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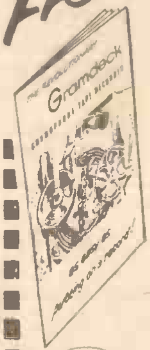

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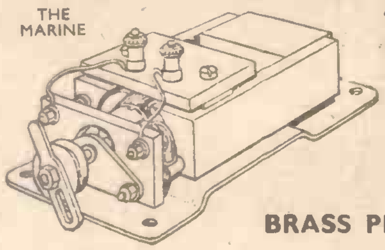

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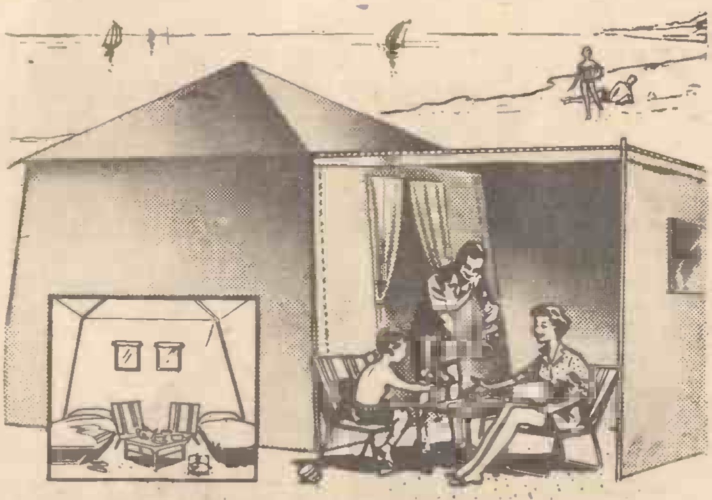

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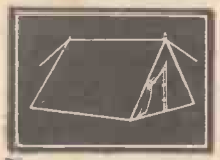

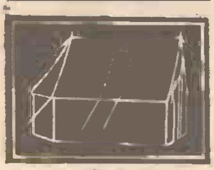

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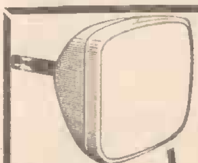

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JANUARY, 1960

Vol. XXVII No. 309

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FAIR COMMENT

DRILLING FOR KNOWLEDGE

SOME momentous and exciting discoveries have made news recently and they have all been connected with space and interplanetary research projects. It might be inferred from this that modern scientific exploration is in one direction only, but in fact this is far from the truth. Many scientists are just as interested in what lies under the earth's surface as others are in what is above it. It is confidently thought, too, that discoveries every bit as exciting as those recently made in space will be made under the earth within a few years.

One of the things which gives rise to this belief is a project being sponsored by the American National Academy of Sciences. They propose drilling through the earth's crust to find out what lies beneath. Modern seismographic research, of course, has given scientists some idea of how this earth of ours is constructed. The old idea of a thin, solid crust covering a completely molten interior of lava has given way to present day conception of a layer of basalt under the earth beneath which is the mantle, comprising a very much thicker layer of solid rock. Inside this is a molten core probably of nickel or iron, the centre of which is kept solid by the extreme pressure. The hole which it is proposed drilling will pass through the top layer of earth, through the basalt crust and into the unknown material of the mantle. The basalt crust is thinnest under the sea and for this reason drilling will be carried out from a floating drilling platform, in the same way as it is when drilling for oil from one of the offshore drilling stations. The experience gained in this type of drilling for oil will be invaluable to the scientists. In fact the several practice drillings which will have to be carried out will employ actual oil-drilling rigs.

When the site has been selected a special drilling rig and platform will be built and the bore commenced. Temperatures in the region of 400 deg. F. are expected and should not prove a problem. Sample cores will be brought to the surface continually while drilling is in progress and these, it is expected, will provide a great deal of exciting new information, long before the level of the unknown mantle is reached. The history of the world will be revealed by the samples of marine life contained in the drilling cores. The culmination will come when the first samples of the earth's mantle come to the surface—the first man has ever seen. What analysis of these will reveal it is impossible to guess. It may not be much different from types of rock already known, but then it may be some kind of material that is entirely new.

Instruments will be lowered into the hole to obtain temperature readings and to measure the magnetic field, gravity, etc. In addition a great deal of practical information may be obtained about deep drilling and oil deposits. This is a project which is in no way "pure research," and the immense material benefits to which it could lead, in addition to the knowledge revealed, can only be conjectured.

NOISE SUPPRESSION

COMPLAINTS have again been made recently by people living near London Airport about the noise of jet airliners taking off and coming in to land; mentioned particularly were the Boeing 707 and the Comet IV. The noise made by these aircraft must indeed be excruciating to bring modern man to the point of complaining. Most of us have grown so used to a perpetual background of some noise or other that we do not even notice it. Could it be this continual cacophony which is responsible for the fantastic increase in nervous illness? Whether noise is responsible or not, many people are beginning to wonder if there is some way of reducing the noise level of modern living. One answer could be to investigate the problem at its source, i.e. every appliance which makes a noise in use could have its noise factor standardised during manufacture. A level could be set for each which must not be exceeded and this principle applied to everything from typewriters to tube trains and hair dryers to helicopters. Perhaps it could form a new branch for the British Standards Institute?

The February, 1960, issue will be published on January 29th. Order it now!

A TWO-SEATER TOBOGGAN

By J. Waller

Make it in Time for this Year's Snow

A FEW hours spent before really severe weather occurs, can produce an excellent toboggan which can carry two persons sitting upright or a single individual in the prone position.

The Chassis

This is made up of ¼in. × 1in. mild steel of the black variety. Two runners are bent with the aid of a vice to the shape shown in Fig. 1. Heat where a bend is to occur does assist the work, but this is not absolutely necessary. Both runners must be identical. Mark out a chalk outline on the garage floor or even on a concrete path, and lay the chassis as bending takes place on the marks; correcting the radii until they conform to the shape and both are the same length. The top of these runners reach back to the front side supports and these latter items are thus a thickness of metal lower than the rear details.

The shape of these side members is not important as they merely carry the two wood side frames on which the seat is eventually built, but the angular form shown here is easy to make and of adequate thickness and strength for the task. The two rear items are a thickness of the metal or ¼in. higher than those in front; you can use washers to make up the difference if an error occurs.

The centre cross brace is bent up about 2½in. to ensure that when running at speed it does not throw up ice or snow toward the seat, yet performs the function of properly bracing the chassis. Two cross-shaped items are no doubt the best form of design here, but with the extra bracing made by the upper wood parts, this refinement is not really essential.

Chassis Assembly

A welded assembly is the most satisfactory way of ensuring strength and the toboggan will not fall to pieces in the event of a crash. If a nut and bolt assembly is used burr over the threads and so make it impossible for the nuts to come apart, but welding is best. A local garage or workshop will not take more than an hour to do the job and £1 is enough to pay.

The Wood Frame

Oak is undoubtedly the best material, but most readers will use white wood as this is cheaper and often at hand. Cut the two long side members which seat on the chassis and bring these well forward as the feet or handles are attached to their ends. Next cut and fit the three tapered cross details—Fig. 2 shows these as being split across the centre but this is not necessary if you can saw the angles correctly. Smooth off all the burrs as you go along and then there is little likelihood of any being missed.

The seat slats are spaced with a 1½in. gap between them—an upholstered seat is left to the reader's discretion and in this case the slats are brought together in an endeavour to prevent snow and ice from contacting the material.

Before assembling the frame to the chassis, remove the scale which is present on this black material with a rough file. A final rub over with emery cloth provides perfectly smooth surface on which to ride. As the welding operation will have undoubtedly left lumps of "almond rock" round the joints which look unsightly, chip and file off the worst of this before proceeding further.

(*Concluded on page 167*)

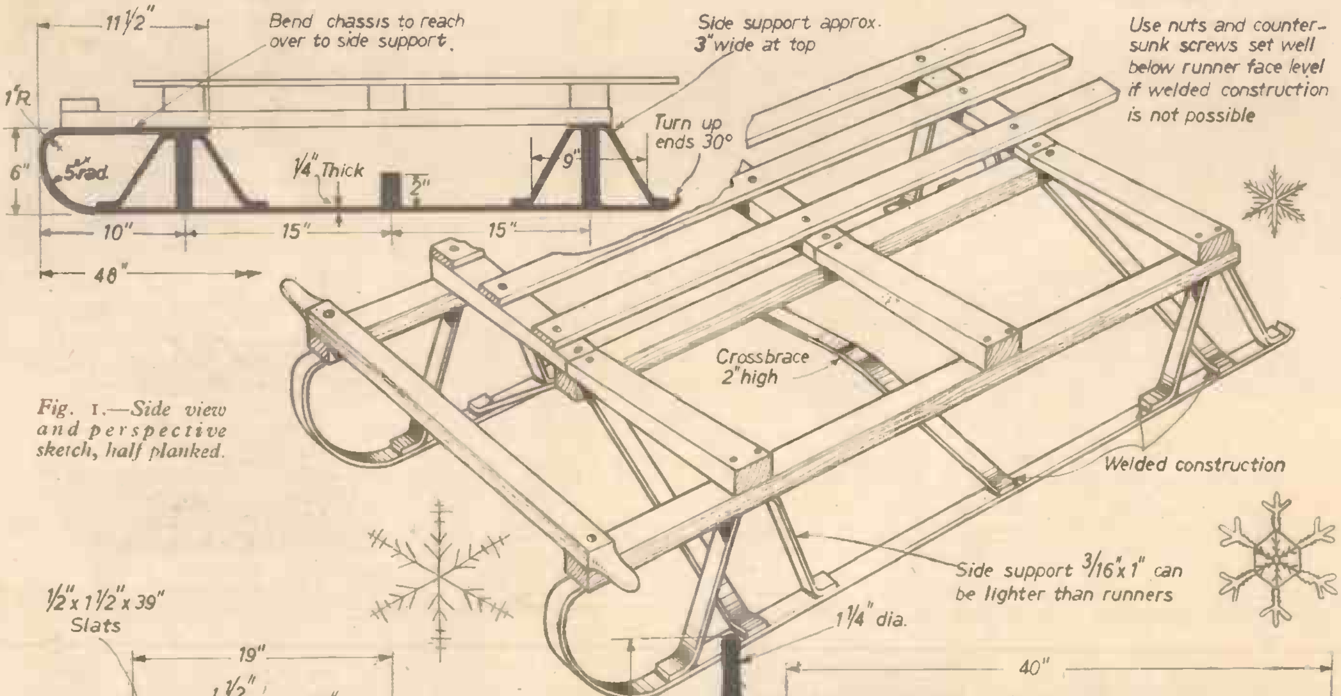


Fig. 1.—Side view and perspective sketch, half planked.

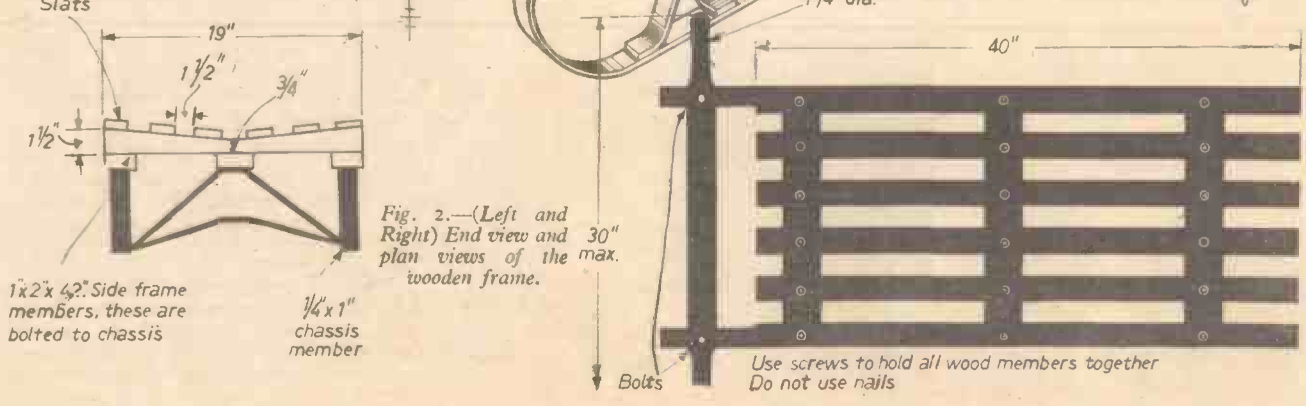


Fig. 2.—(Left and Right) End view and plan views of the wooden frame.

Described by J. D. Pearson

Radio Enthusiasts Among Our Readers May Like to Make This

10 METRE WALKIE-TALKIE

SOME interest has been expressed recently on the subject of portable transmission - reception equipment, more commonly known as the "Walkie-Talkie." The major requirements are extreme simplicity combined with maximum possible efficiency. The design, given here, could more correctly be described as a "Handie-Talkie"; the term usually given to transceivers capable of being held in one hand.

LICENSING

It should be emphasised at the outset that before any type of transmitting equipment may be operated in the United Kingdom the operator must be in possession of the relevant licence. The sole authority in this country for the issue of all types of Transmitting Licence is the Postmaster-General. The licence required for the particular equipment to be described is known as the Amateur (Sound) Licence, which costs £2 per annum.

CONDITIONS OF ISSUE

Before a licence can be issued the applicant must satisfy the P.M.G. of his competence to operate transmitting equipment. This entails a certain amount of theoretical knowledge plus the ability to send and receive Morse at 12 words per minute. To the reader who knows absolutely nothing about radio these requirements may be very discouraging, but it may be stated here that any person of average intelligence can obtain the standard required if he is really determined to do so; and provided he is possessed of enthusiasm and prepared to help himself.

Further information about the Amateur (Sound) Licence can be obtained from: The Radio and Accommodation Branch, G.P.O., St. Martin's Le Grand, London, E.C.1.

COMPONENTS LIST

L1—Single turn link winding (see text).
L2—Nine turns 16 s.w.g. enamelled wire ½in. diameter, ¾in. long (see Fig. 5).
C1—40 pF miniature variable condenser.
C2—100 pF silver mica fixed condenser.
C3—.001 to .01 μF moulded mica condenser.
C4—0.1 μF paper tubular condenser.
R1—15,000 Ω, ¼ watt resistor.
R2—4.7 MΩ, ¼ watt resistor.
R3—100 KΩ miniature variable resistor.
R4—680 Ω, ½ watt resistor.
RFC1, 2—R.F. Chokes (see text).
S1, 2, 3—Three-pole two-way rotary switch.
S4—Double-pole toggle switch.
T1—L.F. intervalve transformer, ratio 3 : 1 or 5 : 1 (see text).
V1, V2—Mullard DL92 (or equiv.).
2 B7G—Ceramic valveholders.
4ft. 6in. length of 1/16in. copper or brass rod for whip aerial.
Connecting wire; 6 B.A. nuts, bolts, solder tags; insulated sleeving, rubber grommets.
Stand-off insulator, or alternative insulated mount for aerial, control knobs (¾in. dia.).
E—Earpiece taken from low impedance headphones.
M—Single button carbon microphone.

THE CIRCUIT

Whilst this may appear rather complicated it is in reality about the simplest possible circuit which will perform the combined duties of transmitter and receiver with some measure of efficiency. The circuit diagram is given in Fig. 1. The valve V1 acts as a Self-Excited Oscillator (S.E.O.) on "Transmit" and as a Super-Regenerative detector on "Receive." V2 performs the function of modulator for transmission and L.F. amplifier for reception.

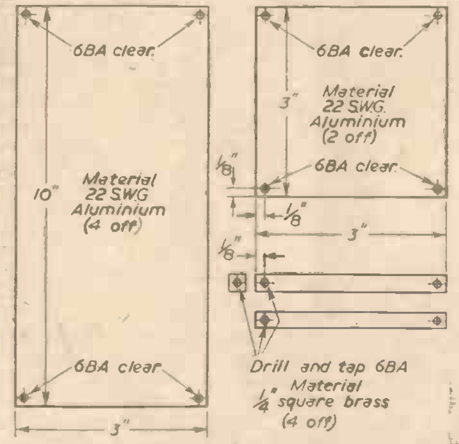


Fig. 2.—Case dimensions.

CONSTRUCTION

In compact miniature equipment of the type described, servicing can be extremely difficult once the components are installed in the case. The beginner is advised, therefore, to build up the circuit on a temporary basis before finally mounting; in this way any slight adjustments or alterations can be made much more easily.

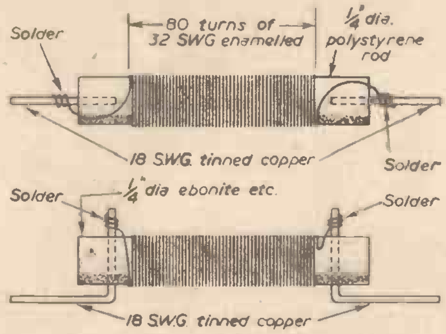


Fig. 3.—R.F. choke construction.

Where component wires, tags, etc., are joined in the final installation, a sound mechanical joint must be made before soldering is attempted. An instrument-type soldering iron together with resin-cored solder is almost essential when building this type of equipment.

The case may be built up in several different ways, depending on what facilities the constructor has available, and his mechanical ingenuity. The essential thing is to ensure that the internal dimensions of the case are not less than 10in. × 3in. × 3in.

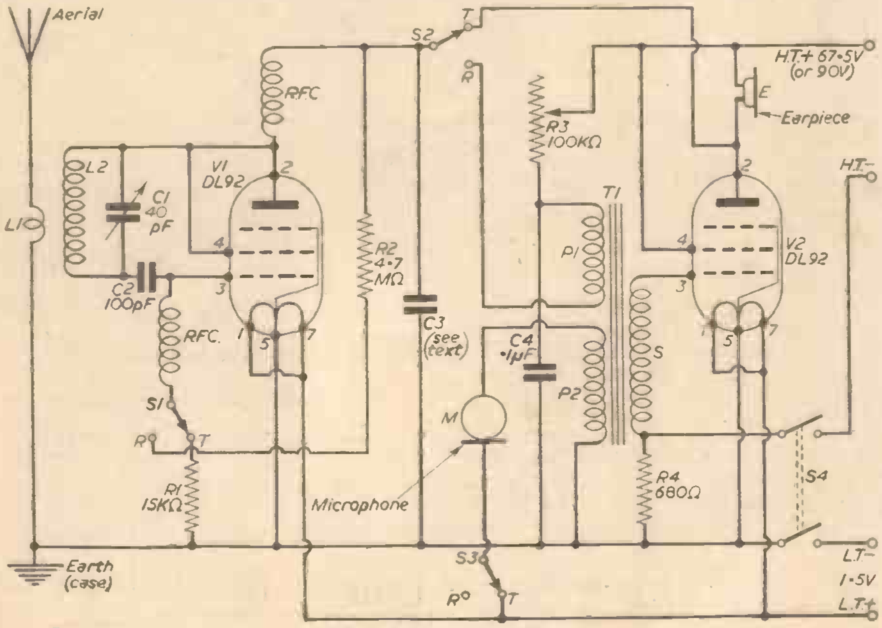
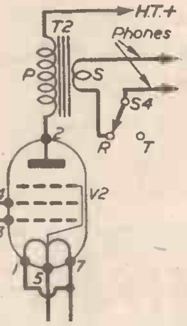


Fig. 1.—Circuit details.



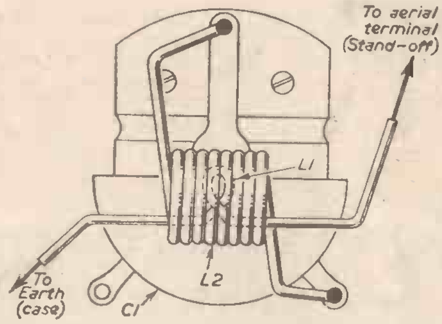


Fig. 4 (Left).—Alternative output circuit. Fig. 5 (Right).—Position of aerial.

Probably the easiest method is to use 22 s.w.g. sheet aluminium secured to four pieces of ¼in. square brass, each piece being 3in. in length, drilled and tapped 6 B.A. This allows the removal of any section of the completed case independently. Almost all of the components can be mounted and wired on the front panel before this is secured to the other three sections which form the case. The two 3in. × 3in. pieces which are the top and the bottom of the case may be added at leisure. The "top" of the case should be drilled to take the stand-off insulator, to which is secured the 4ft. 6in. length of 1/16in. copper or brass aerial rod. It should be noted that one of the 10in. × 3in. pieces is provided with large holes to accommodate the G.P.O. type single-button carbon microphone and the low-resistance earpiece respectively. Incidentally, when wiring these into circuit sufficient slack should be left to allow removal of the front panel. Construction of the case is shown in Fig. 2.

TRANSFORMER MODIFICATION

The transformer T1 is a miniature L.F., or intervalve transformer having a ratio of 3:1 or 5:1. Owing to the fact that a suitable transformer is not manufactured commercially this has to be modified by the addition of an extra primary winding (P2 in Fig. 1) or the microphone.

This is not such a difficult task as the reader may imagine. Many of these small audio transformers have a small air-gap between the winding and the metal core laminations. The transformer should be selected with this point in view. It will be necessary partially to strip the transformer to put on the extra winding which should consist of 55 turns of 32 s.w.g. enamelled copper wire, laid round the existing windings in a single layer and then covered with transparent adhesive tape or thin paper. Sufficient lead-out should be left for connection into the circuit later.

If adequate space is available it is better to solder flexible leads on to the new winding. If the primary and secondary windings of the transformer are not coded when purchased, the primary will be that one which shows the lowest resistance when tested on the ohms range of a multimeter.

BATTERIES

The L.T. supply for the set is derived from a single U2 cell, which also supplies current for microphone energisation. If desired, the case could be made ½in. longer and the microphone supplied independently from one or two pen cells, depending on whether the microphone used requires 1½ or 3 volts—the two cells being in series, of course, for 3 volts.

Several varieties of layer-built H.T. batteries are obtainable; the type used in the original model of this transceiver was the Vidor L5500 giving 67.5 volts. It would be quite in order to use a 90 volt H.T. battery, provided, of course, that this will fit into the space available, and an appreciable increase in working range will result.

R.F. CHOKES

No suitable commercial R.F. chokes are available, but they can be made quite easily.

For each choke a piece of ebonite, Tufnol or polystyrene rod 1½in. long and ¼in. diameter is required. This is wound with 80 turns of 32 s.w.g. enamelled wire laid on in a single layer; the winding should occupy a space slightly under 1in., leaving ¼in. of former to spare at either end. The connecting wires are a force fit into exact size holes drilled into the former, or if polystyrene rod is used, the 18 s.w.g. tinned copper support wires may be heated before being pushed into the former; when the wires are cool they will be firmly embedded in the polystyrene and quite strong mechanically (see Fig. 3). It is essential to scrape the 32 s.w.g. enamelled wire clean where it is soldered to the 18 s.w.g. support wires.

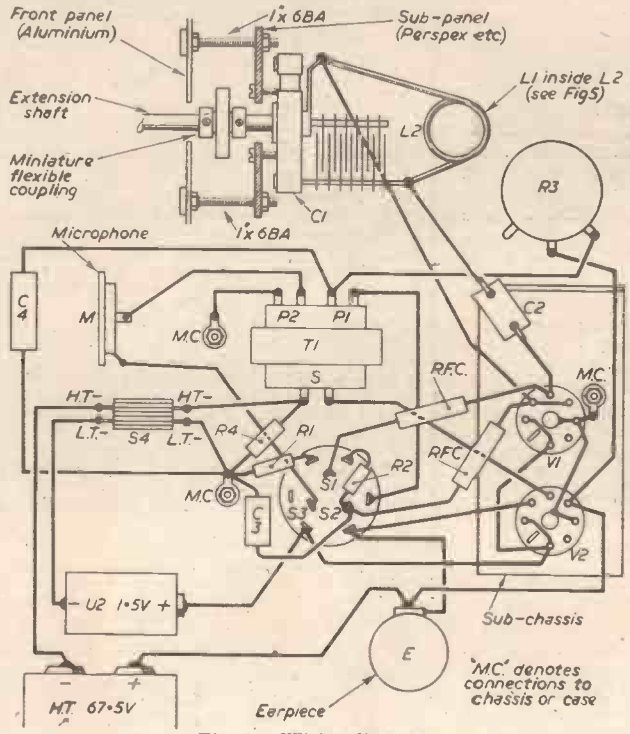


Fig. 6.—Wiring diagram.

MODULATION

The low impedance earpiece E forms the anode-load of V2 on reception and acts as modulation-choke for transmission. If desired, and sufficient space is available, a midget output transformer may be substituted for the earpiece, the primary being connected in series with the anode of V2 and H.T.+, and the low impedance secondary being in parallel across a pair of low-impedance headphones (see Fig. 4). This will give increased modulation percentage on transmission. It will also be necessary, of course, to provide a further switch position to switch out the headphones when transmitting.

AERIAL LINK COIL

This is a single turn link of 22 s.w.g. tinned copper wire which must be insulated as it occupies a position co-axially in the centre of L2 (see Fig. 5).

OPERATION

When the set is switched to "receive" a "rushing" noise will be heard in the earpiece or headphones if the circuit is functioning correctly. This is thermal or "valve-noise" and is due to the process of super-regeneration. This briefly is a state where the detector valve (V1 on reception) is continually swept in and out of oscillation (or "quenched") at the fundamental frequency by the action of a second much lower frequency. The net result is that the detector is at all times operated on the point of oscillation, which is the most sensitive condition for reception.

Regeneration is controlled by R3; when the "hiss" is loudest the circuit is operating at the most satisfactory state for reception of signals. When a signal is received, the "hiss" will disappear entirely or become very weak, depending on signal strength.

Should difficulty develop in obtaining quench action, rotate the tuning condenser C1 through 90 deg., and R3 to either extremity of its travel. Try opening or closing slightly the turns on L2. Shunt a 100 pF condenser across the grid-leak R2. This should clear the trouble if all else fails.

LAYOUT

Owing to the fact that no two constructors will adopt precisely the same layout, and that component positioning and lead lengths have a definite bearing on circuit operation, the value of C3 is subject to variation. Initially a .001μF condenser should be used, the aim being to achieve smooth operation of the regeneration control R3 without any abruptness in the commencement and cessation of quench hiss.

Switch leads should be kept as short as possible, and especially the tuned circuit leads to pins 2 and 3 of the valveholder V1. The coil L2 should be mounted directly across the tags of the condenser C1. The beginner should bear in mind that for clarity of illustration some of the connecting wires, etc., shown on the wiring diagram (Fig. 6) are longer than will be found necessary in actual construction. The tuning condenser C1 *must* be insulated from chassis and case and is mounted on a piece of ⅛in. Paxolin or Perspex, which is drilled according to the component used. The Paxolin or Perspex is mounted sufficiently

(*Continued on page* 178)

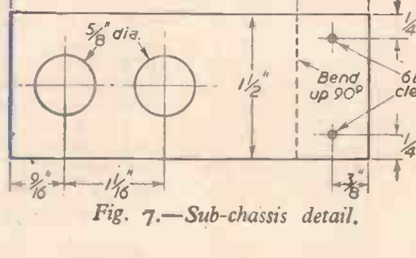


Fig. 7.—Sub-chassis detail.

ELECTROPLATING & ELECTROFORMING

Theory and Practice Explained for the Home Worker
By F. Colin Sutton
B.Sc., A.M.I.Chem. E.

IT is proposed to treat this subject from the point of view of the amateur; so the scale of the plant and processes described will be limited to the resources of the garden shed. First-class work can be turned out under these conditions.

Electroplating can be defined as the art of depositing one metal upon another metal by the passage of direct current through a solution that contains a salt of the metal it is proposed to deposit upon the basis metal.

Electroforming is a specialised modification of the art of electroplating and consists of depositing the desired metal upon a pre-determined shape or mandrel which is then extruded under pressure, leaving behind a shell of the same shape as the mandrel, but of electrolytically pure material. Electrotyping can be regarded as one form of electroforming. Another example is the fabrication of the matrix of a gramophone record.

