water) or if strongly acidic solutions are to be heated.

For such jobs as comparison of thermometer scales, or the warming of alcohol for dissolving chlorophyll it seems very satisfactory. Do not on any account connect the mains to this apparatus except via a properly connected transformer. An auto-transformer is *not* suitable.

Delicate Precipitation and Colour Change Tests

As an example consider the testing of a sample of sugar for starch. A strong solution of the sugar is made and a drop of iodine solution in alcohol is added. Even smaller quantities than 0·1 per cent. starch will cause a blue colouration. When smaller quantities are present it is necessary to have control experiments. A tube of sugar solution known to be free from starch is required and is subjected to the same test. The tubes are held up to the light or viewed against white or coloured paper to detect any difference between the two. For this and similar work a test tube rack is required.

A Test-Tube Rack

This rack (Fig. 72) will hold at least eight tubes upright and eight more in the draining position. The dimensions are not critical, but care must be taken to keep the ½in. deep location holes for the test tubes exactly underneath the holes in the thin top strip. The locating holes must not be drilled right through. Brass nails are best in order to avoid rust troubles and the whole must be given three coats of a good waterproof paint. If used with alkali solutions cellulose lacquer is probably more suitable. White paper may be attached to the back with drawing-pins for the above colour test technique.

(*To be continued*)

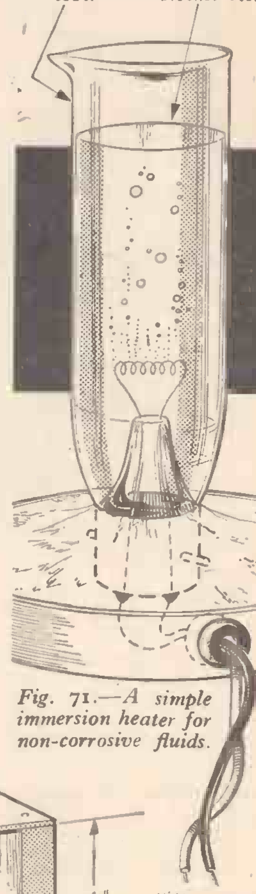


Fig. 71.—A simple immersion heater for non-corrosive fluids.

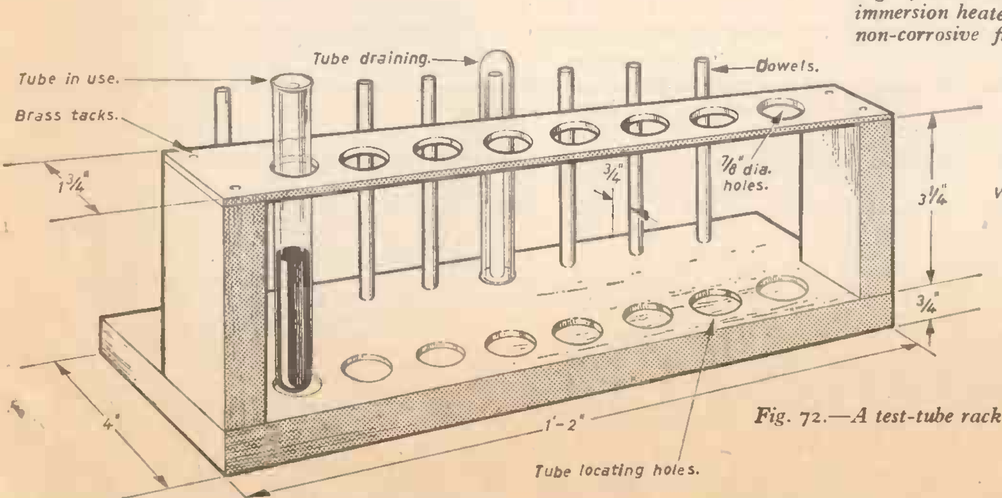


Fig. 72.—A test-tube rack.

A Quality Microphone

Jeffrey Pocock tells you how to make it from an old P.M. speaker

MAKING a microphone is not usually considered a simple task. Apart from the considerable difficulties that have to be surmounted in the design stages there is the need for special equipment for its construction. The model described here, however, is easily built by the average handyman without the need for special tools, and has a surprisingly good frequency response descending well into the bass register. Its performance exceeds that of most cheap microphones not to mention some of the more expensive models.

The unit is based on modifications to a normal loudspeaker—that used in the prototype being a 6in. Plessey unit obtained for a few shillings from a surplus dealer. Other types will suit just as well (see Fig. 1)—the only proviso being that the magnet assembly should be round; about 3in. in diameter; and of the pressed steel variety (not cast) since the outer shell has to be drilled.

Fig. 1.—The speaker unit before modification.

Reducing the Cone

Having obtained a suitable unit, it is necessary to reduce the size of the cone to less than that of the magnet assembly, and for a 3in. magnet a 2½in. dia. cone will be satisfactory. This is done by marking out a circle 1¼in. radius from the centre of the speaker cone (Fig. 2). Next (using small scissors) all surplus material is removed from between the 2½in. circle and the speaker suspension, which must be done with care. The reduced diaphragm will now be supported only by the flexible " spider " assembly surrounding the speech coil. Next, the pressed-metal chassis is removed by tin snips. This must be removed right down to the level of the magnet, smoothing down rough edges with a file. Care must be taken not to damage the flexible leads to the speech coil, and these should first be disconnected from the chassis. The appearance of the unit at this stage will be seen in Fig. 3. Next, two holes are drilled in the casing—one on each side. Since these holes go through into the " pot " assembly care must be taken so that no drilling swarf enters the pole-gap. This is done by using heavy grease on the drill. The hole may now be tapped (a 3 BA tap being used on the original), the tap also being greased. At this point a wire mesh cover must be fitted, and the procedure is as follows: Firstly, the flexible leads are cut as short as possible, and thin insulated wire joined to them. These new leads must be bent (hairpin fashion) beneath the cone and bound to the outer edge of the magnet assembly by insulation tape. When this is done make certain they do not touch the cone or the spider, and that the cone is free to move piston-fashion without binding.

