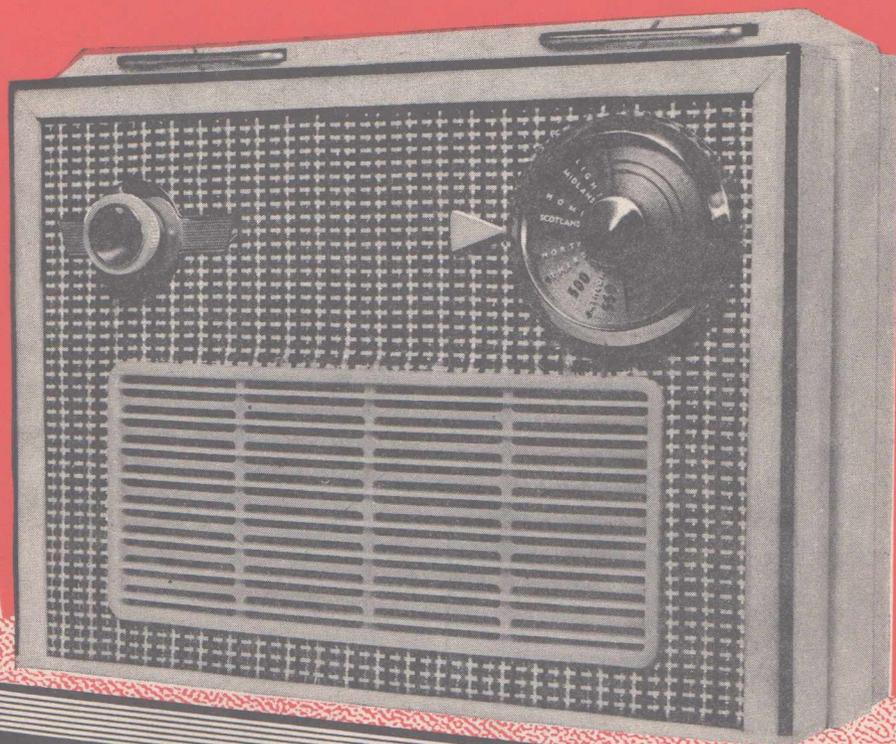


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PORTABLE TRANSISTOR RADIO AND RADIOGRAM

by I. F. Gregory



BERNARDS RADIO MANUALS



The 6 transistor radiogram

General Editor
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STILL E-ZINC AIR

Portable Transistor Radio and Radiogram

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by
I. F. GREGORY

BERNARDS (PUBLISHERS) LTD.
THE GRAMPIANS, WESTERN GATE
LONDON W.6

General Editor
CLIVE SINCLAIR

First Published—January, 1960

*Printed by Weatherby and Sons, 182-4 Campden Hill Road, W.8.
for Bernards (Publishers) Ltd., The Grampians, Western Gate,
London, W.6*

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CLIVE SINCLAIR

London

London

PREFACE

Once again I. F. Gregory has written a first class book on transistors. This time, however, he has dealt far more with the constructional aspect of the design so that whoever follows his simple and well-planned directions is sure to obtain professional results.

Both of the completed units were sent to this office for testing. We measured the sensitivity, stability and the quality of reproduction. On all three counts they surpassed the finest commercial equivalents we have yet come across. The sensitivity is particularly good, due to the very large ferrite rod aerials used.

Mullard transistors were used throughout the designs with the result that the noise level is well below the audible level; something that cannot be said of many sets we have heard.

Unfortunately, the two prototypes were stolen at the recent radio show, however, we have accepted this as just another proof of the popularity of Bernards' radio designs.

The best of luck with your construction,

CLIVE SINCLAIR.

INTRODUCTION

The aim of this book is to describe in some detail the operation and construction of a portable radio and radiogram using transistors.

The radio is not of the pocket type but has been designed with a fairly large speaker thus giving good quality and volume of sound.

It is, however, completely portable and compares very favourably in size and performance with any of the 4-valve battery-operated portables on the market to-day, and has a great advantage over the valve, that of very considerably reduced battery consumption.

The size of the receiver also enables the use of a fairly large battery, the cost of which is only a very little more than the miniature range used in the pocket type receivers, but it will of course give many more hours of effective life.

The second article deals with a small portable record player and radio combined. Readers will notice that the circuits are almost identical. This has been intentional, partly as the components used are readily available, but also to enable constructors to build these receivers to their own layout if they so wish, or to modify the existing arrangements. For example it may be thought preferable to build the portable radio and use it with merely the record unit placed in a separate cabinet. In this case the audio amplifier in the radio gives all the amplification needed. Alternatively, the record player could be constructed in a larger cabinet housing two speakers but still using the same circuit for the audio amplifier.

Before reading on, there are a few do's and don't's

that must always be borne in mind when using transistors. Many reading this book will of course, be familiar with the pitfalls, and may well have had casualties amongst their semi-conductors. However, others may not have been so unfortunate or even not yet used these devices and it is to the latter that these remarks may be of assistance.

First, and of paramount importance:—

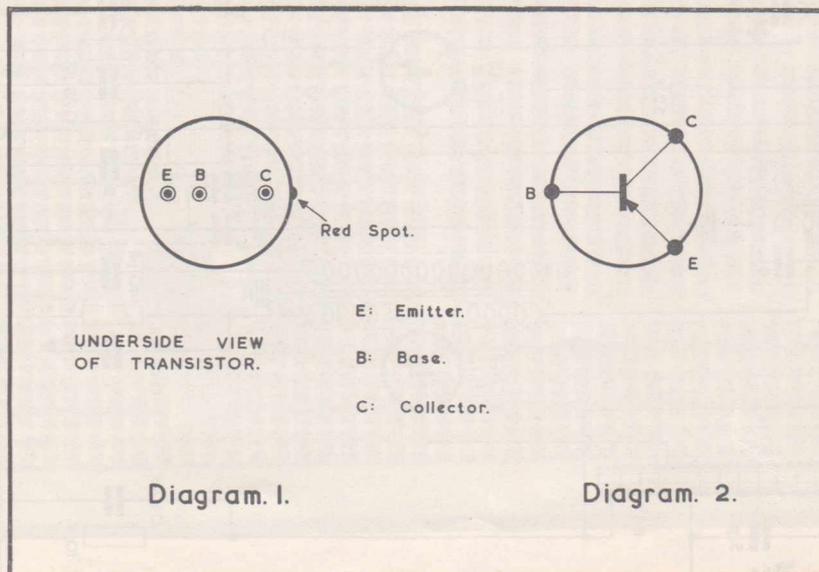
The battery must be connected to the circuit with correct polarity. The vast majority of transistors in this country at the moment are of the P.N.P. variety and these require a negative polarity on the collector.

Diagram (one) shows the position of the lead-out wires. This arrangement is common to most transistors made in this country and applies to those made by Mullard which are used in these circuits.

Diagram (two) shows the conventional symbol for the transistor used in all circuit diagrams.

It will be noticed that a small red spot is placed on one side of the transistor, this is to denote that the lead nearest to it is the collector. It will also be noticed that the wires at their point of entry into the transistor are not evenly spaced. The emitter and base wires being close together while the collector lead is spaced away. This, although very slight, is in itself an indicator and may be of great assistance should the red spot become obliterated.

Another danger to transistors is excessive heat, if soldering is considered necessary great care must be exercised not to hold the iron for a moment longer than needed to form the joint.



