THE JASON "JUPITER" STEREO PRE-AMPLIFIER

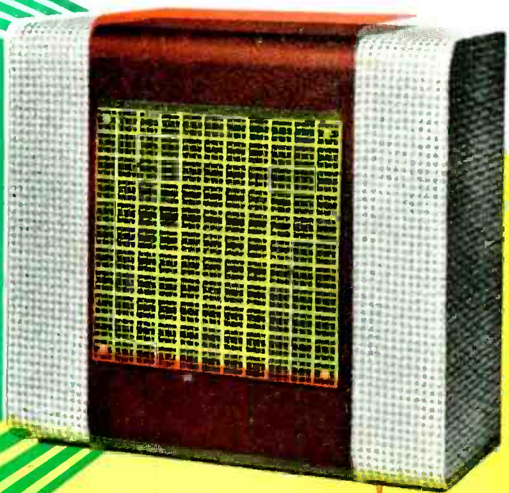
VOLUME 11
NUMBER 12
JULY
1958

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS

CRY BABY

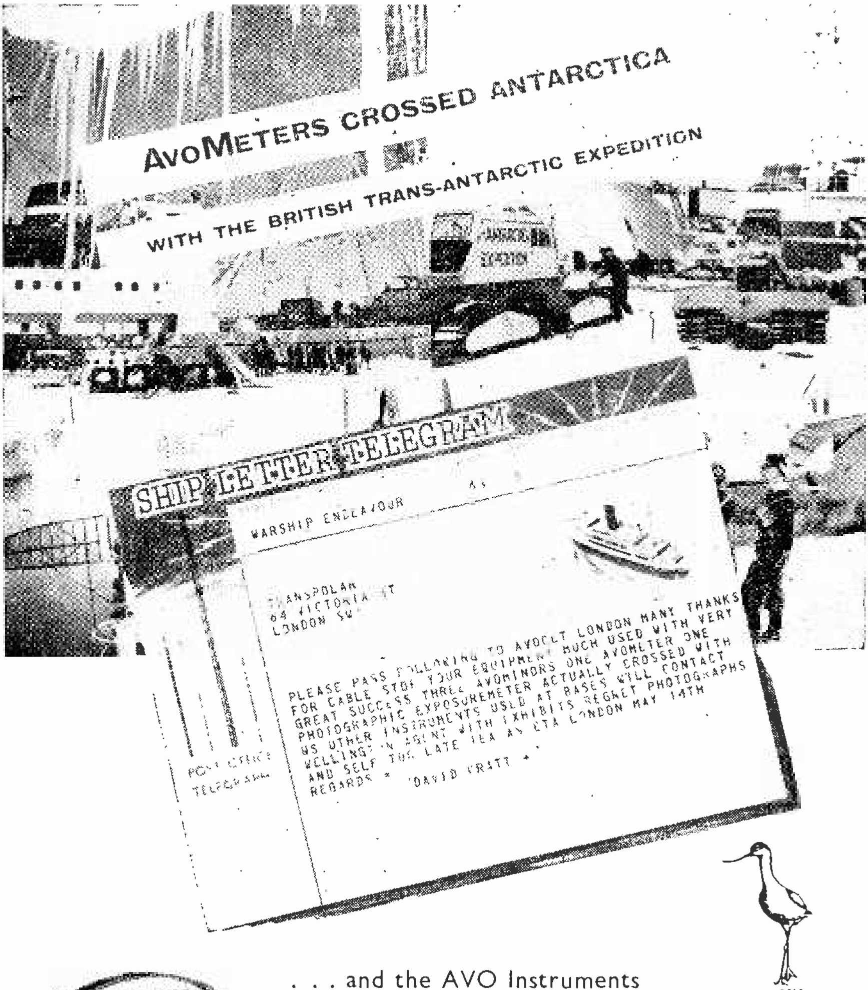
BABY ALARM

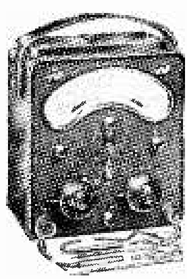


described by E. Govier

Included in this issue

DATA Publications 1/9





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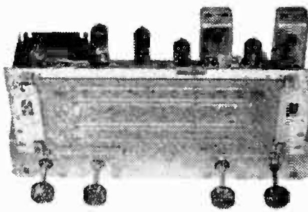

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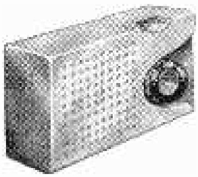

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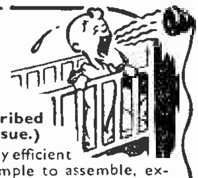

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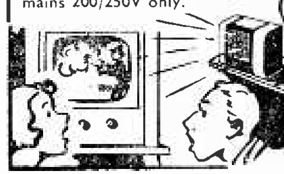

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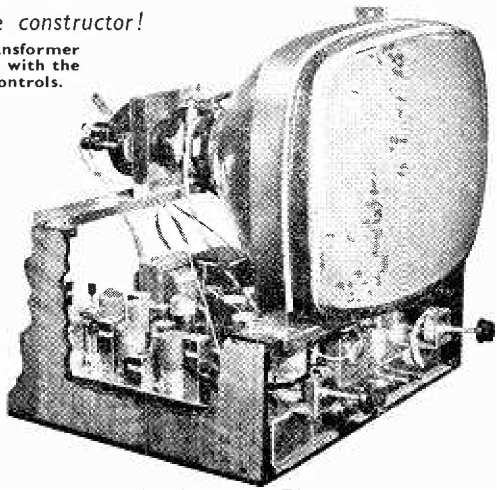

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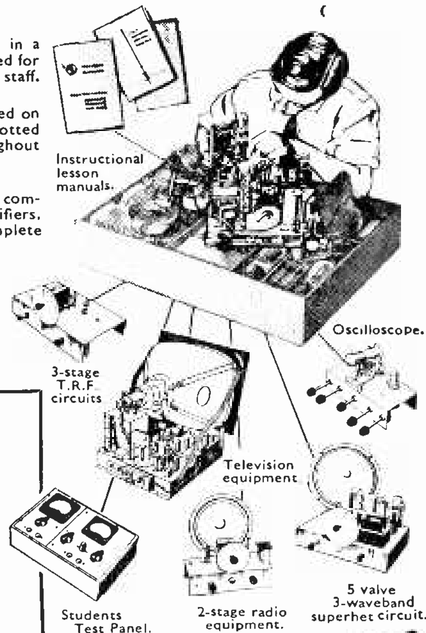

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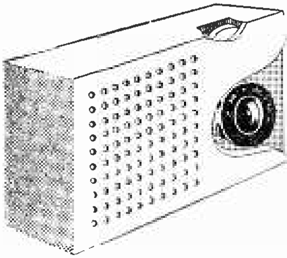

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CONTENTS

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THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included.

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TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

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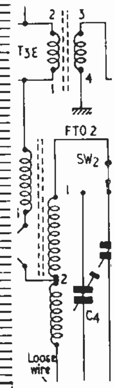

No. 92 A Three-Way Remote Control System

The circuits presented in this series have been designed by G. A. FRENCH, *specially for the enthusiast who needs only the circuit and essential relevant data*

AN INTERESTING FACET OF ELECTRONICS IS provided by the ability to control electrical operations from a remote position. Whilst such simple requirements as the switching on and off of a piece of equipment from a distant station are easy to resolve, it frequently happens that remote control over a number of complex operations is needed. In such instances ingenuity in design is required in order to reduce the number of lines between the remote, controlling, position and the local, controlled, position. If a radio link is employed between the two stations similar design ingenuity is needed to ensure that control may be obtained with the simplest possible form of signal.

A device which assists considerably in the achievement of multiple controls is the relay; and this lends itself particularly well to home-constructor applications owing to its relative cheapness (especially through surplus channels) and its simplicity. In this month's circuit two relays are employed in a remote control arrangement which enables three local circuits to be controlled from a remote position. Only two interconnecting wires are needed between the local and remote positions and one of these may be dispensed with if suitable earth connections are available at both ends. An a.c. mains supply is required at the local position, but the remote control circuit proper is isolated by means of a mains transformer.

Circuit Description

The full remote control circuit is illustrated in Fig. 1, wherein it may be seen that the local position is that shown on the left and the remote position that shown on the right. One of the pair of interconnecting leads between the stations is shown dashed. This lead may be dispensed with if reliable earth connections are available at both positions. Such earth connections would be given by mains socket earth terminals and the like, since these would normally ensure a low ohmic resistance between the two stations. (As in any other electrical application, domestic gas pipes and fittings should *never* be used for earth connections.)

In Fig. 1 the two relays and their contacts are depicted in the "detached" manner of presentation. In simple relay circuits of the type which appear in radio publications it is customary to depict relays and their contacts by means of the "attached" method of presentation, in which the relay winding is shown as a conventional coil and the contacts are illustrated directly above or below. Whilst this type of presentation enables the operation of the relay to be immediately comprehended, it causes difficulties whenever any complex switching arrangements are employed, this being due to the fact that the fixed positions in the circuit held by the contacts cause a large number of "crossovers" in the interconnecting circuit lines. In more complex circuits, therefore, it becomes less confusing to employ the "detached" circuit presentation.

and tells us also that the relay has three sets of contacts. The three contact sets are also shown in Fig. 1, these being designated A_1, A_2 and A_3. Unless otherwise specified, all contact sets in a "detached" diagram are illustrated in the position they take up when their relay is de-energised, and this convention is followed in Fig. 1.