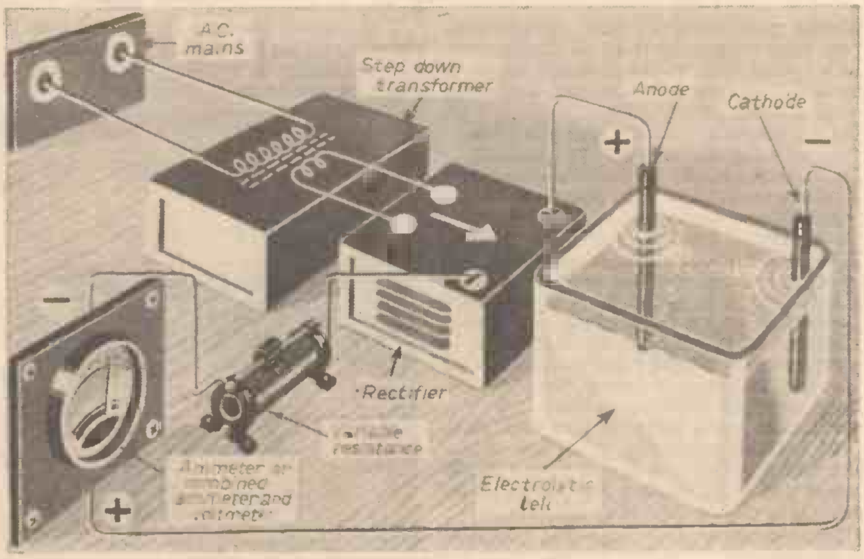


Fig. 1.—The electroplating circuit shown pictorially.

Theory of the Process

In electrolysis, such as occurs in electroplating, direct current is passed through a solution termed the electrolyte between two conducting electrodes known as the anode and the cathode. In the electrolysis of aqueous plating solutions, metal is dissolved from the anodes or oxygen is liberated from them and metal or hydrogen is deposited upon the cathodes. Faraday's law is derived from this electrochemical reaction and is usually expressed as follows:

1. The quantity of any element liberated at either the anode or cathode during electrolysis is proportional to the quantity of electricity that passes through the solution.
2. The quantities of these different elements liberated by the same quantity of electricity are proportional to their equivalent weights.

For example:

If one coulomb (1 ampere-second) deposits 1.118 milligrams of silver, then 10 coulombs will deposit 10×1.118 milligrams of silver. It does not matter whether a current of 1 ampere flows for 10 seconds or 2 amperes for 5 seconds.

The coulomb is that quantity of electricity which will deposit 0.001118 gm. of silver in one second. Or it can be defined as that quantity of electricity which flows when a current of one ampere flows for one second.

The Apparatus Required

Assume that the normal power supply of 230 volts A.C. is available. It will then be necessary to reduce the voltage from the mains by passing the A.C. current through a transformer. From here the current at reduced voltage is passed through a " bridge " rectifier in which the original alternating current (A.C.) is changed to direct current (D.C.). From this point the positive and negative leads are taken to the electrolytic bath. In addition to the above apparatus it is, of course, absolutely necessary to have an ammeter, a voltmeter and a variable resistance in the circuit. For laboratory or small-scale work it is convenient to combine the first two measuring instruments. The circuit is shown in Fig. 1.

Determination of the Current Used in an Electroplating Bath

The usual arrangement is to wire a battery of electroplating baths in parallel; the anode and cathode bars are linked directly to the source of D.C. supply. By this arrangement the current that flows in each tank is dependent upon the total resistance of the circuit in that tank. Provided the voltage applied to the bus bars is constant, the current in a given tank is independent of that in the other tanks so long as they are in parallel. Fig. 2 shows this clearly.

If a potential of 6 volts is maintained on the bus bars and the total resistance of tanks A, B and C are respectively, 0.01, 0.02 and 0.03 ohm, then the current that will pass through each tank is:

$$\text{A.} \quad \frac{6 \text{ volts}}{0.01 \text{ ohm}} = 600 \text{ amps.}$$

$$\text{B.} \quad \frac{6 \text{ volts}}{0.02 \text{ ohm}} = 300 \text{ amps.}$$

$$\text{C.} \quad \frac{6 \text{ volts}}{0.03 \text{ ohm}} = 200 \text{ amps.}$$

The total current drawn from the generator will be:

$$600 + 300 + 200 = 1{,}100 \text{ amperes.}$$

If, assuming that in each tank the cathode area is 20ft.^2, the current densities will be respectively:

$$\text{A.} \quad \frac{600}{20} = 30 \text{ amp/ft.}^2$$

$$\text{B.} \quad \frac{300}{20} = 15 \text{ amp/ft.}^2$$

$$\text{C.} \quad \frac{200}{20} = 10 \text{ amp/ft.}^2$$

Calculating Deposit Thickness

Determination of the thickness of deposit obtained in a given time at a known current density is one of the basic calculations needed when setting up a plating bath. This is worked out from the known electrochemical equivalents of the metal concerned. If the deposition of copper be taken as an example, then, from the standard tables, it will be seen that, assuming a current efficiency of 100 per cent., and a current density of 10 amps/sq. ft. over a period of time of 1 hour, 0.000565 in. will be deposited.

pH Explained

At this point it is desirable to explain what is meant by Hydrogen-ion concentration, or pH, as it is normally expressed. All aqueous solutions contain some hydrogen ions. If an

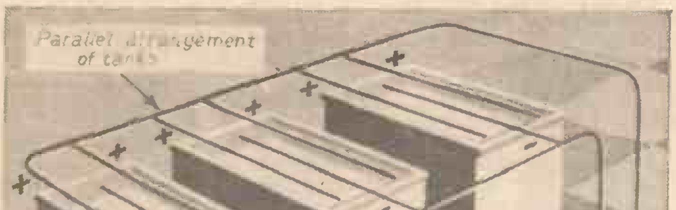


Fig. 2.—Parallel arrangement of tanks.

acid is added, the hydrogen ions increase; and if a base (alkali) is added, the concentration of hydroxyl ions increases. The hydrogen ions are positively charged and they move towards the cathode where they are discharged to form hydrogen bubbles. The efficiency of the cathode is a function of the amount of current that is used to form metal or hydrogen at the cathode. Therefore a 100 per cent. cathode efficiency (in terms of metal deposition) implies that no hydrogen is discharged, while a zero efficiency means that hydrogen only is discharged.

From this it can be seen that it is important to control the pH concentration in those baths that are nearly neutral, such as those used for nickel.

The pH system has been evolved to provide a simple means of expressing the degree of acidity or alkalinity of solutions. Mathematically, the pH is the negative logarithm of the concentration of hydrogen ions:

$$pH = -\log_{10}[H]$$

In a neutral solution, in which the hydrogen-ion concentration is 10^{-7} N, the pH is 7.

The scale ranges from 0-7, and 7-14. Solutions with a lower pH than 7 are said to be acid, and those with a pH higher than 7 are alkaline.

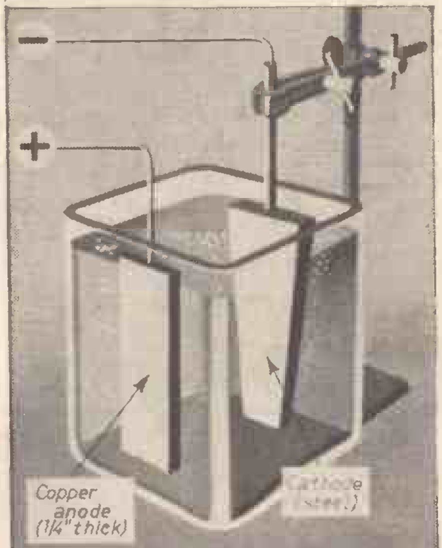


Fig. 3.—A plating tank suitable for the amateur.

Setting up an Electroplating Unit

The fundamental electrical apparatus that is required has already been described.

A convenient bath in which the work is to be carried out can be a glass tank, such is used for large accumulators. A convenient size would be one of approximately 20in. × 12in. × 9in., with a working level of 12in. to 14in. (Fig. 3).

In addition to this main bath it will also be found convenient to have a 5-litre beaker of Pyrex glass; as certain plating solutions, such as nickel, have to be raised in temperature. A 500 watt heating element covered by an asbestos pad, and regulated by means of a variable resistance, will be all that is necessary. (See Fig. 4).

A balance, capable of weighing batches of chemicals up to 1,100 grams, a vacuum pump and Buchner funnel (the former being operated from the mains water supply) should also be available in order to filter the plating solutions after they have become contaminated from continual plating operations (Fig. 5).

Copperplating Bath

The solutions from which metals are deposited by electrolytic processes are known as electrolytes. There is considerable

Fig. 4.—Apparatus for raising the temper of plating solutions.

flexibility permissible in their composition. If we take copper by way of illustration, then a typical bath would be made up from commercial copper sulphate and sulphuric acid of specific gravity 1.84.

Copper sulphate	150-200 gms/litre.
Sulphuric acid (conc.)	25- 37 gms/litre.

On the commercial scale the "Acid copper" bath above referred to is frequently modified by the addition of certain other substances; such as alum, gelatine, sugar or phenol. The latter substance is the one most frequently used. The amount is of the order of 1 gram per litre and it is mixed with about twice its weight of strong sulphuric acid, warmed to 100 deg. C. for an hour, by which time it has formed into phenol sulphonic acid. To make this effective, a heavy current, say 350 to 400 ampere-hours per gallon of solution, is needed to bring the bath into condition.

The Rochelle Salt bath, which has of late come into common use, is a copper cyanide solution and is an aklaline electrolyte. The composition of this bath is as follows:

Copper cyanide	26.5 gms/litre
Sodium cyanide (total) ...	34.2 „ „
Sodium cyanide (free) ...	5.6 „ „
Rochelle salt	60.5 „ „
Sodium carbonate... ...	30.0 „ „
pH	12.6
Water	1 litre

Adjustment of the pH concentration is controlled by the addition of caustic soda if it is low; and if too alkaline, by the addition of sulphuric acid. *As the addition of sulphuric acid releases considerable concentration of hydrocyanic acid fumes it is of paramount importance that efficient ventilation be provided.* Current densities as high as 90 amperes per sq. ft. can be used; but the normal rating is that of 40 amperes per sq. ft.

The anode area should be about twice that of the cathode area with a small proportion of anode in an insoluble form, such as iron. This bath tends to yield a brighter copper than does the acid bath.

Substances known as "brighteners" are sometimes added to the cyanide bath, such as arsenious acid or sodium thiosulphate.

Preparation for Electroplating

Before starting the actual process of electroplating it is of the utmost importance that the surface of the basis metal be perfectly cleaned.

The foreign materials most likely to be present and which must be dealt with prior to electroplating can be classified into three main groups:

1. Grease.
2. Abrasive materials.
3. Oxides.

There are three main methods for the removal of oils and fats:

The first is by the use of an organic solvent, such as trichlorethylene or carbon tetrachloride; and is known as solvent cleaning or vapour degreasing.

The second method is termed emulsion cleaning, where the surface is treated with an oil containing a wetting agent; and the resultant emulsion is rinsed off.

Fig. 6.—Apparatus for electrolytic cleaning.

The third method, shown in Fig. 6, is known as electrolytic cleaning and is effected by immersion of the basis metal in an alkaline solution and making it the cathode and passing a current through it, the solution being held at a temperature of about 80 deg. C. The emission of hydrogen bubbles at the cathode has a mechanical as well as a chemical action in scouring the surface clean.

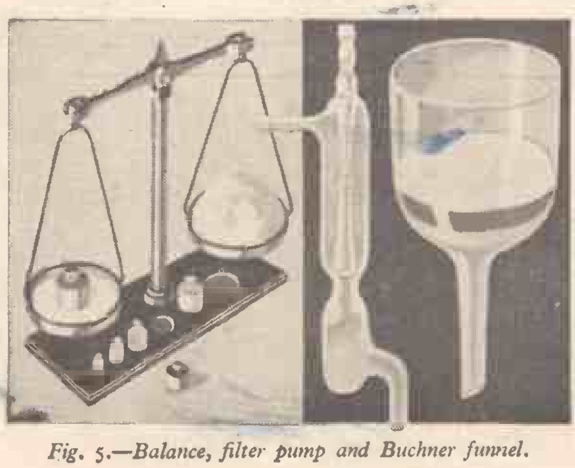


Fig. 5.—Balance, filter pump and Buchner funnel.

The alkaline compounds commonly used in this cleaning solution are Sodium hydroxide, Sodium carbonate, Sodium phosphate and Sodium metasilicate.

The total concentration of these compounds is of the order of 30 to 60 gms. per litre. The current density is 50 to 100 amps./ft.². A two-litre beaker with an iron rod as anode will be found to be a convenient permanent set-up for electrolytic cleaning bath, as shown in Fig. 6.

Removal of Oxides

The methods in general use for oxides removal employ the appropriate acid. The type, concentration and temperature of the acid bath varies in accordance with the characteristic of the oxide to be removed.

For small-scale work sulphuric acid will be found the most useful. Hydrochloric acid is quicker in action in the case of steel; but it is more expensive than sulphuric acid.

For most operations, acid of the strength of 2N is used. For hydrochloric acid this means that one vol. of concentrated hydrochloric acid (Sp. gr. 1.18) is mixed with 15 vols. of water. Therefore, to make up 2N sulphuric acid take one vol. of concentrated acid (Sp. gr. 1.184) and dilute with 15 vols. of water.

Hydrofluoric acid is used to remove silica (sand) from castings or from alloys containing silicon. It is usual to mix a little sulphuric acid to the commercial hydrofluoric acid which is of the order of 50 per cent. to one gallon in strength.

Copper Alloys

Heavy scale, consisting of cuprous and cupric oxide, is removed by a mixture of sulphuric acid and dichromate. Lesser contamination by oxides can be dealt with by treatment with dilute sulphuric acid (8 oz. to 1 gallon).

The following table is taken from an article by A. K. Graham (Trans. Am. Electrochem. Soc., vol. 52, p. 289, 1927).

DIPS FOR BRASS

Compounds	Scaling dip Sp. gr.	Scaling dip fl. oz/gal.	Bright dip fl. oz./gal.
H2SO4 ...	1.84	49	55
HNO3 ...	1.38	9	9
HCl ...	1.18	0.5	0.25
H2O ...	—	68	63

For pickling zinc and die castings immerse the work in dilute hydrochloric acid for 10 to 15 seconds.

For aluminium and its alloys use nitric acid, and for lead fluoboric acid (HBF_4).

Nickel-plating

Nickel-plating is of extreme importance in industry. Prior to the development of techniques relating to the electrodeposition of nickel, chromium was used to give a finish to those electro-plated surfaces where appearance was of importance. However, it was found that chromium coatings were porous and did not, in fact, protect the basic metals from corrosion.

The successful application of nickel-plating techniques requires close chemical control and care in purity of the solutions used.

Bath Composition

The principal salts used are nickel sulphate and nickel chloride. The most effective of the sulphates is $NiSO_4.6H_2O$ which contains 24.7 per cent. of nickel.

The U.S. Federal Specification O S-61 (1930) lays down the following as part of its requirements:

	Nickel Sulphate per cent.	Nickel ammonium sulphate per cent.	Nickel chloride per cent.
Nickel (cobalt) min.	21.4	14.6	24.3
Iron, max. ...	0.08	0.08	0.08
Zinc, max. ...	0.05	0.05	0.05
Copper, max. ...	0.02	0.02	0.02
Free acid, max. ...	0.10	0.10	0.10
Insoluble, max. ...	0.10	0.10	0.10

Buffers

Good nickel deposits can be obtained from baths with pH values ranging from 1.5 to 6.0; and these limits must be controlled within the narrow limit of ± 0.5 pH.

There are three recognised pH zones: each one is used to give a specific type of coating:

A pH between the values 1.5 to 3.0 is the "low pH" and is operated at relatively high temperatures and current densities.

A pH from 3.0 to 4.5 yields a bright nickel coating.

For hard deposits, such as on printing-plates, the pH values is maintained between 4.5 and 6.0.

The buffer most often used in nickel baths is boric acid, H_3BO_3, and this exerts its maximum buffer effect at a pH of 5 to 6. Acetic acid is used to buffer baths with a pH of 3 to 5. Formic acid, HCOOH, is used in the nickel-cobalt bright bath.

The danger of bright nickel deposits lies in the stresses set up in the nickel coating itself. The surface can peel away or become very brittle.

Temperature and Current Densities

At ambient temperature and dilute baths, current densities of 5 to 20 amp/ft.^{2} are used. At higher temperatures and stronger bath concentrations, current densities of 60 amp/ft.^{2} can be used.

Agitation of the plating solution tends to improve the uniformity of thickness of the nickel coating.

When coating cast iron with nickel it has been found that better adhesion can be attained if the object is first "flashed" with copper.

For more detailed information on the techniques employed for electroplating reference should be made to the following authorities: "Principles of Electro-plating and Electro-forming," by Blum and Hogaboom; and "Electroplating," by Field and Weill.

Electronic Lung Replaces Iron Lung

BRITISH medical scientists have recently invented an electronic lung which they claim will replace the present cumbersome iron lung. Called the Barnet Ventilator, the lung has been a joint venture by several companies of the Pye Instrument Group. The new lung gives the patient considerable freedom. Instead of being encased in a box, the patient is able to sit up and is linked to the ventilator by two plastic tubes. It is of the utmost value in every case of respiratory insufficiency.

TV Traffic Control

CLOSED-CIRCUIT television, which enables one policeman to control four busy traffic lanes at West Drayton, Middlesex, went into operation recently.

The television system has been specially designed by E.M.I. Electronics Ltd., and will be used while road widening work is in progress. Without the aid of television three policemen would have been required to regulate traffic. The point duty policeman is able to watch traffic conditions on two roads, which he would not otherwise be able to see, on a monitor screen set up in a special police box.

Computer for Ministry of Pensions

AN order for what, when completed, will be one of the largest electronic computer installations in Europe has been placed with E.M.I. Electronics Ltd. by the Ministry of Pensions and National Insurance, Newcastle. It will deal with the huge volume of data processing connected with the new Graduated Pensions Scheme.

The computer will "store" full statistics, such as name and address, amount of each contribution and sum paid to date, of each of 25 million insured persons. Each day the records of every insured man and woman in the United Kingdom will be processed in order to extract the required information for persons reaching retirement age and other changes in personal particulars.

This one-place, low-cost helicopter can cruise at 60 miles per hour and refuel at any roadside service station. It was recently introduced by the Bensen Aircraft Corporation, of P.O. Box 2746, Raleigh, North Carolina. It will also be available in kit form for individual assembly. The pilot sits in the open cabin with a 360 degree visibility, facing a pair of handlebars suspended from above. Rotor lift and engine power are controlled by twisting the left handlegrip. Forward speed is controlled by pulling and pushing the handlebars, and a pair of rudder pedals steer left and right. The air frame consists essentially of three straight aluminium tubes bolted together for quick dismantling and compact storage. The 60 h.p. Mercury outboard engine is mounted behind the pilot. It drives a short shaft which turns two coaxial counter-rotating rotors. Nicknamed the "Little Zipster" it can hover, fly forward, backward or sideways.

Make This POCKET SLIDE RULE

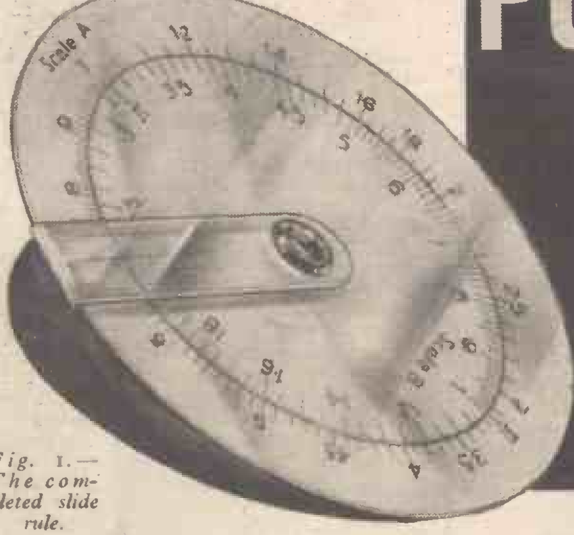


Fig. 1.—The completed slide rule.

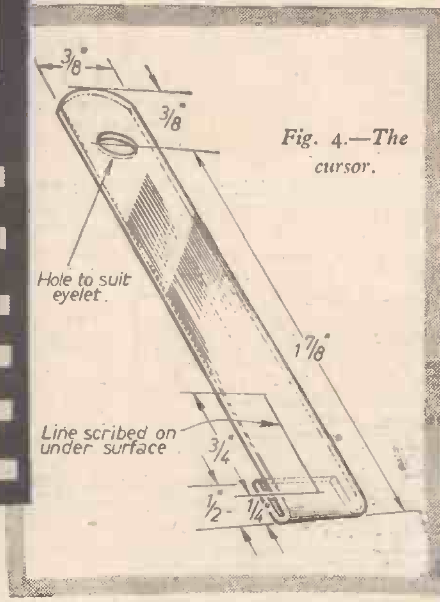


Fig. 4.—The cursor.

By J. A. LOGUE

You Can Make It in an Evening

A CIRCULAR pocket slide rule that can be used for making rapid calculations is shown in Fig. 1. Two scales are set out in black ink on thin tough white card. The graduations can be transferred from Figs. 2 and 3 on to tracing paper and then pricked through on to the cards. The lengths and numbering of the graduations are shown full size in the figures. Alternatively the scales as printed on this page can be used directly by pasting them on to thin card and cutting out along the lines shown.

The Cursor

A celluloid cursor is cut to the dimensions shown in Fig. 4 and a short line is scribed in the centre in the position shown and filled with black ink.

Place the celluloid in hot water and when pliable bend ½in. of one end over a scrap of card the same thickness as that used for the scales, and hold firmly until rigid. Punch a hole in the celluloid cursor to suit a brass eyelet and punch similar holes in both scale cards making sure they are centred exactly. Circles are drawn on both scale cards to assist in centring.

Assembly

The cursor is slipped over the edge of the outer scale, the inner scale is placed in position and the eyelet is peened over lightly. This allows the centre scale and celluloid cursor to be rotated smoothly to any desired position, when in use.

Notes on Using

The single cycle scales are numbered 1 to 10, but the actual extent of the scales is unlimited, for example, the digit 2 on either A or B scales can be used for .02, .2, 2, 20, 200, etc. To multiply, set unity on scale B to the multiplicand on scale A and read the answer on scale A opposite value of multiplier on scale B. To divide, set divisor on scale B to dividend on scale A and read answer on scale A opposite unity on scale B. For continued or combined multiplication and division set cursor to answer of each step of the calculation, without reading the intermediate answers. The decimal point is best ignored until the digits of the answer are read, its position can then be estimated. Ratios and proportions can readily be obtained as the values on scale A are proportional to the values on scale B over the scales, for any relative position of the two scales.

cut these out

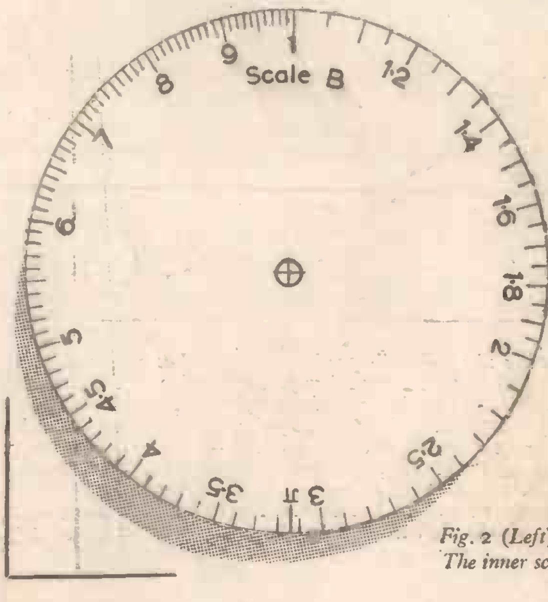
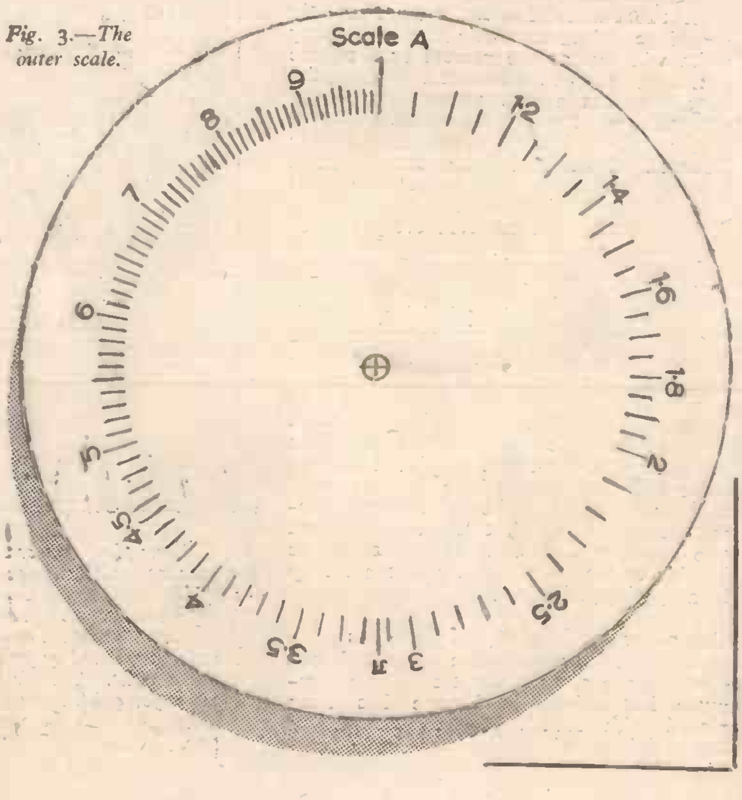


Fig. 2 (Left).—The inner scale.

Fig. 3.—The outer scale.



MOUNTAINS OF THE MOON

Typical Features are Discussed and their Origin Speculated Upon
By V. A. Firsoff, M.A., F.R.A.S.

LATELY the Moon has been very much in the news and telescopic views of her pock-marked face have become familiar to the general public. Rough and rugged it looks, especially where the long evening or morning shadows pick out the mountain detail. Fig. 1 shows the main features of the Moon, which can be identified by means of the map (Fig. 2).

A magnification of 600 does not necessarily reveal more than one of 200. The resolving power of the telescope is determined by its aperture and the quality of its optics. The brilliance of the image decreases and the atmospheric unsteadiness increases with the apparent size. Indeed the seeing is seldom good enough for a power as high as that to be used to advantage and powers in excess of 1,000 are rarely employed in planetary and lunar work even with the giant instruments. Still, size does make a difference. It makes things look more real. And when conditions permit I like to put in a 600x eyepiece into my 12in. reflector and let the magnified rotation of the Earth carry lunar scenes past my gaze.

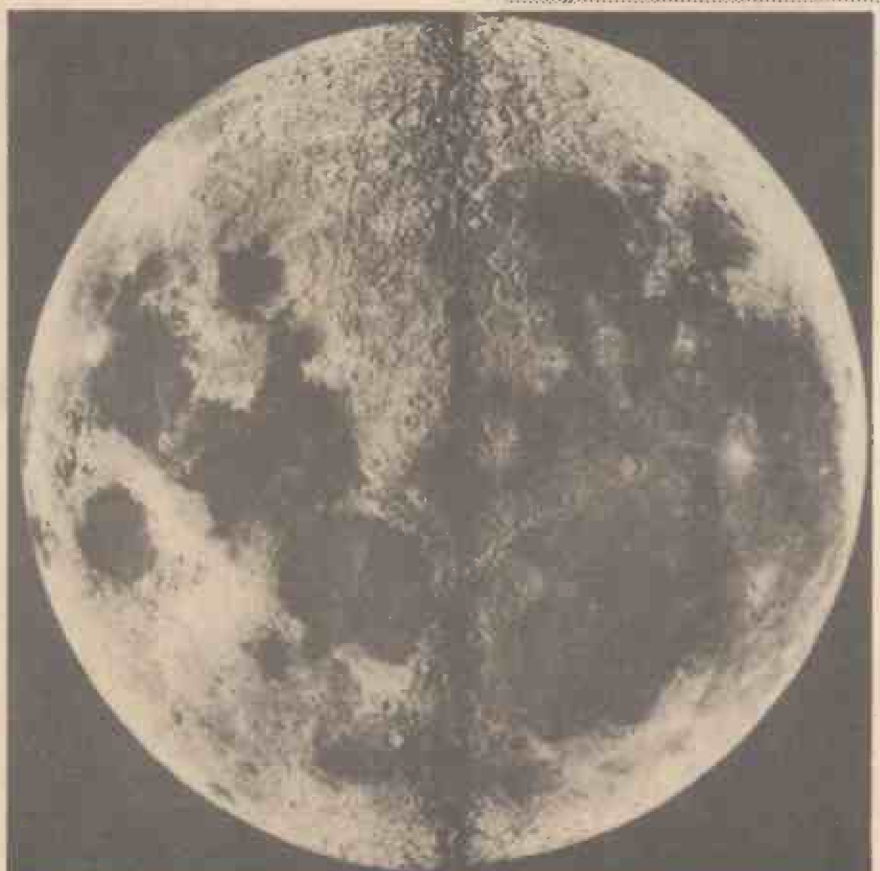


Fig. 1.—Composite photograph of the Moon (100in. telescope). Courtesy Mount Wilson and Palomar Observatories.

