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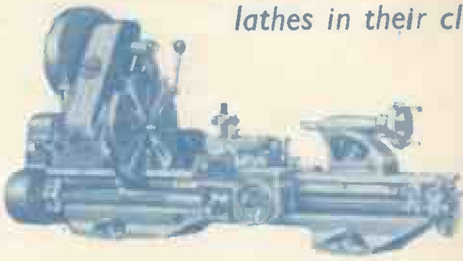

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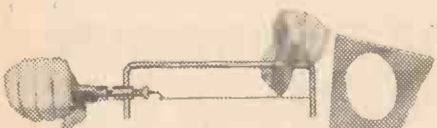

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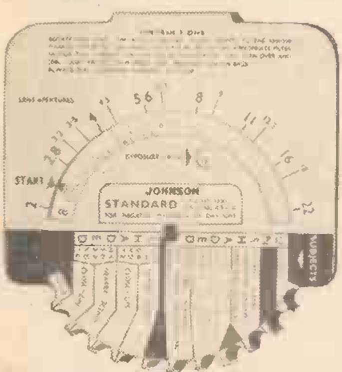

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Practical

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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

DIAMOND JUBILEE!

SYNTHETIC diamonds are not new; they were first produced by the U.S. General Electric Company back in 1955, but now this same firm has succeeded in making much larger diamonds of the same type and this is news. Some of the diamonds are larger than one carat in size but as yet they are dark coloured and because of their many flaws of no real value, even to industry. The mere fact that diamonds of this size have been produced in the laboratory at all is regarded as a major achievement and there is no doubt that they really are diamonds. Intensive tests, including X-ray diffraction, chemical tests and hardness tests have verified this.

Used in the process is very high pressure and temperature apparatus and—most important—a molten metal catalyst which acts as a thin film between the growing diamond crystal and the carbon. This catalyst may be chromium, manganese, iron, cobalt, nickel, ruthenium, rhodium, palladium, osmium, irridium or platinum, and its function is to reduce the pressures and temperatures required to within limits obtainable in the laboratory. Without the catalyst it has been estimated that temperatures of 7,000 deg. F. and pressures of 3,000,000 p.s.i. would be needed. The catalyst reduces these to between 2,200 and 4,400 deg. F., and 800,000 and 1,800,000 p.s.i.

Basically the equipment used is a small cylinder containing graphite and layers of catalyst. The pressure is built up by means of tungsten carbide pistons and an electric current provides the intense heat necessary to melt the catalyst and free the carbon atoms from the graphite. As the catalyst melts it spreads into the graphite, forming an alloy. At the leading edge of the molten alloy a thin film forms and just behind this the carbon atoms are rearranged to form diamonds.

Diamonds will only grow close to the catalyst film and will not form at all without it but the reason for this has not yet been discovered. Strangely enough diamonds can form whether diamond seed crystals are present or not and industrial diamonds of 80 mesh or finer grow in a few minutes. Lowering the pressure and temperature slows up the process, but larger stones result.

One of the most interesting discoveries relating to this process is that the shape of the diamond varies with the temperature. Low temperatures produce cubes, medium temperatures result in mixed cubes, cubo-octahedra and dodecahedra and from high temperatures come octahedra. Temperature also affects the colour of the stones. At low temperature the results are black stones, varying as the temperature is raised through dark green, light green and yellow to white at high temperatures.

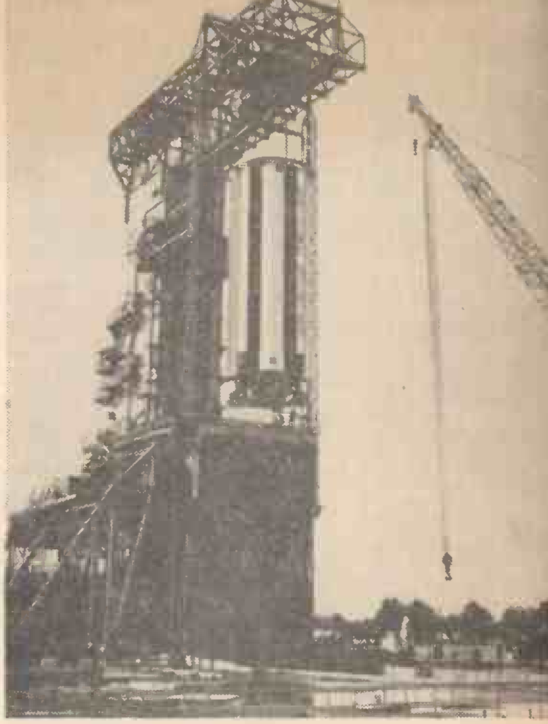
From this it can be seen that by exercising strict control over the production process, diamonds exactly suited for any specific purpose in industry can be produced. And new uses are continually being found.

Recent research showed that the electrical resistance of some types of semi-conducting diamonds varies with slight temperature changes—changes as slight as ·05 deg. C. This characteristic makes them eminently suitable for use in special thermometers.

Research continues and scientists are at present trying to find out if the new large diamonds can be improved sufficiently to be of use in industry and take their place as the latest achievement in the ever growing science of synthetics.

The September 1961, issue will be published on August 31st, 1961. Order it now!

THE SATURN BOOSTER ROCKET



ONE of the most sensational developments in space research took place on 12th February, when Russia blasted a half-ton rocket on a three month voyage through outer space to Venus. The rocket, which is a robot space station, was launched by " guided space rocket " from a satellite Sputnik circling the earth at an altitude of 300 miles.

How this was actually accomplished was, of course, not divulged. It is safe to assume, however, that the equipment involved was similar, in principle, to the huge Saturn booster rocket now being built in the United States.

Dr. Wernher von Braun, who directs the scientific and technical team that is developing the Saturn says that it is expected to become the heavy " work-horse " of American space vehicles. It will, eventually, be used to place large payloads in orbit round the earth; to send multi-ton spacecraft to the moon and more distant celestial bodies, and to put a three-man spaceship in orbit round the moon.

The first configuration, a three-stage version called the C1, will have eight Rocketdyne H-1 engines clustered in the first stage. The engines—improved and simplified versions of the well-tested Thor-Jupiter engines—will burn liquid oxygen and kerosene, and will develop 188,000 lb. of thrust.

The second stage will be a cluster of four liquid oxygen-liquid hydrogen engines developing about 70,000 lb. of thrust, and the third stage will employ two engines of a similar type providing about 30,000 lb. of thrust.

History of the Project

In the spring of 1957, designers were studying a large clustered-engine first stage arrangement and in the summer of 1958 it was decided to proceed with the development of a 1,500,000 lb. thrust stage based on a clustered engine concept.

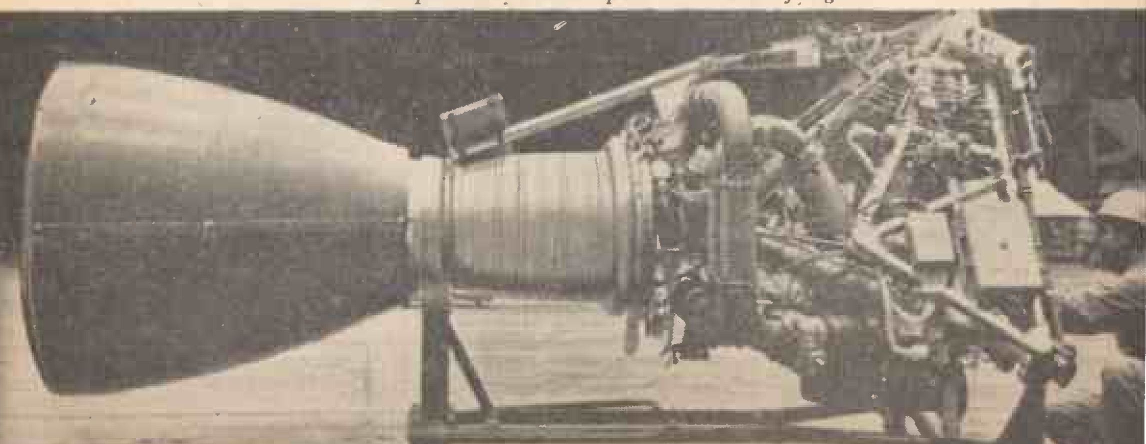
The objective of the programme, at that time, was to demonstrate, with captive test firings, the feasibility of this concept, which, of course, involved the use of heavily constructed tanks, similar to those used in actual flight.

A group of existing tanks was selected for use with the propulsion system utilised in early tests as this allowed tools and experience already accumulated to be put to full use.

It was decided to use a cluster of eight H-1 engines of 188,000 lb. thrust each. By November 1958 the " go-ahead " was given to build four flight test vehicles to study development programmes associated with multi-stage vehicles.

Preliminary planning of the upper stages was also started, and from these early studies in 1958 and 1959 it was decided to use high-energy propellants in all upper stages of Saturn. This not only increases considerably the weight of the payload the first

An H-1 space engine is prepared for installation in the Saturn space vehicle booster prior to static test firing.



(*Left*) *Workmen at the Marshall Space Flight Centre, Huntsville, Alabama, install the Saturn space vehicle booster on a special 177ft. stand in preparation for its first static test firing.*

version of Saturn can carry, but it also allows for the interchange of upper stages as more powerful high-energy propellant engines are developed, or additional upper stages required.

The First Version

The first configuration of Saturn, the C1, will be about 185ft. high and will weigh about 1,160,000 lb. fuelled and ready for launching. Of this weight almost a million pounds will be fuel and oxidiser.

The eight engines of C-1's first stage are attached to an eight-legged thrust frame at the aft end of the vehicle. Four of the engines are rigidly attached in the inboard position and canted at a three-degree angle to the long axis of the booster. The other four are mounted in the outboard position and canted at an angle of six degrees. The outer engines are also mounted on gimbals, somewhat like a universal joint, that permit them to be turned through angles of about 10 deg. to provide roll and attitude control for the entire vehicle during the first stage phase of flight which lasts approximately two minutes.

Nine separate tanks feed the Saturn's H-1 engines. Clustered in a circle around a large centre tank are eight relatively smaller tanks. These are 70in. dia., compared to the 105in. dia. of the centre tank. Liquid oxygen is contained in the centre and four of the outer tanks, while the remaining four outer tanks carry the kerosene fuel.

The tanks provide the first stage with 750,000 lb. of propellants. At the aft end of the first stage all nine tanks are attached to the eight-legged thrust frame and barrel assembly to which the engines are secured. At the forward end the tanks are attached to a circular spider beam.

All the fuel tanks are interconnected with each other, as are the liquid oxygen tanks, an arrangement permitting equalised loading during filling operations and flight. "Saturn can, however," Dr. Wernher von Braun stated, "make a perfect flight even if only seven of its eight engines are operating. The vehicle's guidance system will automatically produce the signals to correct deviation in thrust resulting from the failure of an engine during flight."

The Saturn C-1 will employ a second stage now under development by the Douglas Aircraft Company and a third stage being built by the Convair Division of General Dynamics. The second stage will be 220in. dia. and have four Pratt and Whitney 17,500 lb. thrust engines, using liquid hydrogen as a fuel and liquid oxygen as an oxidiser. This stage will be constructed at Santa Monica, California.

The third stage will consist of a modified Centaur vehicle with two Pratt and Whitney engines of the same design as used in the second stage. It will be 120in. dia.

Higher Performance Vehicle

By using the C-1's second and third stages as the third and fourth stages of Saturn's second configuration (C-2), and by adding a new second stage, Dr. Wernher von Braun indicated that they could construct, if desired, a new higher performance carrier vehicle, which would be about 230ft. high.

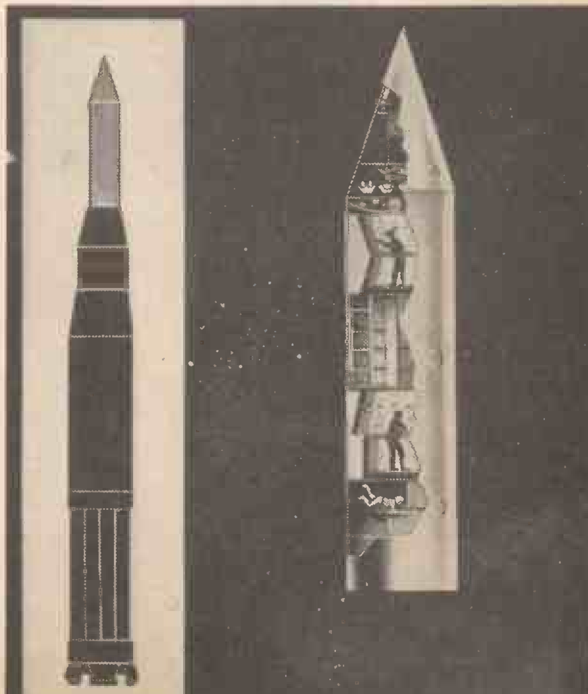
Initial planning suggests that this potential C-2, like the C-1, will be powered by the basic Saturn first stage, or an improved version of it, while the new second stage will be propelled by four liquid-hydrogen and liquid-oxygen engines, each producing 200,000 lb. thrust. The C-2's third stage would presumably have the same four 17,500 lb. thrust engines as those used in the C-1 second stage, while the fourth stage would be the same as the C-1 third stage—two engines producing a combined thrust of about 30,000 lb.

The C-1 version will be able to lift 20,000 lb. into a low orbit. For more demanding missions, it should be capable of boosting a 6,000 lb. payload along an escape departure trajectory, and of making a soft landing with 1,000 lb. to 2,000 lb. on the moon. With a hypothetical C-2 vehicle, a three-stage version could be used to place approximately 45,000 lb. into a low orbit. The payload for high-speed missions would be more than twice as heavy as those of Saturn C-1.

Orbital Refuelling

The capabilities for escape missions have been based on direct flights from earth into departure trajectories. "Now, if we consider an orbital refuelling operation in connection with the Saturn single flight performance," Dr. Wernher von Braun explained, "the capability of such missions as a manned lunar soft landing, or a planetary landing, can be increased by a factor of ten or more, depending on the number of earth-to-orbit refuelling flights and the mission requirements. Of course, a direct departure vehicle could enter first into a temporary low altitude orbit and then transfer to an optimum departure trajectory."

The quicker and less complex direct transfer of a two-man spaceship to the moon's surface capable of safe return, would require a lift off thrust of about 12,000,000 lb. Therefore, with a present basic Saturn thrust of less than 2,000,000 lb., the direct transfer would not be possible until a much larger carrier is available. It naturally follows, that careful studies have yet to be made about orbital refuelling



(*Right*)—*The manned top stage of a hypothetical Saturn C2 carrier would become a manned space station, containing the crew capsule for powered flight, emergencies and re-entry; the instrumentation and working area; and the supply storage room.*

An artist's impression of the space station of the future. It is made of inflated plastic sections and rotates to induce artificial gravity.

techniques, for the early accomplishment of manned lunar flights.

For refuelling, an orbital rendezvous technique is necessary. In the powered and coasting flight phases associated with an orbital manoeuvre, the carrier would first lift the lunar spaceship into an earth orbit, and after the refuelling operation, would head for the moon. Orbiting crews, specially trained to work under zero-gravity conditions, would be needed to connect the moonship and tanker and transfer the propellants. The limited time for the whole operation would demand a large number of Saturn launching pads on the earth. Apart from the all-important human needs, time limitations caused by the orbital storage of hydrogen, over extended periods between individual tanker flights, may be a serious factor. If this should prove decisive, lower energy propellants may have to be used for the moonship, thereby increasing the number of tanker flights by 50 per cent.

The present development of orbital techniques is, more or less, a by-product of the efforts being devoted to instrumented artifical satellites, and the early "man-in-space" capsules. It is apparent that the development of manned satellites, and manned space stations, will follow as a logical sequence to these efforts.

"Three typical stage configurations are envisaged for the transport of men, propellants, equipment, and supplies via Saturn into an earth orbit," Dr. Wernher von Braun said. All these would have the same dimensions and external configuration, and would be top stages of a series of Saturn C-2 carriers.

The manned top stage version, once established in orbit, would become a manned space station. A second and third version would be unmanned, and would be used to supply propellants and cargo respectively to the space station. All these vehicles would be assembled on the ground, and fitted on to the top of the C-2 carrier vehicle.

Manned Station

The manned space station's three individually sealed compartments are (1) the crew capsule for powered flight, emergencies, and re-entry; (2) the instrumentation and working area; and, (3) the supply storage room. Once in orbit, members of the crew would move from one compartment to another by crawling through a tube on the outside of the space station. The tube might be either fixed or inflatable.

In addition to contour beds, the re-entry capsule would contain environmental control equipment, electrical power equipment, oxygen, food, water and other supplies adequate for the station's operating period, with sufficient reserves for the return trip and for possible emergencies. Mounted in an inverted position on top of the other stages, the heavily insulated lower wall of the capsule provides maximum protection for the crew during launching, ignition and burning of all stages of the carrier vehicle, and for re-entry into the earth's atmosphere.

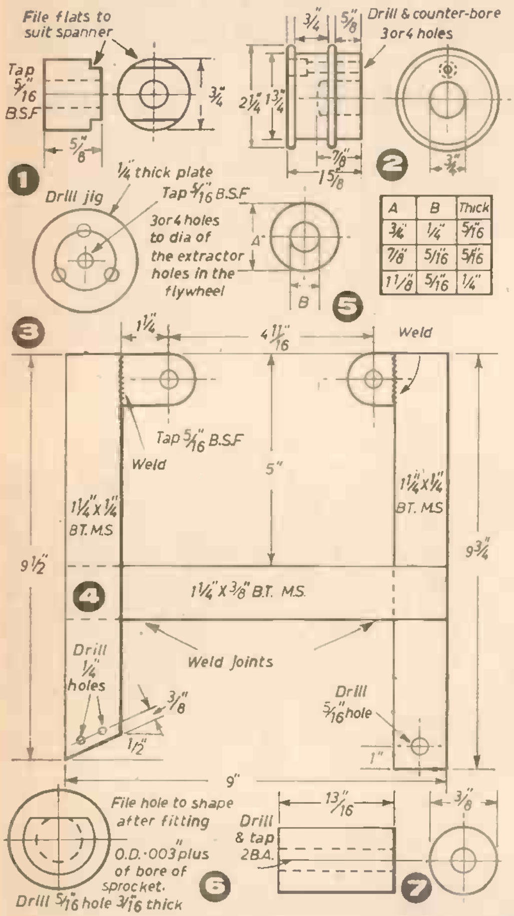
The instrumentation compartment would contain the equipment needed to carry out space observation and experiments. All other supplies and space equipment would be kept in the storage compartment.

The future Saturn C-2 would not only be capable of placing small manned space stations, cargo vehicles, and propellant tankers into orbit, but could also place a simpler version of the space station into a circumlunar trajectory. Such a manned circumlunar spaceship would have the same escape capsule as the space station. "Preliminary estimates," Dr. Wernher von Braun stated, "indicate that it would weigh about 15,000 lb. including 6,000 lb. for the capsule with its instruments and controls. This capsule may well be fitted with lifting devices for use during re-entry before the parachutes are called into use."

In addition to the 6,000 lb. re-entry capsule, 4,000 lb. would be devoted to what is termed the "caboose," the section where the scientific payload, cargo, etc., would be carried. Finally, about 5,000 lb. would be allotted to a combination abort and mid-course control (and possibly re-entry deceleration) propulsion system. If this propulsion system were not required for an emergency abort before the spaceship got into a lunar trajectory, the propellants could be used for course adjustments.

A MOWER MOTORISED . . .

and S. Funnell tells you how it is done, using an old "Cyclemaster" unit



A	B	Thick
3/4"	1/4"	5/16"
7/8"	5/16"	5/16"
1 1/8"	5/16"	1/4"

Figs. 1-7 (Above).—Details and dimensions of the various items which require to be made to link motor and mower.

FIRST remove the engine from the "Cyclemaster" wheel, then the carburettor and exhaust, also the cover over the magneto. Take off the $\frac{5}{16}$in. and $\frac{1}{4}$in. suspension bolts, so that the eccentric housing may be removed, then remove the $\frac{5}{16}$in. nut which holds the magneto-flywheel on. To replace this have a piece of $\frac{7}{8}$in. dia. mild steel turned as shown in Fig. 1, and then file two flats to fit a spanner.

Turn a piece of $2\frac{1}{4}$in. dia. aluminium as in Fig. 2, this is drilled and counterbored to take $1\frac{3}{4}$in. × $\frac{1}{4}$in. Whitworth Allen Screws. The best way to do this drilling is to make a drill-jig first (Fig. 3). The holes in the jig are $\frac{1}{4}$in. dia. to the pitch and diameter of extractor holes in the flywheel (3-hole in early flywheel and 4 in later model) with $\frac{5}{16}$in. B.S.F. Taper hole in the centre. This jig is screwed on to $\frac{5}{16}$in. thread where the nut is to be removed and extractor holes drilled and tapped $\frac{1}{4}$in. Whitworth. The jig is removed and a $\frac{5}{16}$in. bolt screwed into the jig from the face nearest the flywheel, and the nut (Fig. 1) screwed on to the bolt thread. The nut is then fitted into the $\frac{3}{4}$in. bore of the starter-pulley (Fig. 2) and the $\frac{1}{4}$in. holes drilled for the Allen screws. Remove the jig and counter-bore. Next cut a $1\frac{7}{8}$in. dia. hole in the cover for the pulley to pass through.