We may now proceed to the functioning of the remote control circuit. The object of this circuit is to complete one of three controlled circuits by means of a remote switch. A fourth position of the remote

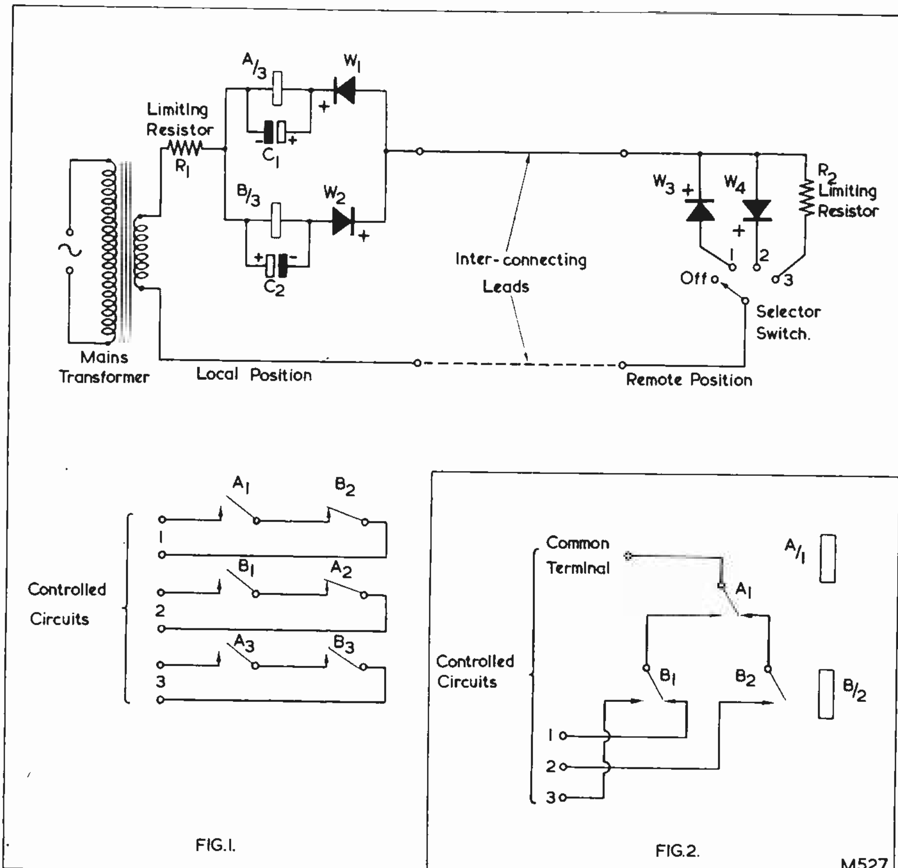

FIG.1.

FIG.2.

In "detached" circuits the winding of each relay is shown as a rectangle, the relay being identified by a letter over a number. The number indicates the quantity of contact sets employed by the relay. Thus, in Fig. 1, the reference A/3 indicates that the adjacent rectangle represents the winding of relay A,

switch enables all the controlled circuits to be switched off.

Commencing at this "off" position of the remote selector switch, we have the situation where no circuit exists across the interconnecting pair of leads and, in consequence, where no voltage is applied to the relays.

The relays remain de-energised and none of the controlled circuits at the local station is completed.

Let us now examine what occurs when we move the remote selector switch to position 1. This at once causes an a.c. voltage from the secondary of the mains transformer to be applied to rectifier W_3. Rectifier W_3 is connected such that only positive half-cycles appear on its upper terminal, these being applied to the upper interconnecting lead and, thence, to rectifiers W_1 and W_2. Of these two rectifiers only one, W_1, is connected up such that it may pass the positive half-cycles to its attendant relay winding. As a result a half-wave rectified a.c. voltage appears across the winding of relay A/3 and this becomes energised. (The purpose of the electrolytic condenser C_1 is partly that of smoothing the rectified a.c. applied to the relay winding, and thereby preventing contact chatter.) Summing up the above circuit operation, it may be stated that when the selector switch is set to position 1, half-wave rectified a.c. is applied to the winding of relay A/3, the current to this winding passing through two series rectifiers connected such that they pass current in the same direction.

When relay A/3 energises, its contact A_1 makes. Because of this, controlled circuit No. 1 becomes completed, the circuit path being made via contact A_1 (energised) and contact B_2 (de-energised). The other two controlled circuits are unaffected because, in the case of circuit No. 2, all that happens is that contact A_2 breaks; and, in the case of circuit No. 3, contact B_3 remains open despite the closing of contact A_3.

When the selector switch is set to position 2, a.c. is applied to rectifier W_4. In this instance it is negative half-cycles which are applied to rectifiers W_1 and W_2, and it is W_2 which is now able to conduct the rectified a.c. In consequence relay A/3 de-energises and relay B/3 energises.

The energising of relay B/3 causes contact B_1 to make, controlled circuit No. 2 being completed by B_1 (energised) and A_2 (de-energised). Circuit No. 1 is broken, both by A_1 (de-energised) and B_2 (energised), and circuit No. 3 cannot be completed because A_3 is in the de-energised position.

Putting the selector switch to position 3 causes a.c. to be applied (via limiting resistor R_2) to W_1 and W_2. Both rectifiers conduct, on alternate half-cycles, with the consequence that both A/3 and B/3 become energised.

This situation causes circuit No. 3 to be completed, the circuit path occurring via contacts A_3 (energised) and B_3 (energised). Circuit No. 1 is broken by B_2 (energised) and circuit No. 2 is broken by A_2 (energised).

A Simpler arrangement

The circuit of Fig. 1 enables three separate circuits to be controlled via a pair of remote leads, it being assumed that the three circuits must be isolated from each other.

It may quite feasibly happen that the three controlled circuits need not be isolated from each other, all that is required being that, say, a common source of potential be applied to each as desired. If this is the case it becomes possible to employ a common terminal for the controlled circuits, this being connected to three other terminals as desired.

A switching circuit capable of meeting this requirement is illustrated in Fig. 2. As may be seen, this is notably simpler than that of Fig. 1, the biggest saving being given by the reduced number of contact sets required on each relay. For instance, relay A/3 now becomes relay A/1, it needing only one set of "changeover" contacts. Relay B/3 becomes relay B/2, the requirement here being one set of "changeover" contacts and one set of "make" contacts. (The two relay windings still remain connected, of course, in the same manner as they were in Fig. 1.)

The switching circuit of Fig. 2 functions as follows. When the selector switch is in the "off" position neither relay energises, and the common terminal remains isolated from the other three terminals.

Putting the selector switch to position 1 causes relay A/1 to energise. In consequence the common terminal of Fig. 2 becomes connected to terminal No. 1 via contacts A_1 (energised) and B_1 (de-energised).

When the selector switch is set to position 2, relay A/1 de-energises and relay B/2 energises. The common terminal now becomes connected to terminal No. 2 via contacts A_1 (de-energised) and B_2 (energised).

In position 3 the selector switch causes both relays to energise. As a result, the common terminal connects to terminal No. 3 via contacts A_1 (energised) and B_1 (energised).

Practical Points

The constructor should have little difficulty in putting the circuits of Figs. 1 and 2 into practice, but the following points may be of assistance.

The types of rectifier employed in the W_1 to W_4 positions, and the mains transformer secondary voltage, depend upon the coil resistances of the relays employed and the energising voltages they require. An attractive proposition might be given by using relays capable of energising at some 10mA coil current, as this would then enable crystal diodes to be employed in the rectifier positions. Although not essential, it is desirable to employ the same rectifier type in all four positions. The condensers across the relay windings are required not only to prevent contact chatter, as was mentioned above, but also to reduce any high reverse voltages which might be given when the current through a relay winding is switched off. To prevent sluggish de-energising, it would be preferable to employ condensers whose value is just sufficiently large to clear chatter.

Care should be taken to ensure that the rectifiers chosen do not have their maximum inverse voltage ratings exceeded. The maximum inverse voltage applied is equal to the rectified voltage appearing across the load plus the peak voltage of the applied a.c. In this circuit it should be safe to assume that the rectified voltage is approximately equal to the r.m.s. voltage across the transformer secondary. Thus, if this latter is rated at 20 volts, the peak inverse voltage would be $20 + (20 \times 1.414) = 48.28$. Any rectifier having a maximum peak inverse rating greater than, say, 55 volts would be more than safe here. Most current crystal diode types meet this requirement.