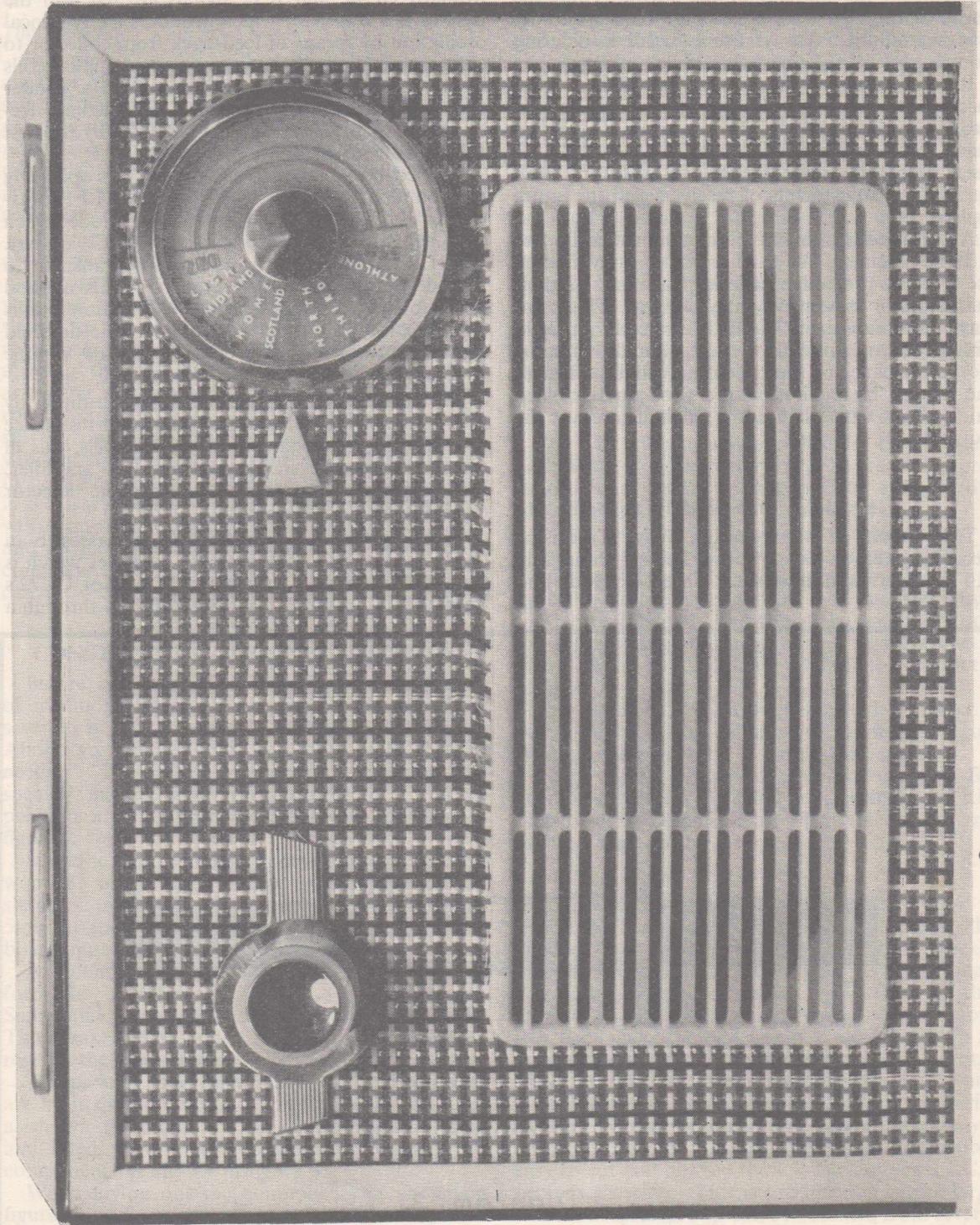


Figure 1 shows the method of positioning the speaker and microphone in the carrying case. This method of positioning facilitates wiring and obviates excessive cramping of the components. The speaker is supplied in a variety of colors and thicknesses and is available at a fairly reasonable cost.

Leads should not be cut, and connections must be made at the far end of the wires. Hold the centre of the wire with a pair of cool pliers to act as a heat shunt. Always use as small a soldering iron as possible (15 watts should be ample).

It is on account of this danger of heat that throughout these articles the use of sockets is strongly recommended. They are of great assistance, not only to avoid danger but to enable the quick and safe interchange of transistors both during final adjustments of receivers and for future replacement.

As Mullard transistors are recommended for use in these receivers, one further warning—Mullard's use a paint protective covering on most of their transistors to prevent the entry of light. This paint may be removed if handled carelessly or held with any form of metal tweezers, should this occur the performance of the transistor will be affected, and it must be repaired with a good quality black paint. Take care when doing this not to cover the red spot.

GENERAL DESCRIPTION

The circuit of the Medium Wave Transistor Receiver given on page 6 consists of six transistors and one germanium diode. Three hf types and three audio.

In the first stage a self-oscillating mixer uses a Mullard OC44, and R.F. signals are fed into the base of this transistor which produces its own local oscillation by means of feed-back from collector to emitter. Tuning of the aerial and oscillator coils is obtained by a tuning capacitor, and a padder provides correct tracking. The intermediate frequency is then taken from the collector by the first I.F. transformer.

The second stage consists of two OC45's operating in grounded emitter circuits, the third I.F. transformer is fed into an OA81 detector diode which supplies an audio output and a D.C. output. This D.C. is fed back to the first I.F. transistor to provide automatic volume control. This method does not give a very strong A.V.C. action but is sufficient for all normal conditions. The detected signal is now fed to the diode load (the volume control).

The small forward bias applied to the diode by the A.V.C. circuit helps to keep the input resistance of the detector constant at all signal levels, this in turn preserves the stability of the I.F. amplifier. This small bias also acts to improve the detector efficiency with weak signals.

From the volume control the signal passes to an OC71 used as an audio amplifier or driver which is transformer coupled to a matched pair of OC72's operating in push-pull class B and finally through a

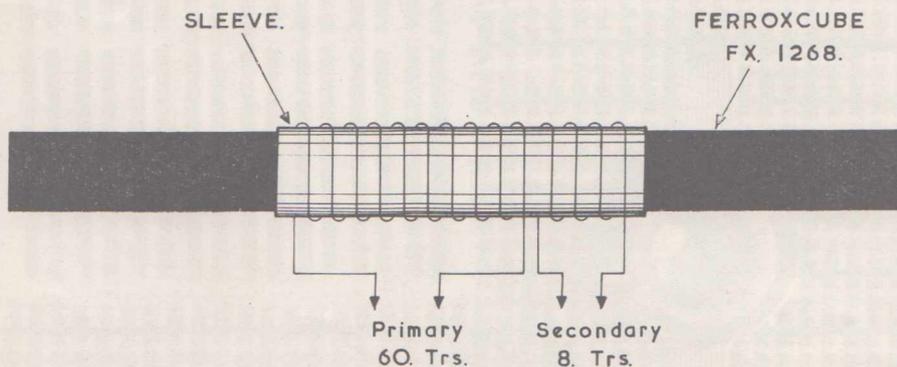


Diagram. 3.

centre-tapped output transformer to the 3 ohms speaker.

The Aerial

In order to obtain good sensitivity and performance the Mullard Ferroxcube rod FX1268 has been selected for the receiver to obtain the maximum possible power. The rod should be as long as is practicable within a given size of cabinet. This particular rod is approximately 7 in. long by $\frac{3}{8}$ in. in thickness. An increase in the diameter of the rod increases the Q and hence the power output.

Diagram (three) shows the rod and the placings of the two windings.

The use of litz wire is recommended for both the windings which should be close wound onto a sleeve to allow movement along the rod. This movement is necessary for final adjustment when aligning the receiver. A convenient method of arranging this movable sleeve is to wind onto the rod several turns of Cellotape with the sticky surface outwards, placing under the tape before winding, a few strands of wire which should be left in position until all coils have been wound. This is necessary because without them the coil windings will clamp the Cellotape tightly to the ferrite rod and so make movement impossible. When both coils have been wound onto the Cellotape the wires can be withdrawn from the sleeve.

CONSTRUCTION OF THE RECEIVER

Before commencing construction a few articles of ironmongery will be required. These include seven $1\frac{1}{2}$ in. 6 or 4 B.A. bolts with nuts and washers. About six smaller nuts and bolts will also be needed. The set is built above and below the speaker magnet when the latter is in a vertical position and the approximate layout is given in figure 2.

Start the construction by cutting a piece of 5-ply wood $8\frac{1}{2}$ in. \times 6 in. Mark on this the external shape of the speaker leaving one thickness of the 5-ply at the lower end. Cut an aperture in this board approximately $\frac{1}{2}$ in. smaller than the speaker.

A second piece of 5-ply should now be cut to form the base board. This is $8\frac{1}{2}$ in. \times $2\frac{1}{2}$ in. Screw and glue the base board to the front baffle. The speaker when bolted into position should just rest on the lower board.

The paxolin sheet on which the first three stages are built should be cut to 8 in. \times $2\frac{1}{2}$ in. and fixed as shown in figure 2. When this has been adjusted and fitted, remove and commence the placing of components as shown in figure 5.

When laying out the components as shown in figure 5, it is suggested that the coils be placed exactly as shown, as this method of positioning facilitates wiring and obviates excessive crossing of

connecting wires. It will also be found that all resistors and capacitors connected to the positive or earth bar will be conveniently positioned to connect directly from their respective components and this will also apply to the negative bar when in fact less connections are made.

The location of the three transistors is indicated and in every case place the collectors forward. This helps with the connecting and also acts as an easy method of identification when inserting transistors into their sockets. If this system is always followed throughout the receiver, many errors can be avoided when transistors are replaced and this in turn prevents the risk of damage should a transistor be wrongly connected.

It is not considered necessary to give further measurements or details of construction as space is not limited and no difficulties should be experienced.

ALIGNMENT OF THE RECEIVER

The I.F. transformers supplied by the Wireless Telephone Co., will normally be received pre-aligned, so avoid altering the position of the ferrite cores during construction of the receiver.

When the receiver has been completed and a signal is heard adjust these cores, if necessary, for maximum volume. Now turn the tuning capacitor to the low frequency end of the medium wave band, e.g. North Regional, and adjust the oscillator core, rocking the gang, and tune for best signal strength, then slide the aerial coil along the rod for maximum volume.

Now turn to the high frequency end of the band and adjust oscillator trimmer or tuning capacitor, again rocking gang for best signal strength.

Then adjust the aerial trimmer on gang for maximum volume. Finally, recheck the three I.F. transformers commencing with the third and working back to the first.

CONSTRUCTING A CABINET

One of the hardest problems confronting the amateur constructor when building a pocket receiver or a portable of this nature is the cabinet. Practically nothing exists on the market of this kind and even if one can find the obscure store that does make the odd box it is almost certain to be unsuitable in both appearance and dimensions. There is left but one alternative, to build one ourselves. Now the problem arises of what material to use, it must be something light in weight yet strong, something non-metallic that is reasonably easy to cut and not too thick. The answer is I.C.I. perspex sheeting. This is produced in rather large sheets but suitable cuts can be obtained from several stockists at a fairly reasonable cost. It can be supplied in a variety of colours and thicknesses and

APPROXIMATE LAYOUT DETAILS AS SEEN FROM REAR OF THE RECEIVER.