The Engine Frame

The most important part is the $4\frac{11}{16}$in. dimension between engine mounting holes, one a $\frac{5}{16}$in. tapped

(Concluded on page 552)

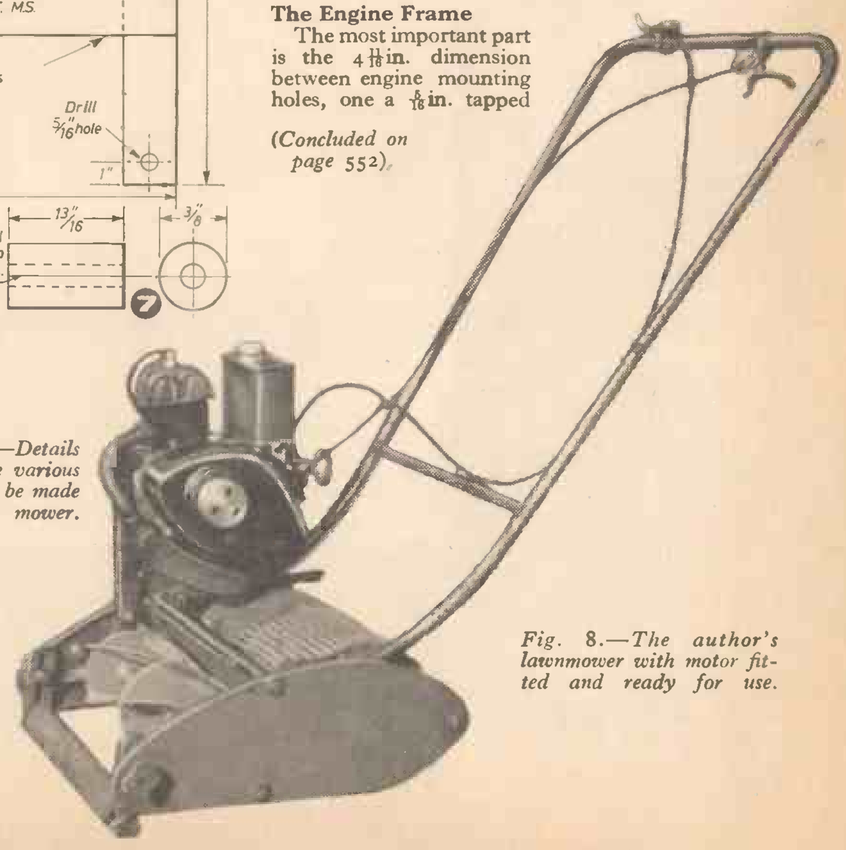


Fig. 8.—The author's lawnmower with motor fitted and ready for use.

Home Jewellery Making

THE object of making jewellery "at home" is not only to save money through the use of one's own labour, nor should it be approached as a means of doing something useful with one's spare time. The aim is to produce an article which, upon completion, can be viewed with a feeling of pride.

Having devoted time is not enough. This is an art, and requires the activity of the mind's eye and must be self-expressive. In the end it may not suit the intended wearer of the particular ornament, but may be ideal for someone else. This is not a bad thing in itself.

It is much easier for a person making a dress to visualise its eventual suitability for a specific person. A pattern is used and a finished drawing or photograph is available, so that a fair assessment can be made. But with jewellery or similar ornamental articles this is not so. To make an item of jewellery of pleasing design is simple but, to make a piece for an individual, to enhance her particular personality, is difficult. The aim should be to create—beautifully, aesthetically. The result will be your reward, no matter who will wear it, or even if it is not to be worn at all.

In these days of ever-changing fashions nothing is too bizarre, too large or too small, too colourful or unusual, but, providing good taste is combined with originality, the wide scope available can be a fascinating thing. One should beware of extremities, of searching blindly for something simply because it is different.

Where coloured beads or stones are used or incorporated, great care in creating a good blend of tone can make a very simple design into a most effective one. In this instance the design or effect consists of a clever use of colours.

It is advisable for the craftworker to ask himself, or herself, these questions: What am I best at? Do I possess a good eye for colours? Am I handy with tools? Have I an eye for detail or shape? Are my tastes traditional or ultra-modern? The work initially undertaken should be based on one's natural ability and expanded from there.

Using Stones and Castings

The simplest method of making a particular piece of jewellery is not to actually produce from raw materials, but to mount in various ways such as hand-setting with a special tool or simply, but effectively, using an adhesive for sticking stones, pearls, marcasites, etc., into predetermined positions in a casting or stamping.

Such mounts in the form of brooches, necklets, earrings, etc., are available finished in every respect except for the stones, which are usually supplied separately by any reputable handicraft suppliers. Now this is simple and can be done by anyone, giving pleasure and saving money, in fact quite a considerable amount!

By V. G Kennedy

Equipment Required

This consists of a table to work on in a well-lit position, covered with a sheet of plain paper, which keeps the table surface clean and assists one to see the objects more clearly. Beginners would be advised to work on a large tray, the lip of which will prevent stones rolling on to the floor. A pair of pointed tweezers are useful; glue and a few pointed matchsticks are essential. Many good types of adhesive are on the market for this purpose and your supplier will be pleased to advise you for your particular task.

Skill is not necessary at this stage but is useful when acquired, which will be more through repetition and common sense than anything else. It can then become a fairly lucrative pastime but cannot, in the true sense of the word, be called an art form.

At the next stage artistry begins to enter in the form of good taste but use is still made of ready-made settings, which are available in great variety. Handicraft suppliers will be pleased to furnish prospective customers with their catalogues. Having selected the designs, order the stones, pearls, etc., with a view to blending colours and creating original effects. The result can be most surprising either way! Certainly they will be very different from the chrome crystal effect. If the worst happens and the result does not please, one can always remove the stones by brushing acetone on to the finished article. The stones will leave their sockets quite easily, though they will not be much use after that treatment. However this is not an expensive hobby and a few shillings will buy a lot of stones! Experiments often pay off with good results.

Working With Beads

Beads, more than anything else, can result in a work of art with the use of comparatively little skill. Whatever their shape, design or colour the truly artistic worker will see in them the basis of the exotic or simple. Certainly this is the most fascinating form of decoration. It can be designed into a multi-changeable accessory. Advantage can be taken of any beads or necklets the wearer has discarded, and perhaps long ago left lying in a drawer or jewel box. Anything can be incorporated from the tiniest pearl or crystal bead (which can be used in the form of " spacers " between larger beads), to the largest. Ingenuity and clever adaptation can turn all these into ropes of varying lengths, cascades, " bib " designs, multi-row chokers, or simply into a single row necklet.

Beads of every type and colour from the softest pearl shades to the most dazzling aurora crystals can be obtained at most reasonable prices from your handicraft stockist, who will also be the best person to approach for all types of threading materials, " gimp " clasps, etc.

USING THE SUN FOR HEAT & POWER

THE sun is a source of energy which is practically untapped by man-made devices. Here, on earth, it is estimated that we receive only two-billionths of the total energy of solar radiation. Yet if all the energy reaching the earth could be tapped and converted to electrical power it would provide the staggering sum of 120,000,000,000,000 kilowatt hours every year.

Solar energy is free for the taking but there are a great many difficulties in trapping it on a practical scale. For a long time inventors have been making sun machines without a great deal of success. In the last few years, however, many of these difficulties have been overcome.

There are several ways in which the heat of the sun can be trapped for use. One of these, used to produce high temperatures, is well known to every schoolboy who has ever focused the rays of the sun through a magnifying glass to produce a hot spot. Using this idea solar furnaces have been built which produce such high temperatures that metals can be melted in a few moments.

Schemes such as this have been largely experimental although they offer a good source of power where the sunshine can be relied upon. There is no doubt that in the future development of the deserts of the world, this way of raising steam will be very popular.

The swimming pool at East Grinstead warmed by a solar heating system. The solar collector can be seen on the right.

by R.J.Salter

Photo-Electric Effects

Solar energy can also be turned to electricity by what are known as photo-electric effects.

Electricity for the transmitting of wireless signals from space vehicles and earth satellites is often obtained in this way. This is made possible because an electric current is set up within some substances such as silicon when they absorb solar radiation. Only a very small electrical charge is emitted from a single cell but banks of these cells can be used to generate sufficient energy to activate low-powered radio equipment.

Many solar house-heating systems are in service through the world although they are not generally considered to be competitive in operating costs with conventional heating systems in the climate of the British Isles.

Solar Swimming Pool Heater

If heating from the solar operated system is only required during the warmer months of the year the situation is different.

This was the case when the question of heating the water in an outdoor swimming pool at East Grinstead was considered. Generally speaking the pool would only be used during the summer, late spring and early autumn, months when a considerable amount of heat could be obtained from the sun.

To trap the heat of the sun a heat collector measuring 34ft. long and 16ft. high has been built. It is inclined at 60 deg. to the horizontal, corresponding to the latitude of its location and faces 10 deg. west of south. This makes sure that fullest use is made of the afternoon sunshine.

A copper collector is used, which has a thickness of 0·028in. and incorporated in the strip are ½in. bore tubes spaced at 5in. centres. Water from the pool is passed through these tubes where it is warmed by the rays of the sun.

A cedar wood frame is used to mount the collector which is covered with 32 oz. plate glass. This air gap reduces heat losses from the front of the copper plate due to infra-red re-radiation and heat convection currents. The front of the copper plate is painted matt black to increase the absorption of heat.

Insulation of the back of the collector is given by a 1in. air gap between the copper strip and the aluminium foil backed hardboard.

It is hoped that by using this solar heat collector the summer temperature of the swimming pool water will be maintained at around 70 deg. F.

Solar Power Plant

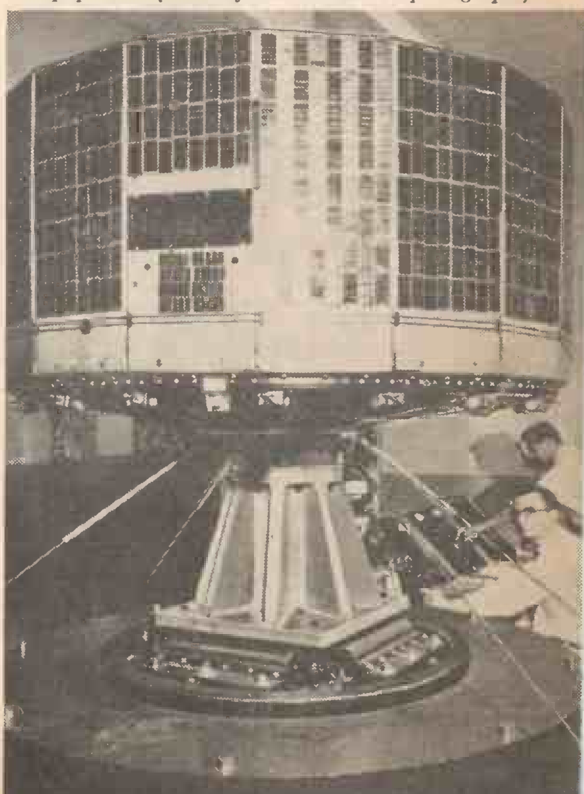
An important solar power plant was built in 1913 seven miles south of Cairo at Meadi. Seven parabolic shaped reflector troughs, each one 205ft. long, giving over 13,000sq.ft. in solar interception area were installed. By these reflectors the heat of the sun

A scientist of the University of Arizona checks intricate recording apparatus which measures the amount of heat and power obtained from the sun at their experimental solar heating station.

generated steam which was used to develop 50 to 60 horsepower for irrigation purposes. Unfortunately the system was eventually abandoned because it was not economically competitive with other irrigation systems.

In the future, solar installations will almost certainly be used to provide heat and power for manned space stations. Here the sun will not be obscured by clouds, one of the greatest disadvantages of solar heating and power systems in our climate.

Over 9,000 solar cells are built into this Tiros weather satellite to provide power for the operation of the electronic equipment. (U.S. Information Service photograph.)



L.B.S.C's 3½in. Gauge

EVENING STAR

Part 6. Constructional details for the boiler feed pump

THE full-size *Evening Star* doesn't possess a boiler feed pump, as her boiler is fed by two injectors, but a pump is very desirable on the little engine. Until Giffard invented the injector, pumps were used on all locomotives, and were driven either from an eccentric, or from the crossheads. They worked all right, but the great disadvantage was that they couldn't feed the boiler while the engine was standing still. When the Stroudley engine 189 *Edward Blount* of the L.B. & S.C.R. was shown at the Paris Exhibition of 1889, the judges told Billy Stroudley that she would have taken top award, but for just that one drawback. Billy's reply was "Ah, but my engines are intended for *running*, not standing still!"

The advantage of a pump on a little locomotive is that while the amount of water it pumps is constant at any given speed, the by-pass valve can be set so that only sufficient water to maintain working level will enter the boiler, the surplus returning to the tank or tender. If an injector is fitted as well, to feed the boiler when stationary (we shall do this on the little *Evening Star*) we have the ideal combination. Continuous feeding by injector only, as in full size, is impossible in 3½in. gauge because an injector cannot be made small enough; but an injector such as I shall describe in due course, would do the job if used intermittently.

It was my original intention to specify the same type of pump that I designed for *Britannia*. This was very efficient, but as *Evening Star's* wheels, being smaller, turn faster for the same running speed, and there is less room between axles, I schemed out a pump more suitable for the job (Figs. 33 and 34). It is easily made, and being set on the centre-line of motion, there is ample room for the valve-box and upper pipe connections. By using an eccentric-rod with a set in it, the drive can be taken from the fourth axle, and the length of the rod is sufficient to avoid undue stress and wear on the gland.

Machining the Pump Body

Grip the casting by one end of the valve-box in the four-jaw independent chuck, and set it so that the other end runs truly. Face the end, centre, and drill right through with No. 23 drill. Open out for about ¼in. depth with a 9/32in. drill, and finish to 7/16in. depth with a 9/32in. D-bit. This leaves a flat-bottomed hole for the valve ball to sit on. Beginners' tip: make your

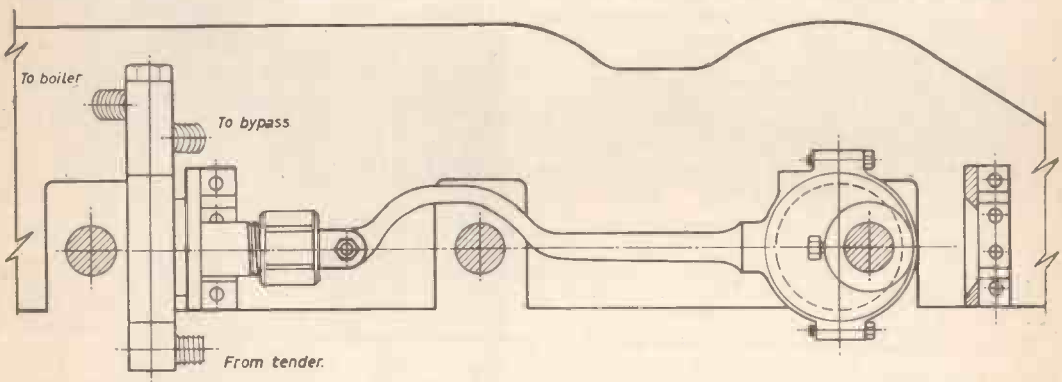
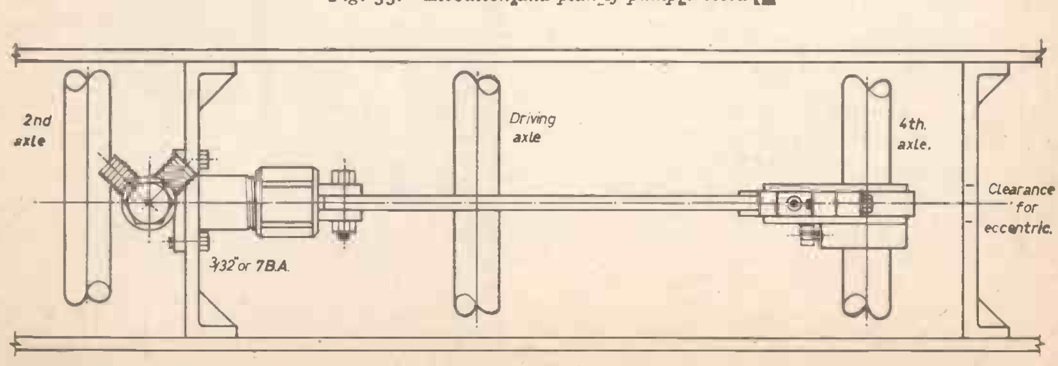


Fig. 33.—Elevation and plan of pump erected.



own D-bit from 2in. of 5/32in. round silver-steel. File away half the diameter for 1/2in. length, and bevel off the end. Heat to medium red and plunge into clean cold water. Rub the filed part on an oilstone until bright, with sharp edges. Hold the unfiled end in a gas or spirit flame, so that the heat will travel down the bit. As soon as the filed end turns dark yellow, drop the bit into the water again, and it is then ready for use. Slightly countersink the end of the valve-box, and tap it 3/16in. × 32 t.p.i. by the method shown for tapping the short crankpins; but be careful that the tap doesn't go too far in, and cattle up the ball seating! Put a 5/32in. parallel reamer into the No. 23 drilled hole for about half its length, to true up the D-bitted end, or alternatively, take a scrape out of it with a taper broach.

Chuck a short bit of round rod not less than 1/2in. dia. in the three-jaw. Face the end, turn about 1/4in. length to 3/16in. dia. and screw it 3/16in. × 32 t.p.i. with a die in the tailstock holder. Screw the machined end of the valve-box on to this tightly, and the other end should then run truly. Face the end, open the No. 23 hole to 5/32in. for 7/16in. depth, slightly countersink the end, and tap 3/16in. × 32 t.p.i. Make a little chisel by filing the end of a couple of inches of 3/32in. silver-steel, harden and temper it like the D-bit, and make four nicks with it at the end of the hole, like the one shown in the pump section. This is very important, for without the nicks, the ball would lift on the outstroke of the pump ram, block the hole, and prevent the ram from sucking any water.

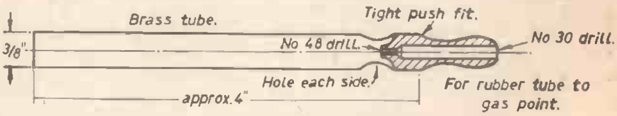
The casting will have a chucking-piece on it, opposite the barrel. Grip this in the three-jaw, and set the end of the barrel to run truly. If it wobbles, a slight tap with a hammer will teach it good manners, as the cast metal is fairly ductile. Face the end, so that it stands approximately 1 1/2in. from the valve-box. Centre, and drill a 3/16in. pilot hole right through into the valve-box, then open it out with a 3/8in. drill. Turn the outside to 5/16in. dia. and screw it for about 3/8in. length with a 5/16in. × 32 t.p.i. die in the tailstock holder. Finally, face off the square section next the valve-box with a knife tool, to about 1/8in. thickness. Saw or part off the chucking-piece, and file the stub flush with the valve-box for neatness sake.

Top Fitting

The top fitting carries in addition to the union nipples, a supplementary clack, or check valve, which will prevent steam and water blowing back from the boiler into the tender, in the event of the top feed clack leaking if scale or grit should accidentally get on to the ball seat. To make it, part off a piece of 1/2in. rod a full 1 1/4in. long. Use drawn bronze or gunmetal for preference; good quality brass will do at a pinch, but don't use the alloy known in the metal trade as "screw-rod," which is very often sold as brass. This is intended for making screws, as its name implies, and takes an excellent clean thread, but is inferior to bronze or gunmetal. It is, however, quite suitable for screwed pipe nipples, and other fitments where there is no movement.

Chuck the rod in the three-jaw, face, centre, and drill through with No. 23 drill, then proceed exactly as described for the upper end of the valve-box. Reverse in chuck, turn 1/4in. of the other end to 5/16in. dia. and screw 5/16in. × 32 t.p.i. Drop a 7/32in. rustless steel ball into the valve-box, and take the depth from ball to top of box with a depth gauge. When I was a small kid, the depth gauge that I used was one of mum's hatpins stuck through a tram ticket. It worked! Incidentally, one Sunday night about 55 years ago, the Vanguard bus on which I was travelling home, konked out in Charing Cross Road, with a slipped magneto coupling. The ex-horse-bus driver was completely stumped, so I reset the coupling for him borrowing a hatpin from a lady passenger, sticking it through a bus ticket, and poking it down the compression release cock on No. 1 cylinder to find top dead centre. It was the last bus that night, and I was on duty early next morning—nuff sed!

Face off the screwed spigot until it is 1/32in. less than the distance indicated by the depth gauge, then cross-nick the end with a thin flat file, as shown. To get the correct location of the union nipples, screw the fitting tightly into the top of the valve-box, after which, the position of each one can be marked off as shown in the drawings, 45 deg. off centre-line, and at right angles to each other. Centre-pop each location, remove the fitting, and drill an 11/64in. hole at each pop. For the nipples, chuck a piece of 5/16in. round rod, face the end, centre deeply with a size D centre-drill, then drill to 3/8in. depth with No. 30 drill. Screw 1/4in. of the outside 5/16in. × 32 t.p.i. part off at 5/16in. from the end, reverse in the chuck—it won't hurt the threads as long as you don't wrench the chuck key—and turn the



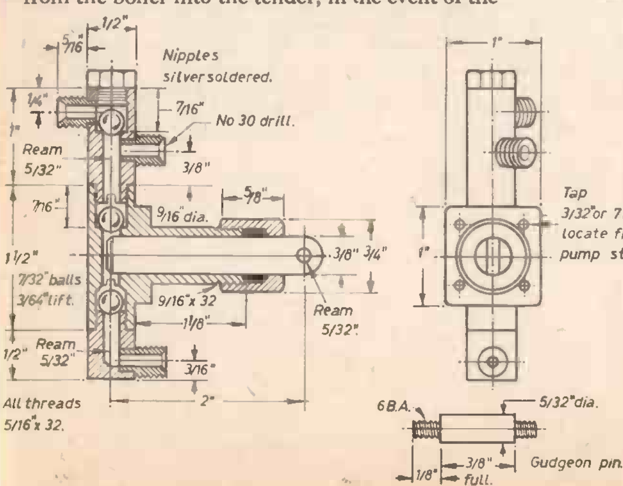
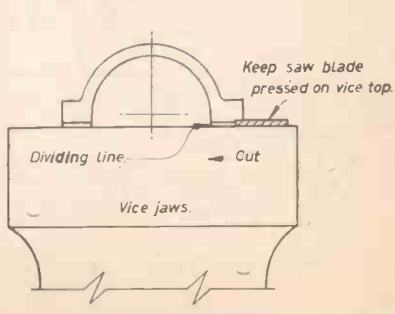


Fig. 34.—(Left) Section and end view of pump.