The limiting resistor R_1 is intended to limit the rectified current when any rectifier is switched into circuit. A simple method of calculating its value consists of assuming that whichever relay winding is connected into circuit presents a temporary short-circuit. The value of R_1 then becomes that which causes slightly less than the maximum forward current specified for the rectifier type used to be passed when flowing through the forward resistances in series of W_1 and W_3, or W_2 and W_4. Details of maximum forward current and forward resistance will be available in the rectifier manufacturer's literature, and it should be assumed that the applied voltage is the peak value given by the transformer secondary. If the latter has a relatively high resistance, this may be considered as constituting part of the overall limiting resistance, and the value of R_1 may be reduced accordingly. The value of R_2 is equivalent to the forward resistance of either W_3 or W_4. Since some readers may not be prepared to tackle the calculation of limiting resistor values it may be helpful to state that, if crystal diodes are used in the W_1 to W_4 positions, safe values for R_1 and R_2 would be 300 and 200 ohms respectively. The resistance of the mains transformer secondary, if greater than, say, 25 ohms, may be subtracted from the recommended value of 300 ohms for R_1, enabling a lower value resistor to be used in this position.

TWO-WAY RADIO IN SOUTH AFRICA

TWO-WAY RADIO IS PLAYING AN increasingly important part as a time-saver—and even as a life-saver—in controlling a variety of government, civic and other activities in various large centres in the Union. In the Cape Peninsula this system of communication is now being used by the Table Bay harbour tugs, the Forestry Department, the municipal traffic department, the municipal fire brigade's central station, the South African Police, the city council's waterworks and cleansing departments, the Red Cross, the fire brigades outside the Cape Town municipality, the Automobile Association of South Africa—and even some of the building contractors and certain of the large taxi services. They are all working on different frequencies allocated by the Postmaster-General.

These organisations have found that two-way radio has greatly simplified and accelerated their work, with time and fuel wastage cut to a minimum. The vehicles using it vary from refuse lorries to the city's big new fire-engines, and the latest group of vehicles to be fitted with transmitters and receivers is the fleet of 30 ambulances serving the Cape Peninsula and the surrounding area. The first of these went "on the air" in the latter part of May.

In the case of the Red Cross, its radio-equipped ambulance—which to give it a greater range works on a lower frequency than most of the other vehicles using radio in the Cape Peninsula—has already helped to save several lives by ensuring prompt attention for patients being rushed to hospital. Examples of this were the use of "radio" ambulances at the scene of the Woodstock and Houboek rail smashes last year, when many people were injured and a number killed. There, through the Red Cross "home" stations, the hospital authorities were notified in advance how many patients to expect, as well as the nature of their injuries, so that the operating theatres could be prepared for their arrival.

A Cape Town municipal official said that the Cape Peninsula was one of the most difficult parts of the Union in which to operate two-way radio, because of the many "blind spots" caused by mountain ranges. For this reason, the Cape Town city council had authorised the putting into service of a special radio-equipped vehicle which would be used in emergencies to provide a link between municipal fire engines and the

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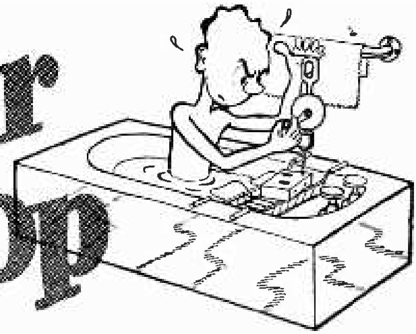
In your Workshop



Aided by his able assistant, Dick, Serviceman Smithy continues to run the Workshop

"THE TIME HAS COME," COMMENCED SMITHY, slowly. He broke off for a moment, collecting his thoughts.

"The walrus said?" suggested Dick.

The Serviceman and his assistant were both sitting outside the Workshop in the hot summer sunshine, and were spending the last half-hour of a lazy lunch break in intermittent conversation. Dick was taking full advantage of the sun's warmth and had divested himself of his shirt and vest; but Smithy, with a sense of the dignity befitting his station, had only allowed himself the digression of placing on his head a handkerchief with a knot in each corner.

"Please don't interrupt," said the Serviceman severely. "You've made me forget what it was I was going to say. Ah yes, I remember now. What I was thinking of is that it's time I started to put you in the picture concerning some of the new devices and techniques you'll be bumping into in the latest receivers. You may have met some of these new things already, but they are still unfamiliar enough to merit a little nattering from me during the next quarter of an hour or so."

T.N.A. Wire

Dick settled himself more comfortably on his seat.

"Fire away," he said, a little drowsily. "I'm always ready to learn."

"Right," said Smithy. "Well, the first thing that comes to my mind is the considerably increasing usage in domestic receivers of what is called 'T.N.A. wire.' T.N.A. wire is ordinary tinned copper wire covered with nylon and, on the outside, a lapping in the opposite direction of acetate."

"That seems to ring a bell," remarked Dick in a tone which showed awakened interest.

"It should do," replied Smithy. "It was described several years ago in the R.E.C.M.F. report in *The Radio Constructor*."

"What are the advantages of T.N.A. wire?" asked Dick.

"It has two major advantages," said Smithy. "The first of these being that both the nylon and acetate coverings melt at normal soldering temperatures. The result is that the wire doesn't have to be stripped before it is soldered to its tag. All that you have to do is to lay it on the tag and apply a soldering iron plus solder. Both the nylon and the acetate melt away, leaving a small amount of black residue, and you then get a good solid joint to the tinned copper wire underneath."

"That seems to be something definitely worth having," commented Dick. "What's the second advantage?"

"The second advantage is conferred by the acetate lapping on the outside," replied the Serviceman. "After you've wound a coil with T.N.A. wire you then brush or spray it with acetone, this dissolving the acetate covering. The acetone only takes a few moments to evaporate, after which the acetate covering becomes hard once more. This time, however, it forms a continuous skin all round the coil, protecting the wire and holding the turns firmly in position."

"I can't see much advantage there," commented Dick. "What's the difference between applying acetone to a coil and applying any of the ordinary forms of coil dope?"

"There's the world of difference," said the

Serviceman. "Pretty well the only practicable dope which can be used with coils is polystyrene dope, and this consists of the basic polystyrene together with a solvent. Which means that, from the manufacturer's point of view, it becomes necessary to ensure that dope containers are kept well topped up with solvent, that the solution is thoroughly mixed, and that it receives continuous attention. If all you apply to a coil is acetone then these troubles are avoided altogether. Also, an acetone-brushed T.N.A. wire coil sets hard far more quickly than does a polystyrene doped coil. Yet a further advantage, albeit a minor one, is that if the acetone is applied to the wires leading from the coil proper to its tags, you get a hard film of acetate around the wire. This provides quite definite strengthening for the narrower gauges, and it also prevents the nylon covering from fraying and unwinding at the solder joint."

"Well," said Dick, as he slowly digested Smithy's information. "All that you have told me has shown that the use of T.N.A. wire helps the manufacturer. However, I'm not a manufacturer, I'm a putter-right of manufacturer's products! So how does T.N.A. wire help me?"

"I don't think," replied Smithy, slowly, "that you're looking at this from the right point of view. Provided that the reliability and performance of a product is not changed, anything which causes a drop in production costs is of assistance to the general trade. Things like television sets are not exactly cheap and it is to everyone's advantage if their cost can be cut by new ideas and methods.

"Apart from that aspect there is also the fact that, if you are interested in servicing a particular product, you should also be interested in the processes employed in making that product and in why the manufacturer employs such processes."

"I stand corrected," remarked Dick contritely. "Now and again I find myself becoming a little anti-manufacturer in my consideration of the set-makers' point of view. I suppose all servicemen get like that now and again."

"They do, indeed," chuckled Smithy. "And I suppose it's a human enough reaction. Anyway, let's get back to T.N.A. wire. As I said earlier, this was described in *The Radio Constructor* R.E.C.M.F. report several years ago, so it is not entirely new. You will probably have seen it used already in some of the later sets which have passed through your hands.

"At the time being T.N.A. wire is used, so far as I know, in solenoid—that is, single layer—coils only. I haven't yet heard of anyone producing wave-wound coils with it. The single layer coils most likely to be wound with T.N.A. wire are found in the i.f. transformers for f.m. and t.v. receivers, and in Band I turret tuner coils. Also, in small r.f. chokes and components of that nature. To the best of my knowledge there is at present* no coloured T.N.A. wire available in this country, so that all the coils using T.N.A. wire will have 'natural' coloured wire. 'Natural' being white."

"There are quite a few shades of whiteness, you know," interjected Dick. "I've heard about them on t.v."

"It's a pity I ever helped you convert your set for Band III," laughed Smithy. "Anyway, T.N.A. whiteness is the whiteness which you thought was white before you used whatever it is that you do use."

"We don't use anything at all at home," volunteered Dick. "We just beat our dirty clothes on a flat stone."

"O.K., O.K.," said Smithy resignedly. "Now, if you're doing any fault-finding on coils using T.N.A. wire, here are some dodges which might be of help to you. First of all, it's a good plan to keep a small bottle of acetone handy. You can get it from any chemist. If you want to move the wire on a coil—say, because a lead-out has broken at the point where it leaves the coil and you want a little more wire to solder to—you can apply a little acetone at the point where you wish to commence operations. The acetone will cause the acetate to dissolve, whereupon the wire becomes easy to handle. After you've finished your solder joint or whatever repair you're carrying out (and don't forget that you can solder straight through the covering without having to strip it away) splash on a little more acetone. The wire will then become re-set in its new position."