A piece of wire mesh is now shaped into a dome to fit over the cone (this is easily done with the fingers) and held carefully on to the band of insulation tape while it is bound firmly into position by several further layers of tape. Crude though it may seem, this method has proved most satisfactory, being quite rigid. If preferred, a worm-drive hose clip could be used here. The appearance of the insulation tape would detract from the finished article, so this is covered by a layer of black P.V.C. tape of the adhesive variety. The two leads are now connected to a small, non-reversible two-pin socket fixed by a single screw to the body of the microphone (drilling and tapping as before) and the unit is ready for painting. A coat of air-drying crackle enamel will give a professional finish, and the unit may be suspended by its mesh over a suitable drying medium (oil stove, or gas flame).

The Stirrup Mounting

This is shown in Fig. 5 and is easily made from mild steel strip, no measurements being given as a

Fig. 2.—The smaller cone marked out.

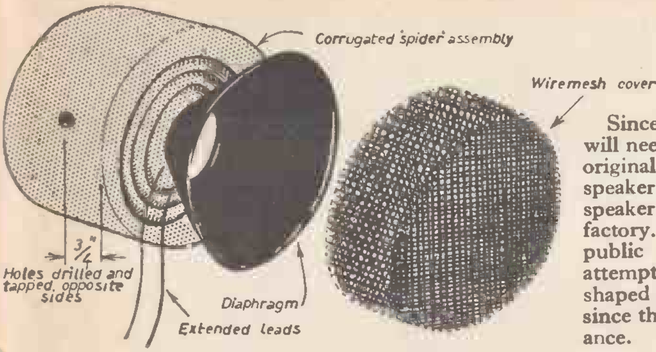


Fig. 3.—Constructional details.

suitable piece may be to hand. It should be bent to a slightly larger curvature than the microphone, since when assembled the 3 BA mounting bolts will be under tension to facilitate swivelling to any elevation required. The stirrup may also be "crackled," and the hole in its base should be much larger than the fixing bolt. The rubber buffers (obtainable from any ironmongers as rubber "feet") form a resilient mounting when the bolt is in position. The table-base is best obtained ready-made, and a suitable model is available from Lustraphone Ltd., of 11 St. Georges Mews, London, N.W.1, for a few shillings. The centre boss of this should be drilled and tapped to take the centre bolt.

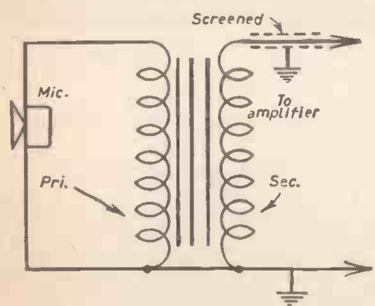


Fig. 4.—The transformer connections.

Since the microphone is a low-impedance type it will need a step-up transformer, and that used in the original was a 100:1 "Radiospares" model—the speaker being of the 3 Ω variety. For a 15 Ω speaker a 50:1 transformer by the same firm is satisfactory. The finished unit will prove suitable for public address amplifiers or tape recorders. No attempt should be made to "box in" the cone-shaped diaphragm other than by the use of wire mesh, since this would have a serious effect on the performance.

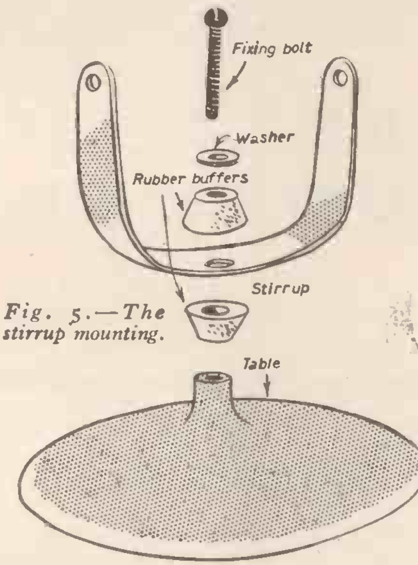


Fig. 5.—The stirrup mounting.

The leads from the transformer secondary must be screened in order to prevent hum. (See Fig. 4.) Those from the microphone to the primary of this transformer may also be screened but owing to the low (3 Ω) impedance it will be found that even with ordinary twin flex no hum will develop.

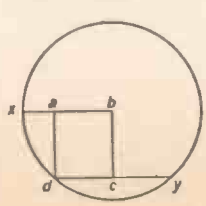
PUZZLE CORNER

Circle Problem

HERE is a simple problem if you think about it. B is the centre of the circle. A, B, C, D is a rectangle. DY = 6in. and BX = 5in. What is the distance from A to C?