It is then as if the Moon were only 400 miles away and if for a moment you forget the optics you seem to fly high above the lunar mountains and can feel their grandeur.

The Apennines

In a broad sweep the Apennines unfold before you. Vertiginously steep over the grey plain of the Sea of Rains, they fan out into the darkness of the night in piled knobbly ridges. The outlines tremble in the air flood, but this does not rob them of reality and it is not difficult to accept the information that these peaks rise to nearly 20,000ft. above the plain.

Or else you may let your eye drift over the great mountains near the South Pole. Nearly twice as high as the Apennines and mightier than our Himalayas, the Leibnitz and Doerfel summits, being near the limb, appear in a more natural perspective. Range upon range, with passes and valleys, in some of which the Sun never shines, just as he never quits some of the highest peaks. At 600 diameters the curvature is much reduced, which adds to the effect.

These mountains bear some resemblance to the terrestrial forms, even if this resemblance is a little strained, and the sculpting forces of ice and water which largely determine our mountain views are absent from the Moon. By and large, however, lunar mountains differ conspicuously from the long arcuate chains, splitting into ridges and still smaller ridges, in the manner of a spruce branch dividing into twigs, with which we are familiar on the Earth.

Fig. 2.—Map of the Moon, showing main features. Key : 1, Ptolemaeus ; 2, Clavius ; 3, Bailly ; 4, Copernicus ; 5, Tycho ; 6, Plato ; 7, Theophilus ; 8, Janssen ; 9, Langrenus ; 10, Grimaldi ; 11, Alphonsus ; 12, Petavius ; 13, Endymion ; 14, Maurolycus ; 15, Gassendi ; 16, Posidonius ; 17, Newton ; 18, Cleomedes ; 19, Albategnius ; 20, Archimedes.

Craters

The Moon is pitted with multitudes of hollows, roughly circular or polygonal, large and small, ringed by ramparts which, steep inside, slope gently on the outside where the general level of the land lies above the bottom of the pit. The smaller hollows often occur in swarms and chains, where they may become contiguous, forming a broad scooped canyon; or else they are strung along a visible fracture or fault in a straight line, like beads on a string. Sometimes there is a row of small hollows nestling at the inner foot of the mountain rampart which girdles one of the big dish-like depressions, or right on the top of the rampart; while a peak or a group of peaks, some with cratered summits, may rise from the centre of the dish.

Depending on their size, these hollows are referred to as craterlets, craters, ring mountains and bulwark plains, which may be up to 200 miles across. Close to the middle of the disc the 90-mile-broad flat of Ptolemaeus is enclosed by laminated ridges. Nearer the South Pole sprawls the majestic Clavius, 146 miles in diameter, and further on, at the limb, lies the 185-mile enclosure of Bailly. Mare Orientale—the Eastern Sea—sometimes visible on the eastern limb, is a vast mountain-girt plain, 200 miles across, that is substantially still a crater. Indeed, the waterless "seas" of the Moon typically follow the same general scheme of polygonal depressions enclosed by high ground which in some cases becomes a clear mountain rampart.

Such are the Apennines enclosing the Sea of Rains in the north-west. The Leibnitzes and the Doerfels have long been suspected and have now been proved by the Lunik III to border a large sea of the averted hemisphere, see Fig. 3. This "Sea of Dreams" does not show to advantage in the Russian photograph, where it is greatly foreshortened, but it appears to be comparable to the Sea of Rains itself. Yet the structure of these ranges is quite different from that of the Apennines, which consist mainly of roughly parallel or divergent ridges. The south polar region is characterised by large and deep craters crowded into a cellular pattern recalling honeycomb, so that their ramparts run together into continuous ridges, the high peaks rising where the craters meet. The whole system is, moreover, riven by deep gashes roughly parallel to the central meridian of the Moon.

The Altai, to the south east of the Sea of Nectar, is different again. It is substantially an upraised scarp of well-worn ancient appearance. The Taurus Mountains in the First Quadrant exemplify yet another structure. They are largely formed by tilted fault-blocks on the lines of the Great Basin Ranges in the western U.S.A.

The "Sovietsky Range" on the averted side of the Moon seems to be over 1,000 miles long. In its main portion it trends

Fig. 3.—The other side of the Moon, photographed from Lunik III. This photograph is not inverted in the usual astronomical tradition. The curved dotted line running from top to bottom divides what we can see from Earth from what has hitherto been hidden. The new features are : 1, The crater named the Sea of Moscow ; 2, Bay of Astronauts ; 3, Continuation of the South Sea from the Moon's familiar side ; 4, Tsiolkovsky crater ; 5, Lomonosov crater ; 6, Joliot Curie crater ; 7, Soviet Mountains ; 8, Sea of Dreams. The remaining features are normally visible from Earth : I, The Humboldt's Sea ; II, Sea of Crises ; III, Sea of the Margin ; IV, Sea of Waves ; V, Smyth's Sea ; VI, Sea of Fertility ; VII, South Sea. The horizontal line shows the Moon's equator.

nearly north and south with more or less sharp bends at both ends. It does not border on any "seas," but there appears to be a difference of the general surface level on its two sides, so that it may be essentially an upraised scarp, like the Altai only on a grander scale. The Altai attains 13,000 feet and the Sovietsky summits may be much higher, but no estimate of their height could be attempted, as they have been photographed under vertical illumination and cast no shadows. Their structure, too, is merely conjectural.

In the "seas" there are low ridges showing folding, in which they resemble typical terrestrial formations, but these *wrinkle ridges*, are of subordinate importance only. The seas also contain isolated, often triangular, peaks, which recall our "inselbergs," or chaotic groups of peaks and short ridges. In fact, the Lunar Alps are substantially a concatenation, degenerating into a jumble, of just such "inselbergs."

This brief survey shows that there is no lack of variety in lunar mountain forms. Yet the craters and walled plains, a good example of which is shown in Fig. 5, remain the most striking features of the lunar surface and much thought has been expended to explain their nature and origin.

Meteorite Theory

Apart from some wilder flights of fancy, there are two main schools of thought. One attributes the appearance of the Moon to bombardment by large meteorites at a remote geological time when large meteorites are supposed to have been abundant in the Solar System. The Earth would have received her share of this bombardment, but its marks would have long been destroyed by erosion and sedimentation, whereas they would still remain on the waterless, airless and therefore, changeless Moon.

There are some meteoric craters of considerable size even on the Earth. The oldest known example is Coon Butte or Barringer Crater in Arizona, but its ¾-mile width has been overshadowed by the recent Canadian finds. The Chubb Crater in the Province of Quebec is well preserved and measures two miles in diameter. The Deep Bay Crater in Saskatchewan discovered by Dr. M. J. S. Innes has no rampart which has been destroyed by glaciers, but measures about six miles. The Canadian Shield is one of the undisturbed parts of the crust and these craters have been able to survive for 70 million years or more.

Thus, there is definitely something in the meteoric idea.

A meteorite does not dig a pit by brute bodily impact. It moves at many miles per second

Fig. 6.—*Collapse of a volcanic cone and formation of a caldera.*

Fig. 5.—*The region of Copernicus. Courtesy Mount Wilson and Palomar Observatories.*

and as it hits the ground the material at contact is instantly vaporised and heated to temperatures of a nuclear explosion. This results in a tremendous detonation, so that the crater will be round even with an oblique hit and it will exceed many times the diameter of the meteorite that has produced it.

In 1949 an American investigator, R. B. Baldwin published an empirical equation which relates the diameter to the depth of an explosion pit and applies well to anything from a bomb crater through terrestrial meteoric craters to minor lunar ring mountains. This was hailed as final proof that the meteoric hypothesis was right and the rival volcanic or plutonic school of thought mistaken.

Volcanic Theory

Unfortunately, however, volcanic craters may also be produced by explosion and some of them definitely obey the Baldwin equation, while, on the other hand, many large lunar craters fail to oblige. Moreover, the meteoric conception assumes haphazard bombardment and lunar craters of comparable appearance are often arranged in clear linear and other patterns. Many of them have central peaks, often with craters at the summits. Even scientists who are in favour of the meteoric conception, such as Dr. G. P. Kuiper, have been obliged to admit that these features are volcanic. Lastly, in November, 1958, the Russian astronomer N. A. Kozyrev observed an actual eruption in progress from the central peak of Alphonsus and even secured a spectrographic record of it, which fairly clinches the issue.

Thus there has not only been volcanic activity on the Moon but it is still going on.

In fact, the idea that the craters of the Moon were volcanic was a natural one and came early. Sir William Herschel observed some bright spots on the dark part of the Moon and thought that these were volcanoes in eruption. The difficulty of the volcanic interpretation, however, lies in the great size of the lunar ring mountains. Volcanic explosion craters on the Earth do not exceed two miles in diameter.

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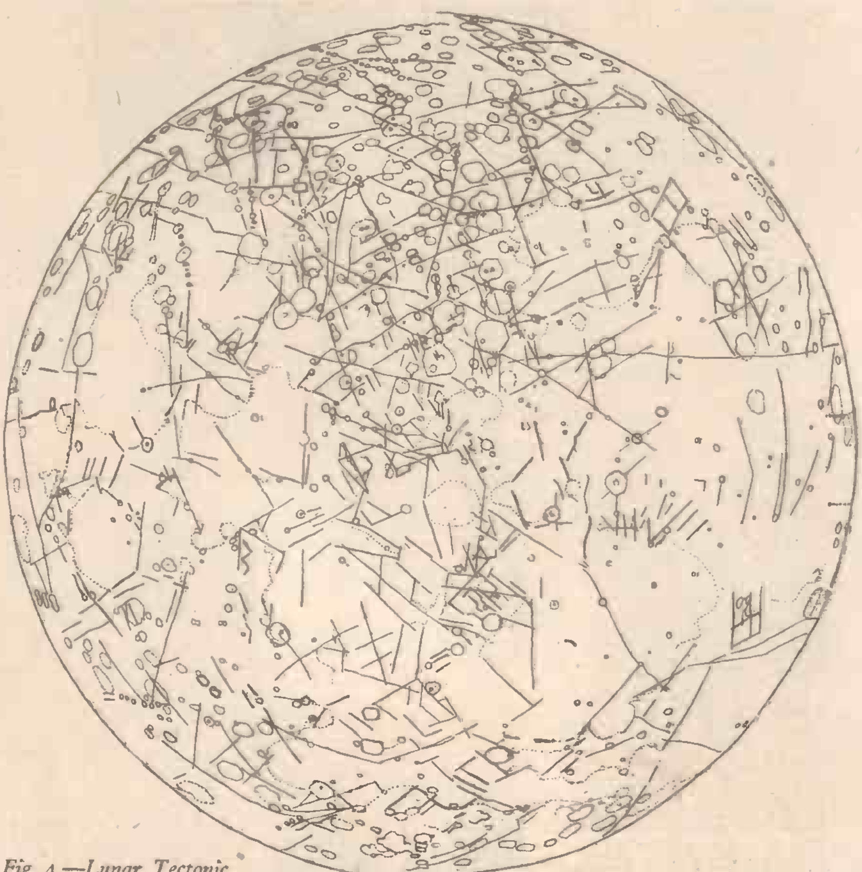


Fig. 4.—*Lunar Tectonic grids. This map appears in "Strange World of the Moon," published by Hutchinson in November.*

Try Woodturning

By A. E. BENSUSAN

THIS contemporary wood-turning design has a multitude of uses in the modern home. The dimensions given in Fig. 1 provide an attractive holder for everlasting rootless ferns. The same sizes are suitable for a match holder, and doubling the dimensions gives a useful spill holder.

Mounting in the Lathe

Any hardwood with good turning properties can be used and a block of suitable length and section is screwed to the faceplate of a drill-powered lathe kit. The wood must be sufficiently long for the section marked with the screw to be cut away. To support the work while turning the outside, dimple the free end with a ⅛in. dia. drill held in the chuck which is mounted in the tailstock. The chuck can then be removed from the tailstock, and replaced by the stationary or "dead-centre" which has been lubricated with a touch of grease.

Turning

The exterior is roughed out with a gouge, and finished with the skew chisel, taking particular care to keep the profile lines straight, without marking the narrow waist of the work. At the point where the job is to be removed from the block the parting tool should be used to form an undercut ⅛in. deep.

The tailstock centre is now moved back and replaced by the drill chuck, holding a drill of as large a diameter as possible. The drill is fed into the work by means of the tailstock lever, until it is at practically the full depth of the finished hole. The tailstock should now be moved right back, and the bore of the work enlarged with the gouge until it is of the required diameter and depth. The small radius left at the bottom is removed with the point of the skew chisel.

Finishing

If the tools have been kept properly sharp throughout the turning and boring operations, the finish of the work should be almost perfect. A light application of well-worn flourpaper removes any slight tool marks, but great care should be exercised since the high speed generates considerable heat. Apart from the danger of scorching the work, the fingers can be burned if the paper is applied too vigorously.

A french polish finish can be given while the work is still on the lathe, gently rubbing down with flourpaper after every application, or this part of the operation can be performed after the job has been cut away from its block with the parting tool.

For use as a match holder, the container may be glued to a square block of matching timber or polished cork. A piece of medium sandpaper serves as a striking strip for non-safety matches, and the side of a matchbox for the safety variety. Secure this with rubber solution, so that the worn strip can be peeled off and replaced when necessary—but wait for the solution to dry before using as it is inflammable when wet.

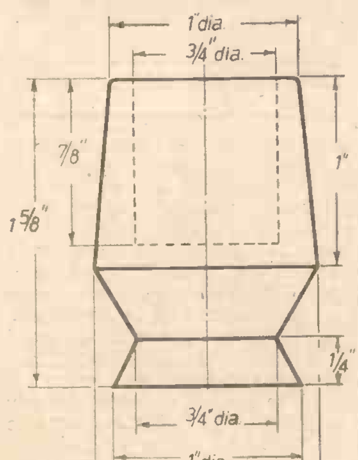


Fig. 1 (Left).—Gives the dimensions, and the photographs (above and at the top of the page) show the various uses.

PUZZLE CORNER

1.—Transport Problem

I AM in the habit of catching a certain train from Euston to the country town near to which I live. My wife leaves home in our car at a fixed time every day, meets the train punctually, and we drive home together. One day I catch a train an hour earlier than usual, but not having been able to notify my wife, there is no car to meet me so I start to walk home. After I have been walking for some time, my wife arrives with the car, turns round, and we go home together. When I arrive at the house I glance at the clock and find I am half an hour earlier than usual. The train journey is assumed always to occupy the same time and the car to travel at a uniform speed on all occasions. Time for turning the car, etc. can be ignored.

For how long had I been walking?

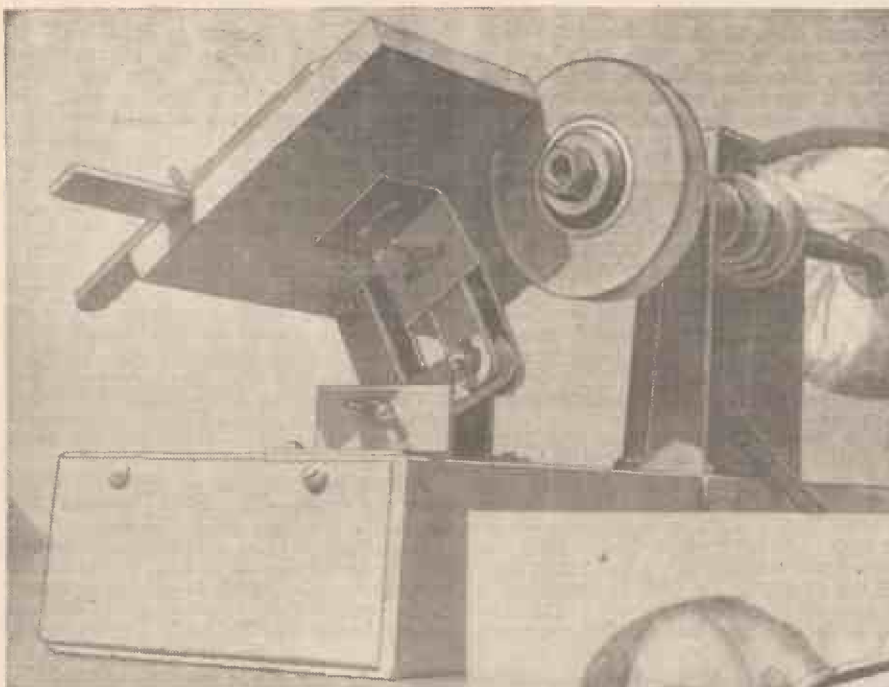
2.—A Missing Link?

A CHAIN is in six pieces each piece consisting of four links. On being asked to make one long chain of them, a blacksmith undertakes the job and agrees to charge 2s. 6d. for each of the links it is necessary to cut and join. What should be a minimum charge for the job?

Answers

1.—Three-quarters of an hour is the answer. I arrived at the station an hour earlier than usual but reached home only half an hour earlier, therefore I must have lost half an hour walking. The car left the house at the usual time and arrived back half an hour earlier than usual, and was therefore on the road for half an hour less time, that is, a quarter of an hour each way. I must have been walking for this quarter of an hour, too. Total walking, three-quarters of an hour!

2.—The blacksmith should cut each link of *one* of the pieces of chain, thus leaving five pieces to be joined together—this he can do with the four separate links. The charge should therefore be 10s.



A *Multi-Purpose* GRINDING REST

This Will Facilitate All Your Workshop Grinding

By Jameson Erroll

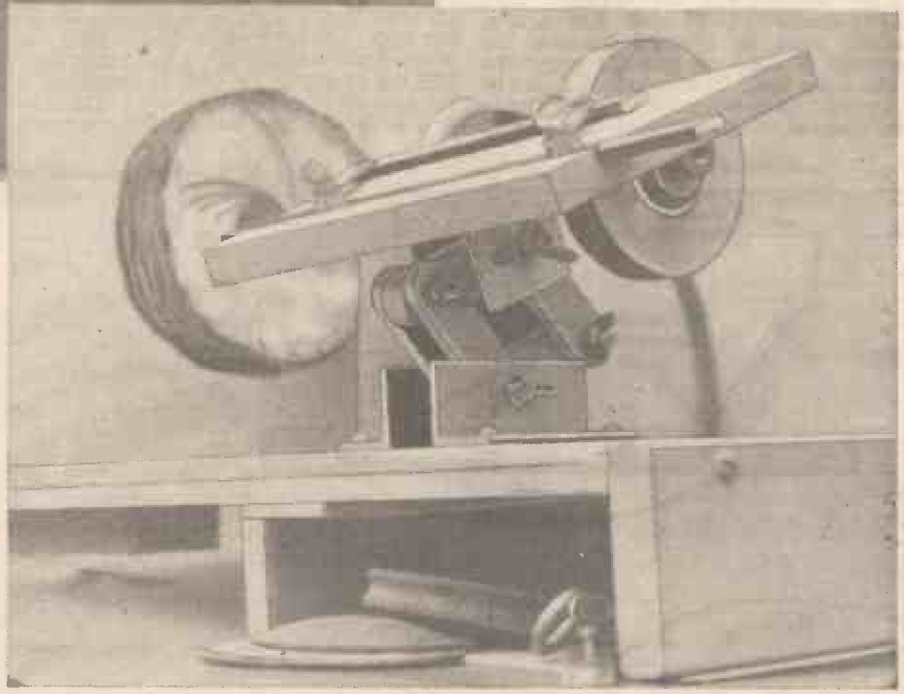


Fig. 1 (Above).—The completed model with lattice assembly. Fig. 2 (Right).—The baseboard can be used to house odd grinding wheels, etc.

ALTHOUGH primarily designed and dimensioned for use with a Picador grinding and polishing unit powered by a separate motor, the essential features can readily be adapted to function with any type of similar machine. For this reason few measurements are given in the drawings, the constructor being left to decide upon the size of table, etc., best suited to his purpose and to the unit he possesses.

Plane irons, chisels, lathe tools, knives, etc., can be ground with absolute accuracy since the table can be adjusted to any desired angle and the tool moved evenly across the face of the grinding wheel. The horizontal rest, Fig. 3, ensures perfect regularity when photo-guillotine knives and the like are being ground, and the angle rest, Fig. 4, serves as a sliding angular or square guide for most ordinary grinding jobs. A recess is cut in the back of the table to provide support when side-grinding is undertaken.

The model shown in Figs. 1 and 2 is constructed on a baseboard specially made to fit that on which a motor is mounted and used for driving other machines. Consequently, the size of the baseboard and the addition of a box underneath (convenient for holding odd grinding wheels, buffs, wire wheels, etc.,) are fixed by necessity but can be altered or adapted to suit individual requirements.

Having decided on the size of the baseboard (18in. × 7in. in the model illustrated) fix the Picador unit more or less centrally along its back edge. The centre of the spindle being approximately 4¾in. from the top of the baseboard and variation of the table height from 3½in. to 6in., ample adjustment is provided. If, however, another unit or assembly is used and the spindle height from the base is much greater, the length of the lattice strips should be increased.

The Adjusting Mechanism

This consists of two pairs of angle-iron brackets 2in. long × 1½in. × 1½in. and an intervening lattice assembly. The lower pair of brackets, screwed to the baseboard, are provided with a central ¼in. hole in the uprights. The upper pair, screwed to the underside of the table, have a ¼in. slot about 1½in. long cut in the upright flanges. Quarter-inch bolts pass through these holes and slots and thus permit the lattice assembly to swing in the lower pair of brackets and both swing and travel along the upper pair. Fig. 5 furnishes a perspective view of this mechanism.

The lattice assembly, which can be seen in Figs. 1 and 5 *may* be made of hardwood, although brass or mild steel is recommended. It consists of two pieces 3in. × ¾in. × ½in. and four pieces 3in. × ¾in. × ¼in. joined at the corners as shown. Bolts are used for this purpose, two (at opposite corners) being ¼in. dia. Whitworth coachbolts for attachment to the brackets, the other two being 3/16in. dia. Whitworth thumb-headed bolts. It will be readily understood that such a movement is capable of minute adjustment both horizontally and vertically, and that the table can consequently be tilted to any angle in relation to the face of the grinding wheel and also moved backward or forward to accommodate differing diameter wheels.

It is not advisable at this stage to screw the brackets to the base or to the table.

MATERIALS REQUIRED

18in. × 7in. piece of ½in. or ⅜in. plywood.
8in. × 6in. × ¾in. piece of oak or plywood.
2 pairs angle-iron brackets 2in. long × 1½in. × 1½in.
2 brass arms 3⅜in. long × ½in. × 1/16in.
2 pieces mild steel or hardwood 3in. × ¾in. × ½in.
4 ,, ,, ,, ,, 3in. × ¾in. × ¼in.
1 ,, ,, ,, ,, 10½in. long × ¾in. × 3/16in.
1 ,, ,, ,, ,, 6in. long × ¾in. × 3/16in.
1 ,, ,, ,, ,, 7in. long × ¾in. × 3/16in.

The Table

That on the model being described is of oak, 8in. × 6in. × ¾in., but plywood can, of course, be used instead. About 1in. from the front edge a groove is cut ¾in. wide and 3/16in. deep; this accommodates the guide bar. The recess at the back is cut about 1in. deep and of a width to accommodate the thickest grinding wheel likely to be used; its inside edge is bevelled.

The guide bar 10½in. long and cutting-angle rest 6½in. long are of mild steel ¾in. × 3/16in. joined by means of a short ¼in. thumb-bolt which is a loose fit in the angle rest and is threaded into the guide bar.

Combined they form a sliding gauge adjustable to any angle. Fig. 4 illustrates table and gauge.

The horizontal or parallel-rule rest shown in Fig. 3 is particularly useful where width has to be regularly maintained. It can be put to use for truing up parallel edges which have been cut with the hacksaw. The same guide bar is used, and the horizontal rest is 7in. long; the two arms, each 3½in. long, are cut from ½in. × 1/16in. brass. The upper ends of these arms are fastened to the horizontal rest either with rivets or 2 B.A. bolts. If the former, the underside of the rivets must be driven into countersunk holes so that the surface remains flat, and care must be taken not to hammer them too tightly. If 2 B.A. bolts are used, the threads in the horizontal rest should be cut on the tight side so that the bolts do not turn when the arms are moved to and fro. Note, that where the arms engage with the guide bar they are connected by ¼in. Whitworth bolts with "thumb" heads and that 3/16in. washers must be inserted between the underside of the arms and the upper-side of the guide bar. These washers may well be sweated on to the arms, or a number of thin washers to the required thickness of 3/16in. sweated together. At a pinch, thick nuts from which the thread has been stripped may be used. This backing-up is necessary since the guide bar slides in the groove in the table, whereas the horizontal rest slides along the top of the table.

Mounting and Using

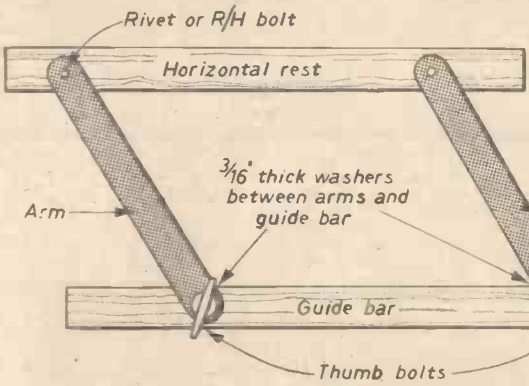
The lattice assembly may now be mounted between the two pairs of brackets, and the top pair of the latter (those with the 1¼in. × ¼in. slot) fixed on the underside of the table. They are mounted in line with the recess but 2¼in. from the back edge, and the bolt and flynut should be dead tight so that the brackets are brought as close together as possible before being screwed down. It will be found that when the flynut is loosened there will be sufficient play to permit adjustment.

Now loosen all flynuts, close the lattice assembly as far as possible, thus giving maximum height, and centre the top bolt in the slot in the brackets. Then tighten all nuts. Let the recess engage the grinding wheel and temporarily clamp down one of the lower brackets to the baseboard. Test that the groove in the table is parallel with the face of the grinding wheel. The best way to do this is to use the horizontal rest in conjunction with an ordinary trysquare, bringing the rest as close as possible to the wheel face and running the square along each side of the wheel. Tap the lower brackets lightly with a hammer until the assembly is perfectly square and then screw the brackets down firmly to the baseboard.

When using, adjust the necessary angle and height of the table in such a way as to preserve as far as possible a comparatively central pressure and thus bring into play the maximum strength of the fitment. Actually, if all flynuts are loosened and the table gripped by both edges and pushed and pulled into the required position, it will be found that it has of its own accord taken the line of least resistance and balanced itself more or less equally. Nothing drastic will happen if the pressure is not distributed as the fitment is strong enough to stand up to any pressure likely to be imposed upon it.

Always wear goggles or construct some form of transparent shield between the wheel and the eyes when grinding.

A number of fine grindings are preferable to an attempt to remove all unwanted metal at one go—great heat will be generated in the process and, most likely, the delicate temper of the tool destroyed beyond recall.



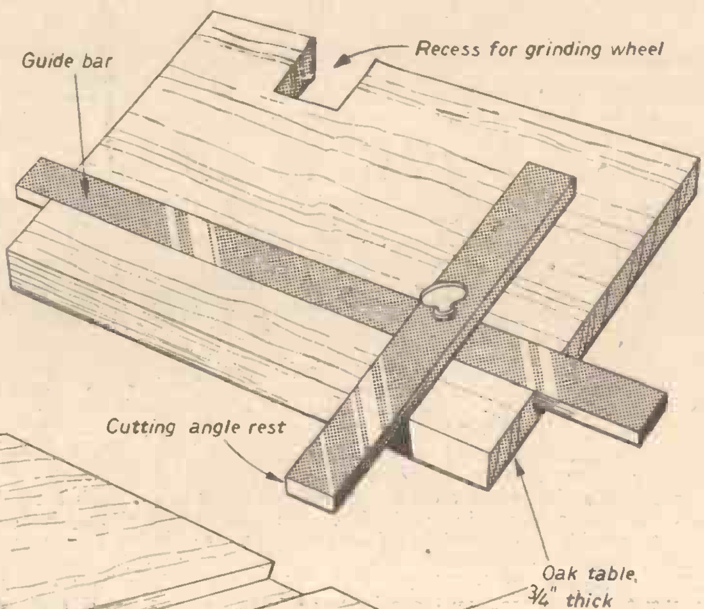


Fig. 3 (Left).—The horizontal or parallel rule rest. Fig. 4 (Below).—Sliding angle gauge and oak table.