"Do you honestly think it's worth getting in a bottle of acetone just for simple jobs like that?" asked Dick. "Couldn't you just as easily tear the wire out of the coil and use a little standard polystyrene dope on it afterwards?"

"Not really," said Smithy, "partly because it's much easier, quicker and neater to use the acetone; and partly because gauges thinner than 36 s.w.g. or so may be held so tightly in the 'acetated' coil that you would break the wire in attempting to pull it free."

"I see," remarked Dick. "Any other points?"

"Just one more," replied Smithy. "This is concerned with bad joints. We all know that badly soldered joints should never occur after a set has passed through its factory tests, but we also know that such joints do show up in practice every now and again. Sometimes, it's years before bad joints give any trouble, and you may occasionally get intermittent faults with them. So far as

* This particular episode was written in May, 1958.

joints with T.N.A. wire are concerned you can always make suspect joints reliably good by holding a soldering iron, with a little solder applied, on to them for just slightly longer than you need for soldering ordinary wire."

"Provided," said Dick, who knew Smithy's weaknesses, "that the tag the wire is connected to is capable of being soldered."

Smithy's face grew redder than was warranted by the heat of the day.

"Now don't get me started on that line again," he protested. All I will say on *that* particular subject is that somewhere in the country is a person who hates service engineers and who devotes his whole life to the design of solder tags which won't solder. I don't know who he is but if I ever meet him . . ."

Smithy left the sentence unfinished but Dick, who had heard the Serviceman's comment on unsolderable solder tags on many previous occasions, had little doubt about the manner in which Smithy would upset the erring tag designer's peace of mind.

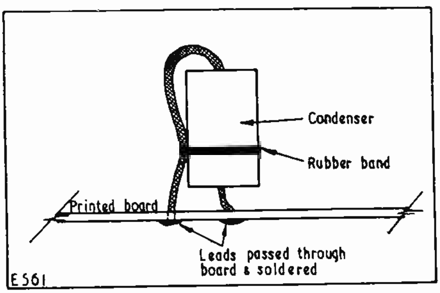


Fig. 1. To save space, tubular condensers are often fitted to printed circuit boards in the manner shown here. A rubber band, or length of adhesive tape, securing the longer wire to the condenser body helps to strengthen the mounting

Component Assemblies

A few moments passed before Smithy's thoughts returned to the subject he had originally introduced.

"Another new technique which is becoming used more and more," he continued, at length, "is occurring on printed circuits. As you may readily imagine, one of the snags of printed circuits is that all the components in a receiver have to be spread out on a flat board, with the result that they take up a great deal of area. In normally wired receivers you have three dimensions to play with, and you can save space by building upwards, as it were; but with printed circuits you only have two dimensions in which to work. One solution towards saving space you will almost certainly have already encountered, this consisting of mounting large paper and electrolytic tubular condensers on end. (Fig. 1.) One lead of the condenser solders directly to the circuit copper whilst the other passes down over the outside of the condenser case. When replacing condensers mounted like this you have to observe the obvious precautions of taking care that you connect up with correct polarity, assuming an electrolytic condenser, and that you use the correct 'outside foil' connection, if the faulty component is a paper condenser in a very critical circuit position. Also, to ensure that the replacement condenser is positioned reliably you should secure the outside lead to the condenser case about two-thirds of the way down. A rubber band or a little adhesive vinyl tape will help here."

"What's vinyl tape?"

"It's more or less the same as p.v.c. tape," replied Smithy, "and it is a far better proposition for radio and t.v. repairs than the ordinary transparent tape you use for sticking papers together or sealing parcels.

"Another effort to overcome the tendency of printed circuits to spread has resulted in components such as small condensers and resistors appearing in complete little sub-assemblies of their own. These sub-assemblies may consist of a small board or tag-strip arrangement, quite possibly printed, to which the components are soldered. A row of lead-out wires appears at the bottom of the assembly, these passing through holes in the main circuit board, where they are soldered. In some cases the sub-assemblies may be quite simple, uncovered affairs, whereupon you can follow the circuit in which they appear and read component values at a glance. Alternatively, they may be covered or potted in some opaque sealing compound, in which case you can't see the components themselves, and you've had it so far as replacement of individual parts is concerned. Also, you will have to look at the service literature to find out what is hidden inside the sealing compound."

"A serviceman's life gets tedious sometimes, don't it?" observed Dick.

"Not entirely," replied Smithy. "The way I see the present situation is that domestic television and radio design is commencing to go through a basic evolutionary change and that we're just seeing the first signs in current printed circuit techniques. I know that the serviceman has to keep himself well up to date with present-day techniques, but this can hardly be described as being a great hardship. After all, we have to be adaptable because that's the first qualification of our trade. So far as changing production methods are concerned, I often wonder what the next ten years will bring."

"How about condensers without wires?" asked Dick, a little sarcastically.

"Oh, we have those already!" chuckled Smithy. "The current types are intended for use in the large number of decoupling positions you get in t.v. i.f. strips and the like, where wide tolerance condensers around 1000 pF or so are required. These 'wire-less' condensers consist of a flat piece of ceramic having a trapezium-shaped outline, (Fig. 2 (*a*)), and having silvering on either side.* The two lots of silvering form the two plates of the condenser. These condensers are intended to be fitted into slots in a printed board (Fig. 2 (*b*)), and soldered over (Fig. 2 (*c*)). Dead easy!"

"Oh, yes," said Dick, brightening up again. "I remember reading about those."

"And you'll be seeing them soon," commented Smithy, "if you haven't done so already. All that a wire-wrap connection consists of is a bare length of tinned copper wire wrapped about seven or eight times around a specially shaped tag having sharp corners. (Fig. 3.) A special tool is employed for putting the wire on, and because of the tension with which it winds the wire around the tag you get a cold weld at each corner of the tag. The connection you get is, in fact, supposed to be better than that given by a soldered joint, and I seem to recall reading that a number of American telephone exchanges have been connected up with wire-wrap terminations.

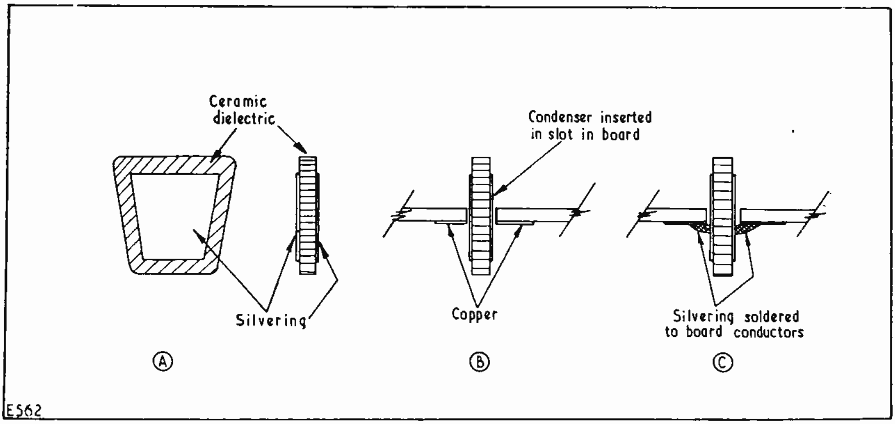


Fig. 2 (a) A ceramic "wedge" condenser, which is capable of being connected into a printed circuit without lead-out wires. (b) The "wedge" condenser is inserted into a slot in the board, as shown in this cross-sectional view. (c) Final connection is made by soldering the silvering to the printed circuit conductors

"Like everything else is," remarked Dick, a little gloomily, "once you know how."

Wire-Wrap

"And finally," said Smithy, "we come to the matter of connections which are made without solder."

"That's all we needed!"

"Cheer up," said Smithy. "If you'd read the American magazines I've been passing on to you lately, you'd realise that what are termed wire-wrap terminations are now 'old hat' in the States."

* Ceramic Wedge Capacitors, similar to that illustrated, have been introduced by A. H. Hunt (Capacitors) Ltd.

"If you ever have to undo a wire-wrap connection during servicing you should usually be able to untwist the wire from the tag without breaking it. You shouldn't get the impression, incidentally, that the ability to unwind a wire-wrap connection means that it is faulty; it merely infers that you have left a little of the wire's plating on the tag. (You may remember my telling you some months ago that you can similarly 'undo' a lightly soldered conventional joint.) When you re-make a wire-wrap joint you merely wind the wire once or twice around the tag and solder up in the normal way. Without the proper tool you cannot, of course, repeat the original wire-wrap connection."