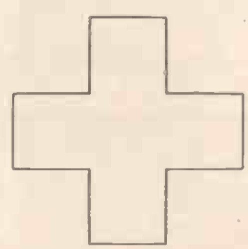
Answer

Since A, B, C, D is a rectangle, AC will be the same length as AB which, as it is the radius of the circle, is the same as BX which is 5in. (Also see diagram right.)



The Peculiar Allotment

A GARDENER works an allotment of a rather peculiar shape. All its sides are equal and they are straight, and there is a right-angle between each pair of adjacent sides. No, it isn't a square; it has twelve sides. Can you draw the shape of it?



Answer

See diagram above. You cannot have missed seeing the answer to this, but why not try it on your friends?

We will pay 10/6d. for every puzzle published in "Puzzle Corner"

Fig. 1.—A photograph of the parts.

AN ADJUSTABLE CORNER CRAMP

By Jameson Erroll

THIS multi-purpose cramp can be used for frames of all sizes, and for shallow boxes, drawers, etc. Its working size is limited only by the length of wire employed, and a good plan is to make up three wires, say 6ft., 10ft. and 15ft. long.

Fig. 2 shows a damaged drawer being cramped; the joints were re-glued and pinned, and the job squared-up and cramped. Fig. 1 shows a photograph of the parts; they consist of five 2in. lengths of $1\frac{1}{2}$in. × $\frac{1}{4}$in. bright steel angle, four small brass base-plates, a larger steel baseplate, two small brackets, two $\frac{1}{4}$in. Whit. thumbscrews, a $4\frac{1}{2}$in. length of Whit. rod with flynut, and a small brass block.

The Corner Blocks

These are shown in detail in Fig. 2, top and bottom. Three exactly similar are required. Ensure that each length of steel angle is cut dead square, in particular those edges on which the baseplates are screwed. These latter are cut from 13 s.w.g. brass (or near) or from $\frac{5}{64}$in. flat bright steel. They are attached to the edges of the corner blocks with three $\frac{3}{8}$in. × 4 BA c'sk. bolts; $\frac{9}{64}$in. holes are drilled in the plates and countersunk, and holes drilled in the blocks with a $\frac{7}{64}$in. or No. 32 drill and then tapped 4 BA. See that the heads are well countersunk so that the plates lie flat. The object of the pin-punch holes shown is to enable the frame to be pinned after glueing but before removal from the cramp. They are carefully positioned to accommodate all normal widths and thicknesses of frame mouldings, etc. The pins are passed through the appropriate holes and tapped in as far as possible with a hammer; a pin-punch is then used to drive them completely home. Later, they may be punched a little below the surface and the small holes filled with plastic wood. Pin-punches may be bought in sizes $\frac{1}{16}$in., $\frac{1}{8}$in., $\frac{3}{16}$in. and $\frac{1}{4}$in.

The wire guides are merely small notches cut in the sharp corner of the blocks with a round file, and serve to prevent damage to the straining wire.

Fig. 2 explains the tensioning assembly and gives measurements. It will be seen that it employs a further two corner blocks which vary but slightly from those already made. The front one needs no baseplate nor wire guide notches, but has two small steel brackets (about 1in./$\frac{3}{8}$in. × $\frac{1}{2}$in. × $\frac{3}{32}$in.) which act as lateral guides for the free end of the tensioning bolt. These brackets can be fastened with 6 BA R/H bolts but, when screwed home, *must* have their ends filed down perfectly level with the inside surfaces of the corner block. If this is not done, they will mark the work being cramped. That portion of the external corner on which the bolt will ride is filed flat to give better purchase. Note at this stage that the bolt does not engage centrally in relation to the 2in. height of the corner block; its centre is approximately $\frac{7}{8}$in. up from the main baseplate. The reason for this is that the majority of work likely to be cramped will be picture-frames and the like, and these do not normally exceed $1\frac{1}{2}$in. or so in height; thus, the main pressure is applied reasonably close to the base of the block, which is all to the good.

The main baseplate, a $4\frac{1}{2}$in. length of $\frac{1}{8}$in. mild steel 2in. wide, carries the assembly, and the front corner block just prepared may now be attached to one end of this plate with three 4 BA screws as were the other blocks to the smaller plates.

The fifth corner block is first mounted on a small baseplate as shown, and then drilled and tapped to receive two wing bolts (one on each side) which need be only $\frac{3}{8}$in. or $\frac{1}{2}$in. long at the most. These two bolts are for fixing the straining wire.

Tension Bolt Hole

The drilling of the hole through the 90 deg. angle—to take the tensioning bolt—must be very carefully done, and the use of a vee-block guide is practically essential. Make sure that the centre of the hole to be drilled is the correct height, i.e., $\frac{7}{8}$in. from the bottom of the small brass baseplate, and commence drilling with a $\frac{1}{32}$in. drill. Then carry out the process again with a $\frac{1}{8}$in. drill, then a $\frac{5}{32}$in. drill, and so on, increasing by $\frac{1}{32}$in. each time, until the hole has a diameter of $\frac{5}{16}$in. which is the tapping size for $\frac{3}{8}$in. Whit. thread. Now use a $\frac{3}{8}$in. drill, but to a depth of only about $\frac{1}{16}$in., to clear the right-angle a little for the entry of the tap. Proceed carefully with cutting the thread and, at the commencement, check frequently that the tapping tool is perfectly upright and that it is kept so.

The brass block at the end of the main baseplate acts as a guide for the tensioning bolt and should be drilled with a good $\frac{3}{8}$in. clearance, say with a $\frac{13}{32}$in. drill. Here, again, the centre of this hole must align with that in the moving angle-block. When drilled, it is attached to the main baseplate with four 6 BA c'sk screws, one near each corner.