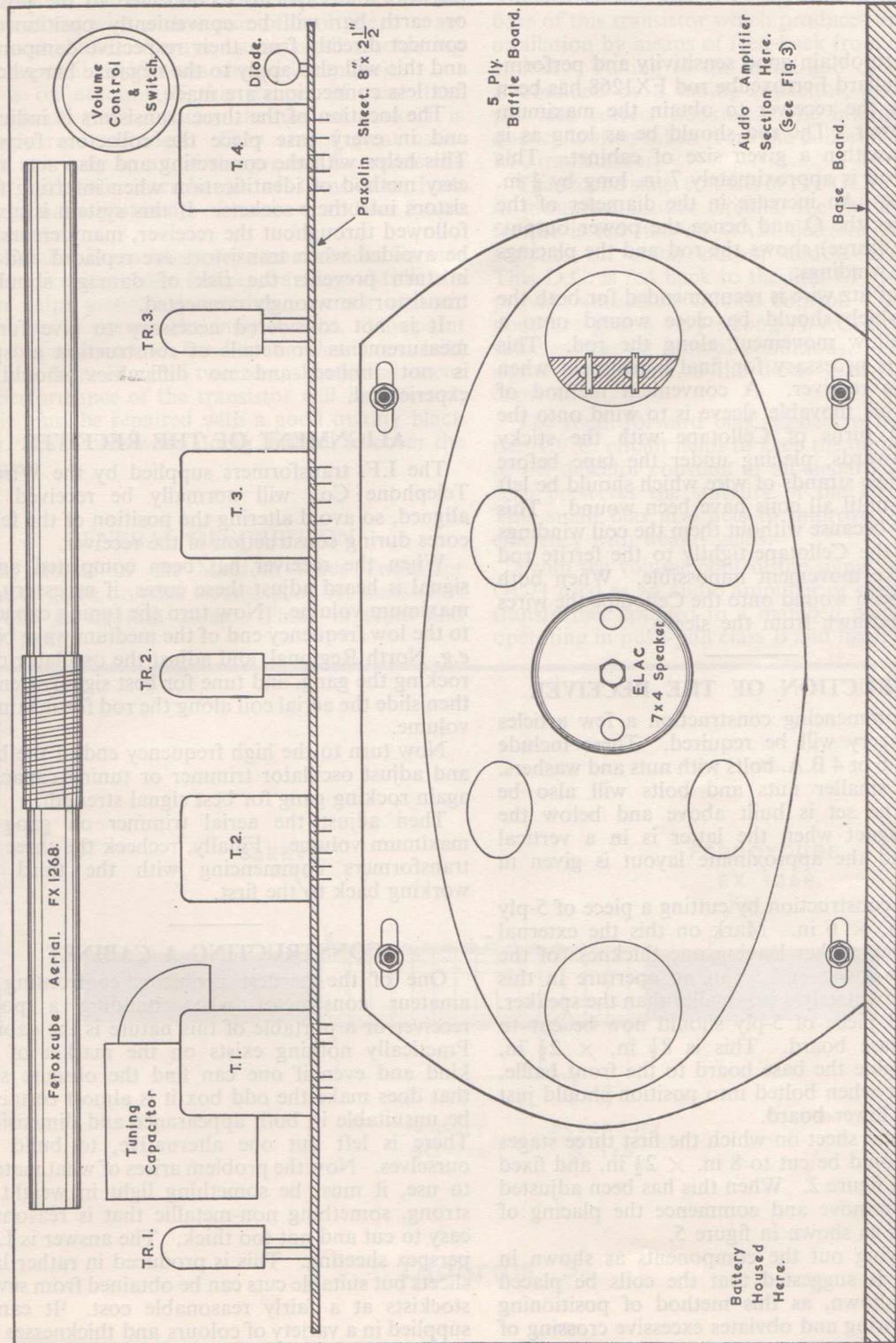


Fig. 2.

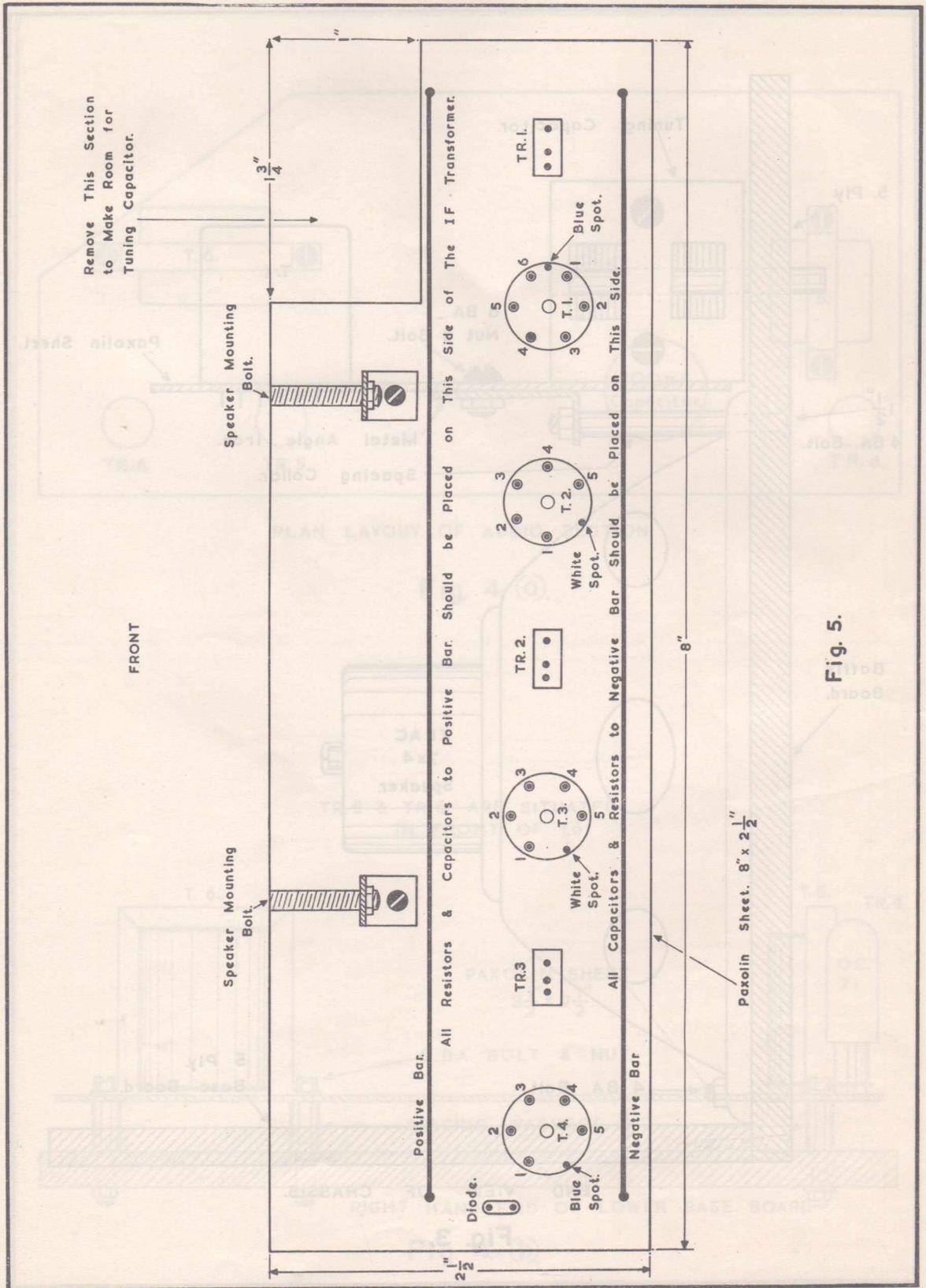
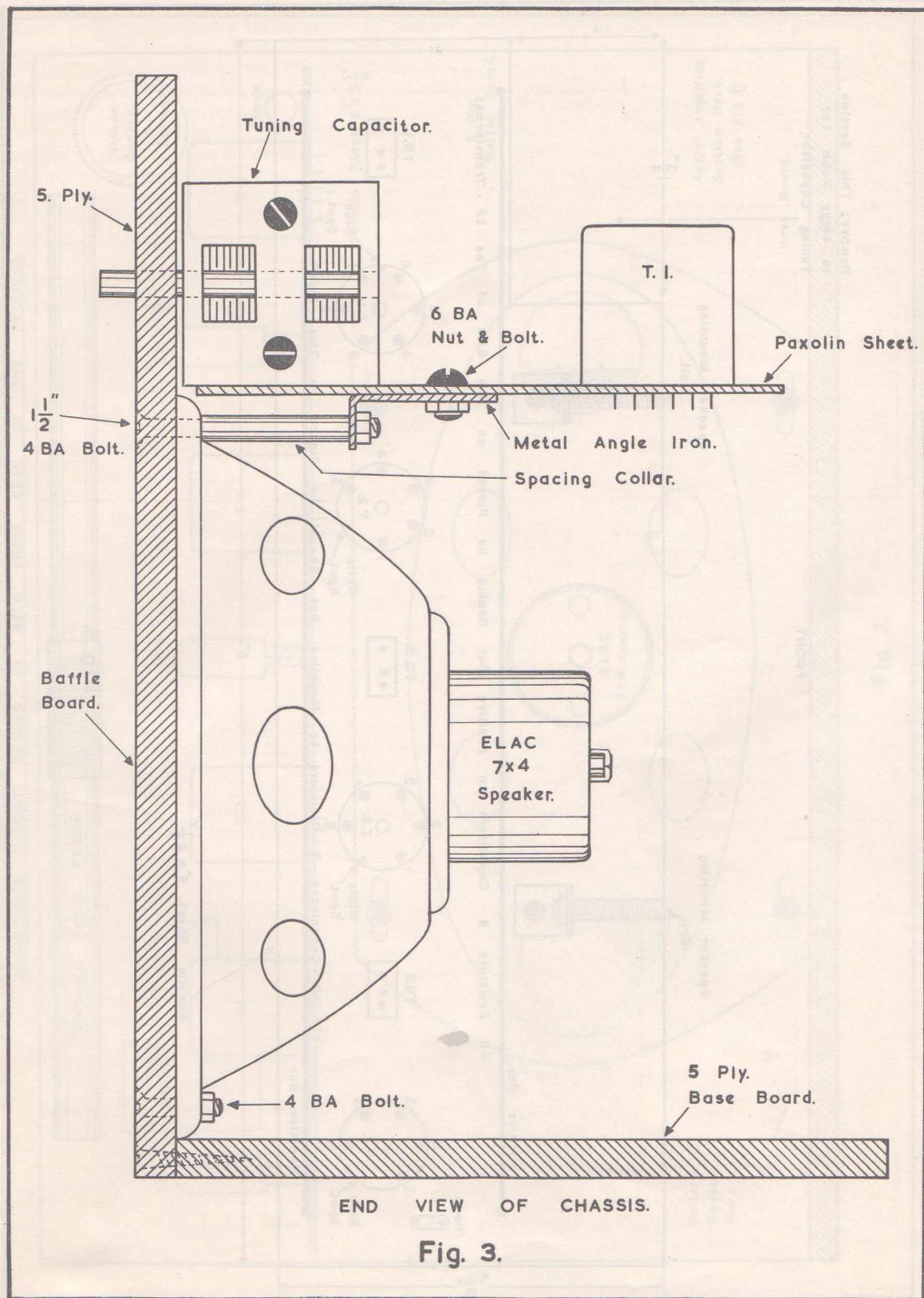
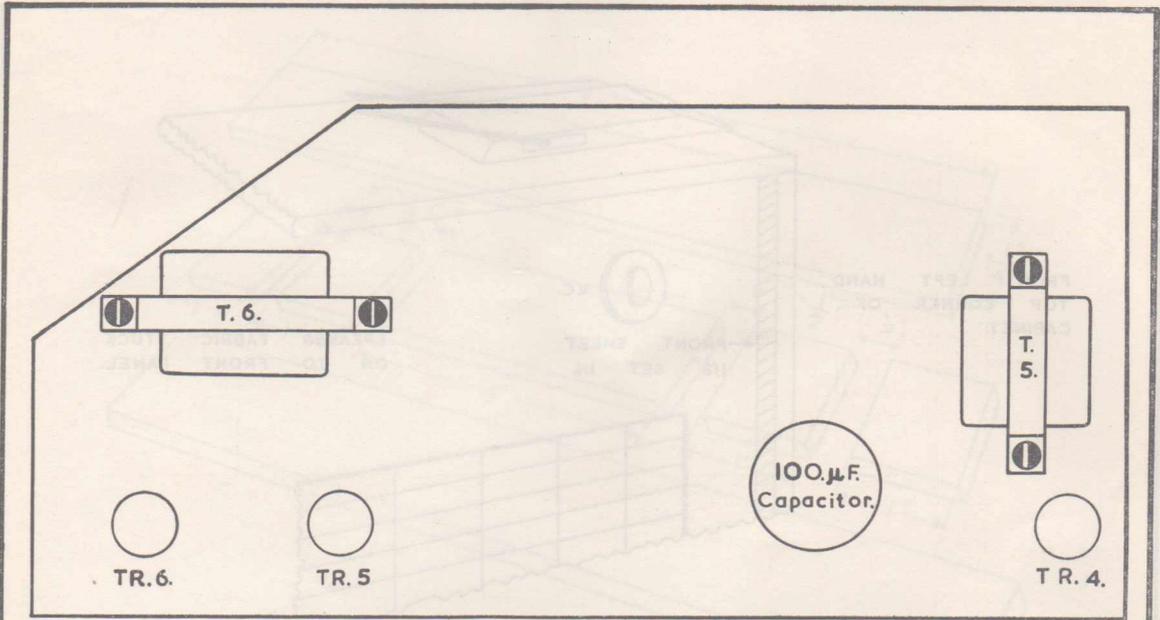