Back to Work

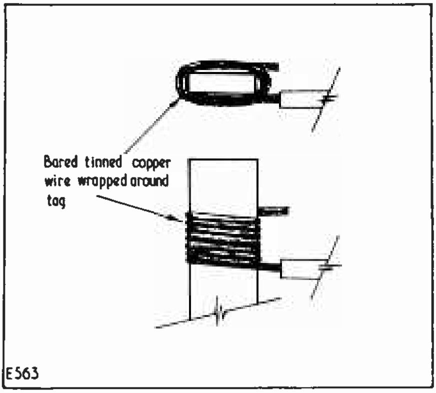


Fig. 3. A wire-wrap connection. No solder is required for connections of this type

"Well, we certainly seem to have had a good session on modern techniques," said Dick, as he struggled into his shirt preparatory to entering the Workshop for the afternoon's work. "And I think I will be better armed to meet these new things when they turn up on the bench. What have you got lined up for me this afternoon, Smithy?"

Smithy chuckled.

"Well, the first set is rather an oldie, I'm afraid," he said. "It's a battery three-valve straight, and I think that the PM2 output valve is losing emission. But the next set is much more modern. It's a five-valve super with real up-to-date side contact bottles."

Dick snorted in disgust.

"And he says you have to be adaptable!" he remarked, walking to the Workshop door.

"Sorry, Dick," laughed Smithy, "I'm only pulling your leg. In actual fact I've got a nice new printed circuit t.v. waiting for you, and it's got a really good intermittent in the gated a.g.c. circuit. That better?"

"I'm not too certain," said Dick, thoughtfully. "Perhaps I'll plump for the replacement PM2 job after all!"

Can Anyone Help?

Requests for information are inserted in this section free of charge, subject to space being available

G. P. Lowery, "Fernleigh", Lowther Street, Penrith, Cumberland, wishes to know if anyone can sell him a copy of the November 1955 issue of *The Radio Constructor.*

* * *

D. Potter, The School House, Monmouth School, Monmouth, has an ex-naval wire-recorder manufactured in New York about 1940, and wonders if any reader could either supply (purchase or loan) the circuit, or could advise him where such a circuit could be obtained.

* * *

R. Shaw, 269 Turncroft Lane, Offerton, Stockport, Cheshire, has a German receiver, made by or called "Mende", type number RENS 1374D. He is willing to reimburse anyone who can enable him to obtain the circuit, as a few adjustments appear to be necessary.

* * *

J. E. Farnsworth, 148 Fourth Avenue, Edwinstowe, Mansfield, Notts., asks for help in obtaining a service sheet or circuit details of the R.G.D. Model 1800, 12" Console Televisor.

A. R. L. Munro, 85 Winifred Crescent, Kirkcaldy, Fife, would be most grateful if anyone could inform him of any modifications they have carried out to improve the performance of the CR.100 receiver, in particular the fitting of modern all-glass valves such as EF85's in the r.f. amplifier stages. Any postage, etc., costs will gladly be refunded.

* * *

F. C. Styles, 5 Stoke Lane, Patchway, Bristol, would like to purchase or borrow the circuit of the original Homelab signal generator—can anyone oblige?

* * *

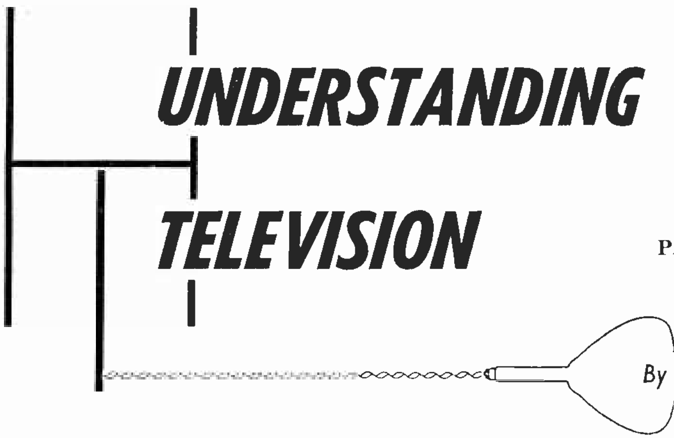
R. Meyer, 341 Dickenson Road, Longsight, Manchester, has purchased a CR.300 receiver which is faulty on the h.f. side, and would be glad if anyone could sell or lend him a circuit or manual of this receiver.

* * *

G. B. Brierley, 99 Chessel Street, Bristol, 3, wishes to purchase or borrow the service sheets for the Models "B" or "D" Bendix Washing Machines. Please quote price, all costs will be refunded.

UNDERSTANDING TELEVISION

PART 7



By **W. G. MORLEY**

The seventh in a series of articles which, starting from first principles, describes the basic theory and practice of television

In last month's article, the second dealing with the subject of the cathode ray tube, we examined the basic principles of electrostatic deflection and focusing. In this issue, we shall continue our discussion of the cathode ray tube by dealing with magnetic deflection and focusing.

Magnetic Deflection

To understand the manner in which magnetic (or, to be more accurate, *electro*-magnetic) deflection of the electron beam inside a cathode ray tube is obtained, it is first of all necessary to refer back to the basic precepts of electromagnetic theory.

Fig. 34 illustrates the lines of force which constitute a magnetic field between two magnetic poles. Such a field could be given between the two poles of, say, a horseshoe magnet. As occurred with the electrostatic fields which we considered last month, the individual lines of force shown in Fig. 34 have arrows which indicate their direction. In a magnetic field the direction of the lines of force is from a north pole towards a south pole.

When a conductor such as a piece of wire carries an electric current, a magnetic field is set up around it, this having the appearance shown in Fig. 35 (*a*). In Fig. 35 (*a*) we see a cross-section through the conductor, and it is assumed that it passes at right angles through the surface of the paper. The conductor has a "+" sign in its centre, this

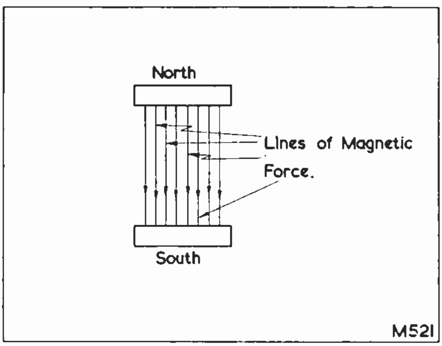


Fig. 34. The lines of force which appear between two magnetic poles. This diagram does not show the field which exists outside the space immediately between the two poles

indicating that the positive potential which causes current to flow is on the reader's side of the paper and that the negative potential is underneath the paper. In consequence, the flow of electrons which constitutes the electric current in the conductor is towards the reader. The lines of magnetic force appearing around the conductor, due to the flow of current in it, are circular in form and are concentric with the centre of the conductor itself. Their direction is clockwise.

those in the conductor of Fig. 35 (*a*). Each travelling electron has its own magnetic field around it and, in company with the case shown in Fig. 35 (*a*), the direction of each field is clockwise.

Let us now see what happens if we introduce our conductor of Fig. 35 (*a*) into the magnetic field of Fig. 34. This we do in Fig. 36 (*a*), and an interesting effect at once becomes apparent. This is due to the fact that, on the right hand side of the conductor,

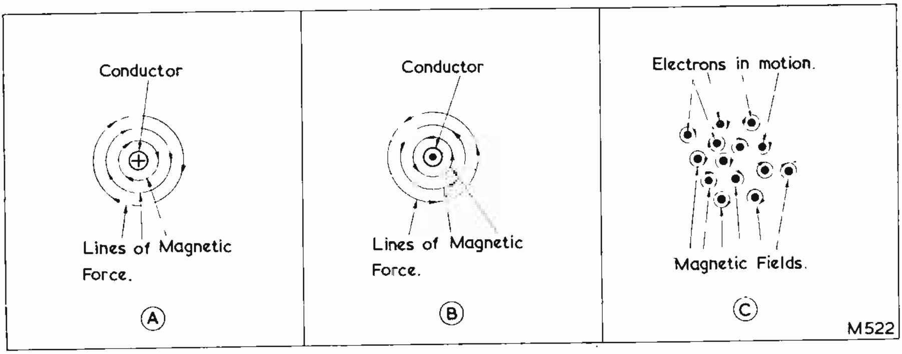


Fig. 35 (a) Cross-section through a conductor carrying an electric current, illustrating the circular lines of force which are set up around it. The current in the conductor is such that electron flow is towards the reader. (b) In this diagram, the current in the conductor is such that electron flow is away from the reader. In consequence the direction of the field is reversed. (c) Electrons in motion also cause the setting up of magnetic fields. In this diagram electrons are travelling towards the reader, and the direction of their individual fields is clockwise

In Fig. 35 (*b*) we see the same conductor. In this case, however, a dot is shown in the cross-sectional view, this indicating that the positive potential is now underneath the paper and that the negative potential is on the reader's side. As a result, electron flow in the conductor is away from the reader. Provided that the current has the same value as occurred in Fig. 35 (*a*) the strength of the magnetic field around the conductor will be unaltered. Its direction, however, will be reversed, this now becoming anti-clockwise.

The electron beam in a cathode ray tube consists, in actual fact, of a quantity of electrons travelling from a negative cathode towards a positive final anode. As such, the beam may be regarded in exactly the same light as an electric current in a conductor. A small quantity of the electrons in a cathode ray tube beam are shown in Fig. 35 (*c*) and it is assumed that these are travelling from a negative cathode, which is below the paper, to a positive anode which is on the reader's side of the paper. In consequence, these electrons will be travelling in the same direction (i.e. towards the reader) as were

the direction of the conductor's circular magnetic field is the same as that of the existing field. Because of this, the circular field assists the existing field in this particular area. On the other hand, the direction of the circular field on the left of the conductor is opposite to that of the existing magnetic field.