Fig. 35.—(Above) Simple gas blowpipe.

Fig. 36.—(Below) How to divide strap casting truly.



plain end to a tight fit in the hole in the side of the fitting. About $\frac{1}{16}$in. length will be plenty. Press the spigots into the holes, and silversolder them.

Silversoldering for Beginners

I silversolder all my small fittings with a home-made gas torch, which any beginner can make in 15 minutes or less. It is just a 4in. length of $\frac{3}{8}$in. tube with a brass nipple pushed into one end, two air holes being filed in it as shown in Fig. 35, and it is connected to the domestic gas supply by a rubber tube. It is self-blowing, and will provide enough heat to do all the small jobs on *Evening Star*. I use Johnson-Matthey's "Easyflo" wire, and the flux sold for use with it. Mix a little with water, to a creamy paste, and smear some all around the joint between nipples and fitting. A tin lid with a layer of coke broken into little bits, makes a nobby brazing tray. Lay the fitting in it, heat to medium red, and touch the joint with a piece of "Easyflo" wire, which can be obtained from our advertiser A. J. Reeves & Co. This will immediately melt, and run around the joint like water. Let cool to black, and quench out in acid pickle. For this I use a jam-jar half filled with a mixture of one part stale accumulator acid to four of tap water. After pickling for about ten minutes, fish out the fitting with a piece of wire, wash well in running water, and clean up. I hold them against a 4in. circular wire brush, the spindle of which is fitted into a hole in the end of the spindle of my tool grinder. It makes them bobby-dazzle!

Bottom Fitting

Chuck a $\frac{3}{4}$in. length of $\frac{1}{2}$in. round rod; face, centre, drill to $\frac{5}{8}$in. depth with No. 23 drill, and ream or broach as previously mentioned. Drop a $\frac{7}{32}$in. ball into the recess in the valve-box, take the depth as before, and turn down the end of the rod to $\frac{5}{16}$in. dia. and to a length $\frac{1}{32}$in. less than the depth indicated by the gauge. Screw $\frac{5}{16}$in. × 32 t.p.i. Screw this tightly into the bottom of the valve-box, and mark the position of the nipple, parallel with the pump barrel. Centre-pop, drill $\frac{11}{64}$in. and fit a nipple as described above.

To assemble, first seat the balls by putting them on the holes, resting a short piece of brass rod on each, and giving it one good crack with a hammer. That prevents water leaking back when the pump is working. Screw the fittings home with a slight smear of plumbers' jointing (Boss White or similar) on the threads, but don't let any get on the ball seatings. The plug for the top of the upper fitting is made from $\frac{3}{8}$in. hexagon rod. Chuck in three-jaw, face off, turn the spigot to $\frac{5}{16}$in. dia. and $\frac{1}{4}$in. length, screw $\frac{5}{16}$in. × 32 t.p.i., face off the end sufficiently to allow the ball $\frac{3}{64}$in. lift, part off at $\frac{3}{16}$in. from the shoulder, reverse in chuck and chamfer the corners of the hexagon.

Ram and Gland

The ram is a $2\frac{1}{4}$in. length if $\frac{3}{8}$in. ground rustless steel, or drawn bronze, and should be a sliding fit in the barrel, needing no turning. Slightly chamfer one end, and at 2in. from it, drill a No. 23 cross-hole. Make certain this goes right across the centre-line, and not to one side; it is merely a matter of care. Cut a slot $\frac{1}{8}$in. wide and $\frac{7}{16}$in. deep, at right angles to the cross-hole, by the method described for slotting the forks of the coupling-rods; then ream the cross-hole $\frac{5}{32}$in.

For the gland, chuck a piece of $\frac{3}{4}$in. round or hexagon rod, face, centre, and drill $\frac{3}{8}$in. to $\frac{3}{4}$in. depth. Open out to $\frac{1}{2}$in. depth with $\frac{1}{2}$in. drill, and tap $\frac{9}{16}$in. × 32 t.p.i. Chamfer the edge, part off at $\frac{5}{8}$in. from the end, reverse in chuck, and chamfer. If round rod is used, four slots can be milled in the outside as shown, which will enable a C-spanner to be used for tightening.

Erection

Take out the pump stay, push the pump barrel through the hole in it, set the valve-box vertical, temporarily clamp in position with the square pad tight against the stay, and run a No. 41 drill through the screwholes in the stay, making countersinks on the pad. Remove the pump, drill the countersinks No. 48, tap $\frac{3}{32}$in. or 7 BA, replace pump and secure with hexagon-head screws as shown in plan (Fig. 33). Note that the pump is fixed to the stay with the valve-box on the opposite side to the stay flanges. The pump gland can then be packed. The best kind of packing would be a few strands unravelled from a piece of full-size hydraulic pump packing; failing that, use graphited yarn. The gland should only be tightened sufficiently to prevent water leaking past. A too-tight gland only causes unnecessary friction. The stay with pump attached, can then be put back in the frame.

Eccentric Strap and Rod

Any roughness on the casting for the eccentric strap should be removed with a file, and the two lugs drilled No. 44. Scribe a line across the centre of the lugs, and grip the casting in the bench vice as shown in Fig. 36, with the line just showing. Saw across the lugs, keeping the saw blade pressed down on the vice top, to ensure a straight cut. Smooth off any saw-marks, then open out the holes in the "ring" half with No. 34 drill, and tap those in the "lug" half 6BA. Join the two halves with 6 BA screws, and chuck the strap in the four-jaw with the cored hole running as truly as possible, letting about $\frac{1}{16}$in. overhang. Face off the side of the strap with a round-nose tool set crosswise in the tool-holder, then change it for a boring-tool, and bore the strap to an easy fit on the eccentric. I always use a piece of round steel

(*Continued on page 543*)

Fig. 37.—Eccentric strap and rod.

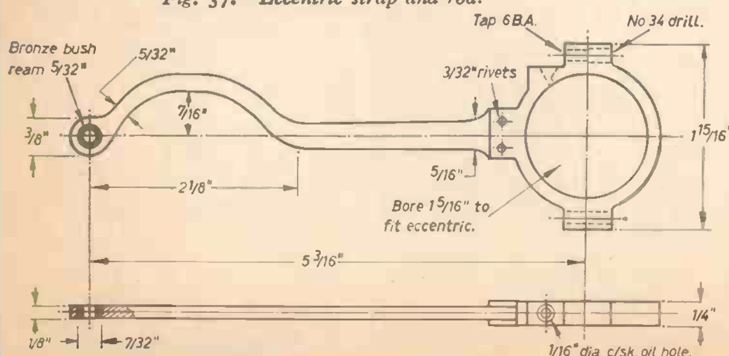
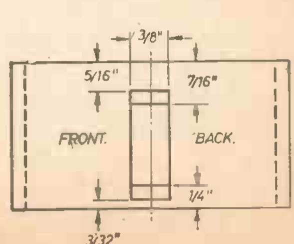


Fig. 38.—Clearance slot in stay.



SCIENCE NOTES

Testing a section of "Nimrod."

Rolls Royce "Spey"

THE type of aircraft most in the news of late has been the projected short-medium haul jet transport. Typical of this class of plane will be the de Havilland Trident and the B.A.C. One-Eleven short haul transport. The Spey by-pass jet engine (see photo below) has been selected to power both of these. Now, in addition, a military version is to be built.

The development programme is now in full swing and five Speys are at present running. Additional valuable development experience has been gained from the larger RB 141 which was developed earlier by Rolls Royce, both the RB 141 and the Spey being derived initially from the Conway by-pass jet.

The following are the main details of the Spey:

Take-off thrust: 9,850 lb. (4,468 kg.) minimum sea-level static thrust (guaranteed).

Typical cruising consumption: 0·766lb/hr./lb. at 25,000ft. (7,620m.) I.S.A. and Mach 0·78.

Engine basic dry weight: 2,200 lb. (998 kg.).

Overall dimensions:

Length: 110in. (279cm.) from intake face to exhaust cone flange.

Maximum diameter: 37in. (94cm.).

Plastic Vacuum Chamber at Harwell

"NIMROD," the 7 GeV Proton Synchrotron now under construction at the Rutherford High Energy Laboratory of the National Institute for Research in Nuclear Science at Harwell, incorporates a glass reinforced epoxy resin double-walled vacuum vessel through which particles (protons) are accelerated until their velocity approaches the speed of light. Some idea of the vessel's size is conveyed by the photograph, in which the first 50ft. outer section is shown under test. Eight outer and eight inner sections, each made from "Araldite" epoxy resin and glasscloth, will eventually be installed to provide a ring-shaped vessel having a diameter of more than 150ft.

A non-magnetic non-conducting material of high mechanical strength was necessary and epoxy resin and glasscloth was chosen as best fulfilling these requirements. Tolerances on the 50ft. sections are less than five thousandths of an inch.

(Above). The Rolls Royce Spey by-pass jet engine.

(Right). Inside the new Ministry of Aviation Telecommunications Establishment.

New Telecommunications Establishment

The Ministry of Aviation's new Telecommunications Establishment was opened recently by the Parliamentary Secretary at Gatwick. It is responsible for field installation work on Ministry-operated civil aviation telecommunications equipment and for work in connection with this, including the design and investigation of new equipment. In the photograph on the right two technicians are shown testing position approach radar terminal equipment.

Building the SeaSkate

by R.W.T. Bradley

Part 2

The Centreboard Box

THIS is an important member and is made up as in Fig. 2 (shown last month). First cut the ½in. ply sheets, notching at the corners, with careful reference to the frames at stations 6 and 7 where they ultimately fit. Glue and nail ¾in. sq. strips along the top and bottom edges. Bring the two cheeks together and fix the 2in. wide vertical spacers, using 2in. copper nails which should be clinched over. The box ready for fitting is shown in Fig. 16. Now glue and nail into position and have your glue "good and thick." Nail through the hull cross frames on the deck underside and into the ends of the ¾in. strips on the bottom edges of the box; then get underneath the hull and nail upwards with ¾in. nails through the deck into the ½in. ply edges. Finally fit the two loose cross frames which were left to facilitate the box fitting (Fig. 17).

Mast Box

Study Fig. 18 and make up the ½in. ply box, glueing and using 1¼in. nails. Drop this into position in between the four appropriate cross frames, fitting the ¾in. fillets at the top and bottom, nailing with 1½in. nails through the cross frames into the end grains. Fig. 19 shows our box in position and being planed off flush and level with the cross members.

Cockpit

See Fig. 20. In making this as a later modification odd scraps of ply were joined together with butt straps to form bulkheads. One is positioned across the hull on frame 5 and two others one either side of the centre board box on frame 6. A ¾in. sq. fillet needs adding to the box sides to allow for nailing. Do not forget to cut the v's in the edges where they fit across the drain grooves; later a cover strip is placed across from bulkhead to bulkhead to carry the drainage through (Fig. 21). We are now almost ready for the bottom

Figs. 16 and 17.—Showing the completed centreboard box and fitting in progress.

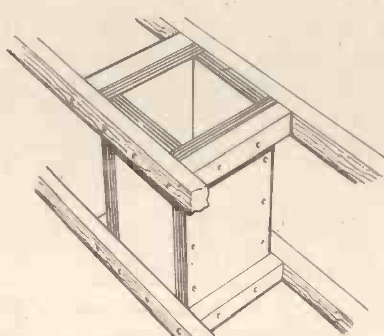


Fig. 18.—The mast box is made and installed like this.

MATERIALS REQUIRED

Timber Spars and Mast
Mast 9ft. 3in. × 2½in. sq. pitch pine or spruce
Boom 11ft. × 2in. × 1½in. pitch pine or spruce
Gaff 13ft. × 1¾in. × 1¼in. pitch pine or spruce

Rigging
Main Halyard. 24ft. × ⅜in. dia. hemp or nylon
Main Downhaul for boom 5ft. × ¼in. hemp or nylon
Main Forward kicking strap 10ft. × ¼in. hemp or nylon
Main sheet 24ft. × ½in. dia. cotton.

Fittings
Mast Tufnol Pulley 1½in. × ½in., 2in. × ¼in. brass pin
Rudder 1 pair gudgeons with straps
1 pair pintles
Horse 1 pair of shackle eyes
1in. to 1¼in. brass ring
1 yard of ¼in. rope
Boom 1 clew band
Gaff 1 kicking strap band and toggle

Fig. 19.—Flush planing the mast box.

ply, but to ensure a good flat fit all the hull members must now be planed flush with each other at the joints and the side planking planed flush with the longitudinal chine members. The hull interior should be given a generous coat of a wood preservative such as Cuprinol. Do not do the upper edges as this may prevent good glueing adhesion.

Bottom Planking

Take the last of your large pieces of ply and place on the upturned hull, the larger piece to the stern and the smaller at the bow end. Push together amidships till they butt, hold down with weights all over, crawl underneath and with a pencil scribe on the underside the hull shape (Fig. 22).

Remove the sheets and cut all round, leaving ⅛in. margin. Plane up the butting edges and join together with a butt strap as with the other planking. When set replace the now complete sheet on the hull and pencil mark on the margin edge where the cross frames are, do this on both edges and then join across the sheet with pencil lines. These are a guide for the gluing.

Now trim the bow end of the ply to fit the rebate at the nose, followed by the same procedure for the transom. The frames and side members should now be well coated with glue and the planking placed into position with as little movement as possible. Nail at the bow rebate and, keeping the sheet pressed down as much as possible, work your nailing along all the frame members at 2in. centres to the stern. Use additional nails at say 1in. centres along the edges of the mast and centreboard box slot. When the planking is set, plane off the ⅛in. margin along the chine.

The Skeg

This is the portion being tried for shape in Fig. 23. If it is made from softwood it can be bent to fit the curve of the hull, but hardwood will need shaping. It is fixed with brass screws through the planking into the 2in. wide reinforcing strip on the inside of the hull. As the hull will get knocked about on the beach ¾in. half round rubbing strips can be glued and nailed to the bottom. Fig. 24 shows the finished operation

Turn the hull over and add the final touches to the topsides before the fittings go on.

Starting at the bow, fair in the side planking and shape up to a pleasing line. Make up the hatch covers as in Fig. 25. To keep these in place we made up turn buttons from scraps of hardwood and cords were attached to the underside of the hatches and secured into the hull to prevent them floating away in the event of a capsize.

The cockpit (Fig. 20) now requires stiffening strips on the port and starboard underside edges and the plywood fillets in the bottom corners to carry through the hull drainage. Round off the bulkhead and deck ply where they meet at the edge of Frame 5 and finally glue into the bottom of the cockpit the three plywood reinforcing strips.

Transom Gudgeon Block

This block (Fig. 26) is added to the topside of the deck and transom to give greater strength for the tiller, it is made from a block of hardwood glued and screwed into position, two screws down the rear edge into the transom and three through the deck ply into the reinforcement on the underside.

The hull is now complete and should be sanded to a good finish prior to painting or varnishing. A painted hull and varnished topside looks well.

Centreboard, Rudder and Tiller

Details of these are shown in Fig. 27. They are mainly made up from the ½in. ply, the centre plate is a ply sheet faired at the front, rear and bottom edges with a ¾in. sq. capping and shaped handle glued and nailed to the top edge.

The rudder is made from ½in. ply, the pivoting blade also being faired at the front, back and bottom edges and grooved round the top curve to take the ¼in. round braided elastic, which serves to hold it in the downward position. The distance piece between the rudder cheeks is ⅝in. in order to give clearance for the blade. To make up this extra ⅛in. use a scrap of the $\frac{3}{16}$in. ply planed down. In the construction make up one of the cheeks complete with the distance piece, gluing and nailing with 1in. nails only. If the centre pivot hole is now drilled the action of the blade can be

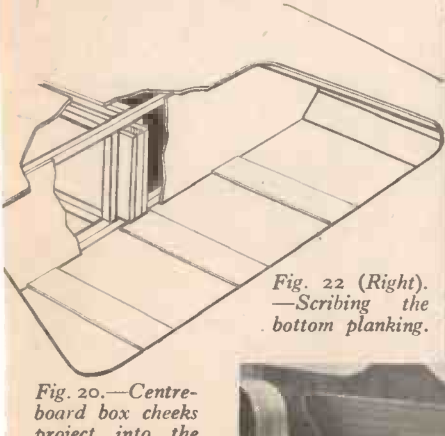


Fig. 22 (*Right*).—*Scribing the bottom planking.*

Fig. 23 (Above).—Shaping the skeg.

Fig. 24 (Below).—Add rubbing strips to prevent wear.

Fig. 20.—Centre-board box cheeks project into the cockpit.

Fig. 21 (Right).—The cockpit, looking aft.

Fig. 25.—Fit sponge rubber on underside of hatch lids.

Fig. 26.—Rudder and sheet horse fittings.

tried out. After any adjustments, glue and add the other cheek, nailing the whole with 2in. nails clenched over on the reverse side. Fig. 29 shows a view of the complete rudder. The corner fillets are $\frac{3}{16}$in. ply, added to give more purchase for the bottom gudgeon.

The Tiller

This needs to be very strong and oak or ash strips should be used. After glueing together, it should be reinforced at the points indicated with roves and copper nails.

All these parts should be well sanded, the centre-plate, rudder blade painted, the other parts varnished.

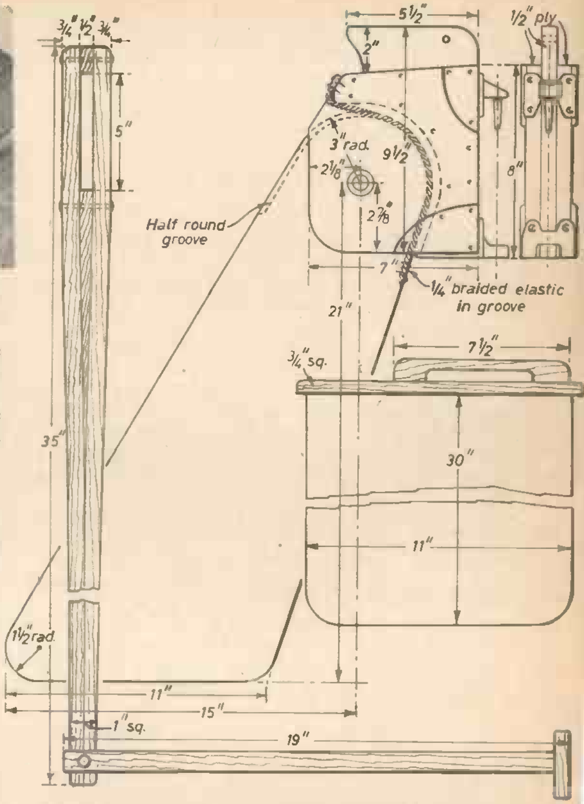


Fig. 27.—Main rudder, tiller and centreplate dimensions.

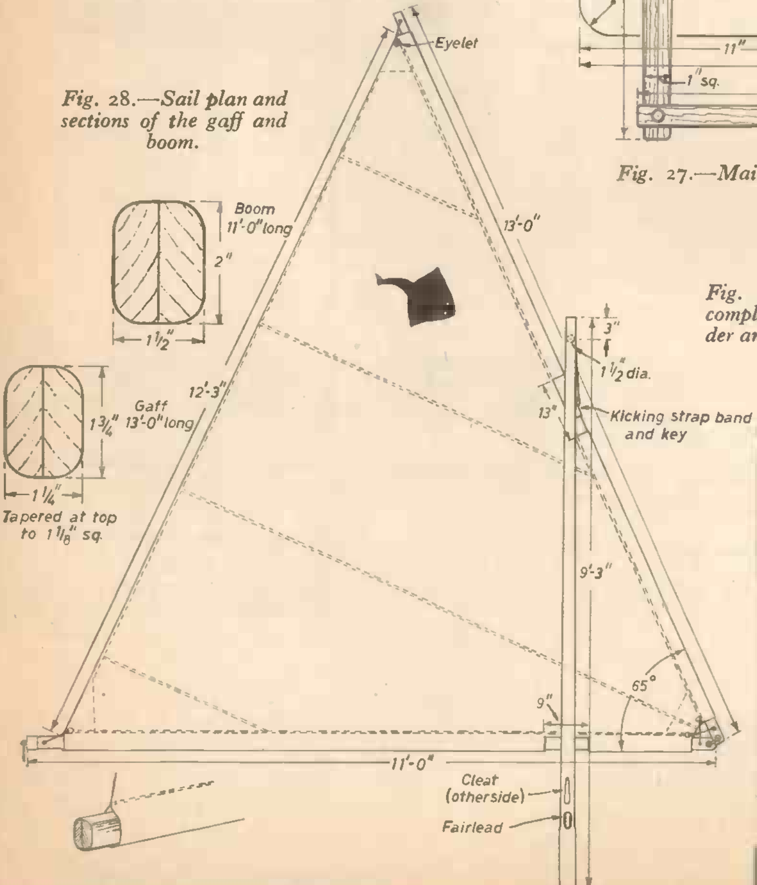


Fig. 28.—Sail plan and sections of the gaff and boom.

Fig. 29.—The completed rudder and fittings.

Fig. 30 (Bottom).—Forward end of the sail showing downhaul and kicking strap attachment.

Mast, Boom and Gaff

These are made from spruce; or the gaff and boom could be made up from bamboo poles. The mast, as it is unstayed, must be strong and so a 9ft. 3in. length of clean knot-free timber must be used, 2½in. squared at the base to fit the mast box and then rounded to the top. A socket must also be cut through at the top to take an 1½in. dia. pulley which is secured in place with a ⅜in. brass pin located in a hole bored to a force fit 3in. down from the top (Fig. 32).