Fig. 5.





PLAN LAYOUT OF AUDIO SECTION.

Fig. 4. (a).

TR.5 & TR.6. ARE SITUATED
IN FRONT OF T.6.

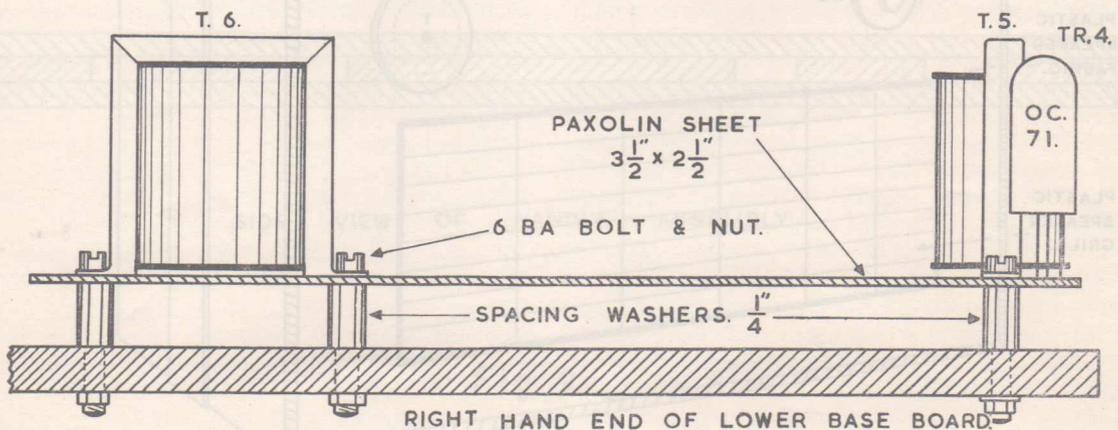
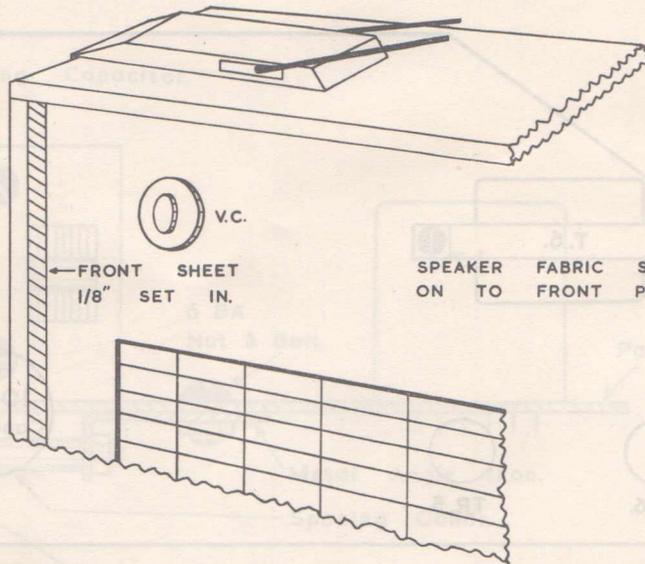


Fig. 4. (b).

FRONT LEFT HAND
TOP CORNER
OF
CABINET.



← FRONT SHEET
1/8" SET IN.

SPEAKER FABRIC STUCK
ON TO FRONT PANEL.

Fig. 7.

VIEW OF PERSPEX CABINET.

PLASTIC
SPEAKER
FABRIC.

PLASTIC
SPEAKER
GRILL.