The immediate result of the interaction between the two fields is that the strength of the existing magnetic field to the right of the conductor becomes increased (due to the addition of lines of force in the same direction) whilst the strength of the existing field to the left of the conductor is decreased (due to lines of force in opposite directions cancelling each other out). The net result is that the magnetic field now commences to look like that shown in Fig. 36 (*b*).

The magnetic field of Fig. 36 (*b*) is obviously very different from that of Fig. 34, wherein the lines of force between the poles were straight. In Fig. 36 (*b*) the lines of force become distorted out of their natural state and they consequently exert a force upon the conductor which will result in their being able to return to their original condition.

In this case, the force exerted upon the conductor is to the left. (Another way of looking at the force exerted upon the conductor is to state that lines of magnetic force conductor; and they exert a force to the left in consequence).

If the conductor of Fig. 36 (*b*) were free to move, the force exerted upon it would

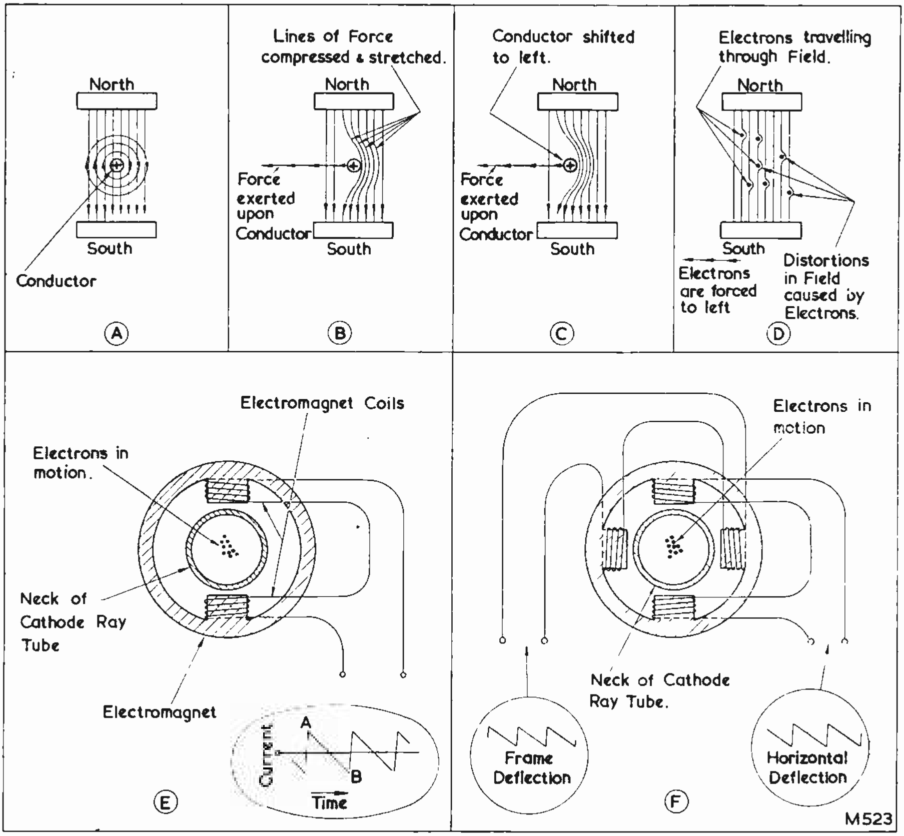


Fig. 36 (*a*) *When the conductor of Fig.* 35 (*a*) *is inserted in the field of Fig.* 34, *their two fields, superimposed, take up the appearance shown here.* (*b*) *In practice, the combination of the two fields causes a distorted composite field to be built up. This results in a force being exerted upon the conductor, the force tending to move it to the left.* (*c*) *In this diagram the conductor has been partially moved to the left, but the force exerted upon it still exists.* (*d*) *Electrons moving through the field (towards the reader) are deflected to the left due to the combination of their fields and that through which they travel.* (*e*) *The electrons of* (*d*) *may be deflected as desired in the horizontal sense by replacing the fixed poles by the poles of an electromagnet. (The two coils are connected in series such that when one pole is North the other is South. Suitable parallel connection of the coils would give the same result.)* (*f*) *By adding two further poles to the electromagnet vertical deflection becomes possible*

tend to follow the shortest path and that, if they have the same direction, they repel each other. The lines of force to the right of the conductor are longer, and are more compressed, than are those to the left of the primarily cause it to be moved to a position such as that shown in Fig. 36 (*c*). However, this does not completely alleviate the distortion of the original field and the conductor still experiences a force in the left direction.

The force on the conductor will only cease when it has been pushed over to the weakest part of the field, at which point only negligible interaction can occur. (Although it is tempting to make the statement that the conductor is pushed right out of the field altogether, this would represent an untrue picture. The reason for this is that a magnetic field such as that of Fig. 34 has no finite boundaries, its fringes extending out into space until the individual lines of force become too weak to be effective or measurable. Due to the absence of a finite boundary it becomes customary to state that the conductor is forced into "the weakest part of the field").

If we had a beam of electrons passing through the magnetic field, as occurs in Fig. 36 (*d*), the same effect would be given as occurred with the conductor. In Fig. 36 (*d*) we assume that the electrons are travelling towards the reader, in which case they may be treated in the same manner as was the conductor of Fig. 36 (*c*), wherein electrons were, similarly, travelling towards the reader. The electrons of Fig. 36 (*d*) are forced by the magnetic field to move to the left. In this instance the amount of displacement suffered by the electrons depends upon the length of time they spend in the field, as well as upon the strength of the field itself.

The steps we have followed in Figs. 36 (*a*) to (*d*) now bring us to the point where we may consider the design of an electromagnetic deflection system for use with a cathode ray tube. The next stage consists of fitting an electromagnet such as that illustrated in Fig. 36 (*e*) around the neck of the cathode ray tube. This electromagnet provides a magnetic field similar to that we have been considering in Figs. 36 (*a*) to (*d*) with the difference that, because we use an electromagnet through whose coils we can cause to flow any current within reason that we choose, we can now control not only the strength of the magnetic field but also its direction. If, for instance, we energise the electromagnet in such a manner that its top pole becomes North and its bottom pole South, the electrons passing through its field will suffer a force which causes them to move, or to be deflected, to the left. If we reverse the energising current in the electromagnet coils such that the top pole now becomes South and the bottom pole becomes North, then the resultant field will exert a force on the electrons passing through it which will cause them to move to the right. We can further develop the system for our own purposes by applying a current to the electromagnet coils which follows the sawtooth waveform shown in the inset to Fig. 36 (*e*). If the uppermost point (A) of this waveform corresponds to the case where the top pole of the electromagnet is North and the magnetic field is at its strongest in the downward direction, then the electrons passing through the field will suffer the greatest force causing them to move to the left. If the lowest point of the sawtooth waveform (point B) corresponds to the top pole being South with maximum field strength in the upward direction, then the electrons will suffer the greatest force causing them to be deflected to the right. Intermediate points along the sawtooth waveform will, of course, cause intermediate forces to act upon the electrons. Should the sawtooth waveform have a frequency equal to that employed at the transmitter for horizontal deflection, and should the two waveforms be synchronised together, then the electromagnet of Fig. 36 (*e*) would enable us to obtain the horizontal deflection of the beam which is required in a television system.

Our final step towards a complete electromagnetic deflection system consists of adding two more poles to the electromagnet in the manner shown in Fig. 36 (*f*). Since these poles cause a horizontal field to be given they will cause electrons passing between them to suffer a force either in the upward or in the downward direction according to the current flowing through their coils. If we make this current follow a sawtooth waveform which has the same frequency as, and is synchronised with, the frame deflection circuits at the transmitter we will now have achieved vertical as well as horizontal deflection of the beam of electrons. In consequence, we will be in a position to reproduce a transmitted television picture.

Before concluding on the subject of magnetic deflection there are one or two small points which need to be cleared up. The first of these is that it is advisable to examine a little more closely the path taken by an electron as it passes through a deflecting magnetic field. In Fig. 37 we see an electron following the path traced out by line ABCD. During its travel the electron suffers an accelerating force due to the final anode, this causing it to move, initially, along the straight line AB. At point B the electron enters the magnetic deflecting field, this being such that the electron suffers a downward-moving force. As a result, when the electron reaches point C its movement is partially forwards and partially downwards. After point C the electron leaves the magnetic field and continues to point D, on the surface of the screen, in a straight line once more. Fig. 37 may help to demonstrate the point that when the electron leaves the field its direction of motion is the resultant of two forces, one forward-acting due to the final anode, and one downward-acting due to the magnetic field.