The tensioning bolt is a $4\frac{1}{2}$in. length of $\frac{3}{8}$in. Whit. rod to one end of which is threaded a flynut, pinned through to prevent it turning. The back edges of the main baseplate should be rounded as shown and the various parts assembled. It should be found that the moving angle-block will glide smoothly along the main baseplate when the flynut is rotated in either direction.

The Straining Wire

This is plainly visible in Figs. 1 and 2 and should be of five or seven-strand hardened brass or steel wire. It takes all the strain yet must not be unduly thick and cumbersome. One end requires to be furnished with a circular loop with an internal diameter of $\frac{5}{16}$in. Bend it round a suitable circular tool or short length of silver steel rod at about 2 in. from the end; unravel *one* strand of wire and wind it tightly around the main wire and the free end; then unravel another strand and repeat; continue until all the strands have been bound around both wires, and tighten and tidy up with pliers rotated in a clockwise direction. To strengthen the joint further it may be soldered. The other end of the wire should be twisted tightly with the pliers and a blob of solder applied to prevent subsequent fraying.

Operation

Work on a perfectly even surface and place the frame upon it with the four corner blocks in position. See that the moving block on the main baseplate is as close to the front corner block as possible so that there is ample play for tensioning. Unscrew one wing bolt, thread on the looped end of the wire, replace the bolt and tighten it up. Pass the wire around the other corner blocks, running it over the appropriate wire guide notches and, only loosening the other wing bolt, wrap the other end of the wire around it twice after pulling it taut by hand. Tighten the wing nut and apply gradual pressure by turning the tensioning bolt. Check for squareness by measuring the diagonals and, when perfectly square, tighten up finally, using just sufficient force to bring the mitres closely together and to squeeze out the surplus glue. Now drive in the pins, two at each corner, using veneer pins for the smaller mouldings and brads for the larger. Allow plenty of time for the glue to set before removing the cramps.

Even if picture framing or other work where the need for an accurate set of right-angle cramps arises, is only carried out very occasionally, the device described will be found well worth while. It enables the worker to save time and to achieve a higher standard of accuracy.

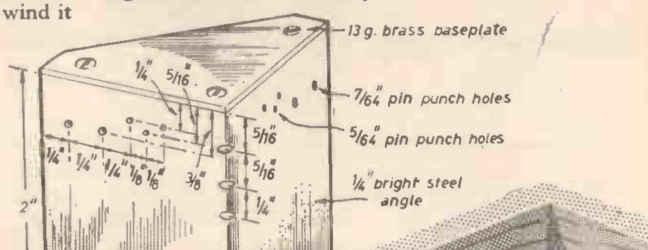
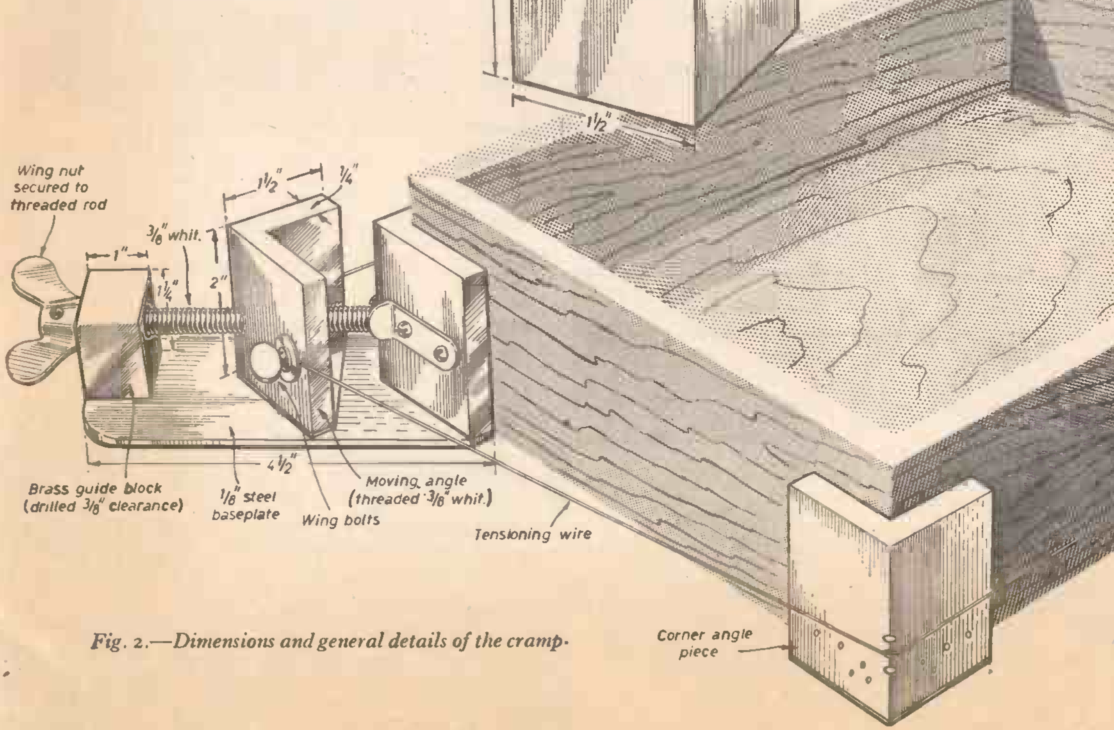
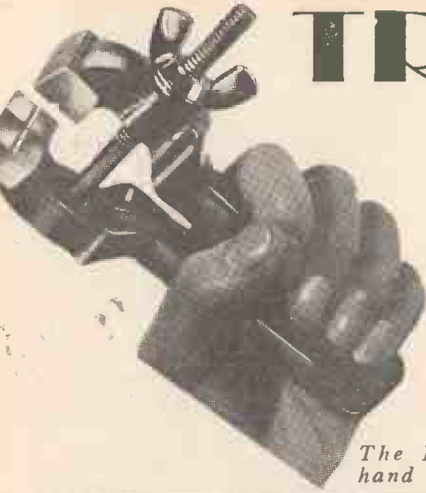