Boom

If made from spruce, it needs to be rigid and free from warp. This is achieved by ordering from the timber merchants two stocks to be cut from the same length, planed on one face of each stock and the planed faces glued together with the grains reversed (see section in Fig. 28). Lots of clamps will be needed for the gluing operation and careful watch should be kept on it to see that as the clamping is carried out, a straight boom results.

When set, planing to the finished shape can be started. A ½in. hole is drilled at the forward end, which is used to secure it to the gaff (Fig. 30).

Gaff

The same procedure is followed for the ordering of the timber and the gluing, as for the boom, but the finished dimensions make for a lighter spar (inset Fig. 28). The mast and spars should now be well sandpapered and given at least two coats of varnish.

Sail

This costs, made up by Messrs. E.S.A. Marine, of Shaftesbury Avenue, London, £12 10s. in Terylene or £9 10s. in cotton. If somebody handy with the sewing machine volunteers to make one, Terylene by the yard can be obtained from Messrs. Russell & Chapple, 23 Monmouth Street, London, W.C.2, white 12s. 6d.; coloured 13s. 6d. to 14s. 6d.

As will be seen from the sail plan, Fig. 28, the work involved in making the sail is not great as it was designed to be home-made, the gaff and boom being accommodated in long sleeves along the hull and foot. These could be made up from odd lengths of the main material and added to the main sail area as a separate item. Eyelets and lacing are required to secure the sail to the spars, one at the head, one at the clew and two at the junction of the gaff and boom.

Sail Fittings

On the gaff, a kicking strap band is screwed (Fig. 32). Attached to the key toggle is the main halyard, which passes over the pulley at the head of the mast, down to the mast foot, through a fairlead screwed to the mast side and is finally belayed to a cleat forward of the cockpit. The Halyard should be ¼in. dia. hemp or nylon.

At the end of the boom a standard clew fitting is used to take the main sheet pulley (Fig. 33). Where the boom crosses the mast a lashing is taken round the boom and the mast and belayed down to a jamb cleat secured to the side of the mast, as shown in Fig. 31.

Where the gaff and boom meet, a forward kicking strap is used (¼in. dia.) and is secured to an eye on the deck just forward of the mast. This also serves to hold the gaff and boom together by being passed through the ½in. holes in these members (Fig. 30).

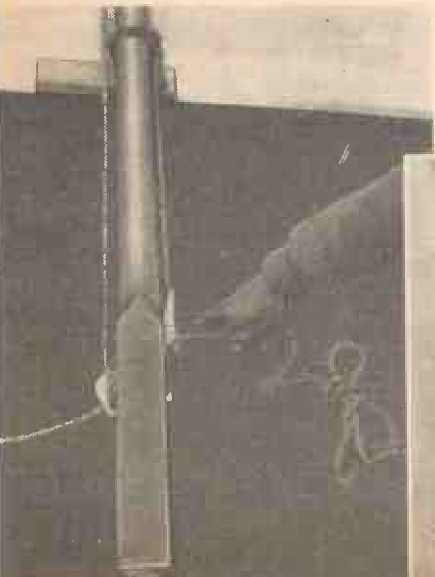
The only other fittings are those for the rudder, which being the Holt Allan variety, are quite cheap. A pair of gudgeons with straps were used, one on the block in the centre of the transom and the other attached to the base of the rudder cheeks. One pintle is attached to the transom and skeg and the other to the rudder stock (Fig. 26). Either side of the transom are attached shackle eyes, to which a horse made up from ⅛in. dia. steel wire or ¼in. dia. rope is fixed. This should be of sufficient length to give clearance for the tiller movement, and a brass ring should be slid on to which the sheet is attached. It then, of course, passes through the pulley at the end of the boom and so to the helmsman's hand.

This then completes your sail skiff. Ours we transport on the car roof rack with the sail, mast and boom rolled and tied alongside ready for quick rigging when the beach is reached.

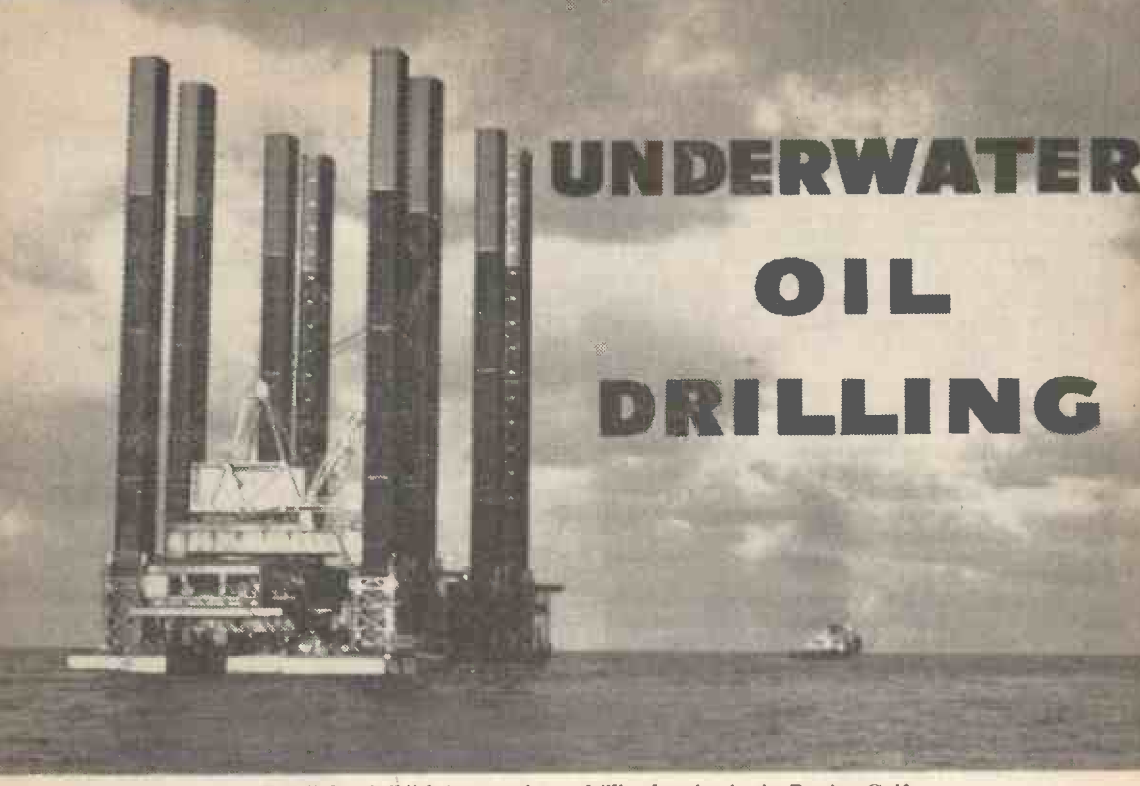
Fig. 31 (Left).—Base of mast showing fittings for main halyard and downhaul.

Fig. 32 (Centre).—Main halyard attachment to gaff.

Fig. 33 (Right).—Aft end of the boom showing main sheet pulley attachment.



UNDERWATER OIL DRILLING



The " Seashell " being towed to a drilling location in the Persian Gulf.

THE vast oil resources which lie beneath the ocean bed are exploited by means of wells in the ordinary way, except that the drilling is done from a sort of floating platform. Two of the latest of these platforms are shown on this and the facing page.

" Seashell "

This is a mobile oil-drilling platform built for Shell as a more versatile successor to the one wrecked in a sudden storm four years ago off Qatar, in the Persian Gulf.

Two Dutch tugs towed the "Seashell" 6,400 miles to Doha Bay from Schiedam, Holland, where it was built. The trip took 75 days at an average speed of 3½ knots. Mostly the weather was good and the tugs could do 4 to 5 knots. But a head-on gale in the Red Sea cut this to one knot for a day or two and even halted progress altogether for a while. Apart from this the voyage was uneventful.

During the journey five men from the towing contractors were on board the 5,930-ton "Seashell," plus two Shell engineers whose job was to maintain the platform machinery.

The "Seashell" consists of a pontoon 209ft. long, 105ft. wide, and 17ft. deep, with eight legs 218ft. long and 10ft. square. It has been designed to withstand gales of up to 100 miles an hour and waves 30ft. high, while working in water 100ft. deep. The pontoon hull carries drilling machinery suitable for drilling to depths of 17,000ft. and ancillary servicing equipment, including a 75 ton completely mobile crane. The " Seashell " has a detachable helicopter deck which projects over the water and can be folded away before making long tows.

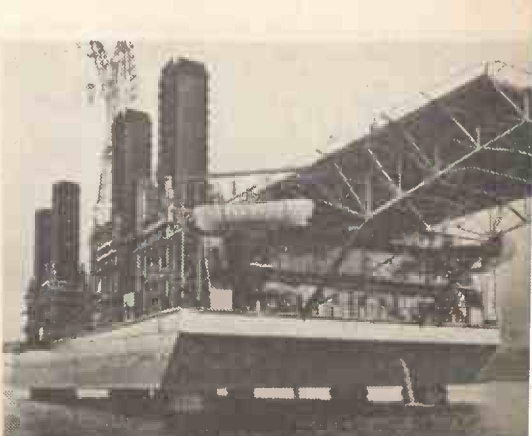
When the " Seashell " reaches a new drilling site, its eight " legs " are lowered to the seabed and drilling operations begin.

On board there is accommodation for a staff of about 70, made up of drilling crews and service personnel. The majority will stay aboard for eight-day spells, followed by four days ashore.

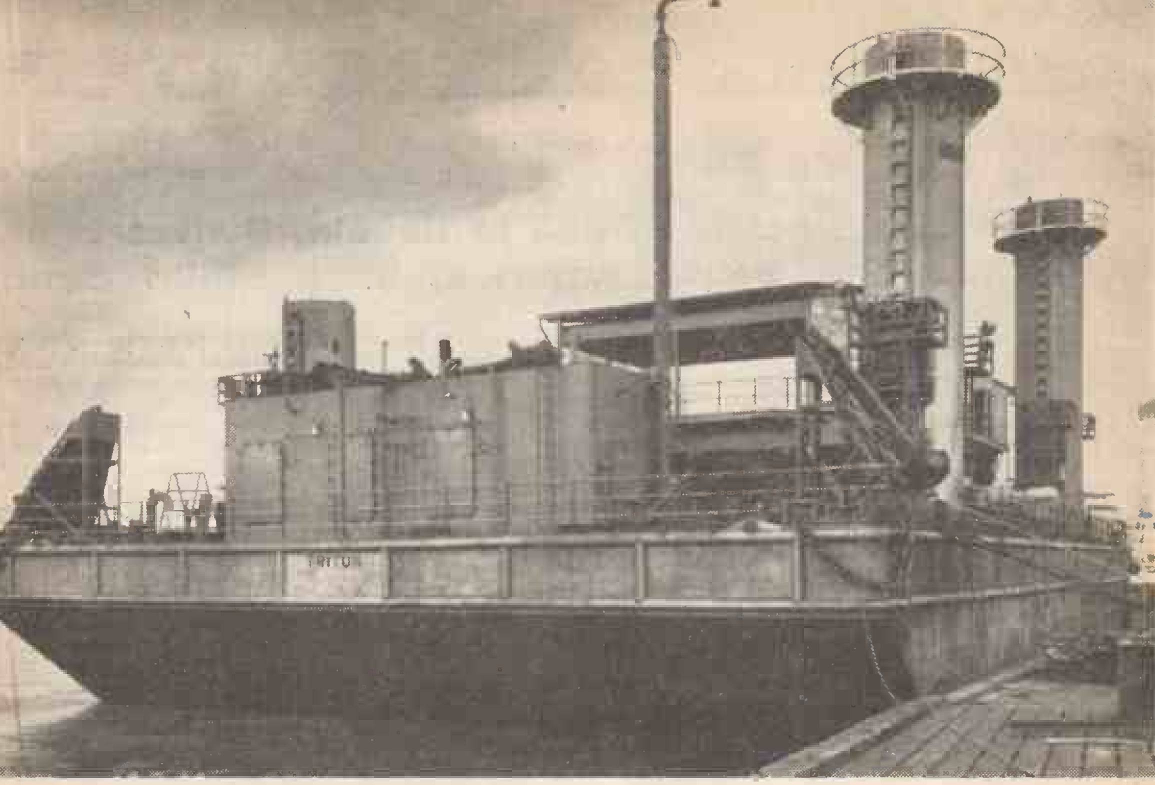
The " Triton "

This is the name given to the mobile oil drilling platform shown on the photographs on the right. Built on Tyneside, under supervision of the American main contractors, " Triton " cost over half a million pounds and contains 1,500 tons of steel. The platform has been built for operations in water depths up to 120ft. and is fitted with four retractable legs, each of 200ft. in length and 8ft. in dia. On the sea journey out to the drilling site, only an 80ft. length of each leg was installed. The remaining lengths, together with 16ft. dia. footings, designed to limit soil penetration were lashed to the deck during the tow.

At the drilling site, the hydraulic mechanism is



General view of " Seashell " on her " sea legs,"



A view of " Triton " as construction nears completion.

used to raise the entire platform, at a speed of 30ft. per hour, clear of the water and any lifting action from waves. As a drilling is finished the legs can be raised and the platform towed to another location.

The " Triton " is designed to withstand waves of 8ft. in height from trough to crest and a wind velocity of 75 m.p.h. under operating conditions.

The hydraulic cylinders for raising and lowering the legs are powered by pumps driven through 60 h.p. electric motors drawing current from four alternators each of 136 kW. rating. Dimensions of the platform are 115ft. long, 80ft. wide and 15ft. deep.

Now Remote Control

The two drilling platforms described in the previous paragraphs are some of the most modern in the world, and now a new development has arrived which will take over where these giants leave off.

A new oil well drilled 8,300ft. below the ocean floor in 56ft. of water, 35 miles off the Louisiana coast, has been brought into production by remote control from the surface of the sea without the use of divers.

The well has been drilled by Shell Oil Company, the largest offshore producer in the Gulf of Mexico.

The new technique is hailed as a significant step forward in obtaining more oil and gas from the outer continental shelf of the United States. It is the result of several years' work by the Exploration and Production Research Division of Shell Development Company at Houston, Texas.

The technique makes it possible to place the equipment necessary for controlling the flow of crude oil and gas on the bottom of the sea over the completed well. Operations involved in " bringing in the well," and subsequent production operations, are all carried out by remote control from the surface of the water.

Hitherto when a successful offshore well has been drilled—a very expensive operation—it has been necessary to erect a permanent structure over it with foundations on the sea bottom, and extend it high above the surface to avoid destructive wave action.

This assembly holds what is known as the " Christmas tree," an assembly of valves and fittings controlling the flow of oil. The deeper the water, the more costly the structure. The need for surface platforms that support above water " Christmas trees " is now eliminated. As a result, possible navigational hazards to craft are avoided, and there is also a considerable saving in the costs of maintaining navigational lights at the spot.

The research work involved not only experiment with many types of underwater equipment and various operating ideas but also an extensive study of wave action, both surface and underwater. The technique will be further developed.

A further view of " Triton."

ALL ABOUT CRA

they are already in use in Russia, Switzerland, Japan and South America, says Philip Banbu

A FEW years after they had built the world's first aeroplane, the Wright Brothers turned their attention to fitting water wings to ships to lift them above the sea. Neither they nor anyone else achieved much practical success for nearly 40 years, but now, at long last, the hydrofoil vessel is coming into increasing use all over the world. You can travel at 40 knots in a hydrofoil ferry from Italy to Sicily, Venice to Trieste, Copenhagen to Malmo, Stavanger to Bergen, and Stockholm to Finland. You can also find them operating in Switzerland, Japan, Venezuela, Russia and elsewhere.

Many early designs performed well enough in smooth water but in rough, either the foils broke surface or air dribbled down on to them and destroyed the lift. Almost every pattern of foil was tried in the search for speed, strength and seaworthiness. Many layouts seemed so clumsy that the hydrofoil boat did not get the attention it deserved.

Aeronautical Principles

The Schertel foil system is the one now used on all the operational craft west of the Iron Curtain. Fig. 5 shows a 70 passenger boat designed by the Swiss firm of Supramar, which has carried over a million passengers across the Straits of Messina since 1956. The V shaped forward foils (Fig. 1) provide lateral stability on the same principle as the dihedral of an aeroplane's wings. A roll to starboard brings the port foil more vertical and more out of the water, spilling lift and the starboard foil more horizontal, increasing it. The downward taper of the foils produces a sharp decrease in lift if they rise too far and a sharp increase if they sink too deep. The cuffs or fences around them restrict the downward flow of air. Tremendous research has gone into this system and any attempt to reproduce it " by eye " would probably be disastrous.

Hans von Schertel started research in 1928, and by 1953 the first passenger carrying hydrofoil craft started work on Lake Maggiore, a " seamark " in the history of shipping. This vessel was the Supramar PT10 now the second smallest of their range. She has 30 comfortable seats, in pairs on either side of the gangway and the passengers have a magnificent all round view through the almost completely glazed cabin sides and ends, as they skim over the lakes at 30 to 40 knots.

Speeds of 35 to 45 knots can of course be reached by many ordinary " speedboat " type vessels, but only by means of much greater power. Until 1959 the Shell Oil Company of Venezuela relied on orthodox high speed launches to carry workers out to the drilling rigs 40 miles off-shore on Lake Maracaibo. Now they have PT 20 hydrofoil boats which carry the same load of 66 passengers at the same speed, on well under half the h.p. (Fig. 8). Small wonder that other boats like them have appeared on the 60 mile long lagoon, and larger PT 50 boats (Fig. 6) are now working between La Guaira on the Venezuelan coast and Isla de Margharita, 120 miles away in the Carribean Sea.

Not only are hydrofoil boats more economical than fast launches but they make very little wash, and can be driven fast on rivers or canals without damage to the banks or other craft. For this reason the River Rhine Police have used hydrofoil launches since 1954. Their vessels are 37ft. long, or about half as long again as the Thames Police boats; and are capable of about twice the speed, or 37 knots, which enables them to overtake anything on the river without causing inconvenience.

The Suez Canal Authority is even more anxious to avoid wash and uses a hydrofoil inspection launch.

There are nearly 40 Supramar designed hydrofoil boats in service including several of the largest size, the PT 50 (Fig. 6) 88ft. long, carrying 110-140 passengers, and maintaining 35 to 38 knots cruising speed in waves up to 6ft. high.

Russian Hydrofoils

East of the Iron Curtain too, dramatic progress has been made with hydrofoil boats, and the Soviet authorities plan to have 285 in operation on rivers and lakes by 1965. There is a regular daily service on the Volga between Moscow and Gorky, 600 miles in 13 hours. *AQUABUS* is an early Russian boat, 89ft. long of 24 tons loaded weight, carrying 66 passengers at

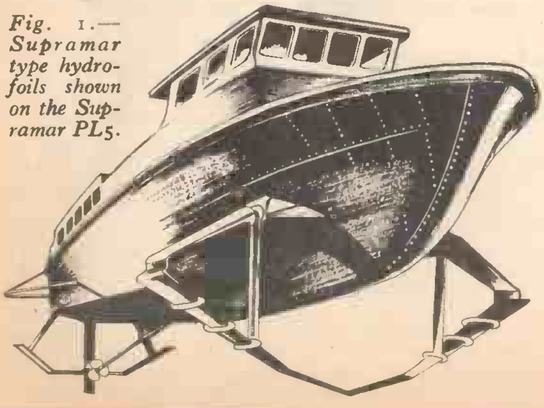


Fig. 1.—Supramar type hydrofoils shown on the Supramar PL5.

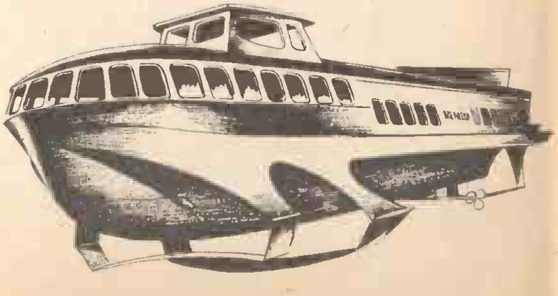


Fig. 2.—The Russian " Meteor " hydrofoil boat can carry 150 passengers at 29 knots.

HYDROFOIL

AFT

Italy, Scandinavia,

ry

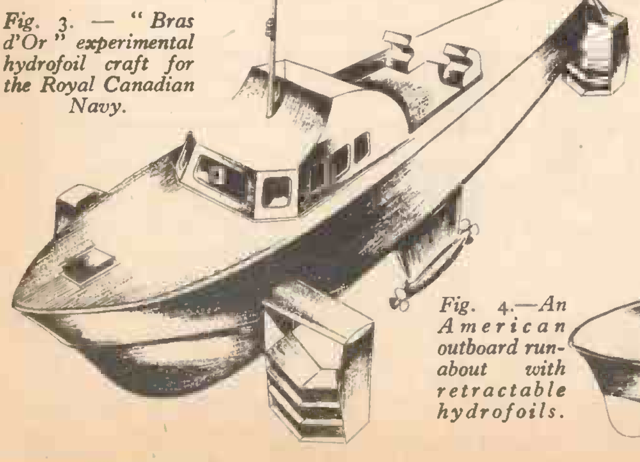
Our artist's impression of a typical hydrofoil craft at speed.

35 knots. *METEOR* (Fig. 2) carries 150 passengers at 29 knots, and *SPUTNIK* to carry 300 passengers is due to go into service at any moment.

All these boats have two horizontal foils under the bow. The leading one is only slightly immersed and if it breaks surface the loss of lift causes the adjacent foil to sink to restore equilibrium. As in the Schertel type boats there is a horizontal foil at the stern which is kept at more or less constant lift angle by this close control of the position of the forward foils.

Whe her the Russian boats are as seaworthy and stable as the western boats is not known, and it is possible that operation on the huge slow flowing Russian rivers does not require such qualities in high degree. A recent report from Russia says that *SPUTNIK* is being built in two versions, a seagoing one and a river one, and that 300 passengers are to be carried at 50 knots.