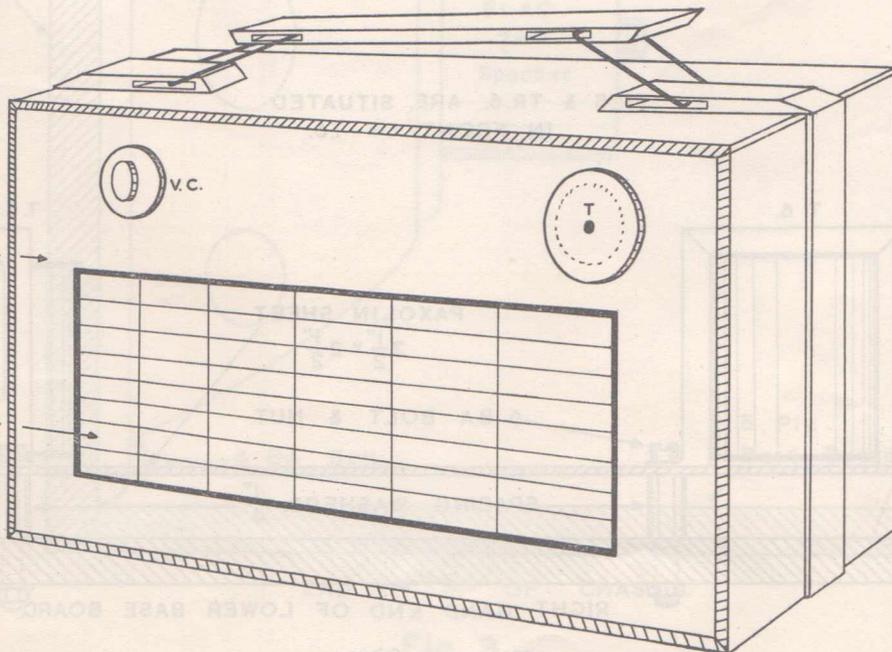


Fig. 6.

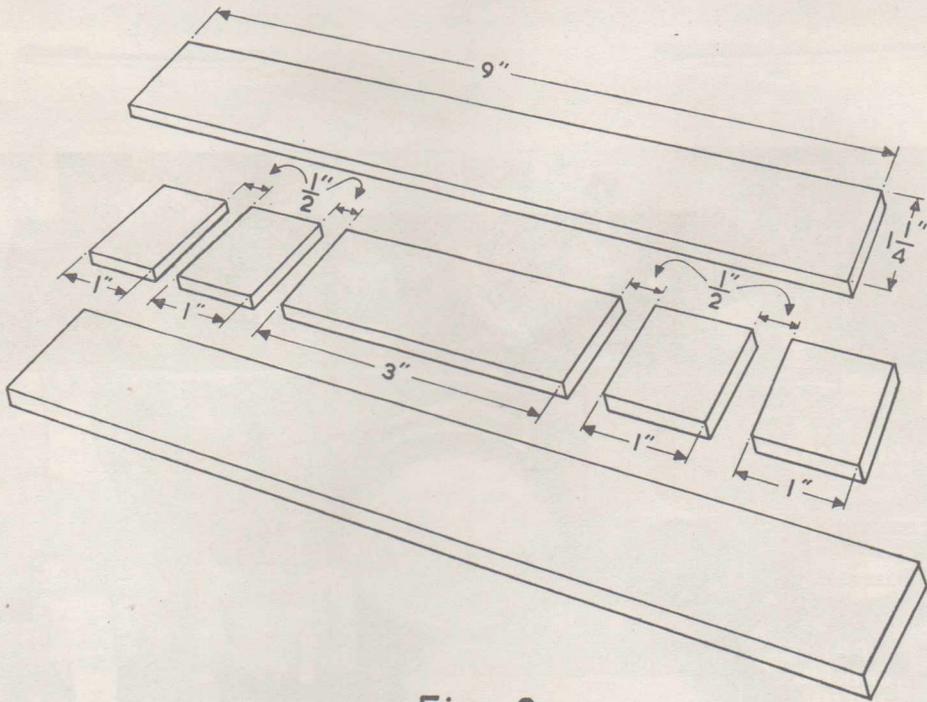
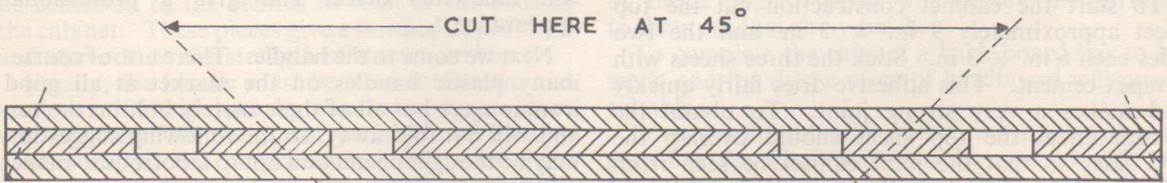
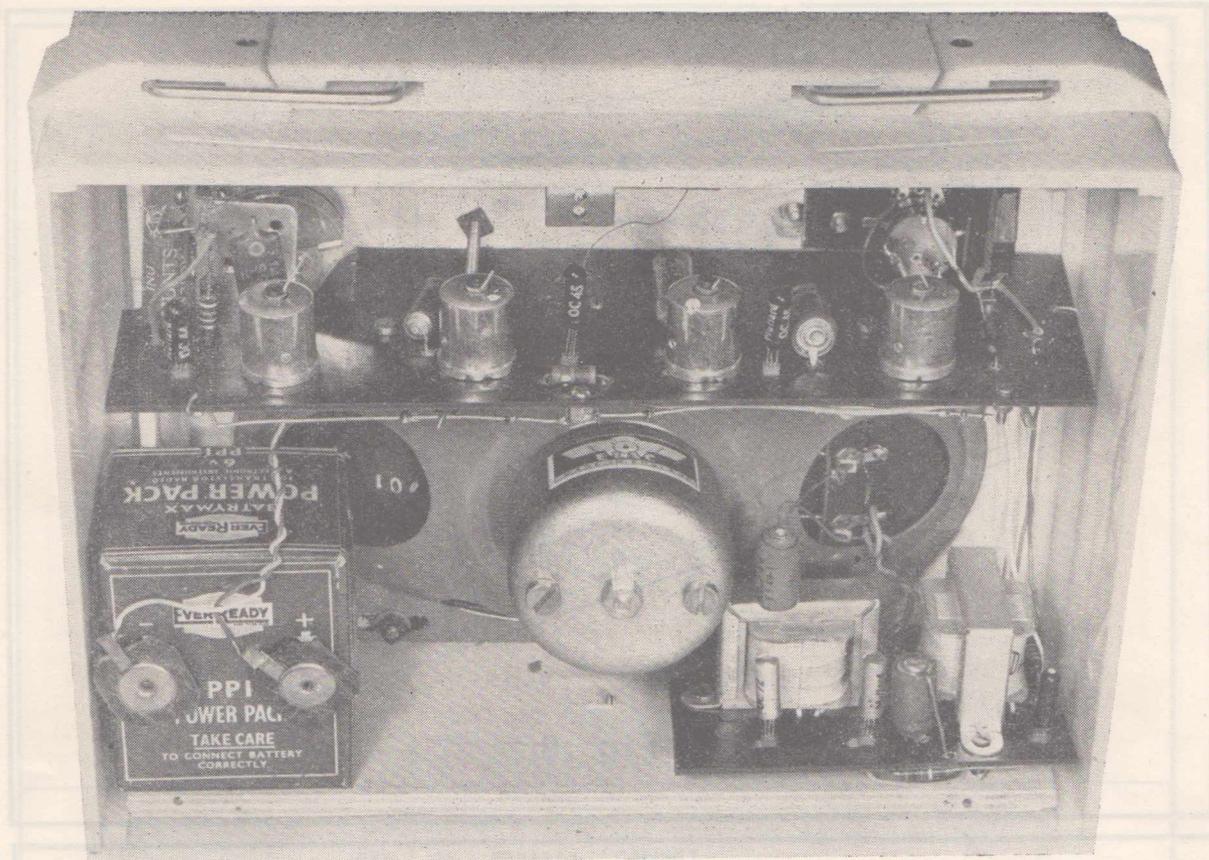


Fig. 8.



SIDE VIEW OF HANDLE ASSEMBLY

Fig. 9.



The 6 transistor receiver showing the positions of the I.F. transformers.

for this application the sheeting should not be less than one-eighth. Figures 6 and 7 will give a suggested arrangement and design.

To start the cabinet construction cut the top sheet approximately 9 in. \times 3 in. and the two sides each 6 in. \times 3 in. Stick the three sheets with perspex cement. This adhesive dries fairly quickly and makes a very strong joint. To obtain the neatest effect the top sheet should overlap the two sides so that the joint cannot be seen from above. Cut and stick the base sheet into position. When the frame has thoroughly dried, cut a piece to fit firmly into the front. This will form the front of the receiver and it is to this that some form of plastic speaker fabric may be fixed. Therefore to stick this sheet into position an aperture must be cut to accommodate a speaker grill.