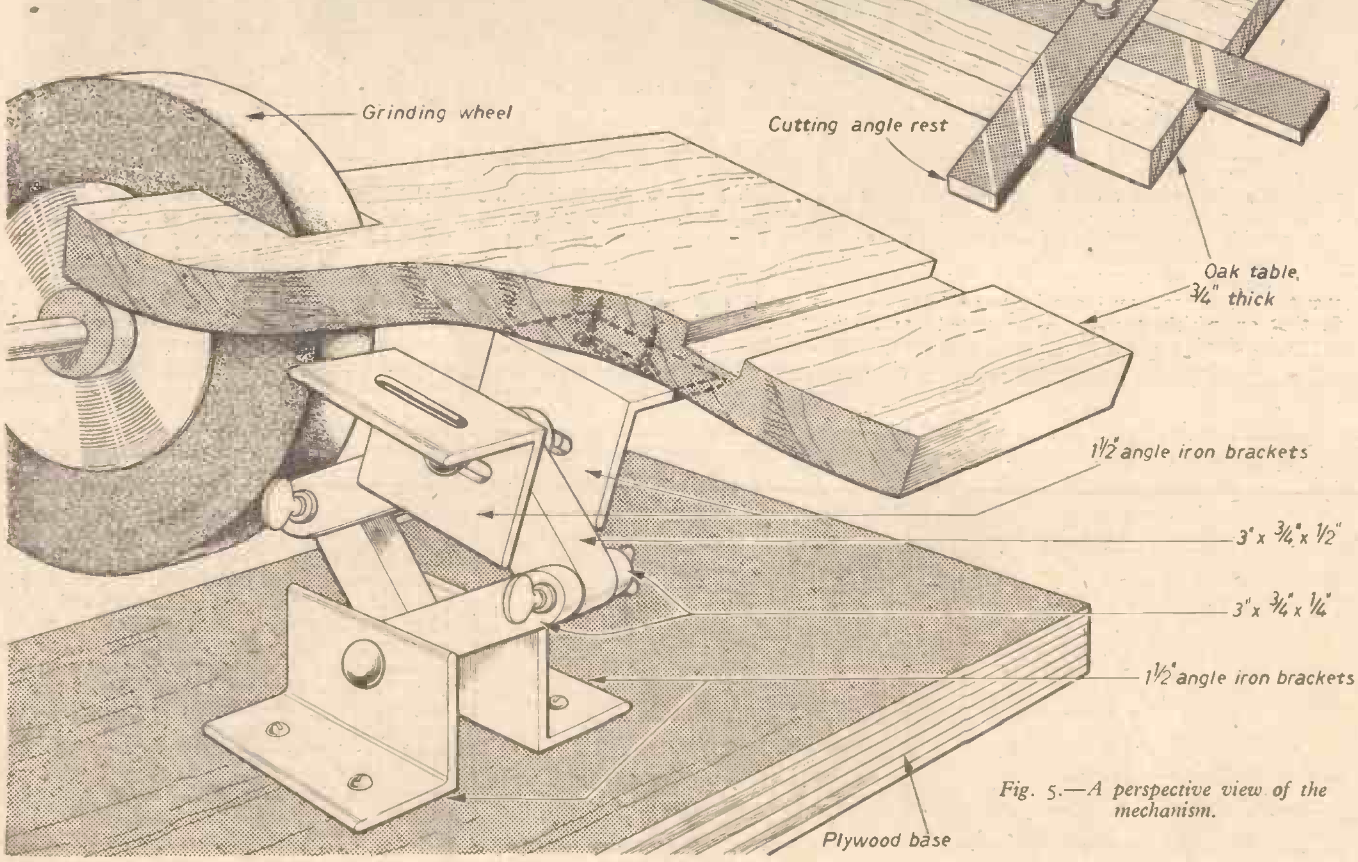


Fig. 5.—A perspective view of the mechanism.

Building the 'Luton Minor'

Part 5 Continues Construction of the Fuselage

(Continued from the December issue)

WITH the cross members fitted in the bottom rear fuselage, cut and fit those at the top longerons (which are lowermost). Also fit the diagonal struts which pass between the sides. Before gluing these in, however, check the alignment of the fuselage sides—all the cross members should be at right-angles to the centre-line drawn on the floor.

The Bulkhead

To complete the structure of the rear fuselage, cut and fit the bulkhead which runs diagonally across the fuselage elevation. The top and bottom cross members which take this should be shaped as shown in the detail on Fig. 31. Before doing this check that the fuselage sides are square. Note that the bulkhead will not be rectangular but trapezoidal as the fuselage is tapered, the top edge being shorter than the lower.

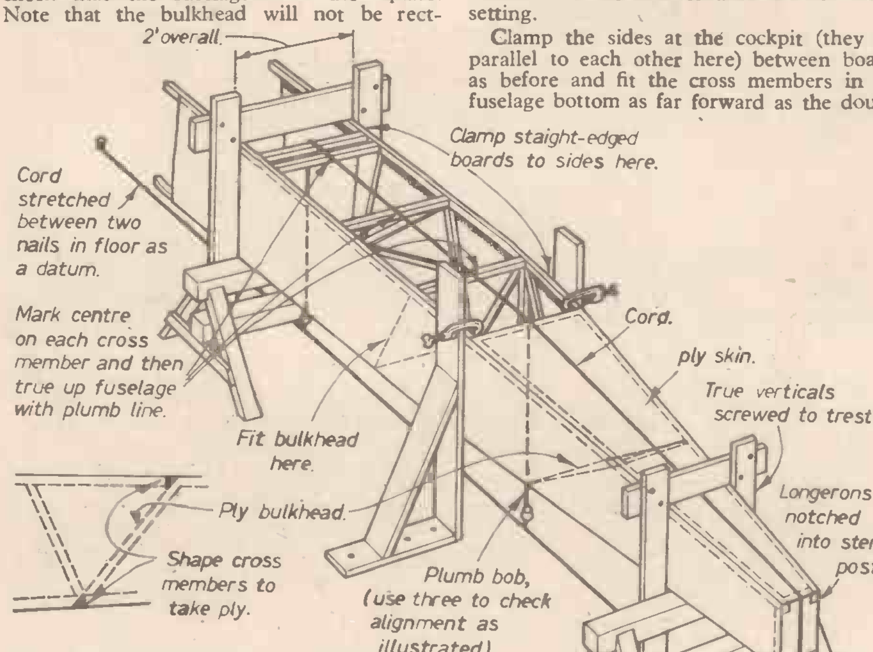


Fig. 31.—The fuselage aligned with plumb bobs and (inset) detail of rear bulkhead cross struts.

The plywood skin can now be fitted to the fuselage bottom from the stern post as far forward as the cross member, 109½in. forward, again moistening the ply. The direction of the grain of the lower ply should be longways.

When stapling plywood to the cross members, get an assistant to support the centre of each member with the flat of a heavy hammer or a heavy block. Failure to do this may crack the member and will certainly result in gaps between the member and the ply skin.

Tack a few strips of scrap wood diagonally across the unbraced forward halves of the fuselage sides to prevent them moving.

Set the fuselage on two trestles with extension pieces as shown in Fig. 31. Stretch a thin cord between two nails in the floor to represent the fuselage centre-line. The illustration depicts the correct method of aligning the fuselage. Remember that the rear end is rigidly boxed and thus alignment is achieved by adjusting the positions of the sides at the front end so that their distances from the centre-line are equal. Plumb-bobs are used to determine the right setting.

Clamp the sides at the cockpit (they are parallel to each other here) between boards as before and fit the cross members in the fuselage bottom as far forward as the double members which take the undercarriage and lift-strut fittings.

Cut a scarf joint on the edge of the bottom ply at the cross member (the end of the ply fitted previously) and to this scarf and fit the ply skin as far forward as the double cross-struts, stopping on the front one of the two.

Remove the fuselage, turn it up the right way and realign it between the uprights on the trestles. Again clamp the top longerons at the cockpit between boards. Cut and fit the cross members at the top longerons and also the bulkhead at the rear of the pilot's seat. Note that this bulkhead again is not rectangular, the lower dimensions being slightly greater.

Curved Cockpit Former

The next job is the making of the curved cockpit former which is made *in situ* and serves to stiffen the fuselage over the cockpit area.

It is made from three laminations of 3/16in. × ¾in. ash, 7ft. long. Glue them together flat, then spring the three pieces into the cockpit, gluing them to the sloping strut which passes down the sides of the cockpit. Cut and fit the cross member at the front of the former and glue and clamp the bow to it at the centre where the former is flattened for 3in. Keeping the edges of the strips flush with the top of the strut in the fuselage side, screw the strips to this member using 1½in. long countersunk brass woodscrews ⅛in. in diameter. Also screw the bow to the last diagonal strut in the fuselage before the cockpit bulkhead, cutting the ends of the strips flush with the rear edge of this member.

The curved seat-back lower former, which forms part of this cockpit stiffening former, can be made separately, using a simple jig into which the two laminations of ¼in. × ¾in. spruce are glued and bent and joined at the centre to the ½in. × ¾in. cross strut. Glue on one ply web, allowing enough ply to glue on to the cockpit former at the sides and the shaped 1in. × ¾in. cross strut at the back.

After this has set, glue this former into place across the rear end of the cockpit former.

Now cut and fit the 1/16in. plywood diaphragms which fit on each side of the cockpit former, one on the top, one below, so that the ply overlaps the edges of the fuselage strut. This is illustrated on the plan.

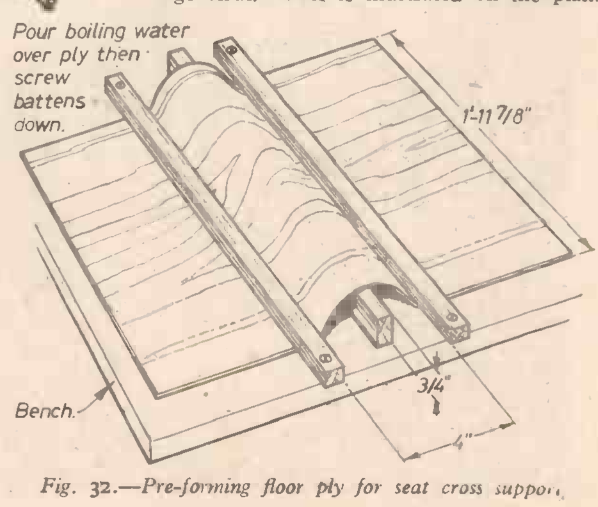
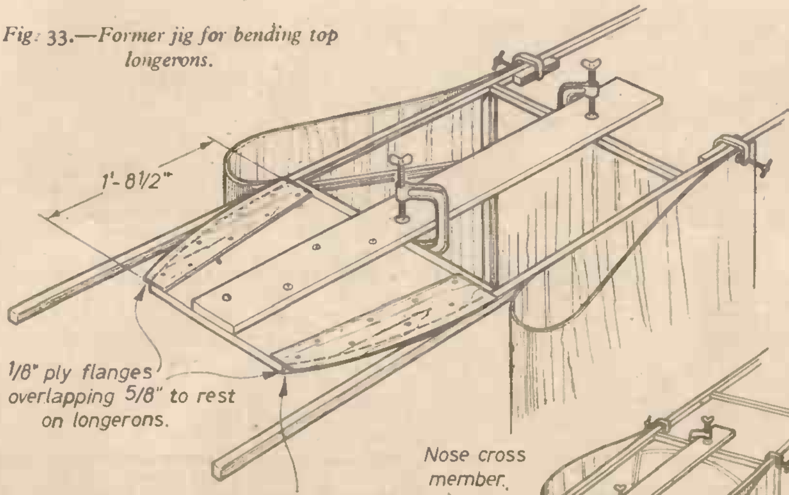
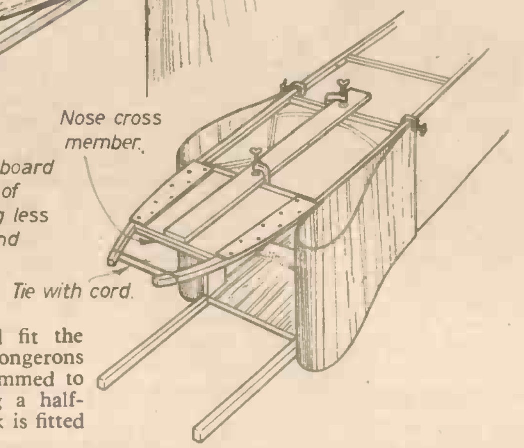


Fig. 32.—Pre-forming floor ply for seat cross suppor

Fig. 33.—Former jig for bending top longerons.





In the same manner, make and fit the former which fits between the top longerons for the seat back. This can be trimmed to the correct angle on the job using a half-round file before the actual seat-back is fitted later on.

Fit the cross member between the top longerons at the front of the cockpit and also the wedge strip between it and the former cross strut.

Make the special seat support cross member and glue and screw it to the bottom longerons using one 1¼in. × ⅛in. countersunk brass woodscrew each side. Glue it also to the bottom ply skin.

Cockpit Floor

The cockpit floor may next be fitted and it is advised that this be done in two sections—from the bulkhead as far forward as the next cross member as one section and then the second section as far forward as the front undercarriage cross member.

Both sections are of 1/16in. ply with the grain fore and aft. The rear section is supported forward of the bulkhead by a ⅜in. × ⅜in. member glued to the bulkhead between the longerons.

The second section (which is overlapped 1in. on to the first) has to be pre-formed to fit over the special seat support cross member. Do this by clamping the ply as shown in Fig. 32 and pouring boiling water over it. When dry, glue and tack it into place.

This completes the fuselage except for the bending in of the longerons at the nose. This is an important job and care must be taken not to crack the longerons. Begin on the two top ones by making an internal former of blockboard as shown in Fig. 33. Fix this to a straight board which is then clamped to the cross members as shown.

Fold back the unglued forward plywood skins and tie them to the fuselage sides out of the way, taking care not to fold them so tight that they split.

Thoroughly soak one longeron in boiling water for several minutes and then, holding it with a glove, carefully begin to bend it. Do not hasten the bending, but work it slowly, applying more boiling water as necessary. Bring in both longerons in this manner and tie them together with cord at the front end where they overhang. Do not remove the blockboard former.

The lower longerons present a slightly more difficult job. Remove the fuselage from the trestles and set it on the floor between the "L" braces as shown in Fig. 34.

Make the jig for bending in the lower longerons (Fig. 35) using softwood and commercial ply. Note how the longerons are located against blocks on the inner profile and are held down in place by cross-beams screwed into the blocks. The dimensions for the profile base may be taken from the fuselage bottom nose skin measurements.

The lower longerons will need steaming and boiling water saturation before and during bending and ideally a shallow tray should be placed under them which is filled with water heated by a gas jet. If this is done, take care that the gas jet is centrally placed under the tray and is not near the longerons where local heating might affect the wood.

When the longerons are supple (after about ten minutes in boiling water), remove the water tray and position the jig.

Check that the jig is in the right location fore and aft and also about the centre-line of the fuselage.

Bending Lower Longerons

Bending each longeron into place in the jig will require the services of an assistant who must press downwards on the longeron immediately forward of the heavy fuselage side member. This is to avoid concentrating all the bending forces at the forward corner of this member which might crack the longeron.

The cross-beams which hold the longerons down against the inner profile blocks are fixed with 2in. long screws so that they can be gradually tightened, drawing the longerons down into place. This permits periodic applications of boiling water as they are screwed down. Again tie the protruding ends of the longerons with cord.

Leave the fuselage set thus for about two days to dry out. Do not try to accelerate the drying by applying direct heat.

The Side Ply

If the jig for the lower longerons has been made right, and the cross-beams are the correct length, it is now possible to glue and staple on the side ply from the undercarriage heavy member forward without removing the jigs for the upper and lower longerons. Before doing this, however, check with a spirit level across the top longerons at the cockpit and again at the nose to see that there is no twist in them. If there is, it can easily be packed out now. Likewise check across the lower longerons at the nose so that the engine bulkhead will be perfectly rectangular.

Once the side skins are in place and the glue set, the jigs may be removed from the nose, leaving the cords in place to prevent any tendency for the side to spring open.

Fit the cross members between the top longerons at the front together with the horizontal plan bracing struts.

With the fuselage horizontally level, drop a plumb-bob over the nose cross member to the lower longerons and in this manner mark the position of the nose cross member in the lower longerons which is set 4¼in. ahead of the top one to give the angled bulkhead.

The side members for the engine bulkhead are next fitted making sure that the ends are correctly mitred to butt against the longerons.

A full set of plans costs £11·10·0 from Phœnix Aircraft, Cranleigh Common, Cranleigh, Surrey.

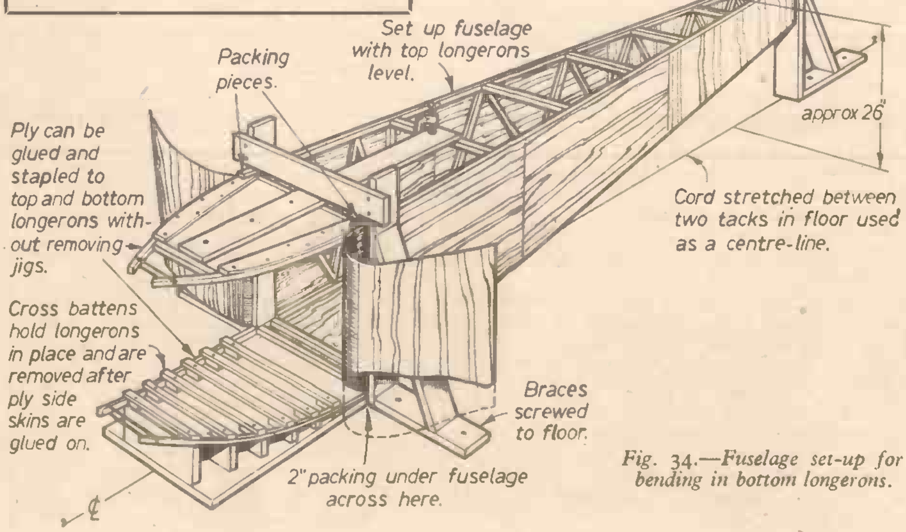


Fig. 34.—Fuselage set-up for bending in bottom longerons.

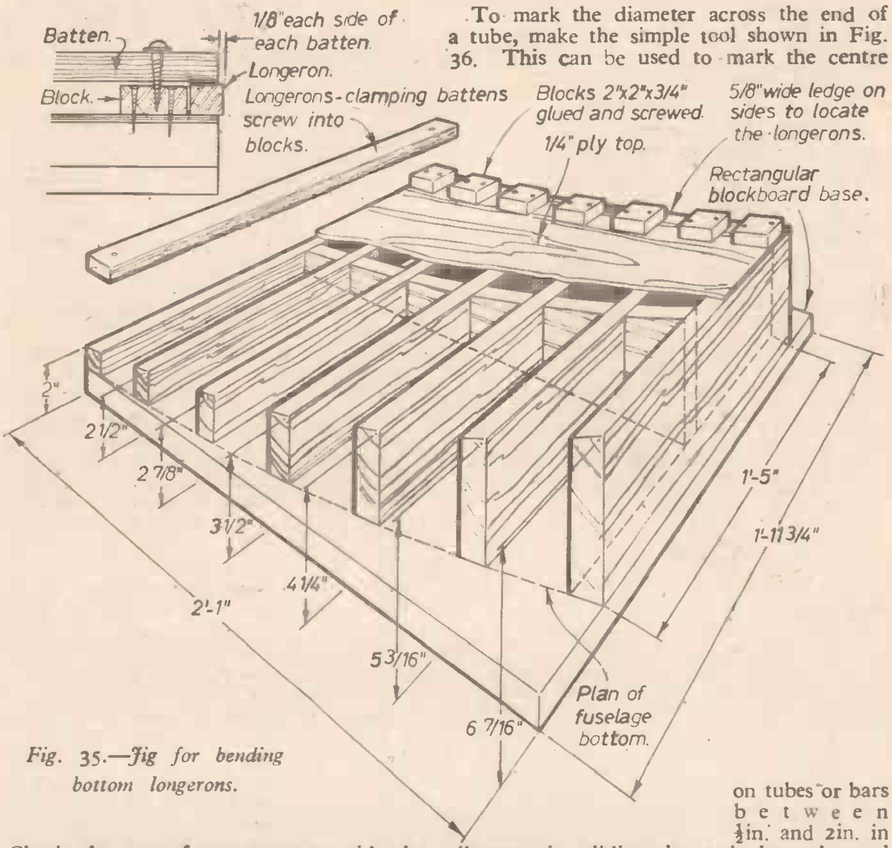


Fig. 35.—*Jig for bending bottom longerons.*

Check the nose for squareness with the rest of the fuselage and then fit the inverted "V" struts in the front.

Fit the ⅛in. ply engine bulkhead, invert the fuselage and fit the rudder bar support and the ¾in. × ¾in. cross member in the nose floor. Scarf on the bottom ply skin from the undercarriage member to the engine bulkhead. The grain of this skin should be at right-angles to the fuselage centre-line.

The forward cockpit floor is made of ⅛in. birch ply with the grain running across the width of the fuselage and is lapped on to the rest of the cockpit floor, terminating on the rudder bar support.

The two ¾in. square members in each side of the nose forward of the heavy undercarriage member can next be fitted.

These struts, if they are straight, will tend to draw the curved side ply flat, giving an unsightly appearance. To avoid this, the struts should be curved to match the side, the degree of bowing being about 1½in. at the middle. Either steam the struts on the bench, or make each strut out of two pieces of ⅜in. × ¾in., laminating them together on the job and packing them out against the side ply from the centre.

The primary structure of the fuselage may now be completed by gluing in the 6in. long ash block at the tail end which takes the tail-wheel leaf-spring and temporarily fitting the tailplane table. This is of 1/16in. plywood supported at the stern post by ⅜in. × ¾in. spruce cross member between the longerons.

Metal Fittings

The next step in making the fuselage is to complete all the metal parts shown on Sheet 3 of the plans, the engine bulkhead fittings on Sheet 11 and the wing pylon fittings on Sheet 10.

Some of these parts are made from steel tubing and a few basic points relating to tube work should be understood.

To mark the diameter across the end of a tube, make the simple tool shown in Fig. 36. This can be used to mark the centre on tubes or bars between ½in. and 2in. in diameter by sliding the tool along the end of the tube. The bisector then allows the marking of the diameter.

The diameter of tubing can be measured by clamping it lightly between the smooth jaws of the vice and measuring the distance across the jaws next to the tube with a rule. Alternatively, of course, use a caliper rule.

If the tube be clamped horizontally in the vice so that its top edge is flush with a straightedge placed across the jaws, a centre-line may be drawn on the tube using a rule and scriber.

Where a relatively long tube is being worked at each end, complete one end first and then insert a long bolt or steel rod through any bolt hole in the finished end. This can then be sighted on from the other end using an engineer's square to ensure perfect alignment of the two ends.

Next month's instalment continues with the construction of metal fittings and carries on with the rear decking, etc.

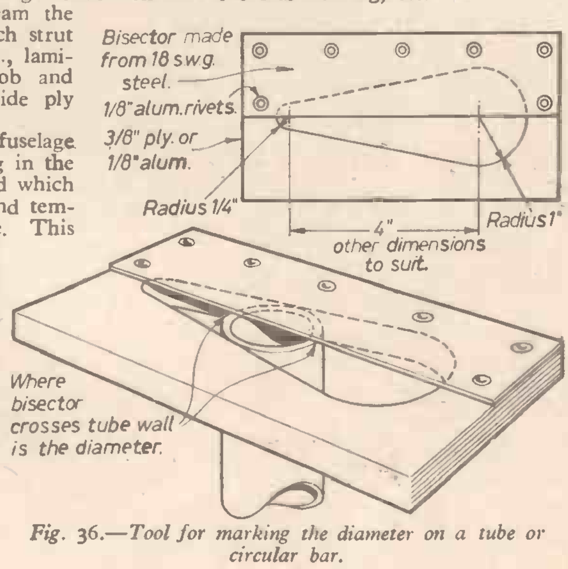


Fig. 36.—*Tool for marking the diameter on a tube or circular bar.*

A TWO-SEATER TOBOGGAN

(Concluded from page 152)

For a really first-class job the chassis now requires a coat of red oxide paint—you cannot leave this until the frame is assembled because the top surfaces of the chassis are not treated, and though the mill scale does to some extent act as a rust barrier, a full protection is not obtained unless a coat of paint is added. Treat all surfaces except the runner surfaces to two coats, as this paint dries fairly quickly.

Assembly

Offer the wood side members to the chassis and mark out the position where the holes for securing them will appear. Drill these to clear the bolts—note the bolt head must not come above the surface of the wood; so counterbore a hole for a distance into the wood which will allow the bolt head to come well below the top surface, before drilling the clearing hole through the remainder of the timber. If this is not performed first, the subsequent counterboring process is awkward as there is no material to act as a pilot for the drill bit.

Having drilled the wood, offer each member to the chassis and drill through the steel using a twist drill on this occasion. Some degree of pressure is required but the addition of a few drips of water will ease the cutting pressure and make the chippings come away much more easily. An electric drill will naturally make short work of this operation but remember to centre punch the steel beforehand. Put a washer under each bolt head and nut and tighten them securely. The addition of these washers will to some extent overcome the tendency for the bolt head to dig into the timber, and make a secure fitting. Hard wood is thus best as suggested earlier, but properly tightened, the bolts will not come loose. Burring over the threads is a wise precaution.

The cross bar on which to rest the feet is added last and the ends are shaped to make a hand grip when laying prone on the seat. This detail is omitted from Fig. 2 showing the end view of the toboggan.

A final painting of the woodwork completes this work—a red chassis with yellow wood gives a gay appearance and it makes the toboggan look professionally made.

Lengthening of the chassis is possible if the family needs make this essential. An extra pair of stays in the centre will be needed with perhaps the exclusion of the low cross brace, but do not make the toboggan too long as this means more effort when pulling it back to the starting point. Sit the family on the dining-room floor close together with legs tucked in and take any necessary measurements before proceeding with construction.

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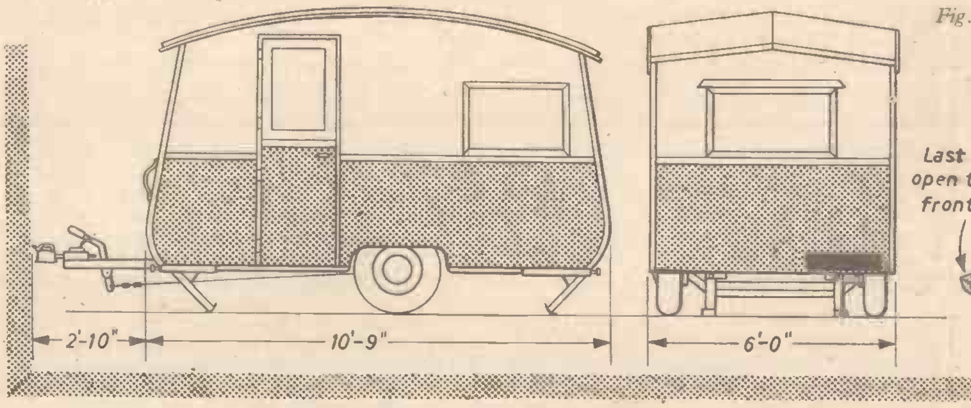
AFTER an initial "bedding-down" run of about 150 miles, this van accomplished well over 1,200 miles of touring during August, 1958. This included negotiating the usual bumpy sites, longish runs over granite setts and very much second-class roads. Nothing was shirked in an effort to find weaknesses, but, apart from a little easily-cured trouble due to under-springing, and a puncture, the longer journeys were quite uneventful. The van towed well, and most of the time was hardly noticeable behind the car, an early Vauxhall Wyvern.

In general the construction is orthodox, although the wooden mainbearers are no longer in commercial fashion in these days of cheap rolled channel-steel; however, they were chosen here to save weight and to facilitate home construction.

Although throughout the accent is on ease of construction, careless and shoddy work is inadmissible; a faulty joint or loose screw may well spell danger and disaster to the driver and other road users. A high degree of skilful craftsmanship is not necessary, ordinary careful work being quite enough, but the home builder who is doubtful of his work on any point will do well to consult a tradesman, particularly over the road-worthiness of the undercart.

So far as the woodwork is concerned only two joints—the halving joint and the plain mortise-and-tenon joint—are needed. An hour or so spent in practising these in scrap timber will be well worth while. (See Fig. 8.)