Fig. 3. — "Bras d'Or" experimental hydrofoil craft for the Royal Canadian Navy.



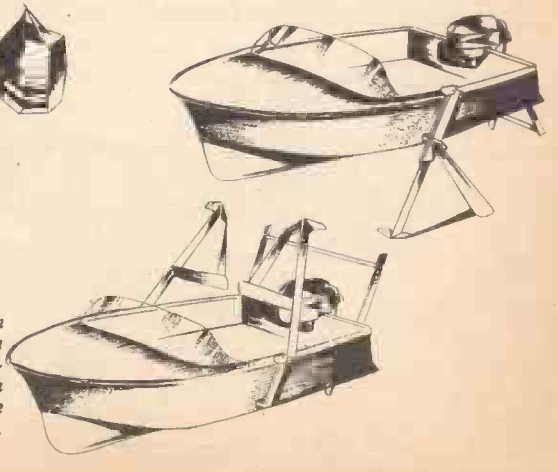


Fig. 4.—An American outboard run-about with retractable hydrofoils.

Fig. 5.—Supramar PT20 hydrofoil boat, which can carry 66 passengers at 40 knots. (Photo by courtesy of Supramar A.G., Lucerne, Switzerland.)

Fig. 6.—Supramar PT50 hydrofoil boat, which can carry 110 passengers at 41 knots. (Photo by courtesy of Supramar A.G., Lucerne, Switzerland.)

British Hydrofoils

The British contribution to hydrofoil development has been small, partly because our rivers and lakes are small, and partly because the early designs were not seaworthy enough to operate in the rough confused seas that can spring up around our coasts. However in 1957 Sanders Roe (Anglesea) Ltd. built the experimental boat BRAS D'OR for the Royal Canadian Navy (Fig. 3). She is the only modern boat fitted with "ladder" type foils although they have achieved considerable success in the past. Her twin propellers, mounted on a deep skeg, emphasise the difficulty of driving screws so far below the hull. The streamline hull is excellent for fast running and in conjunction with the exceptionally high ratio of power to weight (130 h.p. per ton) suggests that BRAS D'OR is very fast indeed. Unfortunately no figures have been published.

The "Hydrofin"

In 1945 Christopher Hook started working on the design of small surfaces to travel on the water ahead of the main foils to "sense" the shape of the oncoming waves. An ingenious linkage trims the main foils to suit. He got little support here for his "hydrofin" and took the idea to America where it was tried out on a landing craft. This proved the effectiveness of the system but the sensors were extremely vulnerable, and later craft use a radar beam instead to "feel" the oncoming waves and feed the information to an aircraft type auto-pilot which continuously adjusts the main lifting surfaces. This vessel has a high performance and very clean lines; whether the advantages outweigh the complication remains to be seen. Kits of parts for a small Hook "Hydrofin" were available at one time and one boat was built in West Africa.

Conversion Kit

A lot of research has been done in America and the U.S. Navy has always been interested. The Grumman Aircraft Corporation has developed retractable foils which are sold in kit form for converting small speedboats to hydrofoil operation (Fig. 4). The speed of the Corporation's own four seat 15ft. runabout is raised from 20 to 39 knots by the fitting of the hydrofoils, using exactly the same 35 h.p. engine. There could hardly be a better example of the advantage of hydrofoils. These kits are available in this country and were shown at the 1959 National Boat Show.

The Grumman Aircraft Corporation is now well advanced on the construction of an 80-ton seagoing craft for the U.S. Maritime Commission. This will have the same type of retractable foils; she will be 104ft. long and 21ft. beam, 60 to 80 knots speed and able to carry 100 passengers from New York to Bermuda, a distance of 600 miles.

The U.S. Evinrude "Jetstream" shown in Fig. 7 also has retractable planing surfaces; but these only obtain lift from the bottom surface and not from *top and bottom* as does the hydrofoil.

For Naval Use?

The draught of the hydrofoil boat when floating is double that when foil borne, and the foils may be inconvenient for operation in tidal waters or for craft that have to be beached.

These are the conditions under which most naval light craft operate and hydrofoil craft have not yet found favour in this role. During the war the Germans devoted a great deal of effort towards hydrofoil torpedo boats and produced one 46ft. long with a top speed of 55 knots. This was 15 knots faster than an E boat but the hydrofoil vessel was not used operationally. Other boats of 80 tons and 40 knots were used as troop transports in the Mediterranean.

With retracting foils for inshore work and with increased range and seaworthiness for offshore patrol, the hydrofoil vessel now becomes very attractive for naval work. The U.S. Navy has two anti-submarine patrol boats being built, each 110ft. long and capable of 70 knots. These are long range vessels and have fixed foils which are fully submerged

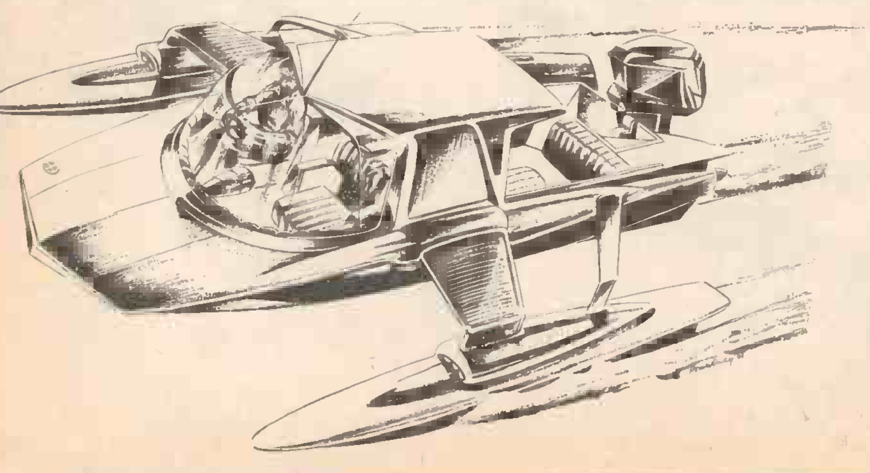


Fig. 7. — The U.S. Evinrude "Jetstream" combines the advantages of an ordinary hull at low speeds with those of the hydrofoil concept at high speeds. Two 13ft. pontoons are mounted to the hull on folded arms. These are lowered into the water as the maximum speed with the primary hull is approached, when the primary hull raises clear of the surface and the craft planes on its floats.

Fig. 8.—Hydrofoil craft PL8, capable of carrying 50 passengers at a speed of 35 knots was built for the Shell Petroleum Company in Holland. It operates on Lake Maracaibo, Venezuela. (Photo by courtesy of F. H. van Dijk, Rotterdam.)

and have their lift angle adjusted by radar sensors.

It would not be catastrophic if a foil was shot away. Tank tests have been made to see what would happen to a hydrofoil passenger vessel that " lost a leg " through hitting debris at full speed. The model came quickly and safely to rest.

Limit to Size

There is no longer any doubt that hydrofoil boats are thoroughly practical, and they are finding increasing use all over the world. Every year brings further proof of their seaworthiness. Greater size confers considerable advantage, but even the present largest vessels, which are still under 100ft. long, can proceed on their foils at reduced speed in waves of 13ft. high. Supramar, the Russians and the Americans are all working on 300-ton vessels to carry 300 to 500 passengers. Greater size still depends partly on whether sufficient strength can be built into a hull which is supported on two points only and partly in the maximum power available.

The largest lightweight marine diesel engine is at present 3,000 h.p. and the largest gas turbine so far is 4,250 h.p. 20,000 h.p. per boat is probably the present practical limit, sufficient for an 800-ton vessel.

There is of course no possibility of putting ships like the *CANBERRA* or the *QUEEN MARY* on foils. The latter would require two million horsepower to make use of them, ten times her present engine room output. Because of its high power requirement the hydrofoil vessel must always be as small and light as possible. Because they can make more voyages per year they will not in any case need to be as large as orthodox ships. Although there would be no room for swimming pools and gymnasiums, there would be none of the limitations of space, shape and operating conditions which result in the tunnel like cabin, restricted outlook and synthetic atmosphere of the airliner.

The Supramar PT50 carries 115 passengers in cabins 20ft. wide, on two levels, and there is an open air promenade deck. PT90 now building, has two passenger decks each 80ft. long × 26ft. wide. There will also be a bow-fronted saloon above the main deck with a magnificent view from straight ahead round to either beam.

The hydrofoil vessel has a much easier motion than the ordinary ship. Naval architects say the vertical acceleration is much less; the Venezuelan Oil Company says the same thing in a more practical way when it says that employees no longer arrive at work seasick.

The world of passenger shipping has not only the hydrofoil craft to consider, but also the hovercraft. The relationship between them is shown by comparing a 70-seat version of each type. The hydrofoil vessel, which has been operating for five years cruises at 40 knots on 1,350 h.p. The Hovercraft, to be test flown this year is expected to cruise at 70 knots on 3,200 h.p.

Whatever the eventual outcome of this rivalry, the hydrofoil vessel already provides shipping companies and the traveller with a handsome ship, of reasonable cost, which has the speed of an express train and the smooth " flight " of an aeroplane.

L.B.S.C's

" EVENING STAR "

(*Continued from page* 532)

turned to the same diameter as the eccentric, for a gauge, which also can be used as a mandrel for facing the other side of the strap. Just clamp it on by its own screws, putting a strip of paper between the strap and mandrel, to prevent slipping; then grip the mandrel in the three-jaw, and go ahead with the facing, until the strap is just wide enough to fit nicely between the eccentric flanges. Drill a $\frac{1}{16}$in. oil hole in the step on the casting, and countersink it, as shown by dotted lines in Fig. 37. The side lug can be slotted for the rod, by clamping it in a machine-vice at requisite height on the lathe saddle, and running it under the cutter used for slotting the coupling-rod forks.

The easiest way to make the rod, and ensure accuracy of the set in it, is to mark it out on a piece of $\frac{1}{8}$in. frame steel, and saw and file to the marked outline. This saves any bending, which is always a time-wasting process of trial and error. The round end is drilled $\frac{7}{32}$in. and bronze-bushed like the coupling-rods. The other end is fitted into the slot in the strap, and secured by a couple of $\frac{3}{32}$in. rivets, countersunk both sides. It may be soldered in addition, which will prevent the rivets working loose. The little end is attached to the pump ram by a gudgeon-pin, which is merely a piece of $\frac{5}{32}$in. silver-steel turned down at each end to $\frac{7}{64}$in. dia. and screwed 6 BA as shown, commercial nuts being used. When they are tight against the shoulders, it should still be possible to twist the pin with your fingers when it is in position in the ram.

A slot will be needed in the back frame stay, to allow for eccentric clearance. Mark out as shown in Fig. 38, drill three $\frac{11}{32}$in. holes on the centre-line, run them into a slot with a round file, and finish to shape shown with a square one.

(*To be continued*)

home-made CHEMICAL LABORATORY APPARATUS

Concluding Instalment—By K. Given

Part 12—Making a Chemical Balance and a Voltameter

SUPPOSE it is desired to find out how much mercury is present in a sample of mercuric oxide. It is necessary to heat a given quantity in a long test tube and to weigh the tube when it is cold and contains mercury only, the oxygen having been driven off. An accurate balance is required.

The model evolved will weigh accurately down to 0·020 grams and, in still air with a skilled operator, down to 0·005 grams. This compares favourably with the cheaper commercial chemical balances costing about £15.

Basically it is a lever balance with gramophone needle points resting on glass sheets as a pivot. These needles are easily replaced if chipped. Arrangements are made to alter the centre of gravity of the pivoting point so that very accurate readings are possible. Each beam also has adjustable weights at each end to allow for day-to-day adjustment, as necessary. Weights are placed in one pan and adjusted in a given manner until the pointer is on zero. The graduations on the scale have no meaning except that when less accuracy is required, two either side of zero could be considered suitable.

Making the Stand

This must be firm, and wood about 1in. thick should be used. Dimensions are given in Fig. 73. The width is important as the beam can be brought

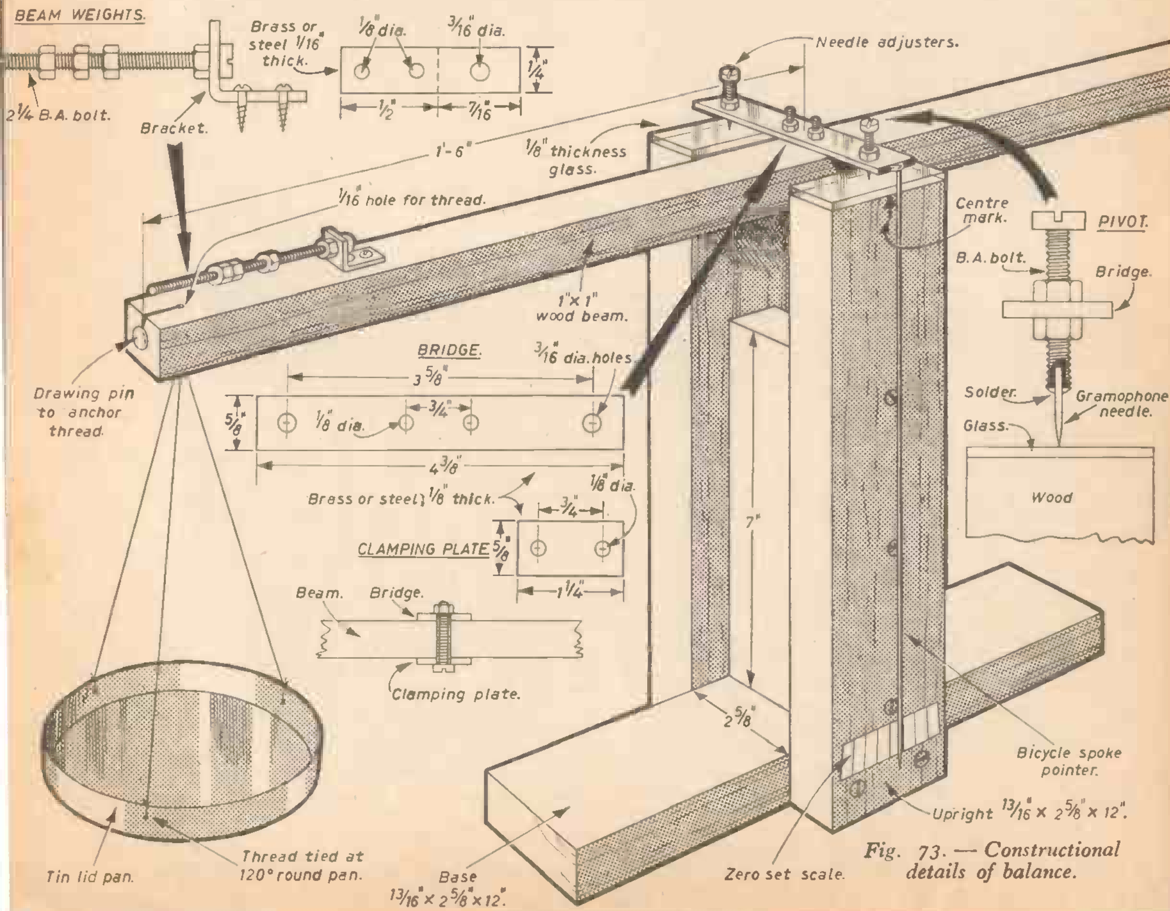


Fig. 73.—Constructional details of balance.

forward to relieve the points of weignt and this action demands accurate measurements of bridge piece and width of stand.

Two small glass sheets are cut to fit on top of the uprights and smeared on one side each with water and carborundum powder, rubbed together for about three minutes, washed and dried. The roughened surface is stuck to the top of the upright with cellulose cement.

The Beam

This is of 1in. × 1in. softwood. A small 1/16in. hole is drilled at each end to take the balance pan threads. Two holes are drilled through the centre of the beam to take bolts which will attach the bridge piece.

Weight adjusters are attached with wood screws at each end. These have to be as light as possible. Nuts may be placed on the threaded rod as required and the bracket should be strong enough not to bend easily.

To stop humidity affecting the beam, it may be given a coat of cellulose lacquer.

Pivoting Arrangements

Two B.A. bolts are drilled as inset in Fig. 73 to take one of the old-fashioned gramophone needles. The "chromium type needles" which are obtainable in packets of about twelve are very suitable.

The needle is soldered in position with *soft* solder and a good flux. In order that the temper of the needle is not spoilt it must be held in *cold* pliers near the tip while being soldered, and quenched immediately with cold water. A needle with no temper left is useless. Spare B.A. bolts, fitted with needles should be made and the pivots in use examined now and again with a glass. Bad pivot points mean poor accuracy.

The Pans

A popular brand of babies' milk food provided two lids which were marked at three points on the rim 120 deg. apart, using a protractor for the purpose. 1/16in. holes can then be drilled in the sides as can be seen in Fig. 73 and ordinary cotton used to suspend the pans. The cotton is taken through the hole in the beam and adjusted so the pans hang horizontal, the end being fixed with a drawing pin.

Pointer and Scale

Any piece of stiff wire can be used for the pointer. A bicycle spoke softened in heat and filed to a point was used in the prototype. The pointer is soldered to the bridge when all other work has been completed.

A piece of card is attached, as shown, at the bottom of the pointer to form the scale. This is not critical so long as the centre mark is in line with the pointer when the beam is horizontal.

Initial Adjustment

Without any nuts on the two beam adjusters, cut or file off wood from one end or other to achieve balance then put one nut half-way along each adjuster and adjust to get as good a balance as possible.

Now very slowly screw down the gramophone needle adjusters, in step with each other and using the two nuts on each. Eventually a place will be found where, when the beam is pushed down on one side, it will stay down, but when pushed down the other side it will also stay down. The beam, if it could be balanced would be in unstable equilibrium (refer to Physics or Mechanics Books). Now undo the gramophone needle adjusters, half a turn each at a time, lock with the lock nuts and test the balance. As soon as the beam returns to balance from being pushed down at each side, leave it alone. The gramophone needle points are in their best position. If new ones are fitted they will need to be readjusted.

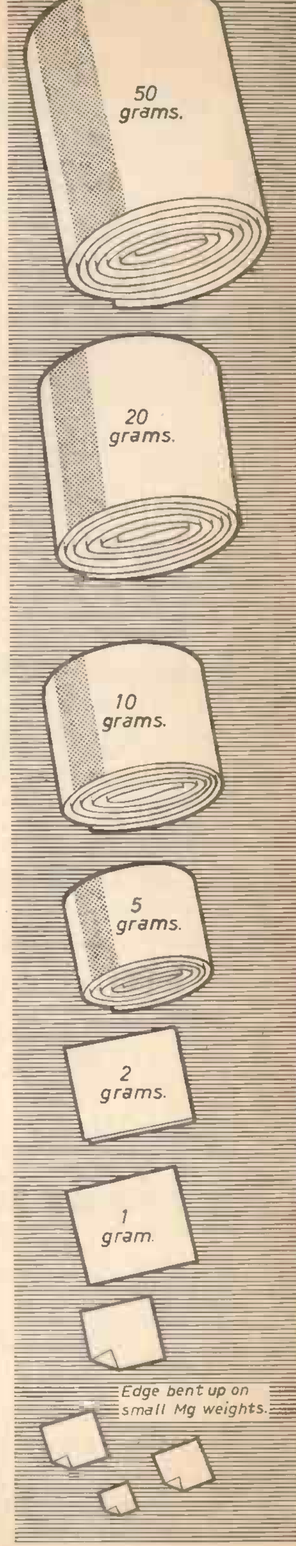
It will now be necessary to carry out very careful adjustment of the beam weights; more nuts may be required on one side. In a very still atmosphere, breathing to one side, let the apparatus centre. View from the front exactly and carry out any final adjustment to the nuts (not the needle holders) on the beam ends.

Drop a postage stamp on the pan and the pointer should move over at least 1/8in. at the bottom. The prototype shown gives a little more movement than that.

Weighing Air

This experiment is suggested to gain experience in using the balance. If the base of a radio valve is crushed carefully in a vice, the valve may be placed in one pan, and dry sand, etc., to balance it in the other. If now the glass seal is broken with a pair of pliers, and the broken glass left in the pan, the valve will be found to have increased in weight. How much may be seen by adding weights or sand to the other side.

Fig. 74.—The balance weights.



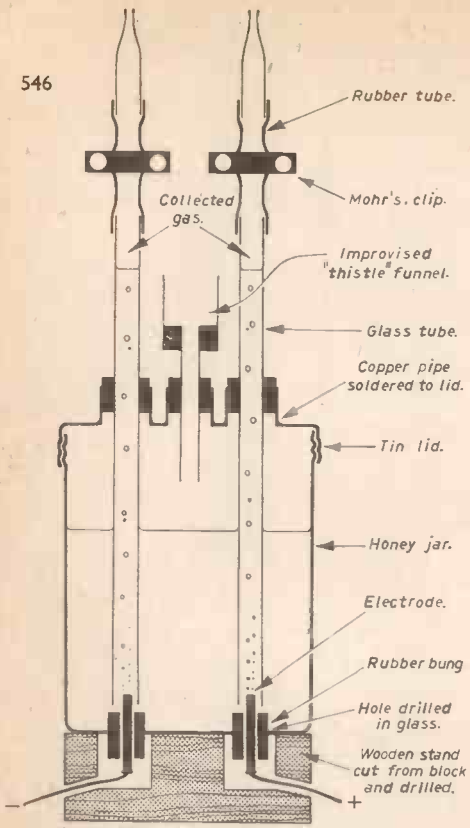


Fig. 75.—Home-made Voltameter.