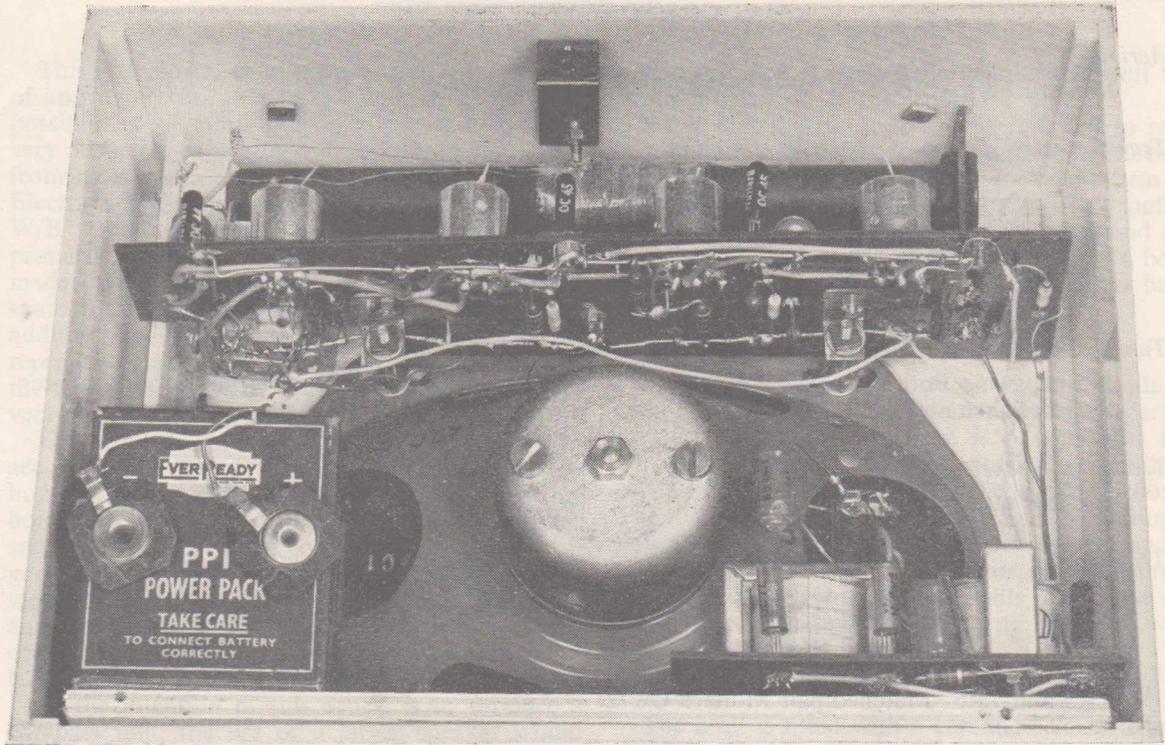
When the grill has been fixed into the slot cut for that purpose the whole unit should be cemented into place. It is quite effective to recess the front about an eighth of an inch into the frame as this enables a border to be placed around the entire front edge, which gives a good finish and covers the

edges of the plastic speaker fabric stuck to the front. The outer edges of this material are rather apt to become frayed and so spoil the effect. The border will hide this defect and give a professional appearance.

Next we come to the handle. There are, of course, many plastic handles on the market at all good ironmongers but all of these merely bolt on the top and will not fold away, so the following suggestion may be thought neater and not to laborious to make.

Cut three strips of perspex about $\frac{1}{4}$ in. longer than the cabinet and about $1\frac{1}{2}$ in. in width. Place one on top of the other and file them all to exactly the same width. (Unless you are a very excellent man with a saw they won't all be the same width.) Cut the centre piece into five pieces as shown in figure 8.

Now cement all these pieces together to form a sandwich with the small cut up section in the centre. You now have one solid piece with four slots $\frac{1}{2}$ in. long. These slots as the diagram shows are to accommodate the thick wire handle supports. The next stage is to cut the whole cemented strip



This view illustrates the wiring of the R.F. section.

into three parts as shown in figure 9.

To improve the appearance of the completed handle assembly the ends may be bevelled as shown in figure 9. When the bevelling and cutting is complete the two end pieces must be cemented to the top of the cabinet leaving $\frac{1}{8}$ in. projecting over each end to cover two further strips that can be cemented to the centres of each of the ends of the cabinet. These pieces give a finished appearance and also add to the strength of the whole box.

Finally, the handle must be fixed to the two end sections. This is done by constructing two stout wire brackets. In the prototype, a pair of knitting needles served the purpose admirably. As there are a great variety of models available in both thickness and colour one will surely find the ideal. After choosing a pair of needles, bend them to form a rectangle 2 in. \times $1\frac{1}{2}$ in. or adjust the last measurement to the width of the handle and insert into the slots.

Now a word about all these edges and saw cuts

and places where the perspex has lost its polish. Wherever the polish has for any reason been damaged or removed completely, sandpaper with, in the first instance, fairly rough paper, then changing to a finer one until all trace of scratch marks or lines are removed. Brush off all dust and perspex filings and polish with Duroglit silver or metal polish, which will restore the surfaces to their original shiny finish.

To complete the cabinet a back board has to be made and for this, a piece of hardboard will prove suitable.

Several holes must be drilled into the hardboard and then the whole unit may be covered with the same type of speaker fabric as used on the front.

To secure the back into position offers no great problems and one simple method would be to screw the lower part to the 5-ply chassis base board and the top to a small piece of angle iron fixed to the top of the cabinet and having a 6 B.A. hole drilled and threaded on the near surface.

COMPONENTS LIST

Aerial

Mullard Ferroxcube Rod Type FX1268 (windings—see text).

Transformers

- T.1. Oscillator Coil. Wireless Telephone Co. Type CP124924/10.
 T.2. and T.3. 1st and 2nd I.F. Transformers Wireless Telephone Co. Type CP124925/A.
 T.4. 3rd I.F. Transformer. Wireless Telephone Co. Type CP124926.
 T.5. Driver Transformer. Ardente Type D4003.
 T.6. Output Transformer. Ardente Type D4004 (3 ohm speech coil).

Tuning Capacitor

115 pf. swing Both Sections, Wingrove & Rodgers Type C78-02 with slow motion drive, inter-section screen and trimmers.

Transistor Sockets

Ardente miniature type.

Transistors

- TR1 Mullard OC44.
 TR2 Mullard OC45.
 TR3 Mullard OC45.
 TR4 Mullard OC71.
 TR5 and TR6 Matched pair Mullard OC72.

Diode

Mullard OA81.

Capacitors

- | | |
|----------------------------|---|
| Daly (2) 100 mu.f. 6 volt. | Hunts (2) .25 mu.f. 6 volt. |
| Daly (1) 5 mu.f. 6 volt. | Hunts (2) .1 mu.f. 6 volt. |
| Daly (1) 2 mu.f. 6 volt. | Hunts (2) .01 mu.f. 6 volt. |
| | Hunts (1) 140 pf. silver mica or ceramic. |

Resistors

- | | | | |
|--|--------------------|--------------|----------------------------|
| (3) 47 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | } T.S.L.
High stability |
| (1) 22 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (1) 10 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (1) 8.2 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (1) 6.8 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (1) 4.7 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (1) 2.7 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (2) 1 K-ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (2) 470 ohms. | $\frac{1}{4}$ watt | 10 per cent. | |
| (1) 180 ohms. | $\frac{1}{4}$ watt | 5 per cent. | |
| (1) Volume control with switch—5 or 10 K-ohms. | | | |

Speaker

7 in. \times 4 in. Elac:

Battery

EverReady P.P.I. 6 volt.

Case

Made with perspex (see text).

THE TRANSISTOR RADIOGRAM

This little portable unit can be built into a space of approx. 11 in. × 8 in. × 5 in. so offers great possibilities of portability and convenience. A very attractive cabinet can in this case be obtained from most radio dealers and is made by Whiteley Electrical Radio Co. Ltd., the makers of the famous W/B Stentorian loudspeakers. It is designed primarily to house the 7 in. record reproducer made by Starr Electronics but it allows plenty of spare room to add a medium wave tuner unit in addition to the Audio amplifier used by the reproducer, and as mentioned early in the book the circuit of the tuner and Audio amplifier differ very little from the portable radio receiver.

The cabinet has been designed not only to accommodate the Little Starr unit but also to house a 3½ in. W.B. speaker S.359 the mounting holes being already drilled, and the use of this small speaker facilitates construction and will give good results. However better quality would obviously be obtained if a larger speaker were used and this is left to the judgment of the individual constructor. W.B. cannot, however supply a larger speaker to fit their cabinet.

As the intention of this article is to produce a compact unit, the use of a larger speaker would necessarily involve a very much larger cabinet.

The Little Starr Battery operated unit is a very neat and efficient instrument and its operation should be thoroughly understood by constructors otherwise damage may occur in handling the pick-up arm. The following is an extract from the manufacturer's data sheet and should prove interesting and useful for both operating and constructing this radiogram.

"The Little Starr" is a battery operated player for single 45 r.p.m. records (which includes the 7 in. extended play type). Extensive use of modern moulding technique has made this light weight unit possible the overall weight being only 15½ ozs.

Operation

The manual movement of the pick-up protective shell.

- A. Release the tone arm from the locked in transit position.
- B. Lift the arm by the rest to a suitable level for playing.
- C. Cleanse the sapphire stylus by means of a built-in brush.
- D. Move the motor idling pulley into the engaged position.

This is normally disengaged from the motor drive to prevent "dimpling" of the rubber surface.

A small movement of the arm away from the turntable starts the motor and the stylus is then placed in the starting groove of the record. An

automatic stop is provided which switches off the motor at the end of the record.

After playing, the tone arm is returned to rest. A slight downward pressure (a) causes the protective shell to cover the pick-up and locks the arm in the 'Transit' position (b) frees the motor pulley (c) cleans the stylus by the built-in brush and (d) switches off the motor if the tone arm has been removed from the record before the end has been reached.