Most of the metalwork consists of cutting angle-iron, drilling it, and bolting it together ready for welding. Such welding as there is should be carried out by a competent engineer.

Proprietary parts have been kept to a minimum so far as possible in order to keep costs down. Apart from small fittings of a general ironmongery order only the corner-jacks and the all-important ball towing-hitch must be purchased. If expense is no object, then such items as proprietary window frames, sink-unit and Calor-gas fitting will save time and improve the van quite a lot. However, some modification of the plans shown here will be necessary to accommodate the stock sizes of such fitments; they should thus be carefully thought about before building begins. Indeed, an intensive study of caravan periodicals and accessories catalogues is an essential preliminary to any caravanning venture.

There is some prejudice against "non-proprietary" or "home-built" vans, as so many of these are badly designed and worse constructed.

Many site-operators forbid such vans entirely, whilst others insist on a superficial inspection. It is as well, therefore, to ensure that only the best is good enough, so far as outward appearance is concerned.

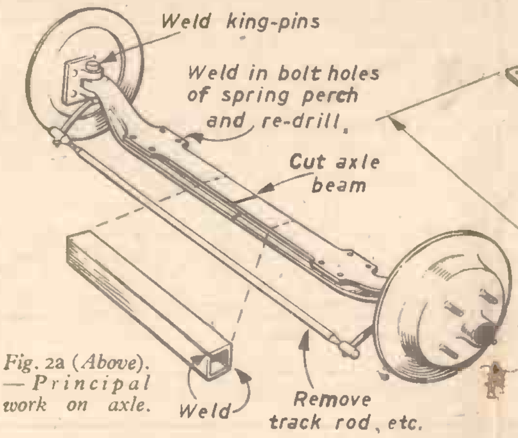


Fig. 2a (Above).—Principal work on axle.

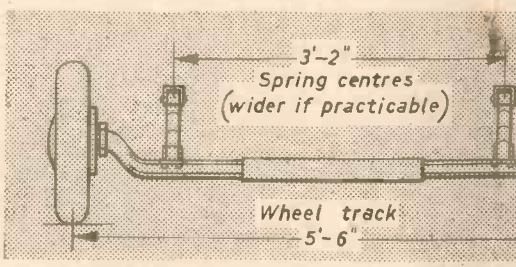


Fig. 2b.—The caravan under-gear.

GENERAL SPECIFICATION

BODY LENGTH - 10 FT. 9 IN.
OVERALL LENGTH 13 FT. 7 IN.
WIDTH - - - 6 FT. 0 IN.
OVERALL HEIGHT - 7 FT. 10 IN.
MAXIMUM HEADROOM - 6 FT. 2 IN.
WEIGHT: 9¾ CWT. IN TOURING TRIM FOR 2 ADULTS, 1 CHILD. NO CALOR GAS EQUIPMENT.
NOSE WEIGHT: BY ESTIMATION ABOUT 1 CWT.
SUGGESTED LAY-OUT: DINETTE/DOUBLE BERTH; CENTRE KITCHEN; SINGLE BERTH AT DOOR-END, OPTIONAL LIGHT BUNK ABOVE.

OWN
rth Caravan

By H. C. Piggin

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The Axle and Wheels

Only sound work will suffice in the chassis. A poorly made chassis will, apart from being a possible danger on the road, be a constant source of trouble in towing, leading to all sorts of misbehaviour on the part of the van, which makes driving sheer hard work all the time.

Some home constructors may prefer to save time by purchasing a ready-built chassis, but this will run to considerable expense. (£30 to £40 on the price quoted.)

The wheels of the caravan described here were adapted for about £7 from an old car front axle, as follows. First, all extra metal in the form of track-rod, shock absorbers, etc., is removed. The wheels are then lined up with a very slight toe-in, and the king-pins are welded-up solid.

The axle is then cut in the middle and extended to give a track between tyre centres of 5ft. 6in., by boxing across the centre with two pieces of angle-iron welded together and to the axle ends. (Fig. 2a.)

For steady, stable towing a wide wheelbase is necessary, with as great a distance as possible between the springs to avoid "top-roll." (Fig. 2b.)

The Springs

These are removed and stripped. They should be cleaned, reset and rebuilt with an extra leaf or two to a total of 9in. × 3/16in. The longer the springs the better.

As they are usually set at an angle on car front wheels, the old bolt holes on the perches should be welded-in, and new holes drilled so as to line up the springs at right-angles to the axle. The minimum distance between the springs should be 3ft. 2in. If the spring perches can be shifted wider apart it is certainly desirable to do so, but this may not be possible on cranked axles.

On straight axles the springs can be re-attached below the axle (underslung), so that a few inches of height reduction are obtained. A low centre-of-gravity is useful for stable towing.

It will be as well to strip and regrease the wheel-bearings and to attend to the brakes (which should be of the cable-operated kind) to see that the linings are good and the action free in operation.

Tyres need not be new, but should certainly not be smooth. In spite of rumours to the contrary, caravans do get punctures and bursts, and as no "spare" is carried as a rule, such mishaps can be embarrassing and involve considerable delay!

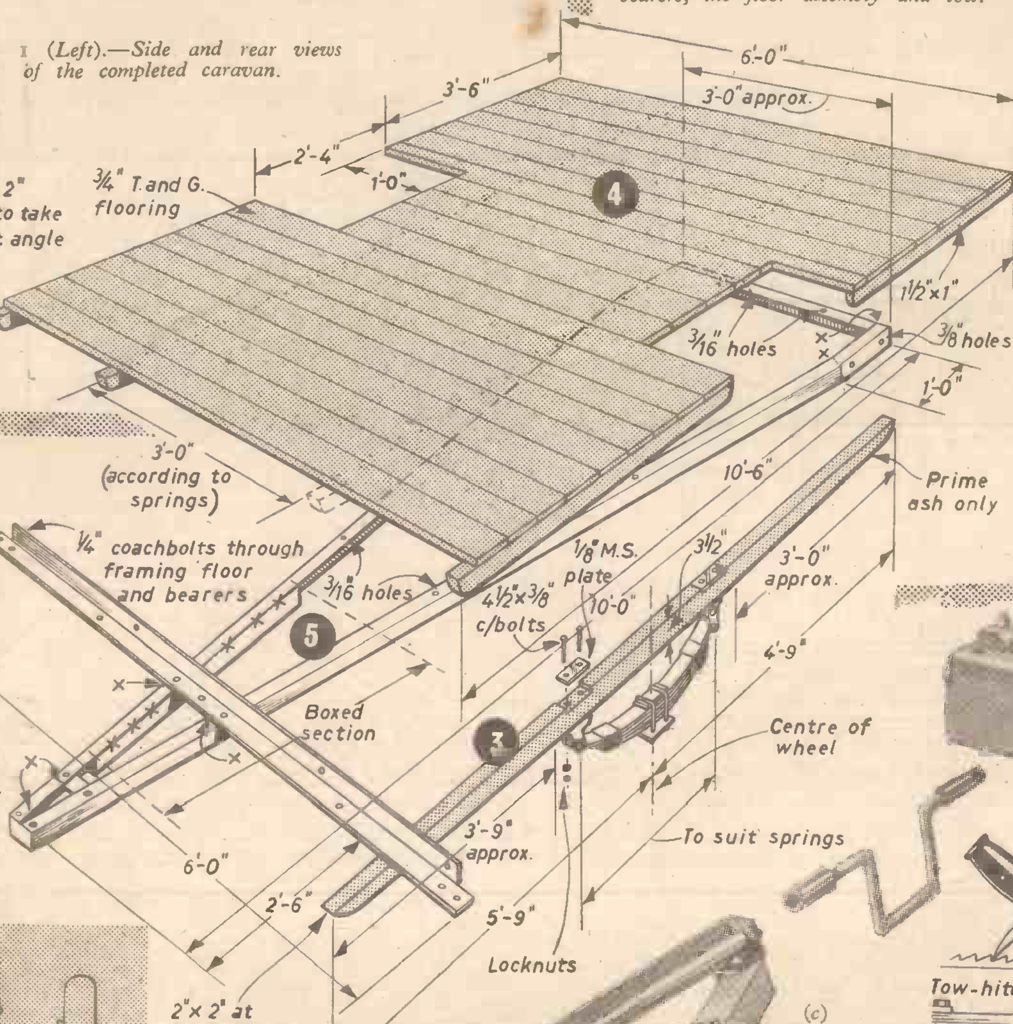
The axle and brake drums can be smartened up with a coat of bitumen paint, and the springs can be sprayed with penetrating oil.

Main Chassis Bearers

These consist of two 10ft. 6in. lengths of 3½in. × 2in. straight-grained prime ash. They must be free of all knots and blemishes, and it is worth paying a little extra to get the best timber. The size given is quite the minimum, and due allowance for planing must be added.

After shaping, the bearers are bolted on to the springs, using ⅜in. dia. coachbolts with extra nuts as locknuts. (Fig. 3.) It is important to mount the rear scroll with its shackle high, remembering that it will settle under load. The bearers should be parallel to each other, and should be braced apart until the flooring is secured. They should also be levelled and supported on blocks until this is done.

Figs. 3, 4 and 5.—Details of the main bearers, the floor assembly and tow.



1 (Left).—Side and rear views of the completed caravan.

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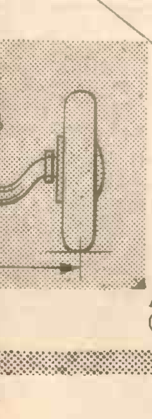


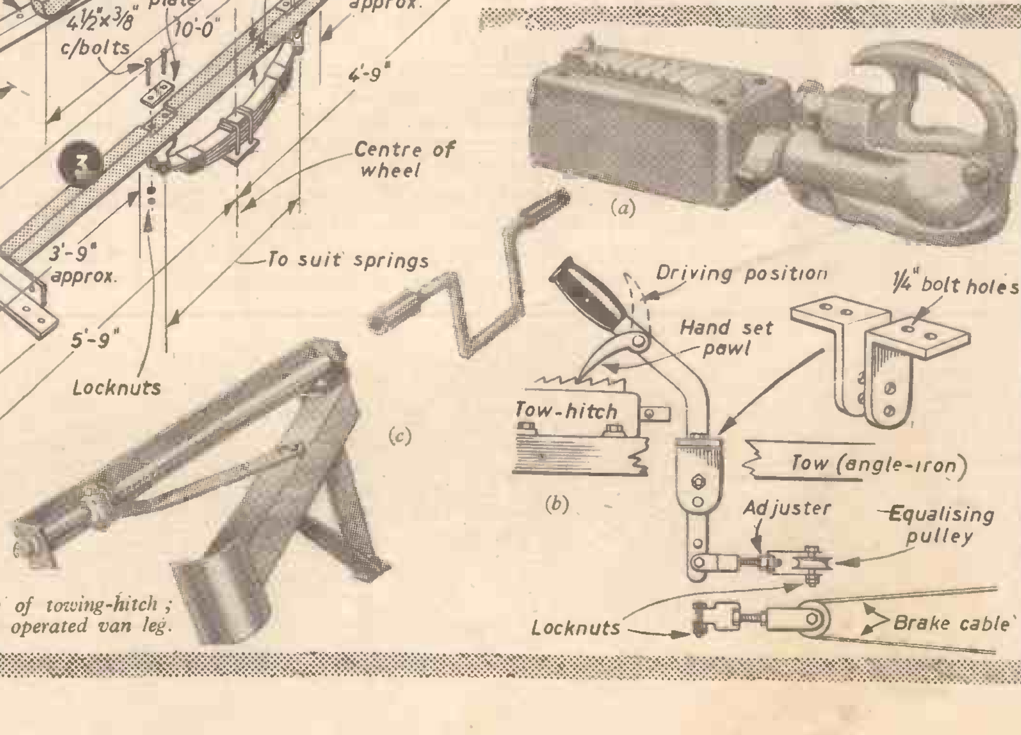
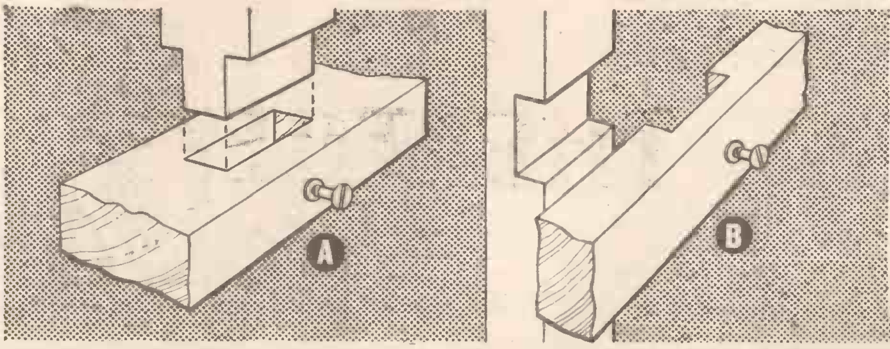


Fig. 6.—(a) "Ball" type of towing-hitch; (b) Hand brake; (c) Brace operated van leg.



dry (Fig. 7). Up to a week may be required to achieve the desired curve. It is important that all ten bends must match up, and as they are made they should be lashed together and stored carefully on end until required.

Except for the spacing of the upright to allow for the door, both side frames are identical.

It is as well to cut all timber to length and number each piece as indicated in Fig. 9a. Then all parts which are to be of the same dimensions can be placed together

Fig. 8 (*a above, left*). —*A simple through mortise-and-tenon and* (*b*) *cross-halving.*

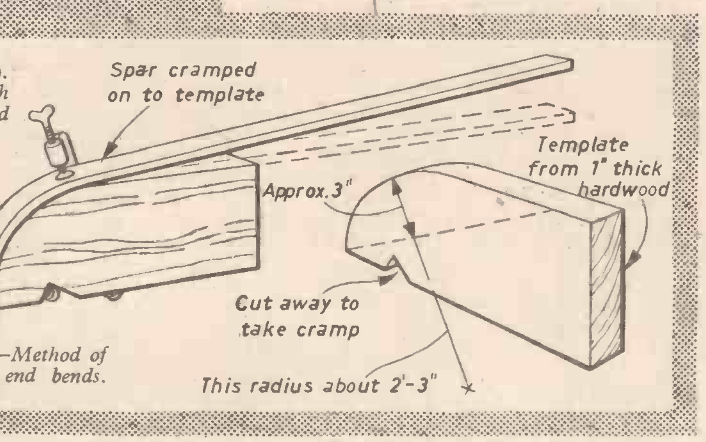


Fig. 7.—Method of making end bends.

The Floor

In this design the floor is an integral part of the chassis. It consists of ¾in. thick tongued-and-grooved deal boards, screwed on to the ash bearers with 1½in. No. 9 steel screws. The boards must be pulled up tight together, and the screws inserted diagonally staggered, not in straight rows. (Fig. 4.)

When all the flooring has been fitted according to plan, the ends of the floorboards should be levelled and the 1½in. × 1in. outrigger supports glued and screwed up tight under the ends of the boards.

At this stage, the complete floor and axle can be fairly easily man-handled by four or five men. It should be turned over for ease of fitting the ironwork—tow and corner-

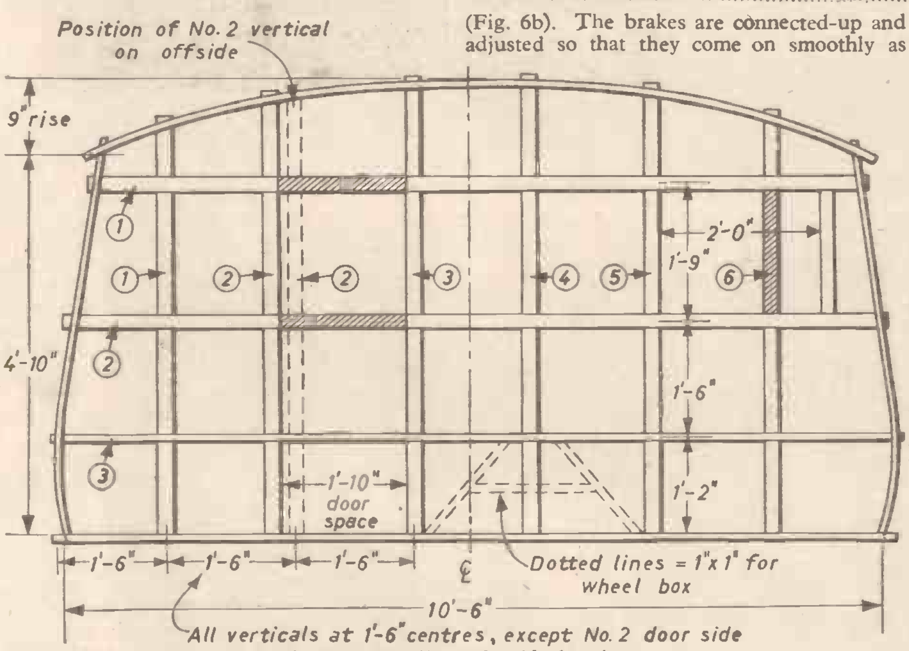


Fig. 9a.—Details of the side framing.

jacks (Fig. 5). At this point, too, the opportunity should be taken to apply several coats of bitumen paint to the underneath parts.

With the floor right way up, it can be levelled on its jacks to await the mounting of the bodywork frames.

The tow-hitch is bolted on to the towing-bar with high-tensile bolts. These should be pulled up a little at a time, checking the over-ride action occasionally to see that it remains free. If one bolt is overtightened it is possible to warp the casing of the hitch and so cause the action to bind (see Fig. 6a).

The position of the brake-lever is fairly critical, and should be checked carefully (Fig. 6b). The brakes are connected-up and adjusted so that they come on smoothly as the over-ride is forced back. Final adjustment is best left until the van is ready for the road. The brakes should never lock the wheels completely on the over-ride but, of course, they must be fully applied on hand-pull.

Body Frames

All body frames are built from prime ash. The joints consist mainly of straightforward mortise-and-tenons at "T"-junctions, and cross-halvings at "through" points. All are glued with a waterproof resin glue, and secured additionally with a ¾in. long No. 8 countersunk steel screw.

The end bends are made by soaking suitable lengths of timber in a water-butt for at least 48 hours. Each is then cramped on to a 1in. thick oak board shaped to the required curve, and is left to

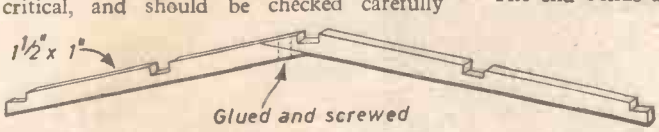


Fig. 10.—Splicing rafters to suit slope of end frame headboards.

and marked-out in one operation, thus ensuring identical accuracy for all floor and middle lengths, uprights, corner bends, etc.

Note that the corner bends are fitted into mortises cut at the necessary angle in the floor-lengths; the surplus is removed after fixing, which is easier than trying to cut true "bridle" joints as such.

Assemble all joints temporarily to check their fit and the truth of the whole framing. Then check the side frames together to see that they are identical and quite flat.

The end frames shown in Fig. 9b present little difficulty. Again, every care must be taken to ensure that they are identical with each other.

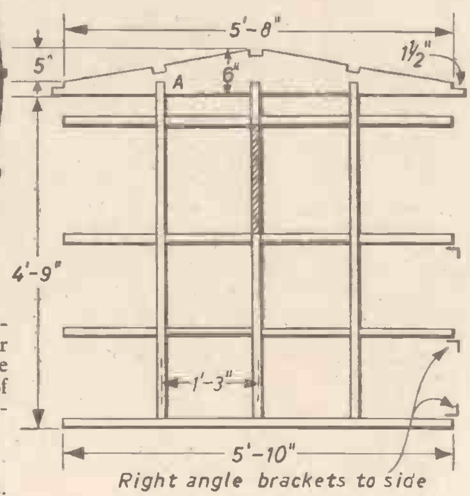


Fig. 9b.—The end frame.

Assembly of Frames on to Floor

The completed side frames are coach-bolted into position on the floor edge; the ¼in. bolts, of course, pass right through the end supports under the floorboards. The frames will require strutting temporarily to prevent them from waving about.

The end frames are similarly bolted down.

The next instalment will complete construction of the body and deal with the interior and exterior fittings.

(*To be continued*)

A PORTABLE MARIONETTE THEATRE

In Part 2, F. Hook Gives Concluding Constructional Details and Deals with Lighting and Electrical Items

THREE bridge supports are required each being a 4ft. 6in. length of 2in. × 1in. deal, as shown in Fig. 13. At the bottom ends two holes are drilled to take the ¼in. bolts holding them to the towers. At the top ends of the supports two holes are drilled through the width of the timber, through which bolts pass to hold the leaning rail in position. The top rear corners are rounded for the convenience of the operators when leaning over the rail. This can be seen in Fig. 14. Sharp or rough corners can be very trying to the puppet operator The leaning rail is 6ft. 6in. in length and of 2in. × 1in. timber and is bolted to the top front edges of the support rails.

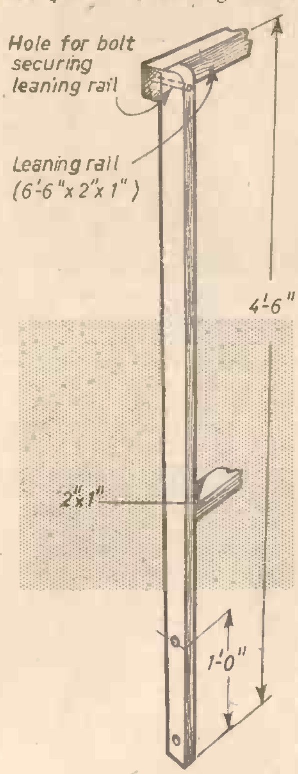


Fig. 13.—The leaning rail support.

When the floors are in position on the towers a few holes are drilled in each floor portion and through the rails supporting the floor. Into these holes are dropped ¼in. bolts which need not have nuts to them as the bolts merely act as locating pegs for positioning purposes and prevent the frames from moving sideways when the operators walk about on the floors.

Back Cloth

The back cloth is hung from the leaning rail. For general use in variety type acts some neutral coloured material hung in loose folds is very effective in conjunction with coloured lighting. These curtains may be supported on a ½in. brass curtain rod or the expanding type curtain rods and the rods are supported on stout hooks screwed into the leaning rail.

The two wing curtains are made from similar material. These two curtains are supported upon a special scissors-type expanding support, the construction of which is shown in Fig. 15. And in use on the stage in Fig. 16.

The object of the expanding device is that the curtains may quickly be pushed together out of the way for scene-shifting between acts.

When a special painted scene is required on the back cloth such scenes are painted on unbleached calico. This is tacked on to a wooden roller or batten which can be supported on the curtain support hooks on the leaning rail. When finished with, the scene can be rolled up round the batten. Generally speaking, the lower side of the back cloth scenes may be just hemmed for neatness sake and no batten is needed to keep it stiff.

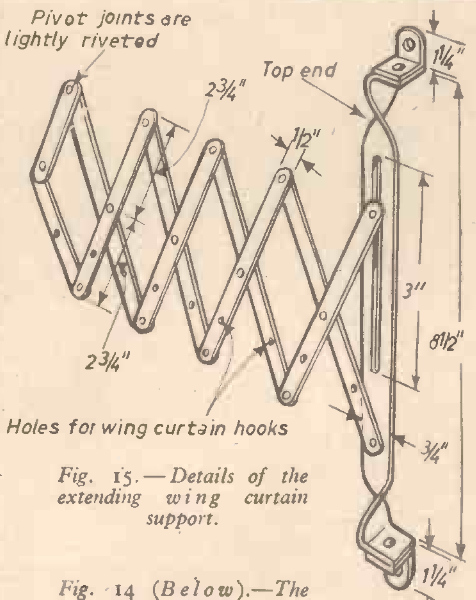
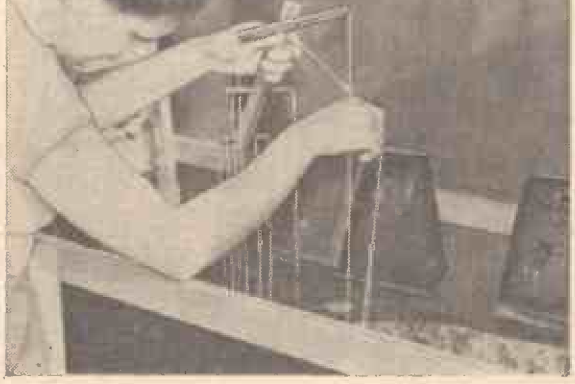


Fig. 15.—Details of the extending wing curtain support.

Fig. 14 (Below).—The leaning rail in use.



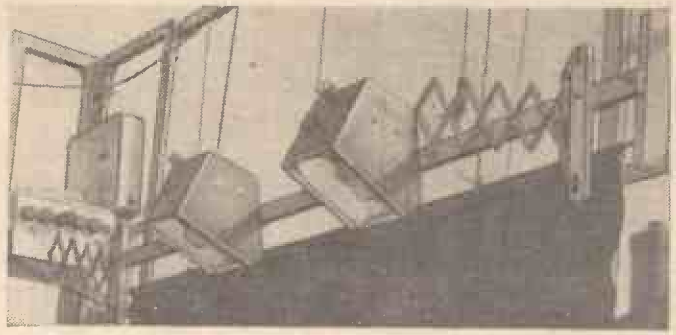


Fig. 16.—The extending wing curtain support in use.

Proscenium Curtain and Fitments

There are many forms of proscenium curtain arrangements but that shown in Fig. 17 has much to commend it for use on the puppet stage. It consists of a piece of thin felt supported on a ½in. dia. curtain rod. The front side of the curtain may be decorated with various coloured braids in any of the traditional or other forms of decoration.

The curtain rail is supported by two pieces of blind cord which have hooks at their upper ends to hang on to the curtain support rail, bolted to the top of the two front towers (Fig. 18).

For raising and lowering the proscenium curtain two more pieces of blind cord are tied to the curtain rail and carried up over two small pulley blocks which are attached loosely by screw hooks to the curtain support rail. The ends of these cords pass along to the left of the stage and just after they pass the left-hand pulley block they are spliced into a single cord which then continues to the outside of the front tower and then passes backwards towards the rear of the stage over another pulley block.

To the top of the tower, and protruding towards the rear of the stage is a support bar 3ft. in length. At the extreme end of this bar, at the back, another pulley block is fixed through which the curtain cord passes and then hangs downwards. To the end of the cord is attached a counterweight made from part of an old sash window weight. Some experiment will be necessary in order to determine its correct weight so that the weight of the curtain is just balanced. In other words, the proscenium curtain will stay in any position required as the counterweight is raised or lowered.

The Gallows

Sometimes it is necessary to have some convenient device to support marionettes on the

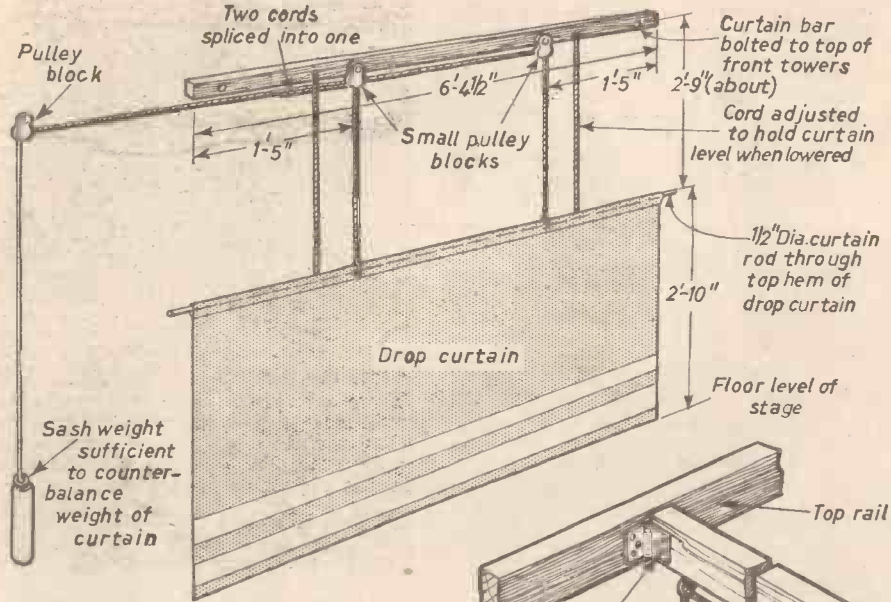
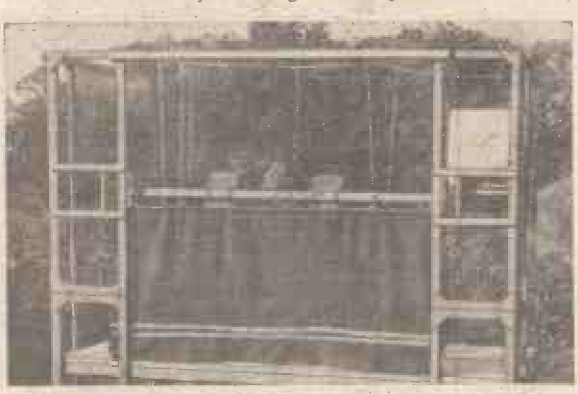


Fig. 17.—Details of the curtain raising and lowering mechanism.

stage as if they are in fact being held by the operator. Such a device is called a gallows. This comprises a length of wood about 18in. × 1½in. × ½in. which is secured to the curtain support rail by a 1½in. back-flap hinge.