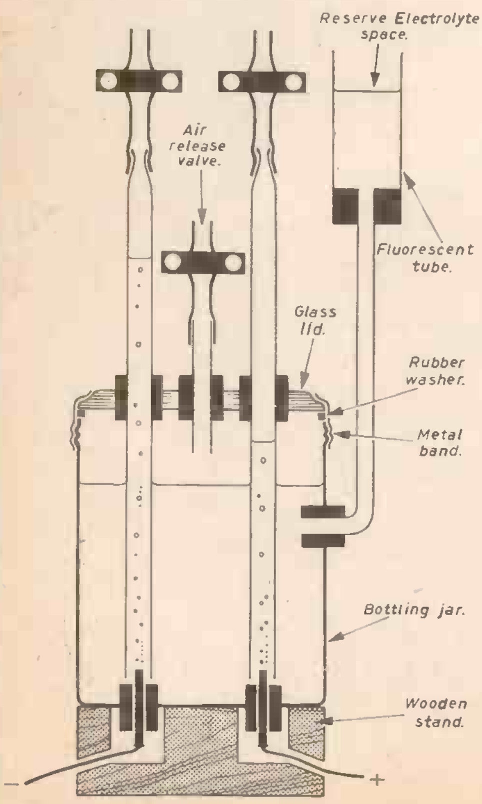


Fig. 76.—Improved Voltameter.

Resting Position

If the beam is lifted and gently pulled forward it will rest on the glass supports with the front gramophone needle over the side of the front support and the back one over the side of the back support. The needle points are thus protected.

Small wooden blocks may be fitted under the pans for use when loading, etc.

Making Balance Weights

If a sample weight can be bought or borrowed, the job will be much easier, but the following method will be reasonably accurate and uses no other standard than either a burette or glass tube of known diameter.

Although any material could be used, a metal resistant to oxidation is best, such as aluminium sheet of about 22g.

Place a beaker on one of the pans and balance it with sand in the other. Put exactly 50 grams of water into the beaker. With the room temperature as near 4 deg. C. as possible 50Ml. of water is measured with a burette or by the tube method described in the section on making burettes. A piece of aluminium sheet, cut exactly square is placed on the other pan. Then pieces are cut off (maintaining the square shape and finally rubbing it along a file), until it exactly balances the water in the beaker. Some idea of the amount which needs to be cut off, can be gained by placing a trial piece on the other pan prior to cutting. The size required for all the other weights (cut from the same thickness sheet) can be calculated on the basis of area. Use tinsnips to cut them out and check their accuracy by the tube method of measuring water.

For smaller weights a thinner gauge of sheet is preferable the corners being turned up to allow them to be picked up easily. The larger ones, as seen in Fig. 74, are marked with a scriber. No doubt brass sheet could be used, especially for the larger weights. Lead is rather too soft to be suitable at all. Small brass tweezers may be made to help with the small milligram weights.

A good set of weights will consist of: Grams. 50, 20, 10, 10, 5, 2, 1 (250g being maximum with this balance). Milligrams 500, 200, 200, 100, 50, 20, 20, 10, 5.

Using the weights

The object to be weighed is placed in one pan and one weight *heavier* than the object in the other. The set of weights made had a maximum of 50g, but you may make them up to 250g. Having found one heavier than the object take it off and put the next weight in order on the pan. If too light leave it on. If too heavy take it off. Put the next smaller on. If too heavy take it off, if too light leave it on. Proceed until a balance is obtained. Do NOT skip a weight (even if, for instance there are two the same). If a balance is not obtained a mistake has DEFINITELY been made. Start again.

Electrolysis Apparatus (Voltameter)

Using the drilling method previously described it is possible to devise much electrolysis apparatus from bottles and jars.

A most satisfactory piece of apparatus is shown in Fig. 75. A glass honey jar is drilled with two ½in. holes in the bottom using carborundum and a copper tube as a bit with a water lubricant. Two holes are drilled in the lid to coincide and another somewhere between them. Small lengths of copper pipe are then soldered on the outside of the lid as shown.

The electrodes are fixed in rubber bungs, two carbon ones from old torch batteries being shown. Platinum ones can be purchased from laboratory suppliers or it is possible to use old relay contacts of the platinum type, all other parts being covered with cellulose or wax. These present a rather small surface for electrolysis, but are nevertheless efficient.

(Concluded on page 553).

A CHAIR-GRIP PROJECTOR TABLE

By
J. C. Lowden

The device shown in use above costs only a few shillings to build; little woodworking skill is called for and only basic tools are required. The main essentials are solidity and rigidity. The measurements shown in the sketch below are not critical and may be amended to suit any projector. Use either hardwood or softwood.

TO begin construction, cut the main clamp bar 20in. × 4in. × 1in. and chamfer off the top corner to a quarter round profile. Rebate as shown to accept one leaf of a single 4in. cast steel butt hinge.

Prepare the top spacer block, as shown and fix in place with countersunk woodscrews about 1in. from the top. Position the second block with about 7in. space between the two.

Make the moving clamp bar and clamp it temporarily in position on the spacer block. Using a ⅜in. bit, drill through the moving clamp bar and partially into the spacer blocks, exactly in the centre of each. Dismantle and continue the hole right through the blocks. Chisel a recess round the hole to fit the bolt heads, replace the blocks. Join the two clamp bars by passing the bolts through holes in the moving clamp bar and secure with washers and wing nuts. Glue viscose sponge to the three clamping surfaces.

The Table

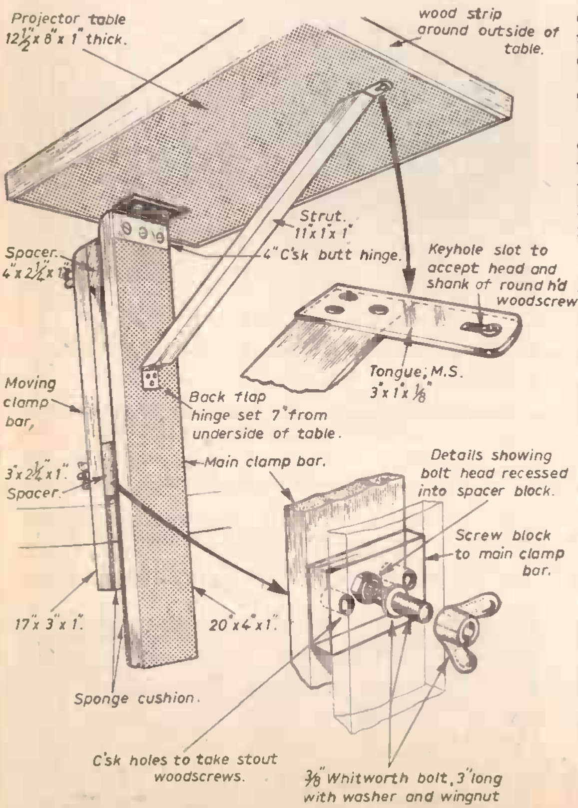
This is a 12in. × 8in. piece of blockboard about 1in. thick. Moulding or strip is fixed around the edge, the corners being neatly mitred. Its purpose is to act as a fence to prevent the projector from sliding off. Fix the table in position by means of the hinge.

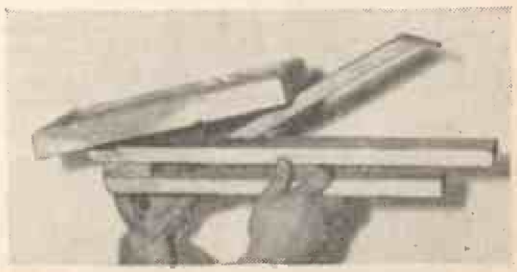
The Strut

A piece of wood 11in. × 1in. × 1in. is used. Cut one end to an angle of 30-40 deg. and screw it on to the hinge. Use trial and error methods to arrive at the correct position for the hinge, the correct angle for the other end of the strut, etc. Alternatively this may be done by means of a full-size drawing.

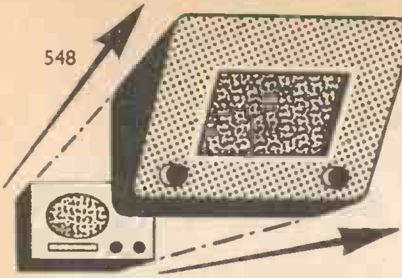
The strut tongue is made from a piece of metal 3in. × 1in. × ⅛in. Round off one end and drill holes which can be chiselled into the shape of a keyhole slot, as shown inset in the sketch. Set up the assembled stand with the table at right angles, swing the strut into position and drive a screw through the narrow slot, allowing freedom of movement. To disengage, pull the strut so that the head of the bolt will pass through the large hole of the " keyhole".

Stain and polish or paint as desired.





(Above) How the table folds for stowage.
(Left) Details and dimensions.



EXTENSION SPEAKERS

Part 18 Concluding the Automatic House Series

by E. V. King

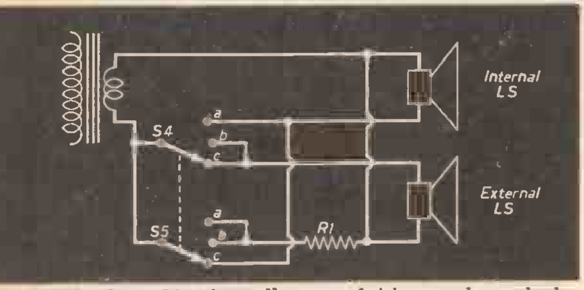


Fig. 163.—Circuit to allow use of either speaker or both with the volume remaining constant.

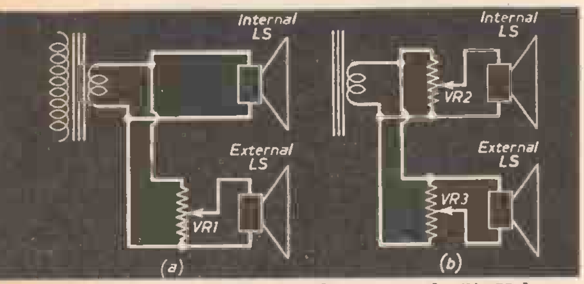


Fig. 164.—(a) Fitting a volume control; (b) Volume controls on two speakers.

Fitting Volume Controls on the Individual Extensions

FIG. 163 shows a method which ensures that the switching to extension, main or both speakers will not alter the volume of either (RI = 3Ω).

Fig. 164a shows a useful method of controlling the volume at the extension speaker. VR1 is of about 10Ω and a suitable control is obtainable cheaply from Messrs. Home Radio Ltd.

Fig. 164b shows how the volume of both the main and the extension may be altered without one affecting the other very much. The set control (the

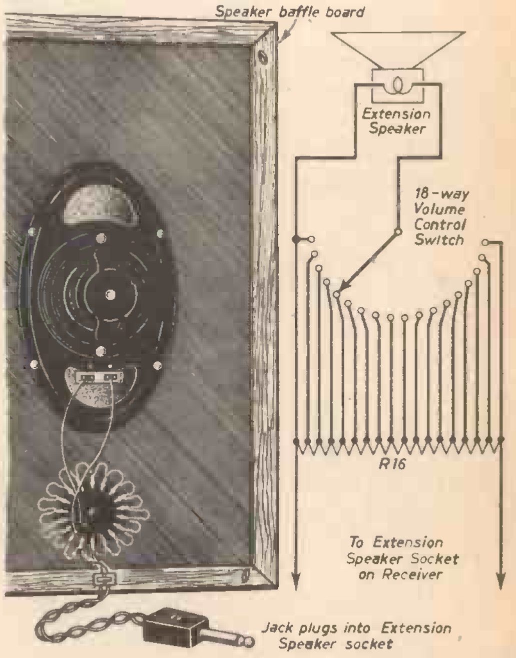


Fig. 168 (Above).—Controlling volume with an 18-way, single-pole rotary switch.

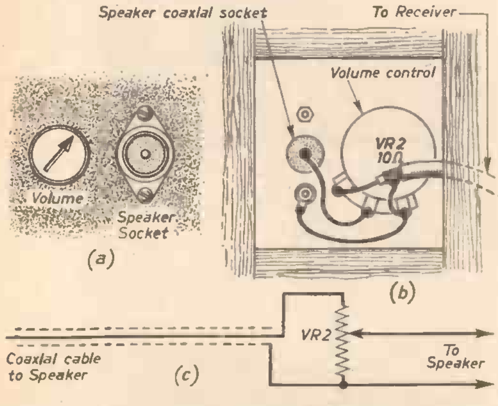


Fig. 165 (Left).—Plugging arrangement fitted with volume control. (a) Wall box; (b) wiring; (c) circuit.

Fig. 166 (Below).—Three speakers with volume control.

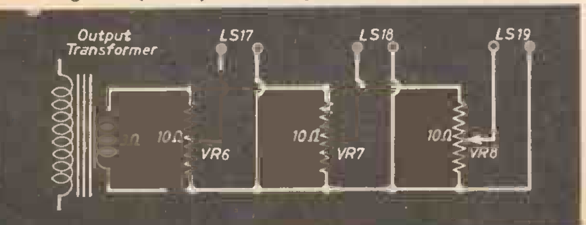
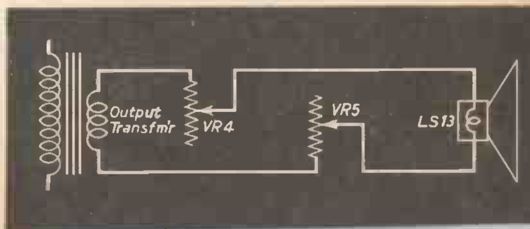
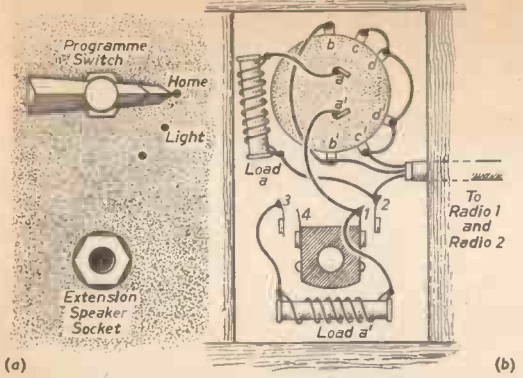


Fig. 167 (Below).—Constant impedance using a ganged control.





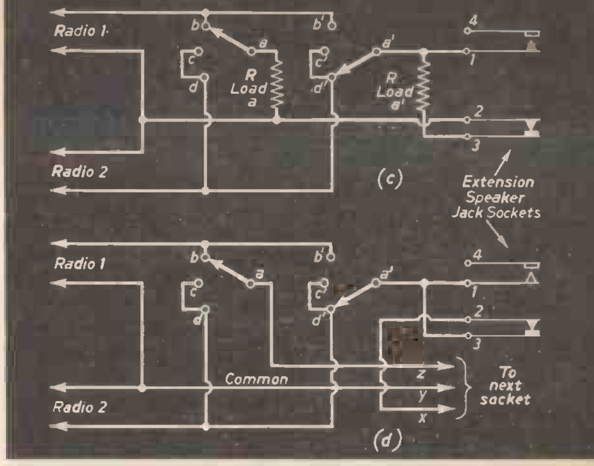


Fig. 169.—Two radio and two programme wiring. (a), (b) and (c) show front view, wiring and circuit of the control box respectively. Circuit (d) allows series connection of any number of plugs.

original makers' one) would be left as far on as possible without causing distortion.

In practice the system of Fig. 164 means either control of volume at the set, at the socket or at the speaker. Control at the socket is best. Fig. 165 shows how to wire up a socket of this type. Otherwise the wiring may be as in Fig. 158 given last month. Also Fig. 153 showed last month how the volume control may be fitted at the speaker and the speaker then plugged into any of the systems already mentioned. There is more danger of the control knob being damaged in the movement of speakers, otherwise the system is just as effective.

Switched Volume Controls

A very good method of fitting volume controls is to make the variable resistance and use a switch to tap in on the resistance. Fig. 168 shows the method; a cabinet of baffle mount may, of course, be used.

An 18-way single-pole rotary switch (Bulgin, S205) is used on the prototype and is extremely satisfactory, the contacts making before the last ones are broken. The resistance wire is made to give about 10Ω, i.e. use 18in. of 32g Ni/Cr wire looped in 1in. semi-circles and soldered around the eighteen contact tags of the switch as in Fig. 168. The sliding contact is connected to the speaker and so is one end of the resistance wire. The input from the radio is taken to the two ends of the resistance. An extension speaker so wired may be used in any of the circuits already mentioned.

An advantage of this system is that the volume may be pre-set very accurately to that required. The theoretical circuit is shown on the right of Fig. 168.

Permanent Extension Speakers

An easy system where permanent extension speakers are installed is to fit controls on each speaker and wire them up as in Fig. 166. The volume obtained at each is not so much altered by the movement of the other controls.

Fig. 167 shows a circuit which may be fixed up if great fidelity of reproduction is required, in the ordinary way such a method is not worth while. The two controls have to be ganged together.

In all cases of permanent wiring the leads may be taken under the floor boards, inside the top of the picture rail or embedded in the plaster of the walls, when a room is decorated. No danger is involved in this process as no mains current is involved.

Two or More Programmes

If two radio sets are to hand, it is very easy to make the Home and Light programmes available at any room in the house. In addition the system may be of the plug-in type, permanently wired and with or without individual volume controls. Three-core cable will be required and one lead of this will be connected to one plug of both radios.

The switching may be done with a switch mounted either on the speaker baffle or at a socket. A suitable circuit and layout is given in Fig. 169. R load may be made about 4Ω and 8in. of 32g Ni/Cr wire will suit. If a copper loop is used instead of the loads no harm will be done, but the volume may be cut on other cir-

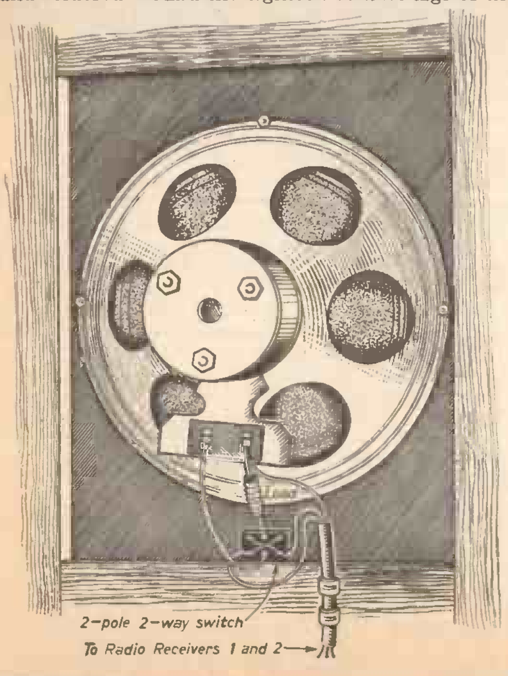
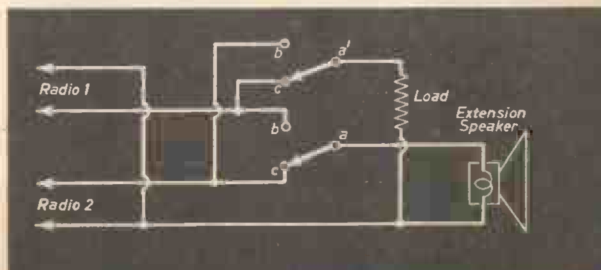


Fig. 170.—Switched two-programme system with the switch fitted on a permanently wired baffle mounted speaker. Both practical and theoretical wiring are shown.



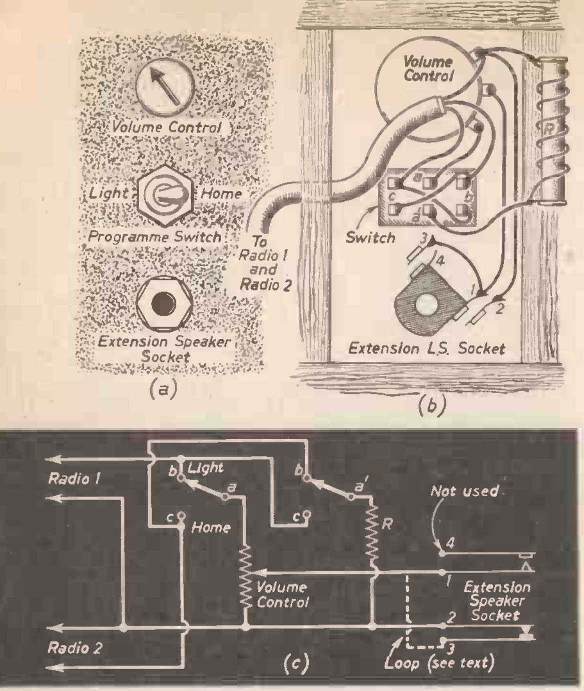


Fig. 171.—Switched programme socket box fitted with volume control. Front view of box, wiring, and theoretical circuit are shown at (a), (b) and (c) respectively.

cuits, when the speaker is removed, or switch moved. If more than one extension is required, up to six or seven plug boards may be wired in parallel if a 15Ω output transformer is fitted.

If this is not possible then any number of sockets may be wired in series (Fig. 169a) provided only three or four speakers will ever be plugged in at any one time. Note that the load resistors have been removed. On the whole more volume will be delivered by this method.

Fig. 170 shows a suitable simple arrangement with a 2-way 2-pole toggle switch (Arcolectric T957) being used for change over. If the load is replaced by a copper wire no harm will come, but the volume of the main radios will be altered on switching from one programme to the other.

Switches with more than 2-way contacts may be used and wave change switches with three ways are suitable. The extra contact must be joined to the adjacent one i.e. "c" and "d" in Fig. 169b have been bridged so that one programme will be received when "a" is on "c" or "d" and the other when "a" is on "b".

Two-programmes Extensions with Volume Controls

If the system of Fig. 169 is used with speakers wired as in Fig. 153 no alteration is required. On the final socket the outgoing leads "Z, X, Y" are all joined together.

If you wish to fit the volume control on the socket mount, a suitable arrangement is shown in Fig. 171. The volume control is a 10Ω type, the switch a T957 and the load 6in. approx. of 32g Ni/Cr wire. The loop between 1 and 3 of the jack socket may be a 3Ω resistor as in Fig. 159.

Fitting Tone Controls on Extension Speakers

This is not very easily done with a simple circuit. It is best to have the radio on with plenty of treble and to attempt to cut this out if required at the speaker end. A circuit which sometimes gives good results is shown in Fig. 172. The final result depends on many factors, especially the transformer. This should for preference be a multi-ratio type so that various tappings may be tried. The prototype design of Fig. 172 uses a standard pentode type of output transformer.