Fig. 2.—Dimensions and general details of the cramp.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.



The Rolls hand vice.

Rolls Hand Vice

THE very many types of job for which this little tool is handy are far too numerous to mention but it is safe to say that some use could be found for it in every home workshop and garage. The jaws and arms are a robust light alloy casting, hinged at the bottom and tensioned by a stout V spring. The jaws which have a maximum opening of $1\frac{1}{2}$in. are grooved for gripping round rod either horizontally or vertically and plastic inserts are also provided for a non-scratch grip. The Rolls hand vice which can be seen on the left costs 6s. 6d. and is available from Do-it-Yourself shops and ironmongers. The makers are Rolls Tools Ltd., 154-156 Blackfriars Road, S.E.1.

(*Above*) *The Artifex flexible abrasive sponge.*

Artifex Abrasive Sponge

CURVED, flat and profiled surfaces can, in one operation, be given either matt or polished finishes by using the Artifex flexible abrasive sponge, shown on the left. Its resilience enables close and continuous contact to be maintained with the work and also takes up chatter and vibration. Little heat is generated and no coolants or lubricants are required. It can be used on steel, iron, brass, copper, bronze, aluminium, plastics and hard woods. The product is marketed by Finishing Aids and Tools Ltd., Chandos House, Buckingham Gate, London, S.W.1.

G.B. Sheet Shear

SHOWN on the left below is a shear which should be of interest to all those who work with sheet metal. It is precision built and based on an entirely new principle. It operates by cutting a narrow strip of metal from the waste side of the cut, producing a clean slot and, as can be seen, metal sheets of any size can be fed forward without obstruction. Buckling, twisting and distortion are completely eliminated, it is claimed. The price of the G.B. Sheet Shear is £45 and the sheet support, £5, from Ferrous Transformers Ltd., Church Road, Croydon, Surrey.

(*Below right*) *The machine for grinding lawn mower blades.*

(*Below*) *The G.B. sheet shear being used.*

Lawn Mower Grinder

THE "Simplon" Lawn Mower Grinding Machine is designed especially for the amateur. Features of the machine, which is shown below, are that it will grind accurately to within a limit of 0.0003in. for straightness within a 14in. length; it is built all of steel, no castings or brittle parts being used; it will grind the lawnmower cylinder *in situ* and grind the bottom blade on or off its sole plate. It will also tackle garden shears. The machine is powered by any popular make of electric drill and costs £12 17s. 6d. plus 7s. 6d. carriage and packing from A. W. Roebuck Ltd., Turvey, Bedfordshire.

LETTERS TO *The Editor*

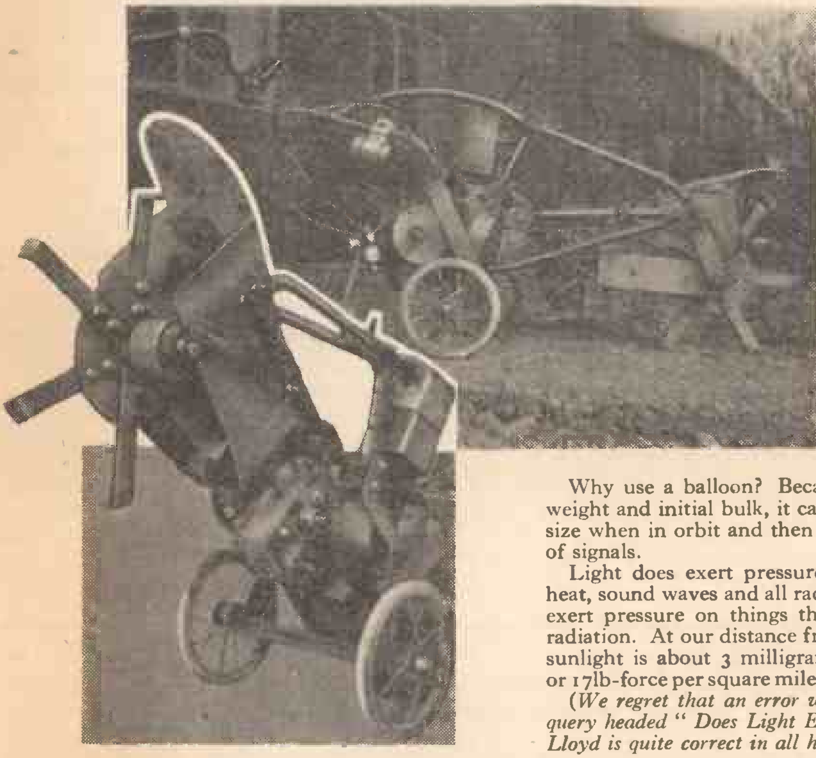
The Editor does not necessarily agree with the opinions expressed by correspondents

Another Scrapyard Cultivator

SIR.—I was very interested in the article on the Scrapyard Cultivator in the March, 1961 issue of P.M. The photographs below show a similar machine which I constructed last November. The frame and engine of a 98cc. Excelsior autocycle were used and to get a gear ratio of 18·5 : 1, which I found to be very satisfactory, I had to fit a gearbox. The chainwheel of the original autocycle, which had 35 teeth, was fitted to the clutch shaft of the gearbox.