Along the lower edge of this gallows are one or two screw eyes through which passes



a piece of blind cord (Fig. 19). At the end nearest to the operator the cord is finished in a loop into which the cuphook at the top of the control sticks may be hooked. At the hinged end a piece of lead piping is attached. This counterweight is approximately equal to the weight of a puppet. The weight is not critical if friction is arranged for the cord by slightly twisting the screw eyes through which the cord passes so that the cord does not have a free run.

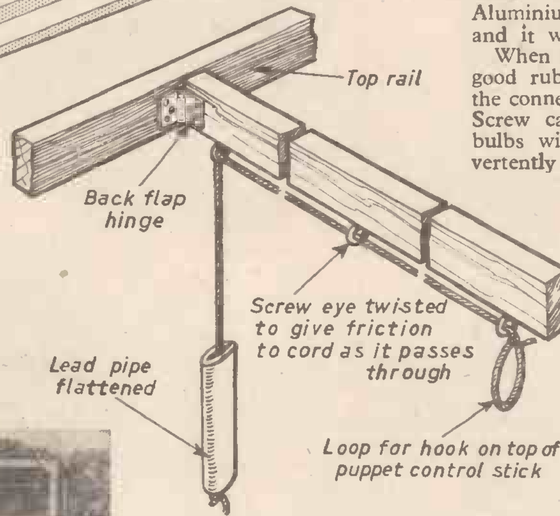


Fig. 19.—Details of the gallows for supporting the puppets when not in use.

Fig. 18 (Left).—General curtain and proscenium arrangement.

Two of these gallows will usually be sufficient for most practical purposes and each is secured a little off centre of the stage to left and right.

Lighting

Stage lighting can be quite complicated but like most other arrangements for the puppet stage, the simplest things are best. For this reason the lighting for this stage has been successfully arranged with but two light boxes, as shown in Fig. 16. Each box has two metal loops on the back which enable the box to be moved from side to side along the lighting bar shown in Fig. 20.

Constructional details of the lighting boxes are given in Fig. 21. Almost any sheet metal may be used for the box construction. Aluminium is as good as any, being light, and it will not rust.

When connecting up the lamp holders use good rubber-covered flex and be sure that the connections are sound and well insulated. Screw cap bulbs are specified so that the bulbs will not be able to jump out inadvertently if the holders are jolted at any time. The bulbs used should be about 500-watt rating.

A refinement to the lamps would be to incorporate a switch on the body of each. Switches at these points are more easily reached by the operator than switches on the small switch board used on the stage and described later.

Arrangements are provided for the use of coloured slides in the lamp boxes.

The newcomer to the puppet stage may well query why there are no footlights for this stage. It must be remembered that the use of footlights on the real stage is to counteract the harsh shadows which are thrown by the strong overhead lighting. No overhead lighting is used on this stage as the light boxes described will project an oblique and well diffused area of light towards the puppets. If footlights were fitted they would have to project a little above the floor level

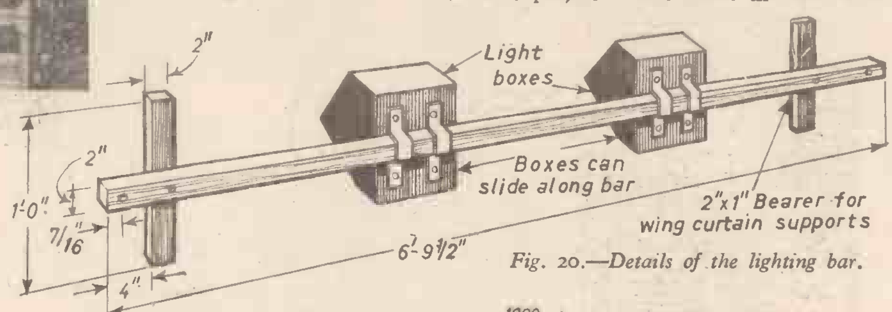


Fig. 20.—Details of the lighting bar.

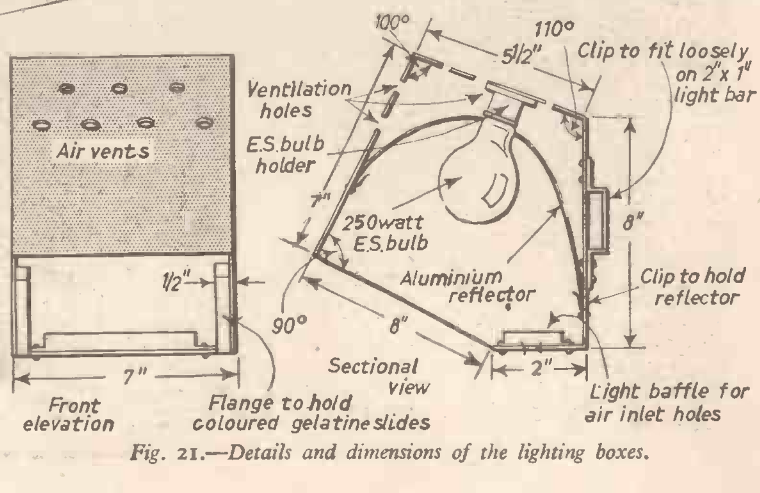


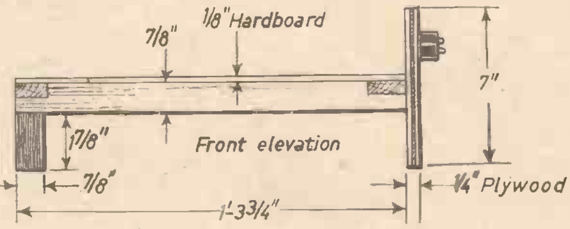
Fig. 21.—Details and dimensions of the lighting boxes.

of the stage and would thus obstruct the line of vision.

The Electric Distribution Board and Record Player Table

This unit is secured by wing nuts and bolts to the left-hand tower as shown in Fig. 22. The dimensions are given in Fig. 23.

The electric distribution board is of the simplest design. It comprises a male plug at one end to which the incoming mains supply is connected. To this plug is connected in parallel five 5-amp. two-pin sockets. Two of these sockets are used for the light boxes, one for the record player and the remaining two are useful for small lights over the puppet rack backstage and over the record player. These latter two lights must be shaded so that no shadows are projected towards the ceiling and other visible surfaces when the puppets or operators move about on the the stage during a performance.



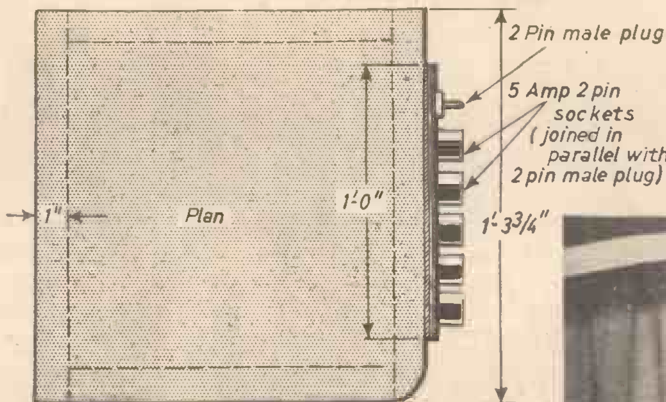


Fig. 23.—Dimensions of the record player table and electric supply board.

The Masking Curtains

Various materials may be used for the masking of the front of the stage. In the stage illustrated, a canvas was used and the proscenium opening was decorated with a contrasting braid. One important feature of this covering is that it must be opaque. The top edges of the covering can be secured to the top rails by large press studs such as are used for holding down carpets to the floor.

It is easier to have a separate piece of material for masking the lower part of the stage from stage floor level downwards.

The Puppet Hanging Rail

At the back of the stage the puppets are hung on a length of ½in. curtain rod when not in use as shown in Fig. 19. At either end this rail is supported by two pieces of 2in. × 1in. deal bolted to the sides of the two back towers. As there will be a considerable weight upon this rail when several puppets are hung, a central prop of 2in. × 1in. deal is a necessity.

In Fig. 24 the operator is shown putting away the marionettes at the end of the show. Each puppet has its own bag which is held in place with a draw string at the top, thus the marionette is prevented from becoming soiled when not in use.

A further refinement for the stage is to use a piece of thick white felt as a covering for the stage floor as shown in Fig. 25. The use of this felt is twofold. First, the puppets can walk on the stage floor without making undue noise which would be distracting to the audience. Secondly, the light from the two light boxes is reflected upwards from the floor by the felt to give added illumination to the puppet figures, and thus gives the effect of footlights.

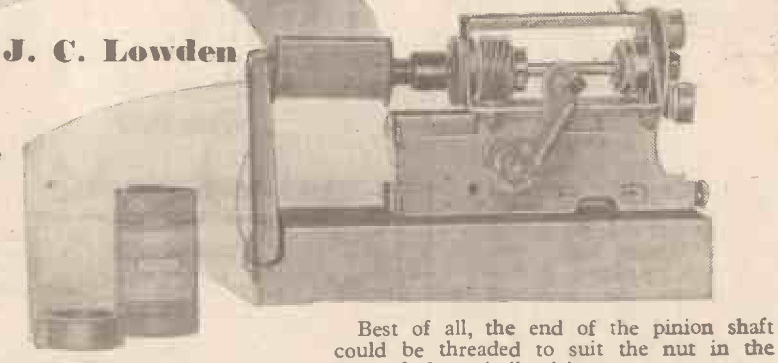
Fig. 24.—Store the puppets in bags when not in use.

Fig. 25 (Right).—A show in progress—note the felt floor covering.

Fig. 22.—The record player and table in position.

THE 35mm CASSETTE LOADER

By J. C. Lowden



(*Right*) *The completed cassette loader.*

This Model with 6-1 Geared Drive and Ball Bearing Movement Cost 6/- to Make

THE loader is constructed entirely from the mechanism of an ex/A.M. switch device containing a wormwheel and pinion drive marked 10 FB/556. This is sold as a unit by Messrs. Milligan, of Harford Street, Liverpool, who advertise in this journal, at a cost of 4s. 6d. plus postage.

The unit should be stripped down to the condition shown in Fig. 1. The only modification to the actual gearing is the drilling of a small hole in the base plate immediately under the revolving "governors." This hole is to accept a woodscrew to secure the gearing to the baseboard. Two holes will be found ready drilled in the other end of the baseplate for the other screws.

The Handle

On each end of the pinion shaft will be found collars secured by grubscrews. Strip down any one of these. A piece of scrap metal may be screwed on to the faceplate of the collar as shown in Fig. 2. At the other end of the scrap of metal a hole is drilled to accept one of the several longer bolts salvaged. One nut is screwed on to the bolt, the end of the thread passed through the hole, and the bolt secured by a second nut. For comfort and finish a sleeve of wood, plastic, or bright metal may be slipped over the handle grip. The handle is secured to the pinion shaft by the grubscrews on the collar. A radio control knob can be fitted instead of the built-up handle.

The Spindle Drive

On the top of the main unit will be found a tiny box marked 10PB/6027. Inside this box are two shouldered rods of black plastic, screwed to the wall of the box. Disengage any one of these rods and strip off the fine wire coil, clearing away the terminals. Reduce the length of the rod, by sawing, to 1in., taking from the thinner end. Across the diameter of the sawn end file or saw a transverse groove ⅛in. wide and just under ¼in. deep (see Fig. 3). This groove is to accept the key in the cassette spindle.

At the broader end of the plastic rod a brass nut is embedded. The hole in the nut should be drilled out to make the rod a "push fit" on to the end of the pinion shaft. If the hole is too large, drill a hole in the plastic of the shoulder slightly smaller in diameter than one of the screws salvaged during the stripping. Driven gently, the screw will cut its own thread in the soft plastic, and will secure the spindle drive to the shaft.

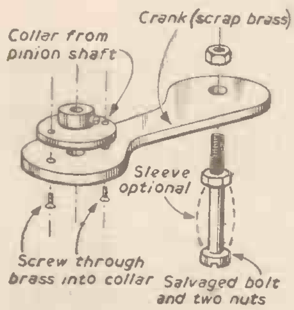


Fig. 2.—Handle assembly.

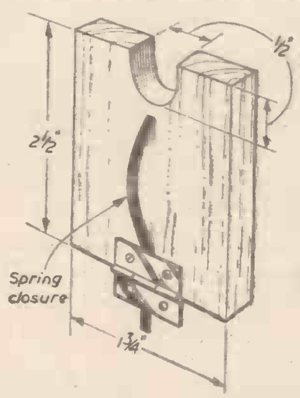


Fig. 4. — The spindle support.

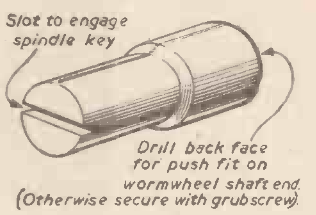


Fig. 3 (Left).—The spindle drive.

Best of all, the end of the pinion shaft could be threaded to suit the nut in the base of the spindle drive.

The Baseboard

The baseboard is a single piece of any timber 5½in. long × 1¾in. wide of any thickness between ½in. and 1in. A "step" ⅜in. deep × ¼in. wide is sawn in one end of the baseboard. The gearing is screwed to the board so that the securing lugs at the governor end are at the end of the board.

The Spindle Support

This is a piece of hardwood 2½in. long × 1¾in. wide × ¼in. thick. One corner of the lower edge may be rounded off. A "U" shaped recess is cut as shown in Fig. 4 to accept the lower end of the cassette spindle, which must revolve freely within the recess. The interior surface of the recess must be smooth.

The spindle support is secured to the baseboard as shown in Fig. 5, by a small brass hinge 1in. × ¼in. flap, and held upright under slight pressure by a short length of light clock spring held in a recess under both flaps of the hinge.

The loader must, in use, be secured to a table or bench top.

Loading the Film

Cut off the required length from the bulk supply and secure one end of the film to the cassette spindle, which should then be set on the loader by pressing back the support, placing the keyed end of the spindle on to the drive, and fitting the lower end of the spindle into the recess in the spindle support.

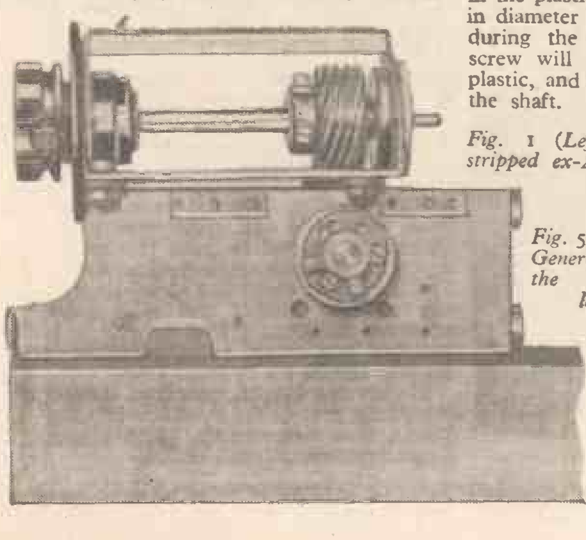


Fig. 1 (Left). — The stripped ex-A.M. unit.

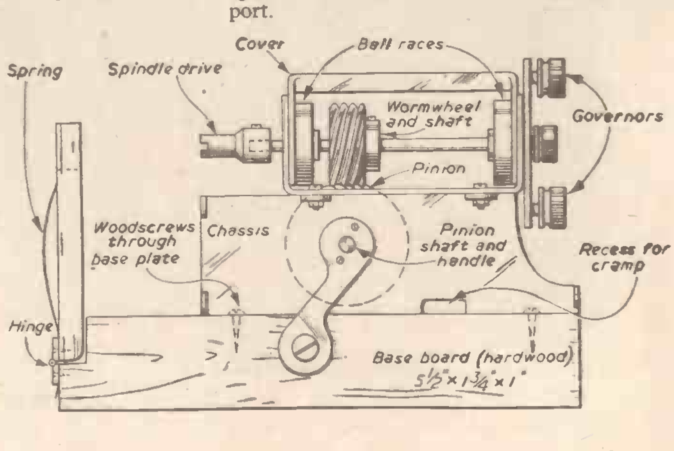
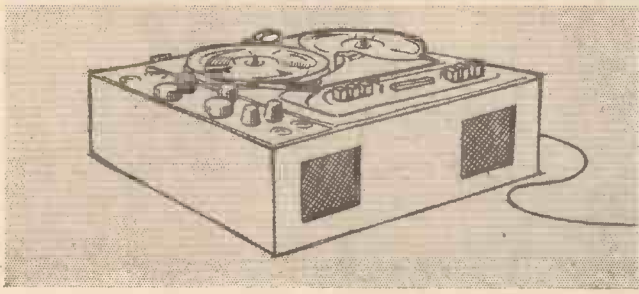


Fig. 5 (Right).—General layout of the completed loader.

Building a Tape Recorder



PART 4
(Conclusion)

Continued from the December Issue

By
S. A. KNIGHT

ON most of the wiring diagrams in this series of articles, no heater wiring has been given as this would only tend to confuse the drawings. One side of the heater on all valves is earthed (shown), and with the exception of V1 the other heater pin is returned to the 6.3-volt A.C. line through pin 1 of Plug "D." The D.C. heater rail to V1 (pin 5 on the valveholder) returns through pin 2 on Plug "D." If no D.C. rail is used, the valve is, of course, lit from the normal heater line. Fig. 20 gives the valve basings and the heater runs.

Assembly

With the wiring of the various amplifier units now completed, they may be assembled on to the back plate as shown previously in Fig. 13. The mid-amplifier, the two small panels with VR3, VR1, SW2 and C10a-b, respectively and the pre-amplifier just described are first screwed into position, and inter-wiring completed. This latter consists mainly of the heater and H.T. line runs, and leads to C10 and the above mentioned switch and potentiometers. A tag strip mounted on the end of the mid-amplifier chassis is useful as an anchor for the incoming power leads from Plug "D," and this can be seen from Fig. 11.

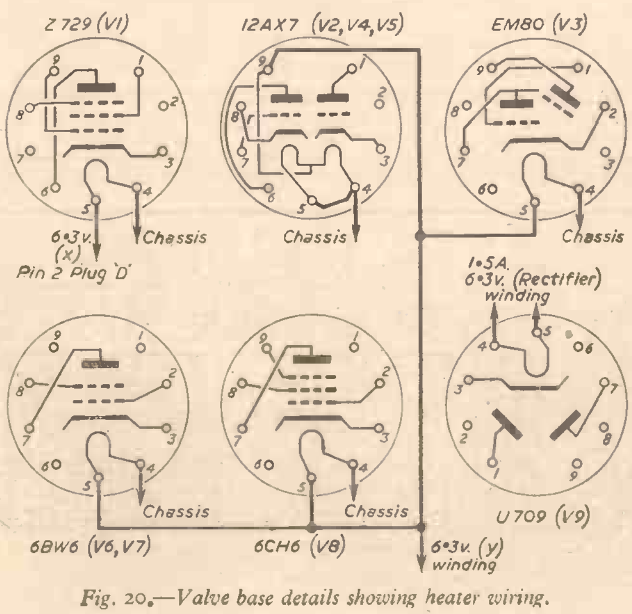


Fig. 20.—Valve base details showing heater wiring.

With this wiring completed, the control panel must be fitted and wired down to the remainder of the circuitry. The magic-eye level indicator should already be in position with its associated components grouped around its base as Fig. 16 showed previously, and the input jacks and switching should be similarly wired. The panel can now be carefully positioned, care being taken to ensure that the various jacks and switching clear the components on the upper part of the pre-amplifier chassis already fitted. All inter-wiring may now be completed, particular care being taken to ensure that the leads to S1 wiper (from socket "A"), the earth return to the tag on V1 holder, and the leads to VR1 are of minimum length.

When everything has been wired, the whole circuit should be checked as far as possible, against the circuit diagram of Fig. 1, particularly with regard to the interconnections between the units.

The extension spindles may now be fitted where necessary, and knobs fitted to the panel, being set to indicate correctly against the scale markings with regard to their travel limits.

Alternative Output

As so far described, the output stage consists of a pair of 6BW6 pentodes strapped as triodes in a push-pull circuit. This arrangement gives an output of about 4 watts under the specified conditions, and for almost all purposes this is quite adequate. Should rather more output be required, however, a slight circuit modification will permit some 7 watts output to be obtained. The change necessary involves the substitution of R39 on the mid-amplifier chassis with a series combination of 2.2 KΩ and 220Ω as shown in Fig. 21, the tapping point being returned to the output transformer secondary winding to provide negative feedback. Pin 3 on Socket "C" may be used again here, of course.

The output valves are also wired as tetrodes instead of triodes, the change being indicated in Fig. 21. The screen stopper resistors of 47Ω are optional, but are recommended. They *must* be wired close to the valve pins if used.

If the secondary of the output transformer is wired in the wrong phase, the amplifier will oscillate, i.e., will "howl." If this occurs, reverse the secondary connections.

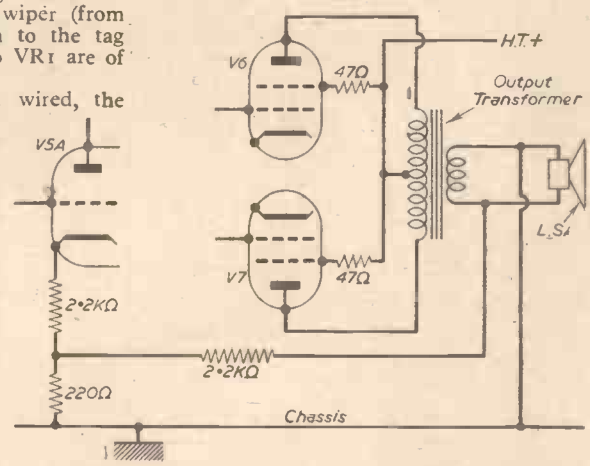


Fig. 21.—Modification to obtain 7 watts output.

Testing

With all assembly and wiring completed, the recorder may now be tested. No elaborate test equipment is called for in this respect, and the whole operation can, in fact, take place without instruments of any kind. It is useful, however, if a good multimeter is available, and this should be considered a minimum requirement.

With the wiring double-checked against errors, plug in the various inter-connections, ensuring that the correct valves are in place, and set the mains input tapping on the transformer to suit the local supply. The output transformer should already have been connected to suit the loudspeaker impedance; this will normally be a nominal 3Ω, and the ratio needed to match the required 4,500Ω of the *triode* connected output valves is about 40 to 1. Using the A, C and E tags as the primary points on the Elstone MR7 transformer (C being the centre tap), the secondary tags are selected to suit the speaker impedance from the list of ratios supplied by the manufacturers. Where a required ratio falls between two possible selections choose the higher of the two, for preference. The speaker (which is separate in this design) should be jacked into the appropriate socket.

The unit may now be switched on, and assuming no wiring errors, voltage checks should be made against the table given in the centre column. The tape deck itself should be switched to Record (either track), otherwise no voltages should be present on the bias oscillator. The figures given are as read with a meter of 1,000Ω per volt on the original design; some slight differences will inevitably be found from model to model, but the general readings should be of the order given, and a 10 per cent. difference either way should not be considered indicative of a fault.

Using the Recorder

For recording from microphone, either a condenser type such as the Grundig GCM1 or a crystal type such as the Acos (various patterns) may be used. The condenser microphone generally gives the better performance for recordings made from a table top, but the crystal may be found more adaptable for recordings where the operation involves movement.

For recording, set the selector switch S_1 to suit the input jack used, switch the recorder itself to the appropriate track, and set switch S_2 to Monitor (if phones are to be used for monitoring the recording), or alternatively to Normal. If the microphone is in close proximity to the speaker on this latter switch setting, howling may result from acoustical feedback if volume control VR3 is too far advanced; in this case, set VR3 to zero. With the recorder running, a recording may now be made, using VR1 as the control, and working to the magic-eye indicator as recording level indicator.

When recording from radio or gramophone pick-up, use the appropriate input jack. A crystal pick-up may be wired directly to this input for re-recording discs. If a radio input is required, it is usual to take this from across the detector load in the receiver, but reasonably good results can be obtained by wiring into the receiver speech coil points. It is not good practice, apart from an emergency, to stand the microphone in front of the receiver and record from the speaker.

When playing back, the main control VR3 should be well advanced, the actual operational control of volume being provided by VR1. This avoids overload at the preamplifier. The preset control VR2 is normally set about one-half advanced, but if the main amplifier is overloaded by the preamplifier on playback (with VR3 at a maximum) this setting of VR2 must be reduced.

When used as a straight amplifier, switch S_2 is set to Amp. and a microphone (crystal) or pick-up may then be fed directly into the appropriate socket jack. When used in this way, the preamplifier is isolated, but VR1 is best set to zero to avoid any possibility of noise breakthrough.

The tone controls are, of course, set as required when tape is being played, or the main amplifier used as described above. The recording characteristics are automatically set in the preamplifier, and the tone controls have no effect on this.

Other Tests

No mention has been made so far about the setting of the cores in inductances L_2 and L_3. With no instruments it is not possible to make a check on these, but it is fairly safe to assume that L_3 is functioning correctly if good recordings can be made. Should this oscillator not be working, a very weak and distorted recording will be made. The frequency of operation of the bias oscillator stage V8 is not critical, and if the core is set to about mid position, no trouble should be experienced. More important is the wave shape, and if an oscilloscope can be obtained to check that the waveform is a good sinusoid (at the erase head point), this should be done. Normally, if the circuit components as specified are used and correctly wired, the circuit should function properly.

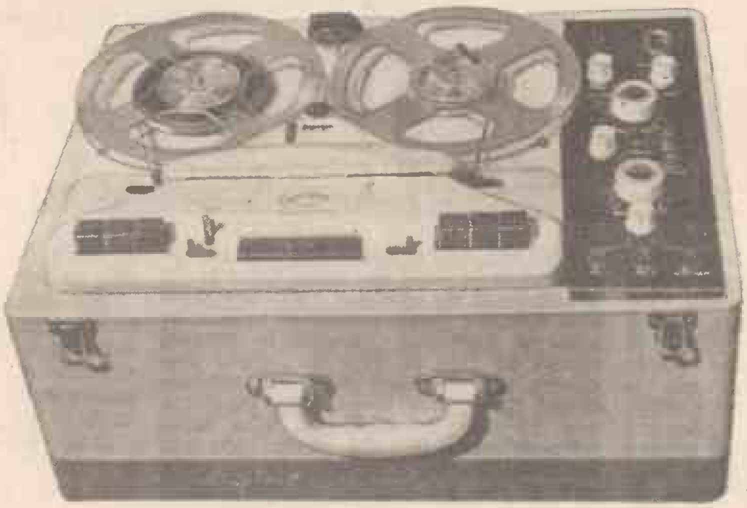


Fig. 22.—The completed recorder housed in a cabinet.

TABLE OF VOLTAGES		
Valve	Anode	Screen
V1	72	80
V2A	135	—
V2B	130	—
V3	190	(Target, from R24)
V4A	110	—
V4B	145	—
V5A	150	—
V5B	190	—
V6	240	240
V7	240	240
*V8	245	230

H.T. line voltage, rail A 255 volts
* On "Record" only.

Valve anode and H.T. rail voltages only are given. Heaters should be 6.3 volts for all valves ±7%.

To set L_2 calls for an oscilloscope. Connect this to the anode of V2B, and with the bias voltage disconnected from the record head (break the lead at the C lead in Fig. 2 previously given), tune L_2 core for a minimum bias waveform at the anode. The internal 'scope amplifier should be used here, and maximum sensitivity given. It may be necessary in some cases to increase C11 from 470pF to 1,000 or 1,500 to get the correct tuning point.

If no instruments are to hand, set the core of L_2 to mid position. Mistuning will not materially affect the performance of the recorder.

Cabinet Fitting

Fig. 22 shows the completed recorder housed in a cabinet. This cabinet was obtained from Premier Radio Co., but had to be modified slightly at the surround of the upper board to take the larger Collaro deck, being made originally, it is believed, for a Truvox type. This cabinet may or may not be still available and is an easy solution, although an internal speaker cannot be fitted on account of lack of space.