The value of C is important and may be between ·01μF. up to about 0·5 μF. Start at 0·25 μF and experiment. The tone control may be any between 100k and 10k.

The volume control fitted is of 10Ω. Note that the secondary circuit of the transformer with the tone control and condenser is not connected to anything else.

A method requiring two *exactly identical* output transformers to be mounted near the speaker is given in Fig. 173. This is a good method. The exact type of output transformer is not important and the variable resistance may be any value between 5k and 25k. The value of C is chosen to suit the listener, anything between ·01μF and 0·5 μF. being suitable. The wires of the high impedance windings should not be touched (High Voltage.)

Taking Extensions Long Distances

Where it is desired to take an extension more than, say 15yd. or so there will be appreciable loss in the

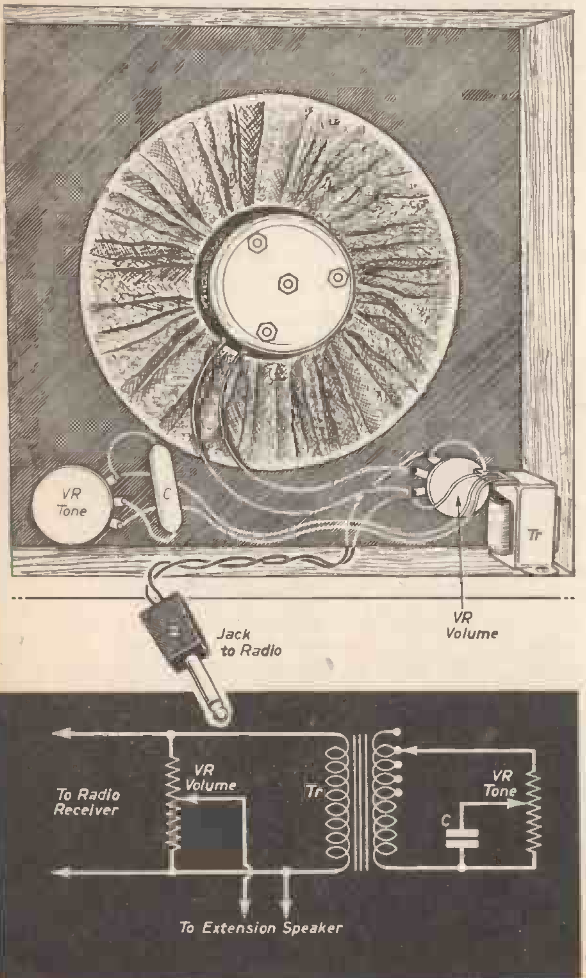


Fig. 172.—Fitting tone control, showing practical and theoretical wiring.

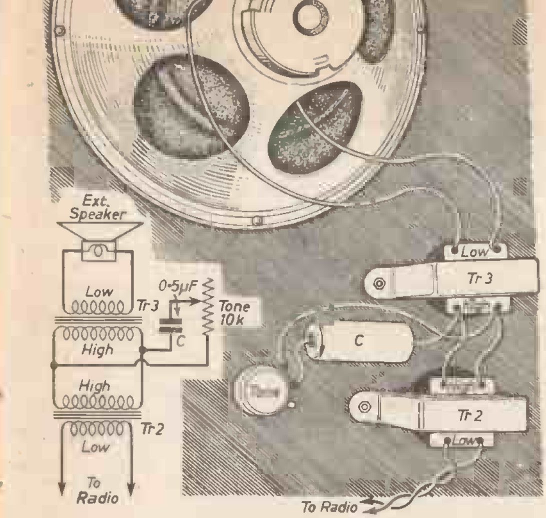


Fig. 173.—Practical and theoretical wiring of a better method of fitting a tone control. Tr2 and Tr3 are exactly similar pentode output transformers.

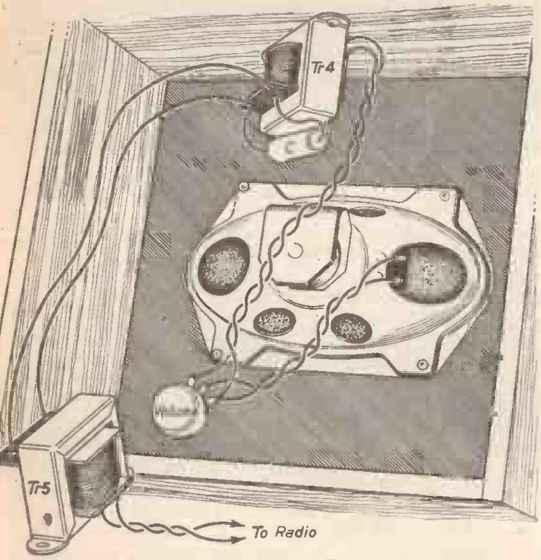


Fig. 174 (Above and below).—Practical and theoretical wiring for a long extension, with little loss of volume.

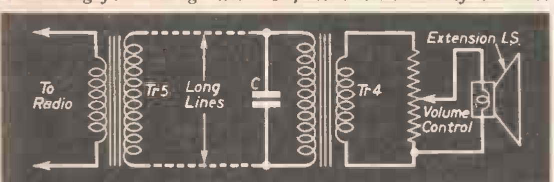
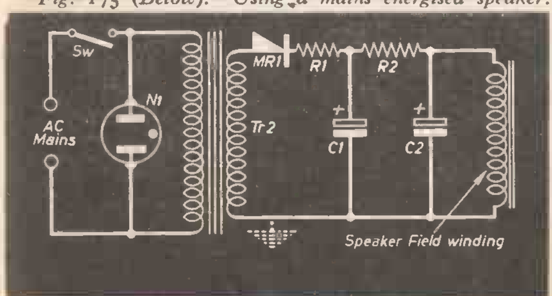


Fig. 175 (Below).—Using a mains energised speaker.



cables unless these are unduly thick. The answer is to use a " line transformer " system.

Fig. 174 shows how this is arranged. Two identical transformers are wired as shown. One being very near the radio, the other very near the speaker. The transformers ought to have 700Ω primaries and 3Ω secondaries, but it is often possible to use two standard speaker transformers. If there is trouble over oscillations, try earthing one of the line leads, the transformer cores and the speaker winding. The condenser C may be required if any tendency to oscillate is still present. There will be very little loss indeed even over distances of several hundred yards. Low capacity cable (i.e. wires well spaced) is best or there may be loss of high notes. The line wire (not earthed) should be well insulated for safety in this system.

Using Headphones

Headphones may be used on extension systems. The Reed Type Low Resistance ones are best and should be fitted with a jack plug incorporating a 3Ω resistor across the terminals. They will then function exactly as the speaker and all the previous systems and remarks may apply.

High Impedance Outputs

It is unusual now to find a radio with high impedance output sockets. The speaker of Fig. 174 may be used without the second transformer (which is shown as being near the radio). Care should be exercised as the system can have high voltages present and good insulation, etc. is necessary.

Energised Field Speakers

These may be found in old radio receivers, the field coil taking the place of the ordinary magnet. The ends of the coil must be located and the circuit of Fig. 175 arranged.

Tr2 is a mains transformer giving about 250V. at 60 mA. and MR1 a metal or similar rectifier (half wave) taking the above current. C1 and C2 are electrolytics of about 50 μF. 300V. working. R1 is a safety resistor of about 50Ω and R2 will be made as high as possible providing the speaker is working at maximum volume for a given input. In any event R2 must not be smaller than 5,000Ω at 3W. The speech coil windings may, of course, be wired in any of the ways mentioned. It is advisable, but not essential, to earth one side of the secondary of Tr2. Air must circulate over the rectifier. N1 is a neon warning lamp.

A SALMON TAILER

J. McClymont

tells you how to make one

ONE of the features of this " Salmon Tailer " is the availability of cheap materials. You will require an old steel-shafted golf club, preferably of stainless steel, 18in. of brake cable, the sort used in heavy commercial vehicles, 1ft. of Bowden cable, 2 brass collars or tubes, ½in. long × ¼in. dia. and about 8 to 10in. of fine brass or copper wire.

The only tools required are a hack saw and soldering iron.

First remove the club head if a complete one has been obtained. Cut the shaft from the top or handle end until it is about 2ft. 4in. long. (Fig. 1.) Make a loop in the Bowden cable big enough to slide freely up the shaft from the bottom, but so that it will grip firmly some 6 or 7in. from the top of the handle.

Join the 18in. brake cable and the 1ft. Bowden cable together by inserting the ends into the brass collar or tube from opposite ends and soldering, as shown.

When soldering one end, plug the centre of the brass collar with a scrap of wood to prevent the solder from running right through and blocking the other end. When this is firm, remove the wooden plug, insert and solder the remaining cable. The collar is then filed to a taper at each end.

Thread the free end of the cable through the loop already formed and push the 18in. brake cable through the shaft from the bottom until it protrudes through the top of the golf club handle. To this end solder the remaining brass collar. When firm, file this to an approximate taper so that it will pull back through the shaft freely until it approaches the bottom, where it should grip firmly. (Fig. 1.) Fit a handle and the " Salmon Tailer " is complete and ready for action.

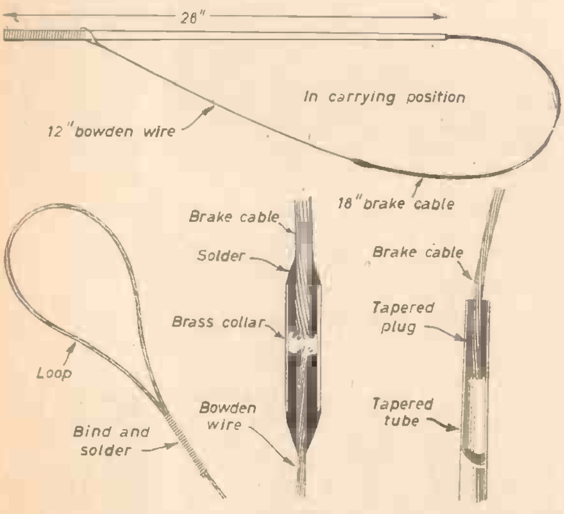


Fig. 1.—Showing details of the various stages in making the " Salmon Tailer." At the top of the figure it is shown complete

A Mower Motorised

(*Concluded from page 525*)

hole, the other a ¼in. hole. To fit this frame, drill and tap two ¼in. B.S.F. holes in the side plate of the mower. The rear upright is held on to the side plate with two 1in. bolts and locked on the inside with nuts. The front upright fits inside the mower plate and is bolted in place by one 1in. × $\frac{5}{16}$in. coach bolt. The reason for using this type of bolt is that it has a shallow head to clear the chain, and the square under the head fits into a slot about ¾in. long, filed in the mower side for chain adjustment. As the mower side is recessed on the inside, a piece of packing about $\frac{5}{16}$in. thick will have to be used to keep the frame upright.

Fitting the Engine

For this you require one 4½in. × $\frac{5}{16}$in. bolt and one 2½in. × ¼in. B.S.F. bolt and nut; also three spacers (Fig. 5). First fit the ⅞in. dia. spacer between the rubbers where the eccentric housing was removed, then pass the $\frac{5}{16}$in. bolt through the engine with the 1½in. dia. spacer between engine and frame. Next pass the ¼in. bolt through the frame, the ⅞in. spacer and engine, fit a washer and nut on the engine side and a lock nut on the $\frac{5}{16}$in. bolt.

A " Cyclemaster " drive sprocket is used for the cylinder drive. First the oil-lite bush is removed, also the two ears on the back. Next it is bored out about ·003in. smaller than the shaft size. Turn a bush of mild steel ·003in. plus size of bore × $\frac{3}{16}$in. with a $\frac{5}{16}$in. hole, press it into the sprocket (teeth side) and weld. File a flat and also the bore to the shape shown in (Fig. 6), to fit the locking flat on the threaded part of the shaft. Now cut part of the mower chain guard away so that the drive chain may line up with the sprocket on the cylinder shaft. Shorten the chain to size and rivet. Fit it on to the engine sprocket also to the cylinder sprocket and press on to the shaft and adjust by means of the $\frac{5}{16}$in. bolt on the frame.

The mower handles are bent to clear the engine and ¼in. holes are drilled each end of the handles to make them a fixture. Refit the exhaust. The carburettor inlet will have to be bent so that carburettor is upright. The petrol tank is made from a pint tin with a bracket soldered to the bottom and screwed to the frame with two 2 B.A. screws. The petrol tap is also soldered into the tin. Levers are fitted to the handles and cables shortened.

The chain guards are made of sheet metal. The back one is fitted with two 2 B.A. screws to the mower side and a distance piece (Fig. 7) between the chain. The outside part is ¾in. deep, shaped and welded, fitted with two self-tapping screws to mower chain guard and a 2 B.A. screw to the distance piece.

Start the engine by using about four feet of cord wound anti-clockwise round the starter pulley, and pulled with the clutch disengaged.

OUTBOARDS ARE FUN!

THE dinghy comes into its own for full family use, with the addition of a motor. We tried out the Evinrude 3 h.p. Lightwin on our Enterprise. Immediately noticeable were the attractive appearance and ease of starting. The cost of running was found to be most reasonable and a whole day's roving round the coast could be done on 1 gal., sometimes covering as much as 14 miles, thanks to the lean mixture controls.

The model we tried was designed for a 15in. transom, but owing to the lightness of the dinghy, sometimes it lifted clear of the water, so perhaps for lightweight boats the 20in. model would be better.

Mainly of diecast alloy construction the Lightwin can be carried by any of the younger members of the family. Ease of servicing has been given high consideration in the design and by the removal of one panel the plugs of the twin two-stroke engine and its carburetter are immediately accessible.

Considerable advantages could be obtained in both evenness of engine tick-over and max. revs., by using the high and low speed control knobs. These are easily accessible and clearly marked, as indeed are all the controls.

Altogether we can recommend the Lightwin.

(*Left*). *Removing one side panel makes the motor accessible.*

(*Right*). *Light enough for a youngster to carry.*

Home-made Chemical Laboratory Apparatus (*Concluded from page* 546)

The gas collector tubes are any convenient length and may be graduated as detailed under burettes in this series. Rubber tubes, Mohr's clips and burette jets complete have all been described and are fitted as shown using rubber or cork bungs in the copper pipes. A "thistle funnel," already described, is fitted in the spare copper pipe.

A wooden block is drilled to take the electrodes, bungs and connections. The block and the metal parts of the lid are given three coats of cellulose lacquer to prevent corrosion.

Using the Voltameter

Carbon electrodes may be used for many experiments including the electrolysis of hydrochloric acid and "ammonia," even water if the oxygen is not required. Add a little dilute sulphuric acid when using water.

It is interesting to carry out the electrolysis of common salt solution containing a little phenolphthalein, or litmus, or potassium iodide solution containing a little boiled "starch."

When using the voltameter, it is filled with the electrolyte to be used to about 1in. from the top. The two gas tubes have now to be filled. This can be done by attaching a filter pump to each jet in turn and undoing the clip until the electrolyte is sucked up. It can be done by mouth, but caution is necessary. In the model suggested in Fig. 76 there is no need to suck the electrolyte up as there is sufficient head of liquid.

Normally D.C. is used and voltages up to about 24 are suitable, common torch batteries giving quite good results.

Making and using A PINHOLE CAMERA

By A. E. Bensusan

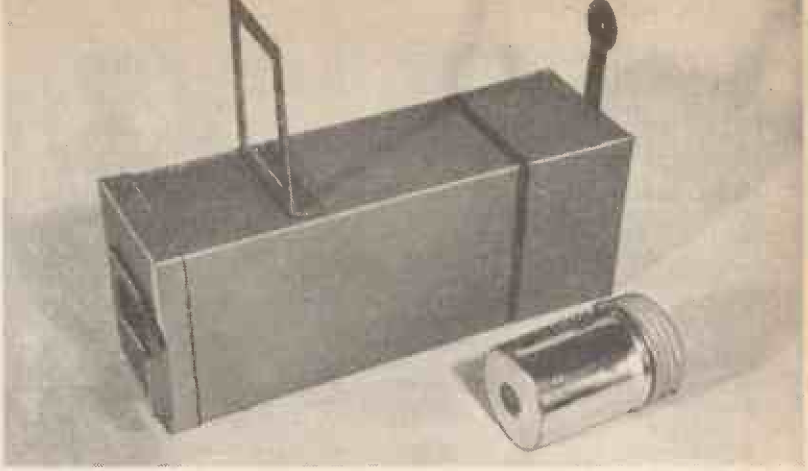


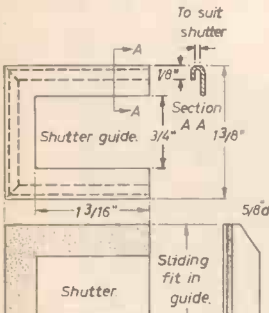
Fig. 1.—Two examples of pinhole cameras.

QUITE apart from the considerable academic interest obtained by producing a photographic negative with virtually no more apparatus than a light-tight box, and without a lens, a pinhole camera can be of genuine use. The focal length, which controls the size of the image, depends only on the length of the camera body. Since the amount of time involved in making this equipment is so small, one can have a series of cameras for wide-angle up to 130 deg., normal and long-focus work in any chosen film sizes.

The Smaller Camera

Fig. 1 shows two pinhole cameras. The smaller consists only of a 35mm. film can, having its interior blackened and a hole in the end covered by a circle of metal foil carrying the pinhole. The film, a cut-down piece of 35mm. stock, is taped to the inside of the lid which is then screwed in place. When the camera is loaded, an operation which must be carried out in darkness, a patch of black tape obscures the pinhole.

It has been successfully used in normal electric lighting by removing the tape, pointing the end of the can in the direction of the subject, and making the exposure by firing two No. 5 flashbulbs together at a distance of just over two feet from the subject. The speed of the flash prevents any movement of subject or camera showing, and the room light which passes through the pinhole while it is uncovered is too weak to form an image on the film.



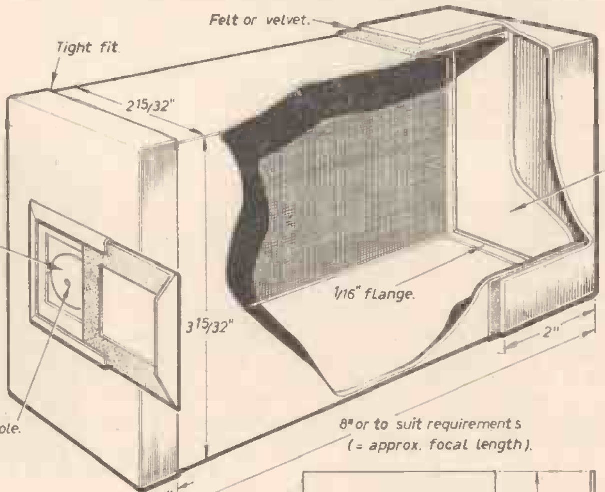
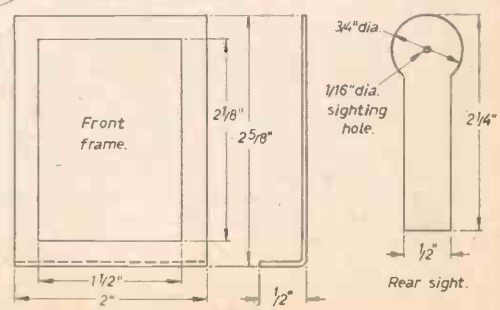


Fig. 2 (Above right).—Perspective view of the completed larger camera.

Fig. 3 (Above).—Shutter details.

Fig. 4 (Right).—How to make the viewfinder.



Focal Lengths

The focal length chosen for a pinhole camera can be arranged to suit the constructor's needs. There is practically no limit in either direction, and the focal length will have no real bearing on the considerable depth of field obtained as the effective aperture of the pinhole is so small. However, since an increase in focal length will reduce the relative aperture, the user will be faced with the problem whether to tolerate the increased exposure time required, or to enlarge the pinhole to keep the exposure short and make do with slightly poorer definition.

A camera of, say, 4in. focal length with a pinhole $\frac{1}{64}$in. dia., will give definition equal to many relatively inexpensive ordinary cameras. The pinhole diameter stated is that most suitable, and the negative will stand some enlargement. Doubling the focal length to 8in. means that the pinhole size should be increased by about 50 per cent. and pro rata, with the result that contact printing will give the sharpest results. It follows that long focal lengths should only be employed with fairly large negatives requiring little or no enlarging.

As can be seen from the data mentioned in the preceding paragraph, doubling the focal length normal to any standard film size is worthwhile when a large image is desired and only contact printing facilities are available. Very small pinholes should not be used in conjunction with long focal lengths or sharpness will be lost through diffraction.

The Large Camera

The larger of the cameras shown in Fig. 1 is of 8in. focal length and intended for $3\frac{1}{2}$in. × $2\frac{1}{2}$in. cut film or plates. The body may be made from stout cardboard, thin plywood, tinplate or aluminium alloy sheet, depending on the degree of permanence required. Dimensional details are given in Fig. 2. As may be seen, the sensitive material is dropped face up into the end cap, which is then slid on the body and effectively light-trapped with black velvet or felt. A disc of thin metal foil has a pinhole centrally pierced with a needle, the burr removed and the needle passed through again. The disc is then cemented over a larger hole in the front panel of the body.

The pinhole may be shuttered with a piece of black tape but, if a more satisfactory arrangement is intended, a shutter and guide may be made up as shown in Fig. 3. The face of the shutter has felt or velvet stuck around its three seating edges, to prevent light leaking through the guide, and the fourth side is closed off at the open end of the guide by a strip of thicker felt attached to the camera.