The Motor

The Little Starr is powered by a "kinder" motor also produced by the company as a separate unit. The operating voltage is 6 volts and the current consumption during playing is as little as 32 m.a. with the needle in the outside groove. The "kinder" motor incorporates a centrifugal governor which ensures that the turntable speed remains constant within ± 0.5 per cent. whatever the applied voltage within the limits of 6.2 and 4.5 volts thus enabling the battery to be used well towards the end of its useful life.

Pick-up

The limit is fitted with a ceramic element transducer provided with two 1 mill. radius sapphire styli suitable for usage under all climatic conditions. When eventual wear necessitates a change, the cartridge can be withdrawn, moved through 180° and replaced within a matter of seconds. A keyway prevents insertion at any other than the correct position.

The power point transducer

Case—Nylon.

Element—Ceramic.

Tip Material—Sapphire.

Tracking Force—5-8 grammes.

Netweight—300 milligrammes.

Terminal—Beryllium copper self-cleaning type.

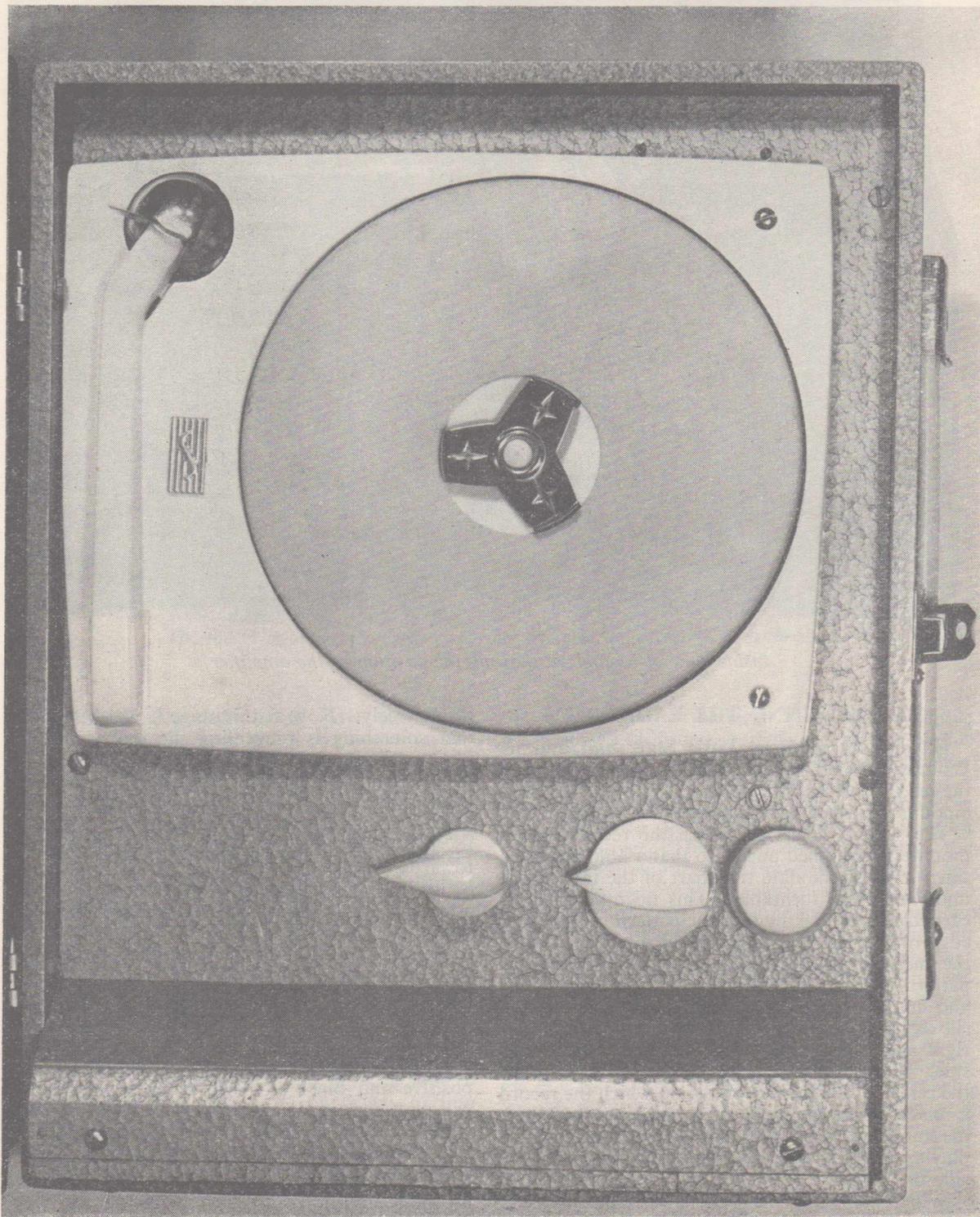
Load—1 Meg: 100 pf.

Average output voltage at 1000 cps., .24 volts. using Decca test record LXT2695.

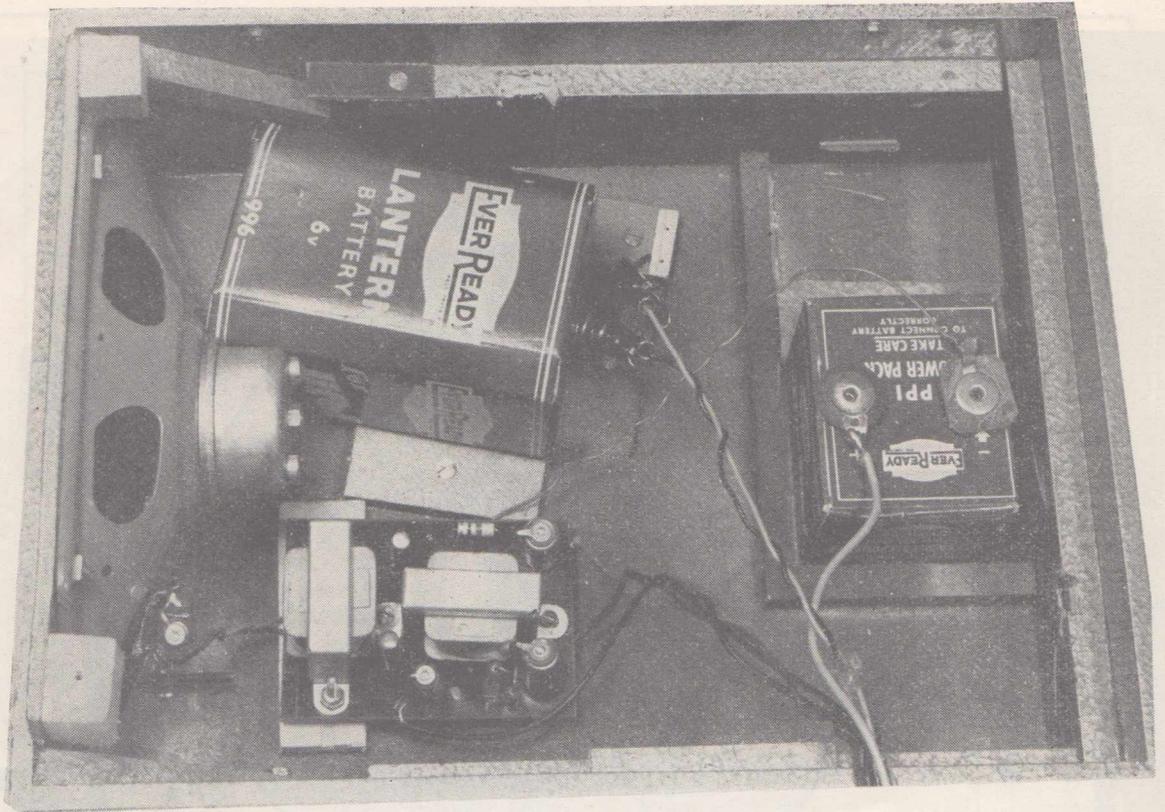
COMPONENTS LIST

The list of components needed for the radiogram is almost identical to that of the radio receiver with the following additional items.

1. Cabinet by Whiteley Electrical Radio Co. Ltd.
1. Little Starr 7 in. Record Unit Type "D" 6 volt English Centre, Starr Electronics Ltd.
1. Battery Ever Ready Lantern type 6 volt.
1. Battery Ever Ready 6 volt P.P.1.
1. Wave change switch used for switching gram to radio—Ardente S1450.
1. Input matching transformer Ardente Type D102.
1. Ferrite Rod aerial Mullard Ferroxcube FX1057.



...place into the cabinet to make sure it would will
...that below the front board the unit
...from the handle and if these adjustments have
...been well done the motor should rotate



Inside view of radiogram showing the position of the amplifier.

CONSTRUCTING THE RADIOGRAM

Having obtained the Little Starr unit and its Whiteley Cabinet, start the construction by mounting the record unit into the cabinet, to do this a certain amount of elementary carpentry is required.