It is probably as cheap to make up a cabinet to suit the chassis layouts, and the design can then be made to suit individual taste. Polished wood or rexine cloth covering may be used. The photograph, however, should give an idea of the kind of layout to aim for.

Final Note

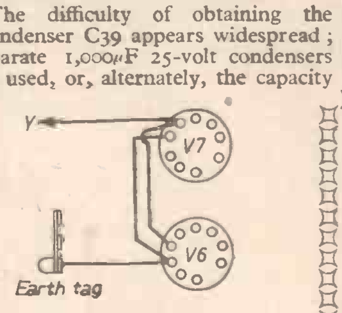
It should be appreciated that it is not possible to give full technical test data for this recorder in a series of constructional articles, and consequently the correct functioning must depend a lot on the care and attention given to construction. Again, a certain amount of common sense must be used when first trying the job out, for small wiring errors, poor joints, or faulty components can easily give trouble, and all possibilities cannot possibly be covered in print.

Sufficient to say that the recorder as described has been thoroughly tested, and gives good service in use.

Answers to Readers' Queries About This Design

1.—We regret that there was an error in the heater wiring shown in Fig. 9(c). This should be as sketched below.

2.—The difficulty of obtaining the BEC condenser C39 appears widespread; two separate 1,000μF 25-volt condensers may be used, or, alternately, the capacity may be dropped to 500μF if difficulty is still experienced. Messrs. Radio Clearance, of Tottenham Court Road, can supply the latter. For components not available from Messrs. T.R.S., the builder should contact Messrs. Alpha Radio, of Leeds, who can supply a kit.



Mountains of the Moon

(*Concluded from page 161*)

The Collapse Calderas

There exists, on the other hand, a different type of volcanic crater—the collapse caldera. A volcanic cone has a hollow base where a reservoir of lava occupies the so-called magmatic chamber. So long as the chamber is full it supports the cone above it, but if it is suddenly emptied of its contents, whether by a violent eruption or a fall in the level of lava, the cone tumbles in and a large cauldron or caldera (fr. the Portuguese for caldron) is the result (see Fig. 6). Such calderas are a feature of extinct or quiescent volcanoes and a large number of them are known in all parts of the world. In Tanganyika there is a whole row of huge calderas of lunar appearance, attaining in Ngorongoro a diameter of over 13 miles. In French West Africa there is a circular depression 36 miles in diameter. The longer diameters of the Japanese calderas, which are of irregular shape (nested calderas), attain 20 miles. This is not such a far cry from the lunar ring mountains or even bulwark plains.

Subterranean Movement

A subsidence, however, can result from a subterranean movement of molten magma even without a volcanic cone, though usually there is some volcanic activity associated with them. Magma may intrude the overlying strata in a boss resembling a mushroom, which the geologists call *laccolith*. This makes the ground heave up in a dome (domes are common on the Moon). The subsequent withdrawal of magma will cause the dome to collapse into a ringed hollow. Apart from laccoliths, there occur even larger thinner intrusions of magma, where it spreads out into a kind of basin between the strata. These *lopoliths* can be of enormous size. The Bushveld lopolith in South Africa exceeds 200 miles in diameter.

The magma is usually molten basalt, which is heavier than the surface rocks and this causes the whole lopolith to sag, producing a depression. If the subsidence is sufficiently marked, the rock strata on its margins will crack, with magma invading the fractures. The upward pressure results in cone sheets, i.e., lava-filled conical fractures sloping inwards towards the centre of the disturbance. The relief of pressure accompanying the central subsidence has the opposite effect and produces ring dykes which slope outwards.

If the lava rising along the fracture reaches the surface it will initiate a ring of volcanoes round the central subsidence and these will build a girdling rampart, not unlike Clavius on the Moon.

All that is needed to produce lunar landscapes is a force that would lead to the alternate welling up and subsiding of the underground magma or any other readily deformable material. There may exist on the Moon a kind of underground sea or seas, so that the material in question could be largely or wholly water, but this does not greatly alter the general picture. The Earth is 81 times as massive as the Moon and the gravitational attractions of the two bodies which are responsible for the tides are in the same proportion.

Tectonic Grids

To-day the Moon has set more or less rigidly in a position where she permanently faces the Earth. This is the result of the powerful tidal action of the Earth on the lunar globe and reduces the present tidal stresses to a minimum. If, however, the Moon at any time rotated in relation to the terrestrial observer and/or moved in a strongly eccentric orbit, the tides due to the Earth's gravitation would have literally tended to tear her into slices and all liquids in her interior would have been alternately rising towards the surface and withdrawing from it. It would be as if a great ground swell were running like a spasm all round the Moon. There would be powerful moonquakes and the ground would be fractured into a regular grid that would become multiple if the polar axis had shifted.

The existence of such a grid would be a sure sign that this had actually occurred. The American geologist, J. E. Spurr, found something of the kind in the polar regions. My study of the Moon's surface shows that the whole of the Moon's visible face is enmeshed in a triple grid of faults, fractures and crater chains of almost geometrical regularity (see Fig. 4) and such views of the other side as we have had indicate that this grid extends to it as well.

The absence from that side of large central sea-plains gives further support to this theory.

10-metre Walkie-Talkie

(*Concluded from page 154*)

far behind the front panel (using 1in. × 6 B.A. bolts, or metal or fibre collets) to allow clearance for the miniature flexible coupler. Full details of the sub-chassis are shown in Fig. 7. The internal and front panel layouts are shown in Fig. 8.

SWITCHING

A three-pole two-way switch is necessary. If a different type from that shown on the wiring diagram is used (but it must, of course, offer the same switching facilities) the beginner is advised to check the operation with a test meter, or a flash-lamp battery and bulb in series.

PRECAUTIONS

This transceiver should not be operated in the immediate vicinity of a television receiver. Owing to the circuit mode of operation (even when switched to "receive") severe interference may occur on television frequencies. It is practically impossible to eliminate interference when using a super-regenerative receiver, but if this set is used for the purposes for which it is designed (e.g. emergency portable operation; liaison at radio-controlled model meetings; contact between fire-fighters or field search parties, etc.), it will give reliable, trouble-free service.

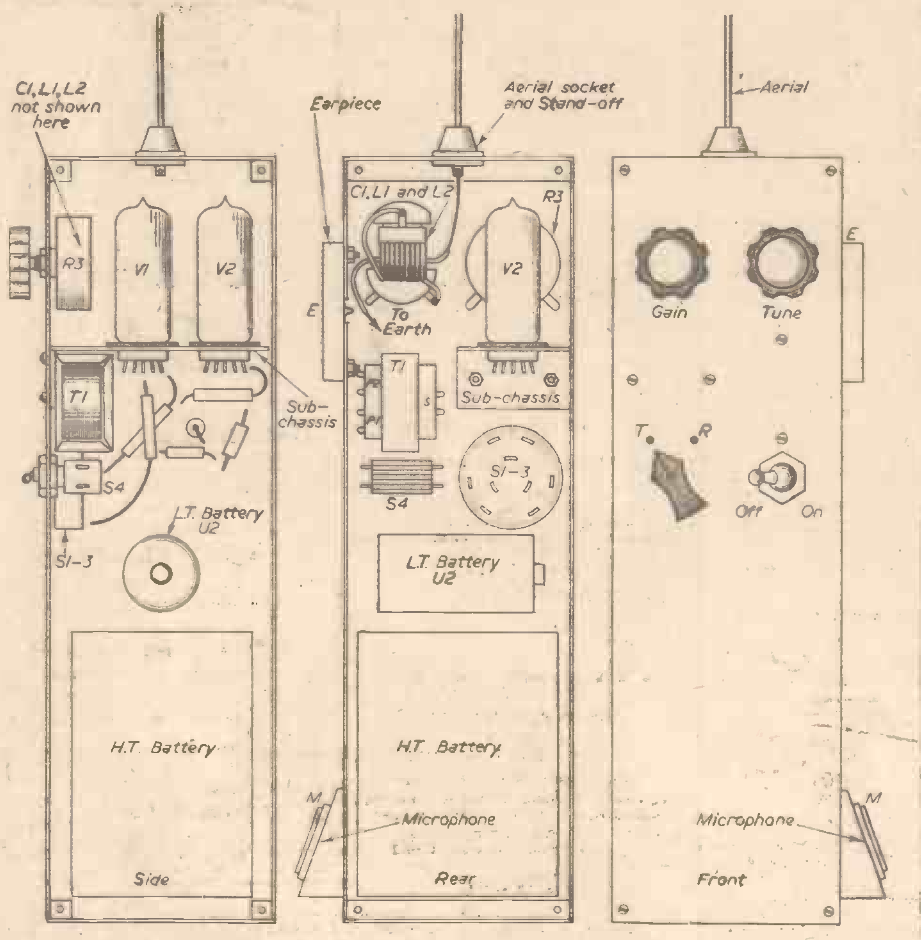


Fig. 8.—Internal and front panel layout.

READERS' SALES AND WANTS

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

FOR SALE

HOUSE SERVICE METERS, credit and prepayment; available from stock. Universal Electrical, 221, City Road, London, E.C.1.

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Suitable for small power drives, lathes, etc. 3½in. Crowned pulley for flat belt, easily adapted to mount extra Vee pulleys. Ferodo lined. Originally sold at 65/- for high speed textile machines. Will last lifetime. NOT second-hand; all unused. Complete with drawing and text showing how to adapt. 22/6 post free.

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FLEXIBLE SHAFTS, Grinding Wheels, Ceramic, Insulators. Govt. surplus; s.a.e. for list. S. Midgeley, Hebden Road, Haworth, Keighley.

4½IN. Planing and Rebating Machines, 30in. overall, adjustable cut, heavy ballraces, £6/10/-. Also 5in., 6in. and 8in. Planers at low prices. Combined 5in. Planer and 8in. Circular Saw (a really useful machine), £10/5/-. Heavy duty combination Woodworking Lathes from £10/15/-. Build your own Circular Saw cheaply: Circular Saw Spindles from 45/-. Full range for saws up to 30in. diameter. All machines fully guaranteed. Send 6d. for full lists and save pounds. Ortan Lathes, Falcon Works, Costessey, Norwich, Dept. P.M.

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VAR. SLIDERS. 10 ohm, 30 w. for chargers, train controls, etc., 3/- ea.
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PRESSURE GAUGES. 250p.s.i., 12/6 ea.
12-WAY P.V.C. Cable, Screened and P.V.C. Covered, 2/6 yd.
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P.P. COMPONENTS LTD., 219, ILFORD LANE, ILFORD, ESSEX. ILF 0295.

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BELLOWS, Camera, Enlarger, Process. Industrial Collapsible Machine Guards. Beers, 4, St. Cuthbert's Road, Derby. (Tel.: 41263.)

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Letters to the Editor

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

Go-Kart Under Construction

SIR,—Knowing the wide range of interests covered by PRACTICAL MECHANICS, I wondered if you would like to see the photograph below of a Go-Kart I am constructing. It is shown here under test, being towed behind

The Go-Kart being tested

a car. There is no engine fitted. Is PRACTICAL MECHANICS going to publish a Go-Kart design of its own?—S. E. NUNN (London, S.E.9).

[*Yes, Mr. Nunn, we are already making preparations to publish a constructional article, and hope this will appear soon*—ED.]

Personal Transport, Magnetism and Gravity

SIR,—I fear that several of your correspondents writing on the subject of personal transport of the future in the November, 1959, issue have neglected to inform themselves on the theory of flight, the cost of jet engines and fuel consumption of any vertical lift machines. Many possibilities have been economic impossibilities and the uneconomy of warfare misleads.

In his letter in the same issue, Mr. Brooks of Scarborough raises the cogent question of magnetism and asks what is happening between a magnet's poles? Some will reply "a distortion of the space time continuum," which sounds better than "I don't know." The latter, however, is the true fact.

Exactly the same thing applies to gravity. It affects everything in our experience. No one knows and, apparently, no one attempts to find out what it is. Einstein could not accept that remote bodies attracted each other in space, yet a wire nail jumps 3in. to my magnet and something causes Lunik III to fall back towards Earth from the orbit of the Moon. We can now sever the bonds that bind atoms together. We cannot, however, sever the bond that chains us to a muddy road, when we might float over it or to the planets, without expending power.

A child's magnet, not a cyclotron, displays a phenomenon that I believe no scientist can answer. Space, which they tell us is "nothing," can get hold of that wire nail, and push or pull it to the magnet, as it can lift a ton of iron scrap if sufficiently "distorted." (Pushed, I believe.) I for one do not believe that space is "nothing" and I feel it is time we started research into things at the ends of our noses. Space may be dense enough to swim in, given the right paddles! —F. O. BROWNSON (Bedford).

Home-made Wines

SIR,—I was surprised to read in your issue of November, 1959, a letter from a "schoolmaster teaching science" including a statement that "home-made wines usually contain about the same percentage of alcohol as ordinary beers." In fact, "ordinary beers" contain 3 per cent. to 5 per cent. alcohol; home-made wines may contain from 12 per cent. to 17 per cent.

An hydrometer will, as he says, give the "gravity" of the fluid, if, by this, he means "specific gravity" or "relative density"; but that is not necessarily any indication of its alcoholic content. Accurate measurement of the latter involves elaborate apparatus, but a reasonably accurate approximation can be made by a "vinometer," which is a simple tube graduated to show alcohol percentage from 0 to 25 per cent. measured by the surface-tension in a capillary tube.

An even more cogent reason than the Customs and Excise man for discouraging the would-be-distiller of home-made wines is the risk of poisoning by other constituents of the distillate than ethyl alcohol.—W. H. SPOOR, M.A. Cantab, M.R.C.S., L.R.C.P.

High-Speed Flight

SIR,—In the November, 1959, issue of PRACTICAL MECHANICS I note that Mr. M. D. Lacey makes interesting comment on my proposed emergency dial in "High-Speed Flight" (September, 1959, issue P.M.). He remarks that two 'planes could converge on each other within the same 120 degree sector and therefore be obliged to obey the same evasive rule of UP or DOWN or LEVEL. This is quite true, but the moderate angle of convergence substantially reduces the closing speed, thus giving the pilots a fair chance to bank their 'planes away from each other. My main concern is that when the angle of convergence is great (170 to 180 degrees), thus involving a dangerously high closing speed, the pilots have a definite and differing evasive instruction. The emergency dial certainly provides this instruction.

Mr. Lacey's remarks as a whole lead me to suggest that the scheme could be improved as follows: when, and only when, the LEVEL instruction applies, the pilot should maintain height but also swing to starboard. This would reduce the risk of collision in the unusual event of the approaching aircraft refusing to dip or climb as indicated on the dial.

I am rather surprised that Mr. R. P. Baylie in his letter (November, 1959, issue P.M.) infers that the scheme is not practical as three aircraft each flying along one of the three demarcation courses would converge—each pilot being confronted with a variable evasive instruction. While this is correct I should like to point out that the chance of such circumstances arising must be one in millions. No one can logically dismiss a safety scheme by hanging on to such a remote possibility.

Mr. Baylie states that all aircraft are given various heights at which to fly. This is only partly true. I assume that he is referring to the Quadrantal Control Scheme which is as follows:

Bearing Quadrant	*Flight Altitude (feet)*
Courses 0 to 89 degrees	3,000, 5,000, 7,000, etc.
Courses 90 to 179 degrees	3,500, 5,500, 7,500, etc.
Courses 180 to 269 degrees	2,000, 4,000, 6,000, etc.
Courses 270 to 359 degrees	2,500, 4,500, 6,500, etc.

This quadrantal arrangement applies only when the pilot is operating under I.F.R. (Instrument Flight Rule) conditions—that is, when the flight path lies approximately within 3,000 ft. laterally and 1,000 ft. vertically of cloud. If cloud is negligible and visibility good he may fly at any altitude. This is known as operating under V.F.R. (Visual Flight Rule) conditions.

The obvious weakness regarding I.F.R. is that high-speed aircraft on medium-range flights pursue a shallow trajectory rather than a fixed level course. Another example: a jetliner starts to "let down" for London Airport while still over the French coast—a long gradual decline from an altitude of seven miles. It is not economically possible to retain the stipulated height for the entire journey.

The grim thought of two jets emerging from a cloud on a collision course brings home forcibly the need for an evasion aid which gives the pilots a reasonable chance to stay alive. Even in a clear sky a fast 'plane is difficult to spot on the approach.

It is suggested that the reaction times stated in "High-Speed Flight" are probably intentionally overestimated. I can assure him that they are not overestimated. There is a big difference between dispassionately going through the test as depicted on paper and actually making those decisions in the cockpit of a supersonic fighter. The identification and decision period of 2.6 seconds seems rather long when considered in a detached manner. In reality, however, allowance must be made for the almost unavoidable mental "flap" or momentary panic reaction the pilot experiences before he can marshal his reasoning faculties. The dot he has seen out in front could be a crow or seagull—or 20 tons of hurtling machinery coming his way. There is a tendency for the mind to doubt or question the first visual impressions. Human sight and mental reactions are not as quick as we fondly believe. The following incident will, I think, prove this point.

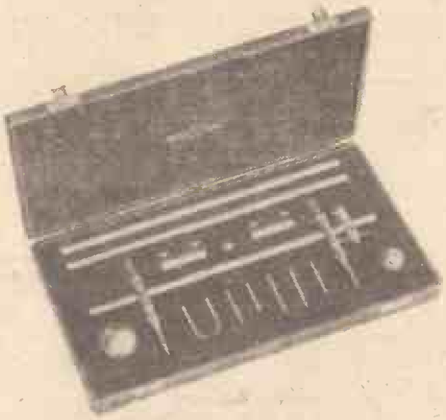
In clear air the pilot of a supersonic 'plane was suddenly confronted with a flight of three other supersonic aircraft. They were on a collision course with him. The closing speed was about 1,800 m.p.h. It was impossible to avoid the group by veering—in fact he had only sufficient time to pull the stick back and go over the centrally placed machine. He struck and carried away the fin tip of this aircraft. He reported back to his base as soon as possible. Inquiry indicated that a flight of 'planes was in the locality at the critical time, having taken off from an airfield some 20 or 30 miles away. This flight, however, consisted of six aircraft, not three as our lone hero had witnessed. When the flight landed a little later, the six crews were questioned about their encounter with the individual 'plane. Not one member of the whole flight had seen the single machine pass through their formation. There was no mistake about the identity of the players in this brief drama—for one machine out of the six was found to be minus its fin tip!—WILLIAM ELLWOOD (Hatfield).

TRADE NOTES

A REVIEW OF NEW TOOLS, EQUIPMENT, ETC.

New Beam Trammel

MOORE AND WRIGHT (SHEFFIELD) LIMITED, Handsworth Road, Sheffield, 13, have recently placed on the market their new beam trammel. This product is made in stainless steel and is supplied in three sets. Set No. 710/1 costs £4 4s., set No. 710/2 costs £8 and set No. 710/3 costs £10.



The beam trammel in case.

Home Radio Catalogue

AMONG all the technical hobbies, it is doubtful whether there is any which requires a greater range of components, tools, accessories, test equipment, etc., than does amateur radio construction. Often the enthusiast is held up while he casts round to find a certain component and thus he above all others knows the value of a comprehensive catalogue. It is just such a catalogue which has been produced by Home Radio (Mitcham) Ltd., 187, London Road, Mitcham, Surrey. Long lists of equipment ranging from television aerials to transistors, from luxury cabinets to condensers and crocodile clips are accompanied by excellent photographic and line illustrations. All items are priced and an index is included. The catalogue costs 2s. from the above address.

Bostik Adhesives and Sealing Compounds

DURING a recent visit to the B. B. Chemical Co., Ltd., of Leicester, who are manufacturers of the well-known "Bostik" adhesives and sealing compounds, we were given the privilege of inspecting their extensive workshops and laboratories. These products have been scientifically compounded to meet the varying needs of many industries and to provide maximum efficiency in joining or sealing hundreds of different materials. Bostik 252 is a black general-purpose adhesive for sticking most porous and non-porous materials. Bostik Clear Adhesive will stick plastics, metal, leather, rubber, felt, textiles, glass, wood, ornaments, paper and cardboard. Boscoseal is an underbody coating for the protection of car and lorry bodies against corrosion and abrasion, also giving a measure of sound deadening. Bostik Glazed Adhesive White is for fixing tiles to various surfaces and Bostik White Sealing Strip is for sealing window frames to masonry, door frames to masonry, sealing around sinks, bathroom fittings, round skirtings, wallboard joints and corrugated roofs.

THE TROKART

FOR the enthusiasts of Britain's newest sport, Trojan Limited, of Trojan Works, Purley Way, Croydon, have placed on the market the Trokart. Powered by the Clinton engine, the Trokart has a low chassis and balanced weight distribution for greater stability. The Kart is completely foot controlled, leaving both hands free to concentrate on steering. There is a choice of three models, The Tiger Cub has a 95 c.c. two-stroke engine, developing 2½ b.h.p., with speeds up to 25-35 m.p.h. and costs £85 10s. The Tiger with a 95 c.c. two-stroke engine developing 2¾ b.h.p., will reach speeds up to 35-40 m.p.h., price £88 10s. The third model is the Trackmaster which has a a 95 c.c. two-stroke engine, developing 4½ b.h.p., and is capable of speeds up to 40-50 m.p.h. This model costs £104 18s. On all models direct drive transfers full power from engine to wheels. They have a low petrol consumption and heavy duty wheels and tyres mounted on taper roller bearings. Trokarts have tubular frames with a minimum length of 6ft. The Tiger and Trackmaster can be converted to twin-engined models.

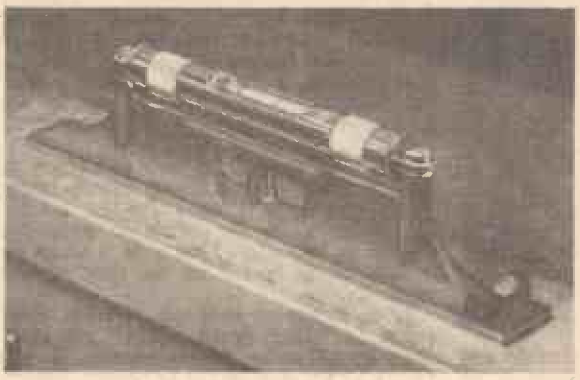
The Trokart in action.

Fry's Diecastings

WE have recently received a copy of a booklet entitled "Designing for Diecasting," from Fry's Diecastings Limited, of Merton Works, Prince George's Road, Merton Abbey, London, S.W.19. This booklet discusses the basic principles for design and contains an illustrated section on the methods of improving diecasting design. It forms part of a series of technical publications by Fry's Diecastings Limited and can be obtained free of charge by writing to the address given above.

Engineers' Level

THIS engineers' level is provided with a main vial, a cross and a plumb vial. The main vial is ground and graduated in 1/10in. divisions and is housed in a chromium-plated brass tube. This tube is surrounded by a protector tube which revolves to protect the vial when not in use. It is provided with a concave groove for use on cylindrical work or shafting. When the level is used on round work it is possible by using the cross vial to check any tendency to cant. The base is made of high-grade cast iron, finished in black crackle enamel. The level is packed in a well-made wooden case and the retail price is £5 5s. It is manufactured by Moore and Wright (Sheffield) Limited, Handsworth Road, Sheffield, 13, and is obtainable from stockists of Moore and Wright tools.

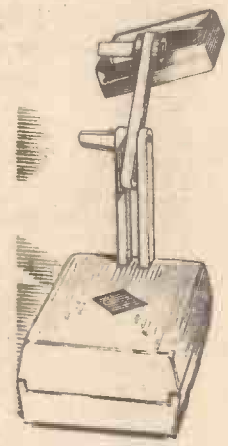


The Moore and Wright level.

Magnifier

A VALUABLE aid to all those who require powerful and distortion-free magnification while leaving their hands completely free is introduced by Combined Optical Industries Ltd., of Slough, Bucks. It is the folding stand magnifier "Meniway," which is of all plastic construction, including its strong, lightweight lens. This can be put to many uses, but has particular application for the engineer.

An instantly adjustable universal arm extends to a maximum of 7in. and the flexibility of this design allows minute adjustments in any of an infinite number of lens positions. When not is use, the "Meniway" folds away compactly into a case which is also a pedestal. The price is £3 3s.

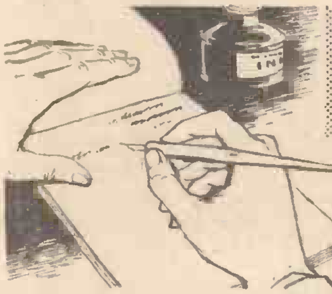


The Meniway.

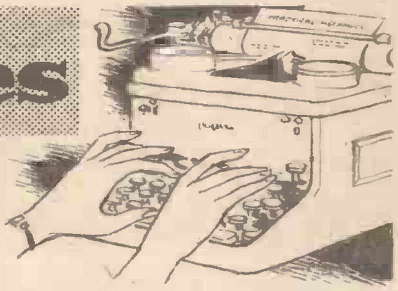
Penetrating Oil: Rust Remover

THE above are two new products of Messrs. Douglas Holt, Ltd., Vulcan Way, New Addington, Surrey. Specially formulated to act as a fast and deep penetrant for freeing rusted and seized-up parts, the penetrating oil, Rustola, by means of its aerosol pack, is particularly easy to apply.

The thixotropic rust remover paste stays in position on vertical and horizontal surfaces without running. After degreasing and scratch brushing the rusted area is coated with the paste which is later wiped off with a wet cloth. It can be used also for rust-proofing metal. Details are available from the address above.



Your Queries Answered



Batteries for ½ h.p. Motor

WHAT batteries are needed to drive a ½ h.p. electric motor for a period of about four hours during the course of a day? Also give information on charging of batteries.—W. Stevens (Birmingham).

HALF horse-power corresponds to 373 watts. Thus, allowing for the internal losses, the input to a ½ h.p. motor on full load would about 550 watts. Any convenient voltage could be used. At 24 volts the current taken by the motor on full load would be at least 23 amps. If one complete charge of the accumulator is to last only four hours the accumulator would, theoretically, need to have an ampere-hour capacity of about 100 on the four-hour discharge rate. However, to ensure more efficient working and to provide for reserve capacity a battery having a capacity of about 200 ampere-hours would be advisable. On 12 volts the full-load current would be at least doubled and the ampere-hour capacity of the battery should be doubled to correspond. It will thus be seen that a large and expensive battery would be required.

If there is a suitable A.C. supply available the best way of recharging the battery would be through a transformer and metal rectifier, or hot-cathode rectifier from the supply mains.

and is then spread in overlapping layers over the inside of the mould until the required thickness (preferably around ⅛in.) is attained. The mould is first rubbed over with soft soap to prevent the paper from adhering. The object should be allowed to dry slowly in a warm room before removal from the mould.

It occurs to us that you may be confusing papier mâché with paper pulp. This is waste paper macerated in a mill until it approaches the consistency of porridge. The pulp is poured into a mould made out of wire mesh, and the water is removed by vacuum. This leaves a felt of paper fibres in the mould, dry and stiff enough to be removed immediately. The process can really only be carried out on a commercial basis.

RULES

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

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

a small model car (base size 1½in. × ¾in.) through a sheet of hardboard for the purpose of propelling it along a roadway.

Could you please give me details of gauge of wire and number of turns, etc.—R. S. Hardee (Ilford).

A PERMANENT magnet could be used if this is to be moved along under the hardboard. Suitable electro magnets for this purpose could be obtained from A. T. Sallis, 93, North Road, Brighton, Sussex. For the core and voltage mentioned, a bobbin about 1½in. long and ¾in. in diameter, filled with 18 s.w.g. wire, would do. If economical running is essential, 22 or 20 s.w.g. wire should be used. It is, of course, not feasible to fix a magnet at a distance, so that it draws the car a long way when switched on, because the magnetic attractive power decreases very rapidly with distance. The object attracted must have iron, steel, or other ferrous base or parts.

Gas Turbine Engine

IN a jet gas turbine engine, the air in the compressor stage reaches, say, 50lb./sq. in.; at this pressure it enters the combustion chamber mixed with fuel, burnt, causing explosion and pressure rises to some 200 to 700lb./sq. in. Why is it possible for air at 50lb./sq. in. to transfer to the combustion chamber where the pressure is so

Papier Mâché Fort

PLEASE tell me how to make a toy fort from papier mâché composition.—H. G. Hogarth (Godalming).

TOY forts are not very easy to make in papier mâché; the most usual method is to make a rough framework out of unplaned wood and to cover it with a mixture of plaster and sawdust. The minor details of crenellations, masonry joints, and so on, are modelled in while the plaster is still moist.