Any corner cut-off of the image may be determined by replacing the end cap with a sheet of tracing paper, and moving a bright light in front of the pinhole. The unobscured field of view can then be seen quite clearly

Viewfinder

If a viewfinder is required, it may be made up as shown in Fig. 4. The front frame is of the same proportions as the negative but not necessarily of the same size. The rear sight is only meant to centralise the eye behind the front frame. For level sighting, the centres of the front and rear components of this viewfinder should be the same distance from the top of the camera body. If parallax correction is needed for close-up work, the rear sight can be made to move up accordingly. The front frame must be set on the body so that the field of view shown through the viewfinder coincides with that obtained through the pinhole.

Exposure

The negative material employed should be of the fastest type obtainable, in order to keep the exposure as short as possible. Even so, the development time will almost certainly need to be doubled to get sufficient density. Any increase in grain caused by this treatment will pass unnoticed as little or no enlarging will be undertaken.

The approximate exposure may be calculated in the following way. For a 4in. camera multiply the focal length by a factor of 10. This gives a result of 40, which is temporarily considered as the aperture in standard 'f' series. With an exposure chart or meter, determine the required time for the subject in seconds at this aperture. Then, give the indicated exposure in minutes instead of seconds. Where the focal length is doubled, i.e. to 8in., the factor is reduced by 25 per cent., i.e. to $7\frac{1}{2}$, giving a result of 60 for the temporary aperture. Intermediate values are found accordingly.

An example of a photograph taken on $3\frac{1}{2}$in. × $2\frac{1}{2}$in. film with a 4in. focal length camera is shown in Fig. 5. For comparison, Fig. 6 shows the same subject taken with a precision miniature camera.

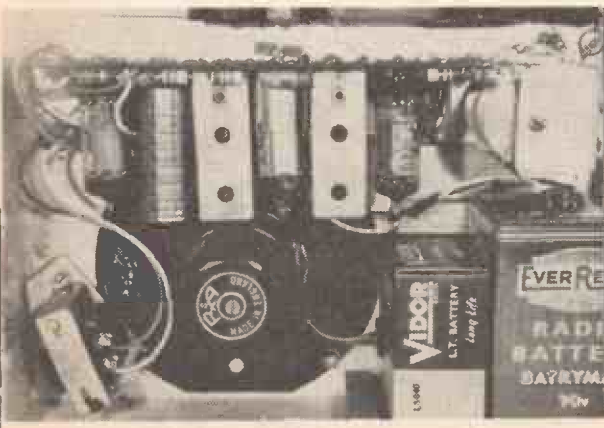


Fig. 5.—Pinhole photograph taken on $3\frac{1}{2}$in. × $2\frac{1}{2}$in. film.

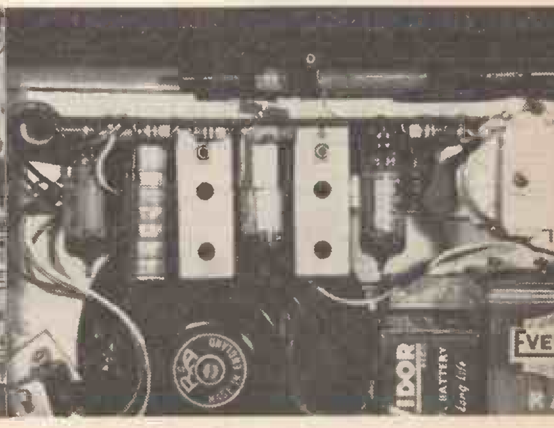
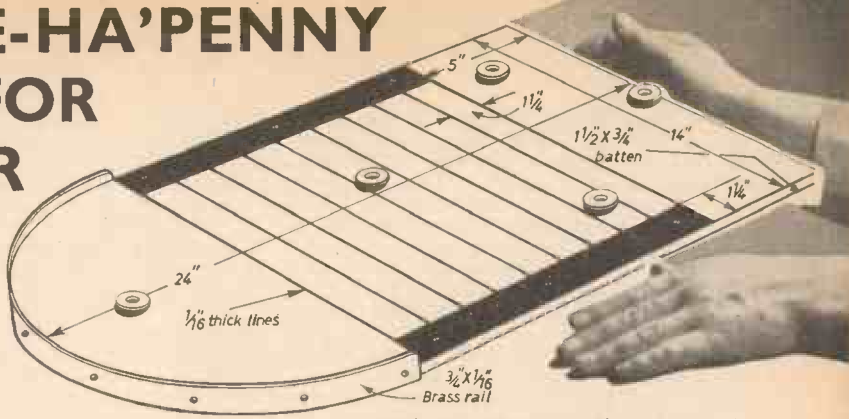


Fig. 6.—The same subject taken with a precision miniature.

A SHOVE-HA'PENNY BOARD FOR HOME OR CLUB

By JAMESON ERROLL



Details and dimensions of the board.

THE shove-ha'penny board is now more or less standardised at 24in. long by 14in. wide, divided by lines or brass rules about $\frac{1}{16}$in. thick into nine "beds" each 1¼in. in breadth. The bed extends to within 1¼in. of each edge of the board, the border so made being used for scoring. The semi-circular space at the head of the board and the 5in. at the foot before the first bed are outside the playing area as are the scoring spaces.

The board is of hardboard mounted on ⅜in. plywood, although other materials could be used. It is true, will not warp, and has an extremely smooth, polished surface. At the foot, on the underside, a 1½in. × ¾in. batten is screwed to engage the edge of the table. Around the semi-circular top a raised rim of ¾in.× $\frac{1}{16}$in. brass prevents hard-hit discs from falling off.

The hardboard is screwed to the ply with ½in. No. 4 wood screws with countersunk heads. Fix the screws ½in. in from the two edges and the curved top but do not fix any along the bottom edge—just one at each corner. The batten may be screwed from the underside of the ply or, better, screw it from the face of the ply before the hardboard is added. The semi-circular top is cut with a bandsaw or hand coping saw and is afterwards finished with glasspaper. Drill the brass rail with a $\frac{7}{64}$in. drill, the holes being $\frac{3}{16}$in. from one edge and about 3in. apart. Fix it flush with the underside of the plywood base so that it stands ⅜in. above the playing surface. Use 1in. No. 4 brass round-head screws at each end, and ½in. ditto for intermediate fixing.

The side scoring pads and dividing lines may now be marked out with Indian black waterproof ink. Draw two lines for each dividing strip, $\frac{1}{16}$in. apart, and then fill in between them with a thicker pen. Note that each division, or bed, is 1¼in. wide *excluding* the thickness of the lines; thus, the nine beds plus the lines total 11¾in. The scoring pads are filled in with a No. 4 camel-hair brush; apply two coats.

Five worn-smooth half-pennies are needed, or exactly similar-sized brass discs.

Play

The object of the game is to succeed in placing three of one's discs in each of the nine beds before one's opponent. The five discs are placed, one after the other, slightly overhanging the bottom edge of the board; they are then struck smartly with the flat of the hand or ball of the thumb. For a disc to score it must lie perfectly in the bed. A "bad lie" can often be corrected by knocking it with another disc. Scores are taken at the completion of each turn (i.e. after five discs have been "shoved" by one player) and in accordance with the lie of the discs at that time. A disc that has hit the brass rim is out of play and cannot be used for cannoning, but if its rebound brings it fairly into a bed in which one's opponent needs a point, he may claim it as a score for himself; further, if a player scores more points in any one bed than he requires, such points may be taken by his opponent should he need them. But neither of these transferences apply to the last point for "game."

PUZZLE CORNER

1.—Digital Problem

I HAVE three particular friends who are on the telephone but I can never remember their numbers. I know that each number contains the same four consecutive digits; in one they are in the correct order, in another in the reverse order, and in the third they are mixed up. I also know that the three numbers added together total 22,011.

What are the various numbers?

2.—Filling the Tank

Water flowing through a pipe 'A' will fill a tank in two days; pipe 'B' takes three days to fill it; pipe 'C' four days; but pipe 'D' only nine hours.

If all the pipes be opened at the same time how long will the tank take to fill?

Answers

1.—Under the conditions laid down, the greatest total obtainable with the digits 4, 5, 6 and 7 is 4567 + 7654 + 7564 = 19785. The smallest total obtainable with the digits 6, 7, 8 and 9 is 6789 + 9876 + 6798 = 23,463. The first total is too small, the second too big. Therefore the digits 5, 6, 7 and 8 must be the ones and the numbers 5678 + 8765 + 7568 = 22,011.

2.—If opened for one hour, the pipes will admit the following fractions of the tank's total capacity:

$$\tfrac{1}{48} + \tfrac{1}{72} + \tfrac{1}{96} + \tfrac{1}{9} = \tfrac{5}{32}$$

Therefore, the tank will take 6 hrs. 24 mins. to fill with all pipes open.

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

Cold Point Drills

IF engineering is your trade, you will probably be interested in a new range of drills being introduced by Coldpoint Drills Ltd., Oak Lane, East Finchley, London, N.2. These are specially designed for drilling high tensile and tough materials and are of completely new design. The new features are negative rake angle; the fact that for most work the drill point is ground with an included angle of 120 deg. nominal; the tip circle is ground with a slight back taper. Write to the above address for details.

Drillapinta! A Coldpoint drill was used.

Hydra-Spray "Golden" Gun

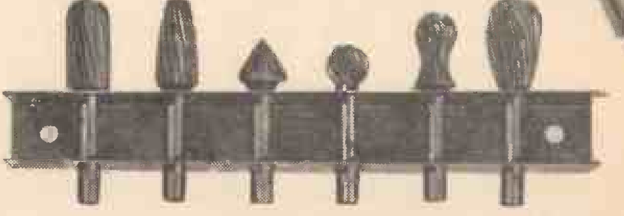
THE new spray gun, together with a range of "FF" fine finishing nozzles for use with Graco Airless Hydra-Spray equipment have been introduced by Alfred Bullows & Sons Ltd., Long Street, Walsall. The gun is equally efficient for high volume fine finishing or protective coating work and a long list of design advantages are claimed by the makers, from whom full details are available at the above address.

The Hydra-Spray "Golden" Gun.

Rexburrs

SPECIALLY designed for the home craftsman and electric drill owner this handy set of burrs has a multitude of uses. The burrs have ¼in. dia. shanks and the same tooth formation as professional rotary cutters for factory use. They can be used on hardwood, softwood, hardboard, plasterboard, plywood, aluminium, brass, copper, zinc base metals, sheet metal and soft mild steel. They will be found useful in almost all profiling and shaping work and for odd jobs like removing nailheads, etc. The modelmaker in particular should find this set, with its special wallfixing rack, a useful addition indeed to his workshop. The makers are B. O. Morris Ltd., Morrisflex Works, Briton Road, Coventry. The Rexburrs, which cost 22s. 6d. per set, should be available from all high class tool stockists.

(Below). The set of Rexburrs in their special wall mounting rack.



Loctite Sealant

ALL motorists, motorcyclists, cyclists, engineers, etc., will, at some time or another, been infuriated by that nut which will persist in coming undone. The makers of Loctite sealant claim to have the answer. A single drop is placed on the thread, the nut tightened and the job is done. The nut will not loosen with vibration but it can be removed when required using ordinary tools. The only stipulation is that the parts must be cleaned thoroughly before the sealant is used. There are many other suggested uses, including the retention of worn or slack bearings and bushes, pot and pan handles, drawer handles, etc. The price per tube is 7s. 6d. and the makers are Douglas Kane (Sealants) Ltd., 243 Upper Street, London, N.1.

(Below). Loctite sealant is applied like this.

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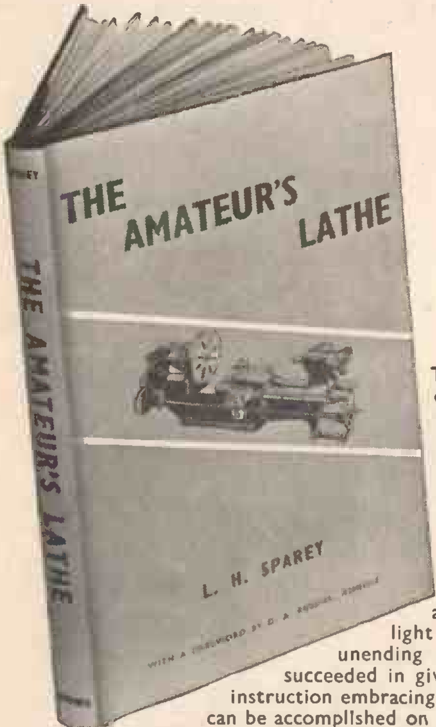

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by
Lawrence
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Here is a book that every amateur, every small garage proprietor and every light engineer will find of unending interest. The author has succeeded in giving a complete course of instruction embracing almost every process that can be accomplished on the highly adaptable small lathe. It is suitable not only for the amateur mechanic, but for the professional also. For the apprentice, the young engineer and the garage engineer with limited equipment, no better book could be possible, if only because it reveals in a carefully selected series of examples the resourcefulness and ingenuity for which the amateur engineer is famous.

224 pages
229 illustrations

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Paint and Varnish Remover

CAN you please let me have the composition of a good paint and varnish remover?—H. Tombleson (Lincs).

TRISODIUM phosphate and sodium metasilicate will quickly remove varnish. They will also work on paint if not too old or too thick. Use 1lb. to 1gal. of boiling water. Mop or brush on and let stand for ½ hour. Rub off and rinse well with water.

Skin Oil

I HAVE about ½lb. of pure lanoline, could you give me a formula for making this into a softer preparation for chapped hands and dry skin?—G. Snow.

A GOOD skin oil can be made by thoroughly incorporating five grammes of lanoline with 95cc. of (odourless) paraffin or some other fatty oil.

Detecting Oil Leak

I HAVE a machine with two gearboxes built side by side in one casting. One is lubricated with light grease and the other with oil. I suspect that there is a faulty seal between the two and that grease is contaminating the oil. Can you tell me of a suitable dye to colour the grease in one so that I can check my diagnosis before stripping the machine down?—J. Hutchinson (London, S.W.17).

WE would suggest that if graphite is mixed with the grease you will get black discoloration of the oil if there is leakage taking place.

Alternatively, you could use "Mechanic's Blue"; but we prefer the first suggestion.

Colouring Ping-Pong Balls

COULD you tell me if there is a compound that will permanently stain ping-pong balls?—D. Tate (Yorks).

PING-PONG balls are made from Celluloid or Xylonite, the surface of which is quite impermeable to most liquids—other than solvents. We would suggest the most satisfactory method would be to coat them thinly with the appropriate colour of brushing cellulose or "Belco."

Cleaning Gilt

I WISH to clean some gilded picture frames. They are obviously good quality but at some time have been treated with gold paint. I would like to remove the paint and clean up the original surface.—W. D. Thomas (Newcastle).

GENTLE but prolonged rubbing with pad soaked in methylated spirit will gradually clean off the gold paint. True gold leaf will not be affected by the methylated spirit.

The Barlow Lens

I SHOULD be very pleased if you could explain the principle of the Barlow lens for telescopic work. Also the method of determining the position and focal length of same.—H. Mills (Yorks).

THE Barlow lens is a negative lens, either of double concave or plano-concave form: in telescope work it is placed between the object glass and the eyepiece and has the effect of lengthening the focus of the O.G. and consequently of increasing the magnification.

Its position can be variable according to the magnification required. If of double convex form its focus is approximately equal to the radius of curvature and if of plano-convex the negative focus will be equal to twice the radius.

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This coupon is available until August 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. August, 1961

Washing Silver Cutlery

I FIND that when washing silver cutlery it becomes stained with minute black specks which necessitate the use of silver polish for their removal. I use one of the modern powder detergents. Can you suggest an alternative?—D. A. Evans (Bristol).

WE think you need a neutral or slightly acid liquid detergent and suggest Comprox A. sold by Irano Products Ltd., Britannic House, Finsbury Circus, London, E.C.2.

Use a tea-spoon of common salt with a tea-spoon of detergent with every quart of water *plus* a few drops of vinegar. Use *hot* water.

A Toy Projector

COULD you please tell me how to make a "toy" projector?—J. Donnelly (Glasgow).

FOR a "toy" projector two lenses of about 2½in. to 3in. focal length, and ¾in. or so in diameter, separated by about 1½in., will do for projection. The distance between lenses, and also between back lens and slide or film, should be adjustable, by having the lenses in sliding tubes, for focusing. Illumination is best by a bulls-eye lens or condenser fixed between bulb and slide, to concentrate the light and obtain even illumination. This lens may be plastic, but should be large enough to cover the slide frame, and of short focus—say 1½in. If glass, it need not be optically worked for such a projector. A reflector behind the bulb will improve illumination.

G45 Clockwork Drive

I HAVE a G45 16mm. aircraft camera which I would like to convert to clockwork drive. I have tried a gramophone motor but find that the turntable spindle is not powerful enough to do the job, that is with the governors in gear. Is there a way to convert these cameras? In what way are commercial cameras controlled to give a constant speed?

I understand that some cameras have a non-intermittent motion achieved by having a piece of plate glass revolving between the picture gate and the lens. I would like to experiment, would you please describe the method used?—B. Orbell (Cambs).

WITH a clockwork motor more turning power will be available at a spindle nearer the spring, but the running time will be reduced for a given speed. Clockwork motor governors are usually friction type, weights flying out drawing a friction disc against a fixed pad. Electric motor governors may resemble this, or have a carbon pile or other variable resistance controlled by governor pressure.

The arrangement you mention uses a 4 or 6 sided rotating glass with polished faces, one face following each film frame so that parallax keeps the image constantly before the lens. It is doubtful whether the glass could be made at home. The system appears in some animated film viewers and you might enquire of large photographic dealers regarding a replacement glass unit.

Making a Relief Map

CAN you please tell me how to construct a model solid relief map of a large area, e.g. Scotland, starting from a contour map?—N. Donaldson (Cheshire).

THE first step is to rule up the contour map from which you are going to work, into squares. Rule up another sheet of paper cut to the size you want to make the model, into the same number, but larger, squares depending upon the number of times the scale is to be multiplied. For example, if the relief map is to be, say, four times the original, then rule the contour map in ¼in. squares and the paper in 1in. squares. Next copy the outlines of the country, square by square, plotting in all the islands. This will be the coastline and land up to 300ft. Next draw in the Lowlands 300-600ft., then the Uplands 600-1,200ft., etc., up to the Highlands. You will of course have to follow the feet elevations given on your own contour map.

Having copied your map to the size you require the model, obtain a sheet of plywood to represent the sea level and which will also be the baseboard of the map. Now comes the relief work which is all in cardboard. Choose a cardboard which will give you a sufficiently definite thickness to represent the different levels and let all the levels be of the same thickness. Next make a tracing off your drawing for the outline of Scotland and in addition to the coastline trace, on the same tracing, the outline of the first elevation, the Lowlands. Transfer both of these outlines on to a sheet of cardboard with carbon paper. With a sharp pointed knife, cut the cardboard to the outline of the coast, the other line is to serve as a guide for the placing of the Uplands. Glue all the pieces representing the coastline down on the baseboard. Next trace and transfer the Uplands 600-1,200ft. and with it the 1,200ft. line. Cut out and glue down, making sure that the cut edges coincide with the transferred line on the first cardboard. Bear in mind that no openings are to be cut in any of the layers of card and when you get to the 4,000ft. level you should have solid cardboard underneath. In such a relief map as you are contemplating it will be best to leave the sharp edges of all the levels showing. The map can be then coloured accordingly.

Restoring a Fur Coat

THROUGH not having been worn, my wife's leopard skin coat seems to have gone stiff. Is there any treatment I can give the skin to restore its suppleness?—F. James (Birmingham).

THE softening of a fur coat pelt is not a task to be undertaken lightly by an amateur. It would appear to us that there are two reasons for the skin becoming hard. First that the dressing (tanning) was defective, or secondly that it lacks grease and therefore pliability.

The lining of the coat would have to be removed and the coat cut into suitable flat pieces. Then, depending upon the defect, it would have to be retanned with alum and salt, and/or greased with a sulphonated oil, such as sulphonated cod oil. After drying in a stove or drying room, it would have to be cleaned in sawdust to remove excess grease, and then remade into the garment and relined. This would be the task of a manufacturing furrier.

SALES AND WANTS

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

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TELEVISION

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ASTRO TELESCOPE MAKING.—Standard Ramsden Push-in Eyepieces, ¼in., ⅓in., ⅔in., focus, 35/-, with R.A.S. thread, 42/6 ea. S.A.E. list, Object Glasses, Newtonian Mirrors, Diagonal Mounts, Focusing Mounts, Tripods, Mountings and Terrestrial Telescopes.—W. Burnet, Grand Sluice, Boston, Lincs.

FOR SALE *continued*

STOP Condensation with our attractive ceiling tiles, made from expanded polystyrene, bevelled edges. 9½d. each delivered. Sample tile, 1/9. Full details Nero Construction Co., 41 Brunswick Road, Gloucester.

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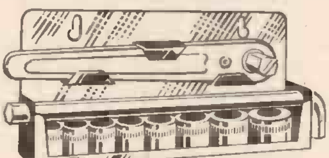

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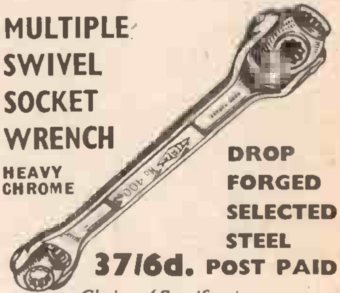

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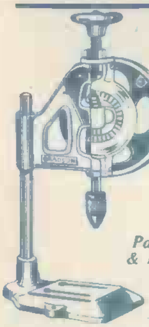

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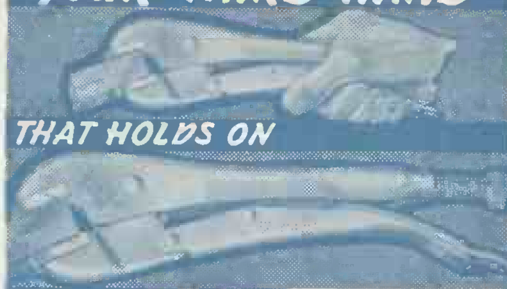

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