A further point which needs to be discussed is one which is exemplified by the fact that, in Figs. 36 (*e*) and (*f*), the electrons passing through the deflecting magnetic field were shown as a number of dots spread over a fairly large area. The reason for showing the electrons in this manner is that, when they pass through the deflecting field, they are divergent due to their having just left the second focusing lens. The next point at which the electrons will converge is at the surface of the screen itself. Because of the divergent nature of the electrons when passing through the deflecting field it is necessary to ensure that the latter is as regular as possible over that section through which the electrons pass.

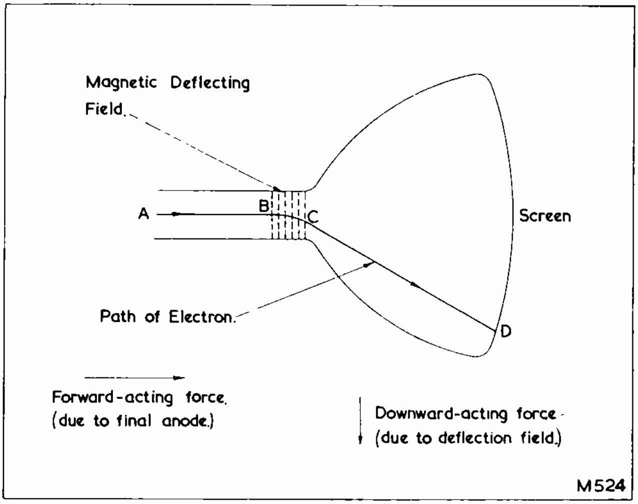


Fig. 37. The path followed by an electron when passing through a deflecting magnetic field. This diagram shows the two forces acting on the electron during the time it is in the field

This will then ensure that electrons passing through at different points will still suffer the same amount of deflection and may consequently still strike the screen at the same point. If the deflecting field were not sufficiently regular the fault known as "deflection defocusing" becomes apparent. The usual symptom of deflection defocusing is poor focus at the edges of the scan.[1]

The four-pole electromagnet shown in Fig. 36 (*f*) could be described as a *deflector coil assembly*.[2] Practical deflector coil assemblies, whilst functioning under the same principles as that shown in Fig. 36 (*f*), take up quite different forms. However, it would be impossible to enter into any detailed description of practical assemblies in the space of a single article, and this subject must be left to a later date.

Magnetic Focusing

The processes involved in magnetic focusing are somewhat more involved and complicated than in the case of magnetic deflection. The main reason for the complication is that electrons travelling through magnetic focusing fields encounter lines of force which are curved and which cause a number of different forces to be exerted.

Fig. 38 (*a*) illustrates part of the magnetic field which would be given if a coil of wire were placed around the neck of a cathode ray tube. A current is passed through the coil, and this causes a magnetic field to be set up around it. It is assumed in Fig. 38 (*a*) that the coil is energised such that a South pole appears at its left hand side, whereupon lines of force whose direction is from North to South appear inside the neck of the tube.

When an electron travelling along the path ABCD of Fig. 38 (*b*) enters the magnetic field it encounters lines of force which are neither parallel nor perpendicular to its own line of travel and which become weaker as they approach the centre of the tube neck. An approximate idea of the field in which the electron finds itself is given in Fig. 38 (*c*),

[1] Poor focus at the edges of the scan may also be caused by faults other than deflection defocusing.

[2] Other easily recognisable terms may be employed to describe this assembly, one frequently encountered being "deflection yoke."

which shows the situation existing on the section XY of Fig. 38 (*b*). (It is assumed, in Fig. 38 (*c*), that electrons travel towards the reader.) The lines of force *immediately* the tube neck is illustrated by the shaded areas. The lines of force in the circle are not in the same plane as the paper and their lower ends are nearer the reader than are

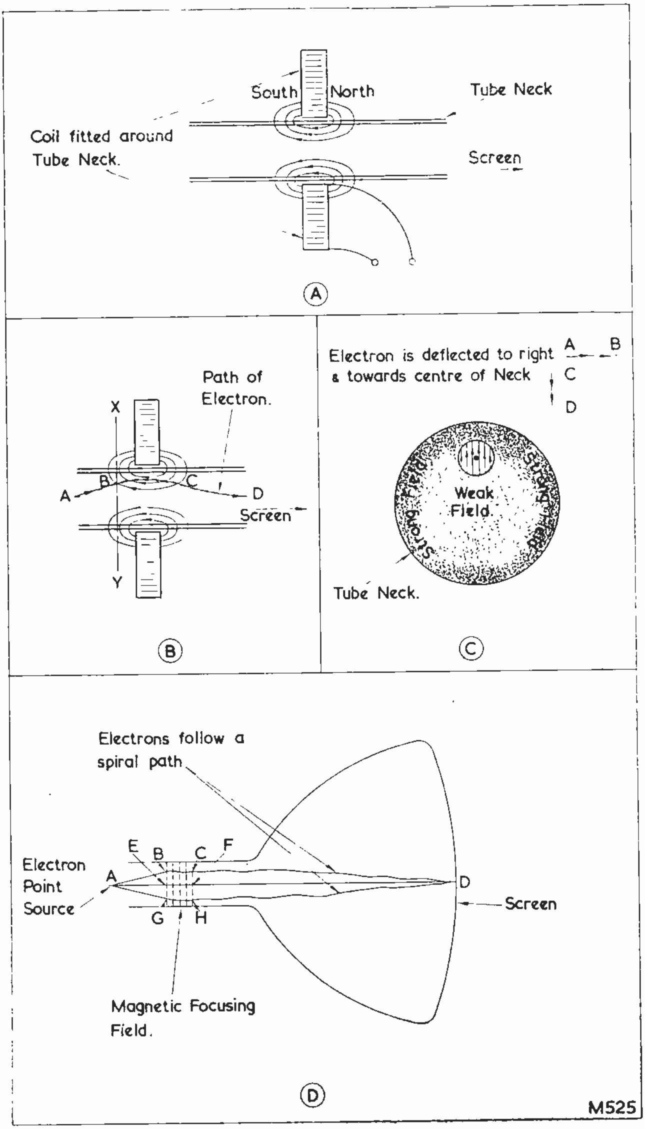


Fig. 38 (a). A coil fitted around the neck of a cathode ray tube can cause curved lines of force to appear inside the neck. (b) The path followed by an electron when travelling through the curved lines of force. (c) A presentation of the conditions existing in the cathode ray tube neck along section XY of (b). The shading indicates that the field is weakest at the centre of the tube neck. (d) When electrons are deflected inwards by a focusing magnetic field they assume a spiral path

around the electron of Fig. 38 (*b*) are those shown in the circle of Fig. 38 (*c*) whilst the fact that the field is weaker at the centre of their higher ends. Despite this fact, the circled field immediately around the electron is still sufficiently similar (apart from its upward direction) to that shown in Fig. 34 for the electron to suffer sideways deflection, this time towards the right. At the same time, we already know that a magnetic field always tends to deflect an electron in motion towards its weakest part. The result is that the electron of Fig. 38 (*c*) becomes subjected to two forces. One of these forces, indicated by the arrow AB, causes it to be deflected to the right, and the other, indicated by the arrow CD, causes it to be deflected towards the centre of the tube neck.[3] The net result of these two forces is that the electron is not only deflected towards the centre of the tube neck (the desired effect) but that it is also deflected sideways. The combination of these two forces causes the electron, whilst travelling through the field, to assume a spiral path. After leaving the field it continues on this spiral path until it finally strikes the screen.

magnetic field, and suffer no deflection because they pass through a point of zero field strength. In consequence, they do not assume a spiral movement.

So far as the television design engineer is concerned, the usefulness of the magnetic focusing system is that it causes electrons to be deflected inwards, thereby allowing the focusing magnet (or electromagnet) to function as a lens. The fact that the magnetic field imparts a spiral motion to the electron is incidental, and can be ignored if the goodness of focus given by the magnetic system is not impaired thereby. In practice, magnetic focusing systems are capable of providing excellent results, and it is only their bulk and expense which nowadays makes them unattractive for commercial television receivers when compared with electrostatic focusing systems.

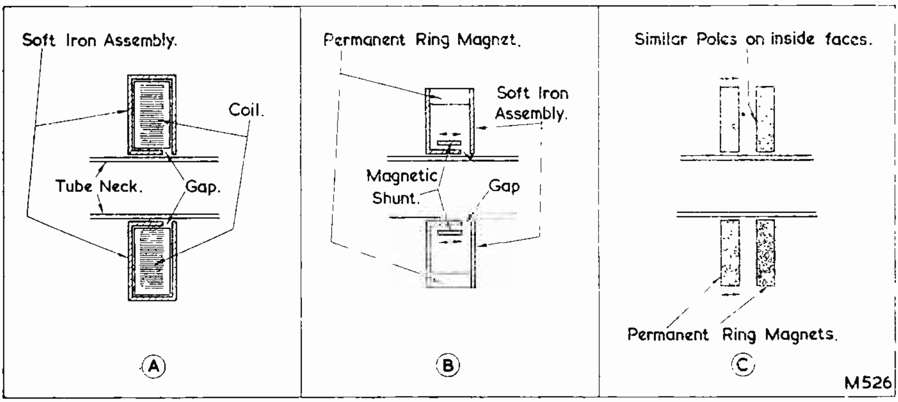


Fig. 39 (a) A practical focus coil. (b) A permanent magnet focusing assembly. The ring magnet is magnetised such that one pole appears on the right hand face and the other pole appears on the left hand face. (c) An alternative permanent magnet focusing assembly. In this case two ring magnets are employed, the distance between them being adjustable

The overall effect is illustrated in Fig. 38 (*d*) wherein the paths of several electrons are traced as they travel through the magnetic focusing field. Apart from electrons following line AEFD, all electrons are deflected inwards towards point D which should lie on the surface of the screen. Also, after leaving the magnetic field they all have a spiral movement. Electrons following path AEFD carry on in a straight line through the centre of the

[3] It is sometimes a little difficult to understand the reason for the inward-going deflection of the electron, this being due to the fact that, when it enters the focusing field, its path is in the same plane as the lines of force it encounters. However, after it has been initially deflected sideways, this condition does not exist and deflection inwards becomes possible.