The rotor is a 7in. disc with six spring steel blades bolted to it. The disc is welded to the bottom bracket shaft of a Raleigh Moped. This also gave me two $\frac{5}{8}$in. needle bearings and provision for a ten-tooth sprocket. The engine is started by a pulley fitted to the fly-wheel, on to which a rope is wound.

The original coil of the fly-wheel magneto had gone, so I made use of a lighting coil and an old magneto armature which I had on hand.—G. Tesseyman (York).



Two views of Mr. Tesseyman's Cultivator.

Light Does Exert Pressure

SIR,—In your May issue you answered a reader's query about balloon satellites and light pressure, but I am afraid your answer was misleading in its first part and incorrect in its second.

Balloon satellites do not rely upon buoyancy in the air; their orbits lie well clear of the atmosphere and are maintained because gravitational force is balanced by centrifugal force.

Why use a balloon? Because, though it has little weight and initial bulk, it can be inflated to immense size when in orbit and then acts as a strong reflector of signals.

Light does exert pressure. Radio waves, radiant heat, sound waves and all radiations that carry energy exert pressure on things that deflect or absorb the radiation. At our distance from the sun, the pressure sunlight is about 3 milligram-wt. per square metre, or 17lb-force per square mile.—J. L. Lloyd (Brighton)

(*We regret that an error was made in our reply to a query headed " Does Light Exert Pressure? " and Mr. Lloyd is quite correct in all his comments—Ed.*)

Metal Tanks for Hot Water Heaters

SIR,—I was much interested in the very practical article, " Hot Water at the Sink," by E. W. Monarch in the May 1961 issue of P.M. I would, however, strongly advise against using aluminium for the water container, as it will be found that the water of some districts will corrode this metal in a very short time.

I made the sink heater described in P.M. for September 1953, at first with an aluminium tank, and found, to my dismay, that it was corroded in many places after less than six months and was leaking badly. It was therefore replaced by a rectangular fabricated copper (18g.) tank, which has been perfectly satisfactory for over seven years.—Ronald Thorpe (Cornwall).

Recharging Dry Cells—A Warning

SIR,—I see, on reading the Letters to the Editor page in the May issue of P.M. that some of your readers propose to attempt to recharge dry cells. This seems to me potentially hazardous. During recharging, chloride ions will migrate to the anode and be discharged as chlorine gas. It seems possible that this might diffuse through the polariser into the ammonium chloride and produce the highly sensitive explosive, nitrogen trichloride. This is not very likely, but anyone considering recharging dry cells, especially large ones, ought to make sure that the cell is safe.—E. M. Hildgard (Cambridge).

Comments from a Steam Advocate

SIR,—Recently you published an article in which the railway steam engine was compared to the diesel. I have driven both steam cars and i.c. engine cars and there is no comparison; the simplicity and long life of the steam car is far superior. But who today wants long life and simplicity? The key question is does the i.c. engine do its job? " I don't think anyone can deny that is does.

I will not repeat the technical points raised in the article but I would like to mention one thing which, if fitted to all steam engines, would have made a vast difference to their power; that is an efficient condenser. With this the piston does not pump the steam out of the cylinder, the vacuum created in the exhaust sucks it out. In the i.c. engine too, the pumping action of forcing out the exhaust gases takes quite a percentage of its power. Incidentally, I think it was the late Prof. Low who calculated that an i.c. engine gave in useful work only one-sixth of the potential power it consumed.

I have always been at a loss to know why some very good ideas were never developed. The Humphrey pump, for instance, was a wonderful invention. Here was an engine which had no " works." The water which passed through it was piston, con. rod, etc., and there was no prop shaft or rudder. The invention was just not wanted and steam is in the same position. If an engine were developed which could generate steam as easily as the carburetter generates a combustible mixture, the world would refuse it!

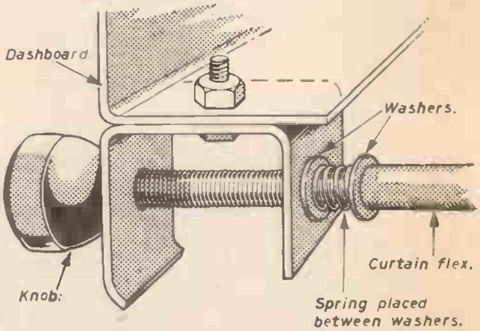
At one time there was an engine which used i.c. at one end of the cylinder and steam at the other and also I remember an emulsified petrol (40 per cent. water). I wonder if anyone used it and with what results. There have been many of these ideas in the past and once I fitted a water injector on an old model-T Ford—there was an improvement at slow speeds, but not much.—C. V. Thompson (Herts).

Using a Portable Radio in the Car

SIR,—I recently purchased a transistor portable radio for use both in the home and in the car. Whilst the set gave excellent performance in the car, I found it difficult to operate from the driving seat, so I devised the following method of remote control, which may be of interest to other readers.