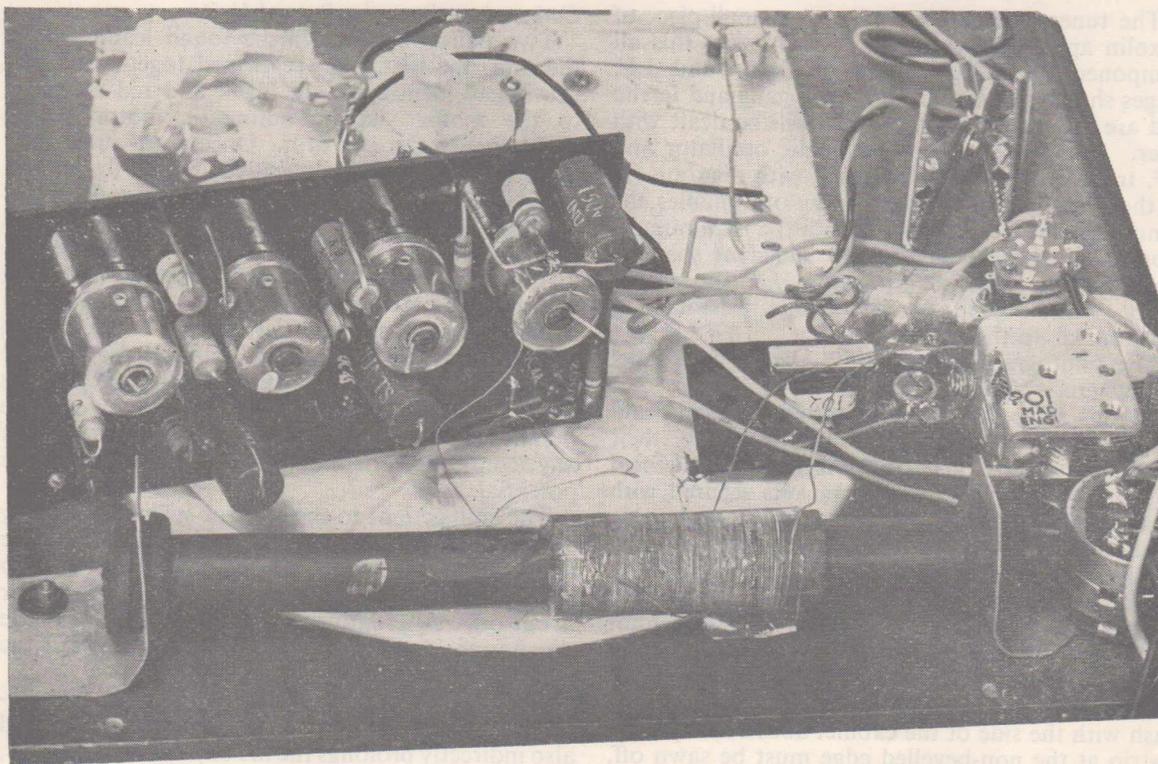
The surface board on which the record unit is mounted is supplied uncut, so that a hole has to be sawn to accommodate that part of the instrument underneath the turntable. This operation is best carried out by making a paper pattern of the outer edge of the cream plastic mould taking care that the measurements are correct. Then reduce this pattern by $\frac{1}{8}$ in. Transfer to the mounting board and cut out the required piece. The photograph shows that the unit is placed at the tone arm edge right against the side of the cabinet on the hinge side. This is essential as $3\frac{1}{2}$ in. must be left between the centre of the motor spindle on which the record is placed, and the sides of the cabinet. If these measurements are not exact the record when in the playing position will not rotate freely but foul side of the box.

When the hole has been satisfactorily cut, carefully fit the unit, and before screwing down, place into the cabinet to make sure a record will

rotate freely. Now at this stage it will be noticed that something is preventing the tone arm from freely swinging into position. This is due to the wooden rail onto which the mounting board is fixed. Note just where this interferes with the tone arm action and remove that part of the rail to allow sufficient movement of the arm both towards the turntable and also away from it as it is this latter movement that starts the motor. This adjusting operation can be rather lengthy but time spent at this stage will be well rewarded later. Anything not quite satisfactory will cause trouble, may damage the record unit, and certainly will be very much more difficult to rectify at a later stage.

When the final adjustments are complete, connect the lantern battery to the black and red twined wires making sure that the red is connected to the positive and black to negative otherwise records will play backwards. (Perhaps no great drawback with some recordings but not recommended as a general practice.)

Push back the transparent protective cover and lift the tone arm from the recess, swing over away from the turntable and if those adjustments have been well done the motor should rotate.



The motor board-control panel showing the position of the R.F. section.

The photograph of the inside shows clearly the position of batteries and other components and as space once again is in good supply no exact details are needed of lay-out.

A few points, however, must be borne in mind.

The ferrite rod must be situated along the handle edge of the cabinet and at the end farthest from the speaker. Keep the audio transformers as far away as possible from the rod as feed-back may occur if they or the speaker are placed too close to the aerial.

It will once again be noticed from the photographs that the audio stage is constructed separately. This method does simplify the building operations and also allows modification to these circuits as given.

The next stage in construction is to fit the lantern battery in position and secure by means of thin strips of 5-ply wood.

In the prototype, a larger speaker has been used but is not recommended as rather more advanced carpentry is required as may be seen from the photograph: however, this can be left to personal choice but whatever speaker is used it should be mounted before the lantern battery. When replacing

the rather bulky battery, the most suitable position will be found as indicated by the photographs. Put the battery in place and replace the record unit on its board to make sure that it can be fitted correctly and does not foul the battery. When this is done, secure with the thin wooden battens. These wooden strips prevent the battery from sliding about on the bottom of the cabinet while allowing its removal when the unit is lifted free of the box. Now the second and smaller battery used to provide power for the radio and amplifier, should be similarly secured at the other end of the cabinet, within the already supplied railed enclosure. The best position inside this area will be found at the end nearest to the cabinet handle and may easily be held in position by a single strip of wood glued to the bottom on the far side. Having placed and fixed all the larger components we are now ready to start on the amplifier and tuner units. The construction of the amplifier need give no difficulty and is built on a small strip of paxolin similar to the one used in the first receiver, and for simplicity is mounted on the base of the cabinet next to and parallel with the large battery. This position brings it close to the speaker and reasonably well spaced from the aerial rod.

The tuner unit can be built on a small piece of paxolin approximately 4 in. × 2 in. On this all components relating to the oscillator and I.F. stages should be placed. The twin gang and ferrite rod are mounted separately and will be dealt with later. The exact positioning of the oscillator and I.F. transformer should conform with diagram (5) in the previous article, as this lay-out enables the connections to be carried out with the minimum of crossed wires and ensures that sufficient space is available for other components, *i.e.* the rather bulky .1 mf. capacitors and various resistors that go to make up the unit.

The photograph shows quite clearly this panel and where it should be mounted.

At this stage we have completed the tuner and amplifier and secured both of them into their allotted positions. The tuner is fairly easily held in place by two small angle brackets secured with small wood screws to the record unit mounting board and 6 B.A. bolts to the paxolin strip. Now finally the last stage, where a little more carpentry is required:—It will by now have been noticed that the small sloping board above the speaker cannot be placed in position, this is due to the lantern battery preventing the board from sliding down to its full extent. In order that it should be finished flush with the side of the cabinet above the speaker a strip at the non-bevelled edge must be sawn off, about an inch should be sufficient.

We still have a few components not mentioned—the volume control, and ON/OFF switch, tuning capacitor and selector switch for radio or gram. A convenient place for mounting all three of these will be found on the record unit mounting board between the unit and the sloping board just mentioned.

They must all, however, be placed at the cabinet handle end of this area, otherwise the parts that protrude well through the board will foul the lantern battery or speaker magnet, and great care should be taken when drilling the spindle holes for these components that there is in fact sufficient room underneath the board. The tuning capacitor will be found in the centre and the volume control nearest the cabinet handle.

The small Ardente input matching transformer (D102) can conveniently be mounted on the record unit mounting board in line with and between the selector switch and the point where the braided wire leaves the record unit.

Connections from the Record Unit

Two pairs of wires will be found leading from the unit, the first two are twined together and as previously mentioned are black and red and lead to the motor via the automatic motor switch controlled by the tone arm. Once again a reminder to connect the black to negative and red to positive side of the battery using a pair of crocodile clips for the purpose. The other two wires are the pick-up connections. The braided wire should be at Earth potential and connected to the matching transformer and the centre wire to the other side of the primary winding. Care should be taken with this braided wire as it is connected to the positive side of the battery and must not be allowed to hang loosely, but should be secured with cellotape to the mounting board wherever it is in the vicinity of any connection or component with a negative potential.

The connections to the selector switch are clearly shown in the circuit figure 10, switches 2 and 3 are formed in this switch (2) which has been included so that when the record player is in use power to the tuner is cut off. Alternatively, when the radio is in use the power is switched back to the tuner and the record player input is cut off.

The use of this selector may be thought unnecessary but it does reduce battery consumption and also indirectly prolongs the life of the RF transistors, as they will not be functioning in the present arrangement whenever the record unit is in action.

Mounting the Ferrite Rod

Mounting this rather heavy rod does present certain problems. It must, as previously mentioned, be placed, as far as possible, from the tuning capacitor. The most suitable position then would be on the mounting board parallel to the cabinet handle. One convenient method of fixing the rod securely is to construct two angle brackets with $\frac{1}{16}$ in. aluminium sheeting. Don't make them larger than necessary as the metal will have a damping effect on the aerial circuit. Use rubber grommets to hold the rod into the brackets and fix the brackets to the board with small bolts rather than wood screws for added strength.

Aligning the Receiver

The same procedure should be followed here as described with the previous receiver.

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