Papier mâché work is really more suitable for objects of fairly regular and simple external form, which can easily be withdrawn from the mould when dry. If you really want to make a fort from papier mâché, you could make a wooden mould (perhaps in several pieces hinged together, if the shape of the fort is elaborate).

The material used is merely newspaper, torn small but not finely shredded, which is thoroughly soaked in paperhanger's paste

Electro Magnet

I WISH to construct an electro magnet with ½in. laminated core, and 12V working, with sufficient strength to attract

Information Sought

Air Conditioners

CAN you tell me of a book in the "do-it-yourself" style, which deals with making an air conditioner from an old refrigerator.—E. S. Carruthers (Australia).

Paper Chinese Junks

SEVERAL years ago I was shown how to make Chinese junk models by folding paper in a certain sequence, but I have forgotten the method. The paper junks had a hollow hold in the centre and raised decks at either end. Can any of your readers tell me how to make them?—L. Palliser (Lancs).

much higher? Why does the higher pressure combustion gas go only backward and not forward into the compressor unit and back?—N. Cooper (Birmingham, 7).

THE cycle of operations of a basic gas turbine is that air is drawn into the compressor, where it is compressed and passed to the combustion chamber, in which fuel is burnt continuously in an excess of air. The products of combustion are then allowed to expand through the compressor and power turbines and finally, to exhaust.

From the foregoing, it will be seen that the products of combustion have free access to the atmosphere, which, being at a lower pressure than the air supplied for combustion, i.e., 14.7lb. per sq. in., must promote a continuous flow of gases, from air inlet to exhaust, in the required direction.

Making Scale Model Trees

PLEASE tell me how to colour steel wool either brown or green. Can you suggest a material to represent leaves on

trees to 00in. scale, apart from dyed sawdust and green tea?—R. G. Griffiths (Wales).

TO colour steel wool, painting is perfectly suitable, in fact, painting, by spraying the paint on, is the only way to do it. It must be done after the tree is made and before the "foliage" is put on. The paint had better be of the flat kind, not glossy, and the colour a greenish, or brownish grey. The trunk and main frame of the tree must be made up of bundles of fine wires and soldered together.

To the steel wool the foliage is added by spraying with an enamel paint where the leaves are to go. Almost any material will do for foliage: sawdust, powdered tea leaves, broken or powdered moss or anything light and fine enough. But its colour will not matter because it will have to be spray painted after it is stuck on and the enamel is dry. The final enamel should be of light grass green and had better be thinned with turpentine to enable it to flow. Finally, go over the trunk and bare branches with a brush and the grey paint, touching up where necessary.

Building an Incinerator

I WISH to build an incinerator to burn cardboard packing, etc.

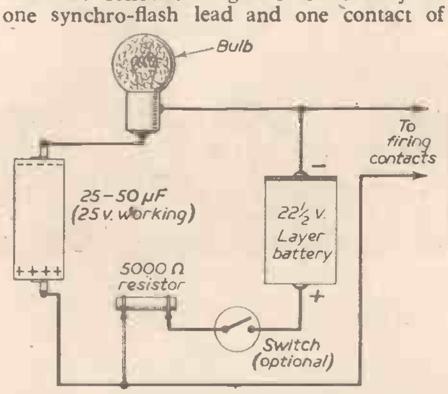
Would ordinary brick be suitable and would a single or double wall be necessary? What material should be used for bonding?—L. J. Snooke (Shrewbury).

OLD fireclay bricks would be better than ordinary bricks. You should be able to obtain some cheaply from local gas works. A single wall of this material should be suitable, bonded with a fireclay cement, such as Pyruma. Here again your gas works should be able to help.

Capacitor Flash Circuit

PLEASE give me the circuit of a capacitor type flash-gun, and details of the capacitor, etc. I wish to use a 22½ volt hearing aid battery and "Speed Midget" flash bulbs.—E. Walker (Sheffield).

WIRING for the capacitor flash-gun is as follows: negative of battery to one synchro-flash lead and one contact of



Capacitor flash circuit.

bulb; second contact of bulb to negative tag of condenser; positive tag of condenser to second synchro-flash lead and to one tag of resistor; second tag of resistor to positive on battery. The inclusion of a switch as shown in the circuit is optional. A 50μF. 50V. condenser such as used in radio receivers is suitable for firing up to two bulbs. The resistor may be of about 5,000Ω and is in no way critical. A small carbon 1-watt type is suitable. The bulb should be inserted shortly before it is to be fired, in order that the condenser may have time to charge up.

Motorising a Sewing Machine

I WISH to motorise a hand sewing machine. Could you tell me what type of motor I require, and give general information regarding wiring, etc.?—J. Bundy (Camberley).

YOU require a series (universal) motor which could be about 1/12 h.p. This could be connected in series with a variable resistor which has a full-on position. The variable resistor could be wound with resistance wire connected to a number of contact studs on a tapping switch and tough-rubber sheathed flexible cable could be used for connecting up.

Cellulosing Sheet Aluminium

HAVING built a side-car using sheet aluminium I now wish to cellulose finish it in black. I understand that aluminium has to be treated first. Can you tell me the method for doing this; also the type of undercoat needed?—E. W. Huish (Leyton, E.10).

A METAL surface does not usually require any special treatment previous to cellulosing. Merely clean the aluminium surface and apply to it two coats of an ordinary commercial cellulose transparent lacquer. The lacquer will dry within a day and it will give every satisfaction in use. It is immaterial whether the lacquer is applied by means of brush or spray.

OUR PRINTING PRESS
Further Information

I WISH to make the printing press, the instructions for which were given in the November issue, but there are one or two points on which I should like further information: 1. Please give fuller details of the forme construction. 2. What sort of type used? 3. Can you give some hints on using the press? 4. What is the price of type?—L.V.D. (Cardiff).

1.—The prototype forme was made from 3/16in. three-plywood, cellulose adhesive and some small woodscrews. Using a fretsaw, cut out three frames all the same size. The first prototype frame was 4in. × 6in. outside frame size and 3in. × 5in. inside measurement. The three frames should be cut with the grain running in different directions in order to give strength to the final forme because it is subjected to considerable pressure when the type is set up in it. The three frames are glued and screwed with two countersunk screws on each side and from each side to the centre frame. Then the forme appears as shown in the sketch.

Quarter-inch thick plywood is also suitable. The height of type is about 1in., so the forme has always to be less in "thickness" than the "height" of the type. This keeps the type face clear of everything surrounding it.

A forme may be made any size, but not greater than the area of the plate glass which presses the card or paper against the inked type. The author's largest forme, made from three-plywood, is 5¾in. × 7¾in. outside and 4¼in. × 6¼in. inside; this giving a slightly greater width to the sides to withstand the correspondingly greater pressure exerted on the forme to keep the type in position.

2.—The author uses the following types: Plantin Italic, 12pt.; Plate Gothic, 12pt.; Nos. 1 and 2; Plate Gothic, 6pt., Nos. 1 and 2; Plate Gothic, 6pt. Bold, No. 4; Caslon Old Face, 8pt.; Old English, 12 and 8pt.

You should search the local Public Library for practical books on types, type-setting, and hand-press printing, and study the catalogues and print supply lists of:

Essex Printers' Supply Company, 240, Cann Hall Road, Leytonstone, London, E.1., who are excellent for good secondhand type and accessories; Adana Limited, 15-18, Church Street, Twickenham, Middlesex, who sell a book "How to Make Good Printing," as well as supplying catalogues of type and accessories, and Dossetter Printcrafts Limited, Nelson Wharf, London, E.14, who supply types and blocks.

Forme details.

You can use any type you fancy within reason. Billheads and posters need very large type and a fount is an expensive item. For cards, an 18 point fount with 12 point, 10 point and 8 point founts will cover a great variety of work.

3.—Assuming that the matter to be typed is already set up in the forme all is ready to take a test print. A small spot of ink is rolled out on a piece of plate glass with a printing roller, like a roller squeegee. Then this same roller charged with a thin film of ink is rolled over the type. Place the card or paper into position on the platen or even straight down on the type, then bring down the platen on to the card or paper. Apply a slight pressure on the handle. Lift the handle and the platen and then the print. The result will show where pressure is, perhaps, uneven. The unevenness is adjusted by means of either or both of the nuts at each end of the support hinged to the platen or by also moving forwards or backwards slightly the large round movable dowel which forms the pressure head on which the shaft of the handle rests during pressure.

Before each print the type is re-inked.

4.—The price of type depends on size and style. For Old English 12pt. Adana charge 36s. 9d. for a fount based on capitals, small letters and punctuation marks. For Old English 10pt. the price is 28s. 6d.; 8pt., 21s. For Plate Gothic 12pt. Dossetter Printcrafts charge 3s. 3d. for a small fount, and 12s. 6d. for a large one. For Old English the charge is 5s. 6d. for a small fount of 12pt. and 19s. 6d. for a large fount. Second-hand type in bulk can be obtained from the Essex Printers' Supply Company.

Beginners are advised to buy only one fount complete and then add to that style of fount some, if not all, of the remaining sizes. Endless variety is bewildering. The writer keeps his type in large egg containers obtainable in clean, unused condition from most grocers. The print is divided out into alphabet, figures and punctuation marks.

The would-be printer is advised, as already mentioned, to read all the available literature on the subject at the local library and to study as many catalogues and price lists as possible. When the machine has been made, a fount of type, quads, spacers, wedges, leads, ink, ink roller, tweezers, paper, card, plate glass on which to roll the ink and paraffin, brush and rag, etc., to clean the type will be required. Practice is the secret of successful printing.

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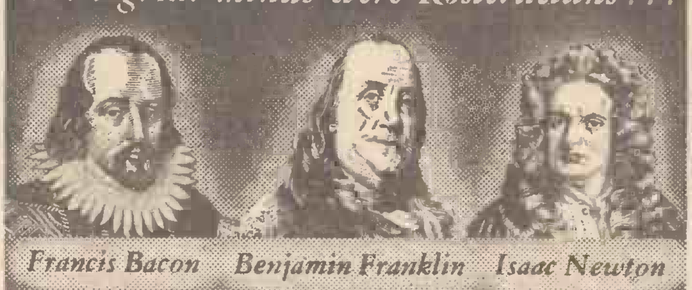

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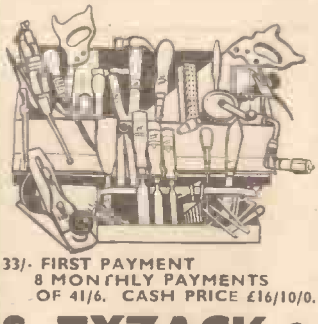

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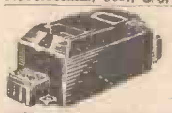

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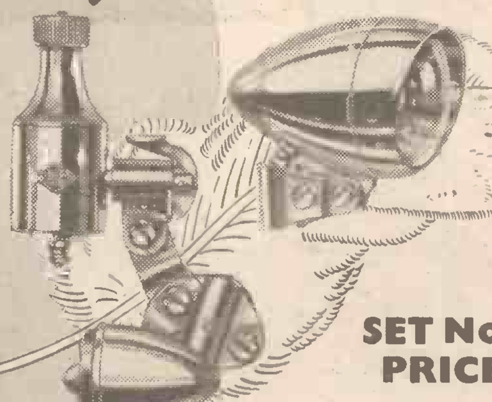

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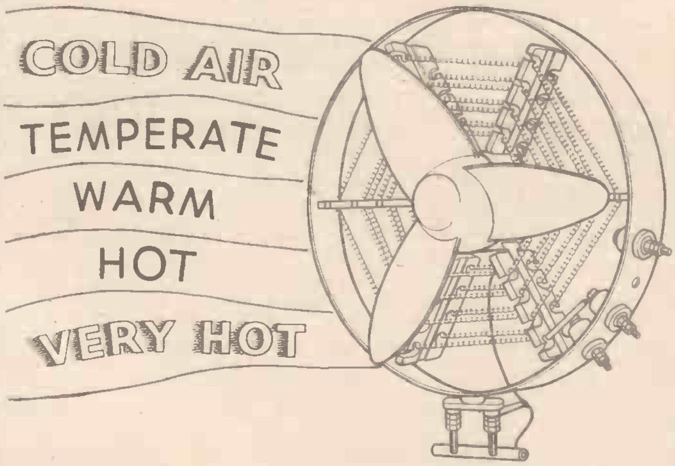

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Vol. XXVIII No. 448

COMMENTS OF THE MONTH

The Cycle as a Trainer

ALMOST everyone nowadays, whether they live in the country or in the town, has, in some capacity or other, to use the roads, be it only as a pedestrian crossing them from time to time.

Young pedestrians while they are still at school are taught the principles of road safety and crossing-the-road drill, but the one thing this training cannot give them is an appreciation of the other road user's point of view. The young road user obviously cannot gain first-hand knowledge of motoring, but he can, by means of a bicycle, gain experience of travelling along a road as opposed to the purely pedestrian experience of merely crossing it.

The pedestrian who has personal experience of cycling is in a much better position to understand the problems of motorists and cyclists. He will understand, for instance, that if he causes an oncoming cyclist to brake sharply on a wet road, the cyclist is likely to skid. He will also understand that parked cars can obscure the vision of the oncoming motorist. In other words, he will readily be able to put himself in the place of other road users and by understanding their difficulties, use the road more intelligently himself.

There is another aspect of this idea of using the bicycle as a trainer. The experienced cyclist has a road sense unequalled by any other class of road user. He is the most vulnerable of all road users, and in addition to learning all the techniques necessary for using the modern road, he develops, self preservation being a primary instinct, an almost exaggeratedly cautious sense of safety first. If he takes this sense with him when he becomes a motorist, he will be a far better driver than are many one meets on the road to-day.

A Cycling Licence

Although the days have past when cyclists were invariably described as "menaces" by motorists and blamed for far more than their fair share of road accidents, the question of applying a system of testing to cyclists as well as to motorists does occasionally arise. In fact these tests already exist in a way. The cycling proficiency test, although not compulsory, can be attempted by children and a certificate obtained.

If a scheme for testing cyclists and issuing them with licences were mooted, it is probable that a great many cyclists would oppose it vigorously. Would such a scheme, however, be such a bad idea? If we agree to the testing of motorists, why not cyclists?

There are a great many people who think that the present system of testing drivers does not go far enough. They liken it to a schoolboy swotting for his exams, passing them and then proceeding to forget all he has taken so much trouble to learn. A driver, carefully and meticulously observing every rule of the road and being courteous to pedestrians and other road users while he has the examiner beside him, is a very different person when seen a month or two later. The present system is unfair in another way too, in that a great many drivers at present using the roads have never had to pass a test at all, as they were driving before the present system of testing drivers was started. The solution suggested to these problems is to make it compulsory to take a test every two or three years. This would ensure that all drivers and cyclists reach and maintain approximately the same standard; it would also weed out those whose sight is failing or who are otherwise unfit to drive or ride.

Probably, however, these tests will have to remain in the idea stage for a long time. Judging by the disgraceful time one has to wait to take the test—running into months usually—it is doubtful whether any Government department would be capable of organising the scheme, taking into account the vast amount of extra work involved.

The "Roughstuff" Season

Triggered off, no doubt, by the revived interest in cyclo-cross, there seems to have been an increased participation during the past couple of years in the sport of "roughstuff" riding. This has always been popular among a small minority group of cyclists but deserves to be wider enjoyed. And why is it regarded as a winter activity? Surely the chaotic state of the roads during this last summer would indicate that during the hot weather is the ideal time to leave the roads altogether for the lesser known tracks and paths. One reads from time to time of hair-raising pass-storming expeditions undertaken by cyclists over almost impossible terrain, but given the right sort of machine and riding it intelligently, there need be nothing remotely hazardous or daring about roughstuff riding. It will take the cyclist into parts of the country that cannot be invaded by the motorist with his accompanying effluvia of petrol vapour and smoke and enable him to enjoy views amid the quiet of the countryside miles away from the nearest road.

B.S. for Chromium Plating

Chromium plated parts on a bicycle are called upon to stand up to pretty severe conditions of weather and wear and in the past, particularly just after the war, they were tried many times by cyclists and found wanting. To-day, a severe defect in chromium plating, so far as the cyclist is concerned, is an infrequent occurrence, but with the introduction of this new standard, it will become almost unknown. The standard of chromium plate required for cycles is to be marked with a red label and one of the main features of the new high standard will be an increased deposit of nickel under the chromium top coat. Comprehensive tests will be applied.

Haslemere—A charming Surrey town with many lovely Georgian houses and old inns.

A Chat About the TRANSMISSION

THE importance of the transmission on a bicycle is obvious and it is all the more surprising, therefore, that it is so often neglected. For enjoyable cycling it must be properly adjusted, aligned and maintained.

When buying a chainset, it is always worth while paying more for one of good quality. The best type is known as "solid forged," which means that the crank and chainwheel are cast in one piece instead of being "crimped" together. This makes for a much stronger and longer lasting unit. This chainring is usually made in two parts, as shown in Fig. 1, the actual chainring being fixed to the spider by means of three or five bolts. The advantages are that a worn or broken chainring can be replaced quickly and a smaller or larger ring can be fitted simply. The snag is that the threaded holes in the spider sometimes wear and the screws tend to work loose. The remedy is to drill out the holes and fit nuts and bolts (see Fig. 1).

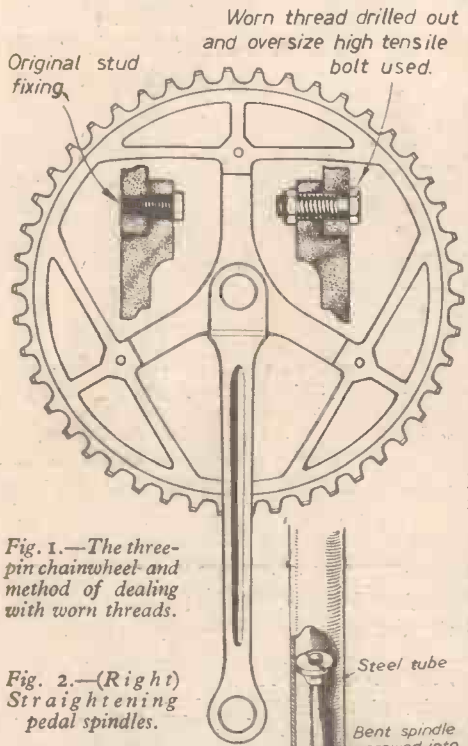

Fig. 1.—The three-pin chainwheel and method of dealing with worn threads.

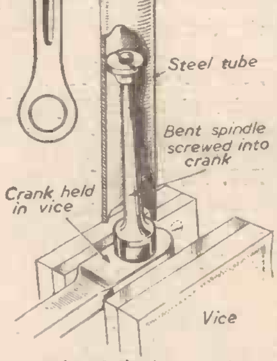

Fig. 2.—(Right) Straightening pedal spindles.

Truing the Chainset

Sometimes it becomes necessary to straighten cranks which have become bent out of true. This can be done by sliding over piece of metal tubing and pulling the offending member back into truth, or if available using a wringing iron. For straightening pedal spindles use the set-up shown in Fig. 2. If the chainwheel itself is bent out of line, it can be straightened by passing a long rigid lever of some kind between the outer ring and the spider and levering it back into truth (Fig. 3).

Chain Alignment

The chain should run in a straight line between the chainring and the rear sprocket. If these two are not in line, the chain is pulled clear of some of the chainring teeth (Fig. 4A) thus increasing the strain on those which are properly meshed and causing additional wear to the chain. To avoid this, check first that the correct length of bottom bracket spindle is fitted—i.e., not a gear case clearance type. Now look at the rear hub to ensure that sufficient packing nuts and washers have been fitted to extend the width of the hub to the width apart of the fork ends. Chainwheel and rear sprocket should now be in line, but if not, pack shims behind the sprocket until they are. A final check can be made either by sighting down the chain by eye or by means of a steel straight edge. When derailleur gears are fitted the chainring should be aligned with the centre of the multi-speed block, as shown at B in Fig. 4.

The derailleur gear, is not, mechanically speaking, the ideal form of transmission as, except when in middle gear, the chain is running out of line. It is for this reason that chain alignment is even more important here as the amount of variation from true must be kept to the minimum.

Make sure too that the chain runs smoothly over the various sprockets, pulleys, etc., of the mechanism without touching the guide plates in any gear. The use of a riveted chain helps to avoid this.

The Chain

Both chain and sprockets can wear. Worn sprockets almost always can be detected by the hook shape of the teeth and a badly worn chain usually makes itself heard in the form of grinding, cracking, or banging noises. The easiest test for a chain is for stretch. This is done by pulling the upper and lower strands of the chain towards one another immediately behind the chainwheel with one hand and seeing if the chain will pull away from the teeth on the front of the chainwheel with the other.

If the chain has been run for some time out of line, it is quite probable that the side plates have been sprung and the chain will bend sideways. Either of these two conditions necessitates replacement. The chain should be cleaned and oiled regularly. When overhauling the machine, soak the chain in paraffin to clean it, dry it and soak it in a bath of heated grease.

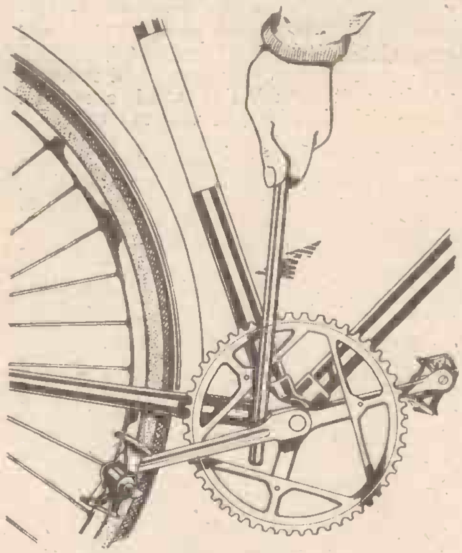

Fig. 3.—Truing up a chainwheel.

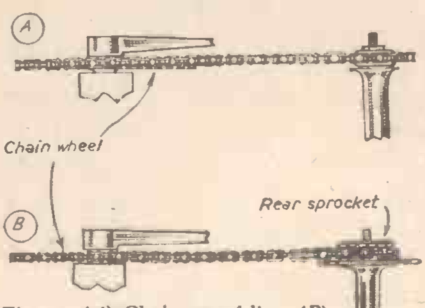

Fig. 4.—(A) Chain out of line. (B) Chain correctly lined up on centre sprocket.

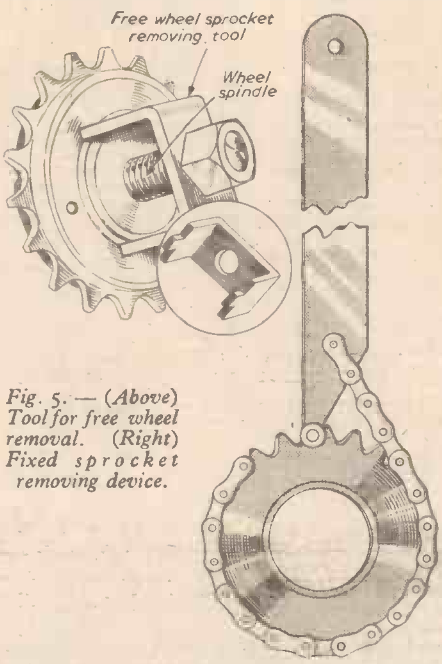

Fig. 5. — (Above) Tool for free wheel removal. (Right) Fixed sprocket removing device.

Sprocket Removal

This is a job which often causes trouble for the cyclist, but whether it is a freewheel or a fixed sprocket being removed, the correct tools make the job an easy one. Fig. 5 shows the tool required for unscrewing a fixed sprocket. The chain is merely wrapped round the sprocket teeth and the lever used to unscrew the thread. The locking ring must be removed first, of course, remembering that it has a left-hand thread.

An entirely different tool is used for unscrewing a freewheel. This is the "Dog" shown in Fig. 5. It is passed over the wheel spindle and the two pins located in the notches in the freewheel. It is fixed in position by means of a locking nut, then the dog is placed in the vice, the wheel turned, thus unscrewing the free wheel.

Gear Calculations

The gear ratio of a bicycle is always expressed in inches. This figure has no real significance except as a comparison between one gear and another. However it can be given some meaning by multiplying it by π or 3 1/7 to find the distance the machine will travel when the cranks are revolved once.

The gear of a bicycle in inches is ascertained by multiplying the diameter of the road wheel (in inches) by the number of teeth on the chainwheel and dividing by the number of teeth on the rear sprocket.

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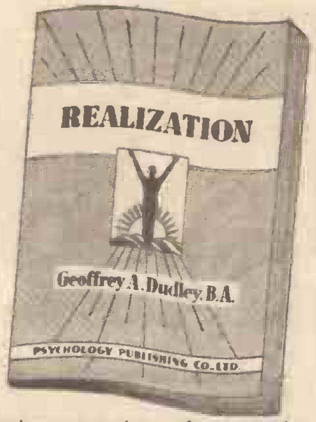

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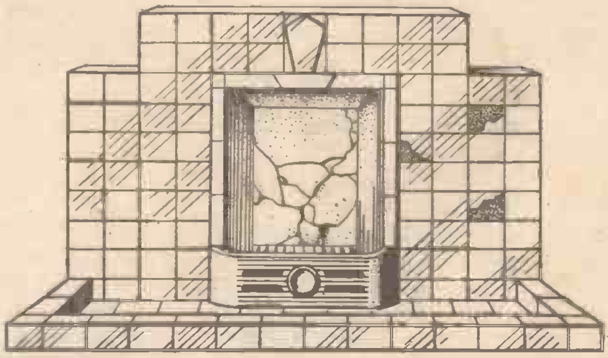

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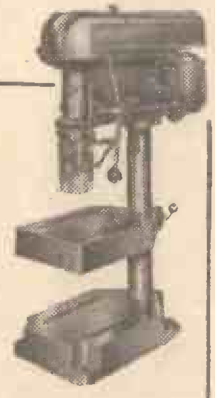

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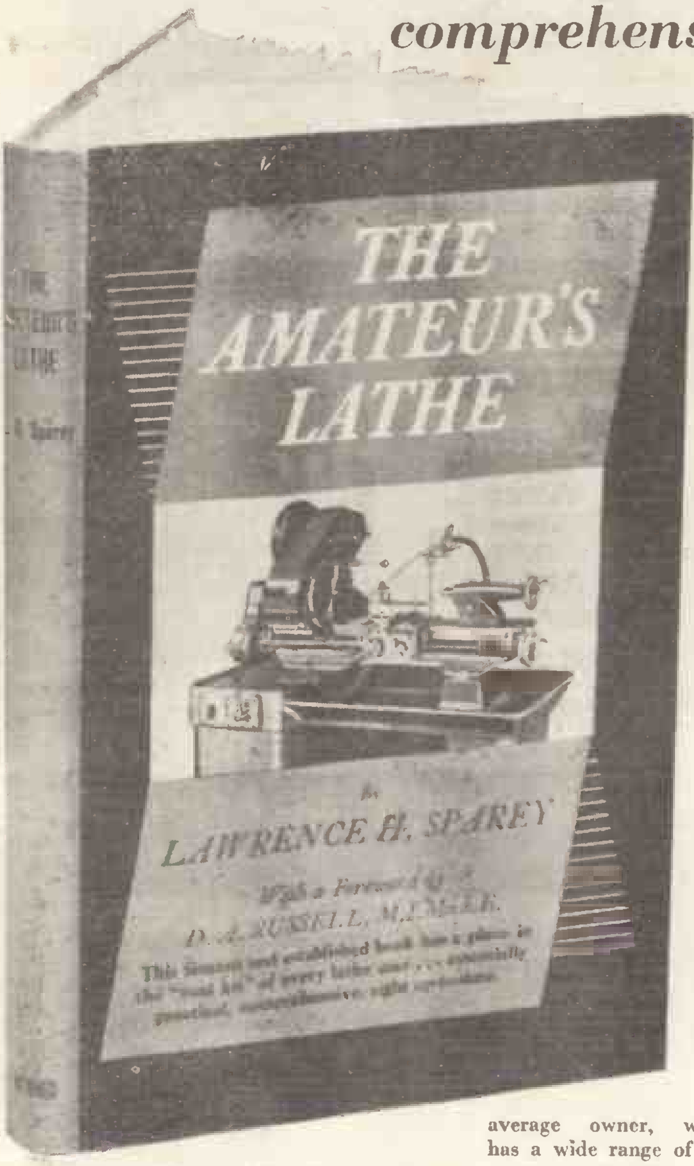

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