The important feature is that no modifications are made to the set and it is not damaged by permanent attachments.

A small bracket (see sketch), drilled to take two small knobs, as used on furniture, was fitted to the



Dashboard bracket construction.

bottom of the dash. These knobs can be obtained in a large range of colours, shapes and sizes to match the interior decor of the car. The screw shanks of the knobs were fitted into the ends of lengths of curtain wire. The other ends were fitted with rubber suckers for attaching to the control knobs on the set.—F. Crimmins (Dalbeattie).

Adjustable Back Tool Post—Correction

WE regret that owing to a typographical error the price of the Adjustable Back Tool Post mentioned in our Trade Notes column in the June issue, was shown as £35. This price should have read £3 5s.

MODEL OUTBOARD LAUNCH

(*Concluded from page 500*)

clear model aeroplane dope and cover with lightweight model span tissue. Give the entire model another two coats of clear dope and then colour to suit. The prototype shown in the heading was doped red and yellow.

It is recommended that the fittings mentioned in the materials list be used as they add a great deal to the finished appearance of the boat and cost only a few pence. The motor used (See Fig. 2) is made under licence in England by Selcol and may be purchased from Hobbies Ltd., New Oxford Street, London, for 10s. 6d. Any other outboard motor will also be satisfactory.

A small cover can be cut from $\frac{1}{16}$in. sheet balsa to fit over the battery if desired.

YOUR Queries ANSWERED

Roof Prism Binoculars

COULD you give me information on the construction of roof prism binoculars.—K. Bradley (Liverpool).

A PRISM, whatever its type, is simply used either to provide a longer path from object lens to eyepiece; or to invert the image (or both). The long path is necessary for high magnification without a long tube as found with a telescope. Inversion is necessary when the number of lenses are such that the scene would appear upside-down. If you sketch the prism, measuring angles correctly, and draw lines striking a reflecting surface at the same angle as lines leaving that surface, you will obtain the path taken through the prism. It is not possible to cover this in detail here. The prisms do not provide any magnification themselves.

"Copper" Paint

I WISH to buy or make copper coloured paint. I believe it is a mixture of fine copper dust mixed with clear lacquer.—P. Hyland (Birmingham).

SO far as we can discover there does not appear to be a paint such as you describe on the market. George Rowney of 10 Percy Street, W.1, inform us that they supply a " copper " coloured paint in their range of Poster Paints.

However, if you wish to use metallic copper as a coverage, similar to gilt lacquer, you can obtain copper dross and suspend this in a vehicle such as industrial spirit (alcohol). This could be applied by brush.

Automatic Electric Fire

COULD you please advise me as to any method of adapting an electric alarm clock for switching on an electric fire at a set time.—A. Batson (Herts).

"Practical Mechanics" Advice Bureau. COUPON
This coupon is available until July 31st, 1961, and must be attached to all letters containing queries, together with 6d. Postal Order. *A stamped addressed envelope must also be enclosed.*
Practical Mechanics. July, 1961

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.

WE feel that the best way to arrange an ordinary alarm clock to work a fire is to fix a micro-switch on the back of the clock so that when the alarm goes off the alarm wind key actuates the switch. We have tried this with great success with the Burgess BR and as long as you do not connect it to a fire of greater wattage than 1,000 and it is on A.C. mains all will be well.

The alarm rewind key only has to be turned through about 60 deg. to re-set the alarm.

Starching Collars

I HAVE rather a short neck and I find that my semi-stiff collars turn up at the points and crease readily after only being worn for a short while. Can you tell me of a really good stiffening agent.—W. Adams (Glos.)

AN answer to your problem could be to add gum arabic to rice starch. Alternatively use one of the plastic starches but follow instructions given by the manufacturers. These give durable stiffness but no gloss.

Battery Filling and Charging

WOULD you please give me information on the initial charging of new accumulators.—R. Ward (Yorks).

PRECISE instructions for particular batteries are usually included on a leaflet with the new battery. It may also be in a semi-charged state, and after filling with acid, and allowing to stand for about 12 hours, or given a light charge on a home charger, can be put into service.

The acid used has a specific gravity between 1.250 and 1.300. The acid commonly obtained by garages has a specific gravity of 1.350. It is not important whether the acid is added to water or water to acid with this strength; the latter may be advisable—a little water at a time, stirring in and allowing to cool, for some heat may be generated. If very strong acid is used, this is always added to water.

Having filled the cells with acid of correct specific gravity, the battery can be left to stand for a time, to gas freely—and more acid may then be needed to compensate for that which is absorbed by the plates. Then the battery can be put on charge; as a rule the rate is between 3.5 and 4.5 amps, and is kept up until the cells are gasing freely. Naked lights should be kept away from the cells, as the gas is explosive. After some hours, say from night until morning, the acid can be checked and the specific gravity adjusted with stronger acid, or some distilled water; the acid level being kept above the plates, and the stoppers out of the cells for charging, or laid loosely in the apertures. If a voltmeter is available, this can be used to verify the voltage of each cell; it should be well up with a new battery, say, in the region of 2.3 volts per cell. Finally when the battery is charged and the specific gravity of the acid is correct, only distilled water should be used for making good loss from the cells.

In adjusting the specific gravity of acid before pouring into the dry cells, the mixing should be done in glass jars.

Reed Unit Construction

I AM interested in constructing a reed unit for a radio controlled model and would be grateful for any information which you could supply concerning the steel reeds which must have a natural frequency of 200 kc/s to 400 kc/s. Will the silver plating of the reeds alter their frequency? The completed unit will have six reeds and the coil will have an impedance of 2,000 to 4,000 Ω.—P. Revell (Staffs).

THE reeds require to be of thin tempered steel. Plating would probably lower frequency slightly, due to the increased weight. The reeds would be very narrow and short. As the size would have to be found by trial, they could be clamped between two solid metal pieces, so that their length can be easily adjusted. A variable pitch oscillator should be made up, and its output fed into the coil. The pitch at which the reeds resonate can then be observed. In most circuits the exact frequency is of no importance, provided it matches the reeds, and if frequencies are sufficiently separated to avoid other reeds responding as well. If the transmitter has a modulator circuit giving specified frequencies it is then necessary, however, for the reeds suit their frequencies.

A Thermograph

I AM interested in building a thermograph, could you please give me details of what is entailed.—K. King (Notts).

BI-METAL thermometers are so constructed that they have a bending coefficient in relation to the temperature. They are made of two metal strips with different coefficients of thermal expansion welded together at one end. The metal combination is either Invar-brass or Invar-steel. One end of the strips is fixed and the other end operates a series of magnifying levers which in turn operates an indicating device.

We would suggest that you hunt round for an old barographic clockwork drum as your recording unit and utilise the linkage mechanism from an old air-speed indicator, altimeter or pressure gauge.

Calibration of the bi-metal thermometer can easily be done by reference to a liquid of known B.P. or F.P.

Obtaining Full Format

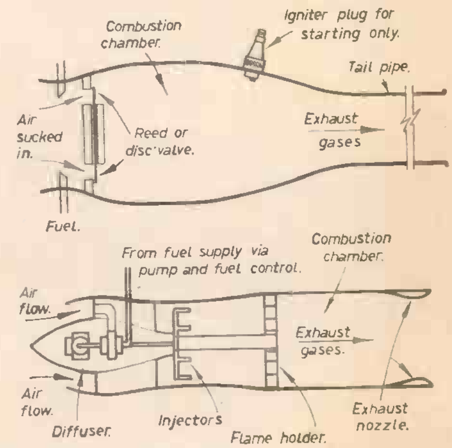
I HAVE been trying to take some photographs by using a 8 × 30 monocular in front of the lens on my Pentacon 35mm. single lens reflex. So far I haven't been able to obtain a full format getting only a ring or a hexagonal. How can I overcome this?—W. H. Davies (Glam.)

COMPLETE coverage cannot be obtained because the angle of view of the monocular is not sufficient to cover the negative area. This is quite usual. No simple way of overcoming the difficulty exists. If the camera lens is removed, and a negative lens substituted, it may be possible to obtain coverage, but definition is likely to suffer. If the lens is fixed, this cannot be attempted. For complete coverage the whole system requires to have a wide enough angle of view, and this would require a monocular of very much larger aperture than 30 with 8 magnification.

Ram-jet and Pulse-jet Principles

WHAT is the difference between a ram-jet and a pulse-jet engine?—E. Lewis (Exeter)

THE principle of the ram-jet is as follows: The ram-jet motor consists of an open-ended tube suitably shaped on the inside to permit the smooth flow of air and gas (see sketch below). Inside this tube there is a diffuser, fuel injector rings and a flame holder. The section behind the flame holder forms the combustion chamber and exhaust nozzle. The ram-jet, if fitted to guided weapons or aircraft,



(*Top*) *The pulse-jet.* (*Below*) *Details of the ram-jet.*

must have some other motive power such as rocket boosters or a turbo-jet for take off. This is because a ram-jet must have air passing through it before it will work. With the air passing through, fuel is injected and ignited, this produces a continuous explosion, the gases passing rearwards through the exhaust nozzle thus producing thrust. The ram-jet is capable of an overall efficiency of over 25 per cent. at mach 3 and is almost certainly more efficient as well as being much lighter than the turbo-jet at speeds above this.

The-pulse jet is started on the ground by using an igniter plug (for starting only), at the same time air is forced into the combustion chamber, where it mixes with the fuel and is exploded. Spark plugs are also used and this means that a trembler coil must be in circuit. When the motor is running the air and ignition leads are disconnected. As the temperature in the combustion chamber is high the fuel ignites immediately on entering into it. Some of the disadvantages of a pulse-jet is that it is very noisy, has a high rate of fuel consumption and a limited speed range. The best example of this type of motor can be seen on a VI "buzz bomb" used by the Germans during the war. There are of course other types as used for model aircraft; these are more popular in the U.S.A.

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.

RADIO

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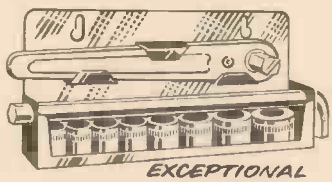

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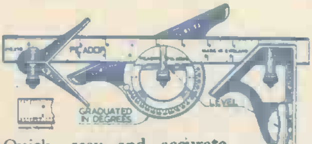

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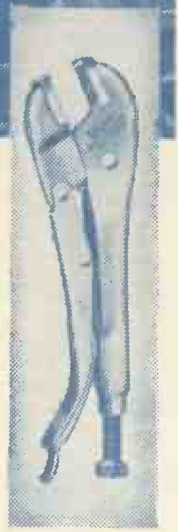

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