In Fig. 38 (*a*) it was assumed that the focusing electromagnet was so connected to its source of supply that its left hand side became a South pole. In practice, the polarity of the focusing magnet, or electromagnet, does not matter.[4] Reversing the polarity of the electromagnet of Fig. 38 (*a*) would not affect its ability to focus the beam, it would merely reverse the direction of the spiral traversed by the electrons before striking the screen.

Control of focus when using magnetic focusing systems may be obtained by varying

[4] Provided that its external stray field does not interfere with other magnetic fields controlling the electron beam, or that stray fields from other magnetic assemblies do not interfere with the focusing field.

the position of the magnet assembly, or electromagnet, along the neck of the tube, and/or by varying the strength of the field it provides. In many commercial receivers the position of the magnet on the tube neck is fixed (the optimum position having been found before the receiver went into production) whereupon the only adjustment of focus is given by variation of field strength.

Practical Magnet Assemblies

The simple coil shown in Fig. 38 (*a*) would be uneconomic in a practical television receiver, as an excessive amount of current would be required to enable it to provide a sufficiently strong field.

This difficulty is overcome in the arrangement shown in Fig. 39 (*a*). In this diagram the electromagnet coil is enclosed in a soft iron container which enables the field to be concentrated in a "gap" close to the tube neck. The electromagnetic arrangement illustrated in Fig. 39 (*a*) is very typical of the "focus coils" which were employed in domestic televisors some years ago. These focus coils have now been ousted by purely magnetic assemblies, which are dealt with later in this article.

Over the period when they were used, focus coils provided several advantages. One of these was that they enabled a fine degree of focus to be obtained by means of a simple potentiometer circuit which could vary the current flowing through the coil. Also, the potentiometer controlling focus could be mounted at any convenient point on the receiver chassis. The disadvantages of the focus coil were that they were wasteful of rectified h.t. power (which is always at a premium in a competitively priced receiver); that the resistance of the wire with which it was wound was liable to increase as it grew warmer, thereby (unless special precautions were taken) causing reduction of energising current and the necessity of re-adjusting the focus control; and that, due to the large number of turns of copper wire needed for its manufacture, it was in itself an expensive item.

Whilst the disadvantages just outlined preclude the use of focus coils in current conventional domestic televisors, focus coils are still used in such specialised applications as projection receiver cathode ray tube assemblies and camera tube assemblies.

Fig. 39 (*b*) illustrates a cross-section through an early type of permanent magnet focusing unit. In this case the field is once more concentrated inside the neck of the tube by means of a soft iron assembly with a "gap". Control of the strength of the magnetic field is achieved by varying the position of a soft iron magnetic shunt close to the gap. When the magnetic shunt lies over the gap, most of the lines of force appearing at this point flow through it. When the magnetic shunt is moved away from the gap, a large proportion of the lines of force flow out into the neck of the tube.

More recent magnetic focusing assemblies employ two ring magnets positioned as shown in Fig. 39 (*c*). These two magnets have similar poles on their inside faces, with the result that opposing fields appear inside the neck of the cathode ray tube. Control of the composite focusing field obtained with this arrangement is obtained by varying the distance between the two magnets.

Next Month

In next month's article, we shall conclude our discussion of components which are employed in company with the cathode ray tube.

TWO-WAY RADIO IN SOUTH AFRICA

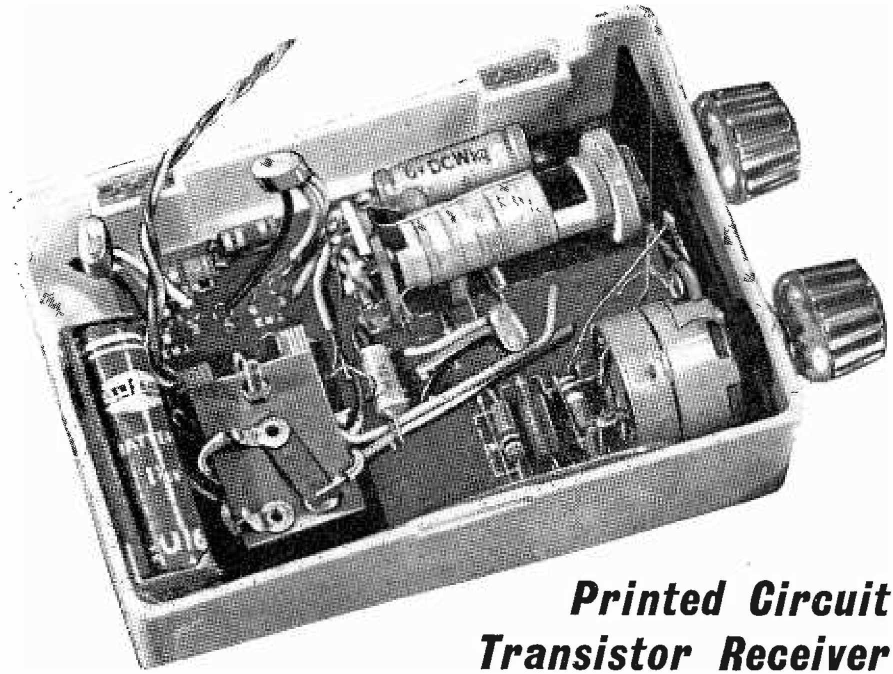
continued from page 865

central fire station in cases where "blind" spots restricted radio communication. Most of the vehicles fitted with radio apparatus, he said, used very high frequency, which had a limited line-of-sight range. All the apparatus had to be crystal controlled, to ensure that there was no deviation from the frequency allocated. The use of two-way radio was strictly controlled by the Department of Posts and Telegraphs, and it could be used only after the granting of a licence, costing £5 a unit a year, by the postal authorities.

In addition to four-wheeled vehicles and harbour craft, motor-cycles are now being fitted with two-way radio. The Cape Town fire brigade already has one of these, and the traffic department's motor-cycles are to be fitted with sets for keeping in touch with the headquarters of the department.

With television still to be introduced in South Africa and the Federation of Rhodesia and Nyasaland, and the date of this still likely to be some years off, the demand for the ordinary types of radios is good, and models in a wide range of prices are prominent among the lines with which the furniture dealers gain steady turnover. In many cases the more expensive types of radios are imported in the partly finished condition—that is to say, the often elaborate cabinets are the products of South African factories. Gram-radios and similar combinations are also made up in this way in South Africa.

The TELETRON "COMPANION"



Printed Circuit Transistor Receiver

This article gives constructional details of a simple 3-transistor receiver which may be built in a relatively short space of time. The receiver employs a printed circuit, and a plastic cabinet is available

described by S. BENNETT

Over the past few years amateur constructors have been quick to take advantage of the many benefits provided by transistors. These are by now so well known that the writer does not need to devote any further space to them in this article. Another recent newcomer to the electronic scene, the printed circuit, has not, however, been utilised in home-constructor circles by any means as extensively. The reason for this state of affairs is mainly due to the fact that printed circuits are specialised items which lend themselves only to the particular piece of equipment for which they were originally designed. In practice, nevertheless, the printed circuit offers the amateur such considerable advantages over conventional wiring that it is almost a pity that it has not been more frequently employed.

The receiver which is described in this article employs a printed circuit, with the result that a very compact layout may be achieved. Also, the constructor has the comforting feeling that his component and wiring positioning is almost inevitably bound to be closely similar to that employed in the prototype. The printed circuit used here (available, incidentally, from the Teletron Co. Ltd.) employs the especially useful device of marking all the major circuit points with suitable references, thereby obviating any doubts concerning the correct point to which a particular component should connect. On the Teletron circuit board some considerable thought has gone into ensuring that all points are adequately identified, the upper (non-copper) side showing component outlines designated by their circuit references, and the lower side having circuit points denoted by numbers or letters printed in the copper itself. As a result of this care in design the risk of making incorrect connections becomes very small indeed.

The "heart" of the circuit is provided by the coil L_1. This coil differs from the more conventional types employed on medium and long waves insofar that it is wound on a long former in which is fitted a similarly long internal dust-iron core. As such, the coil assembly becomes closely similar to a conventional ferrite frame aerial, and takes on the property of the latter of being able to pick up transmitted signals without the use of an external aerial. Also, due to the

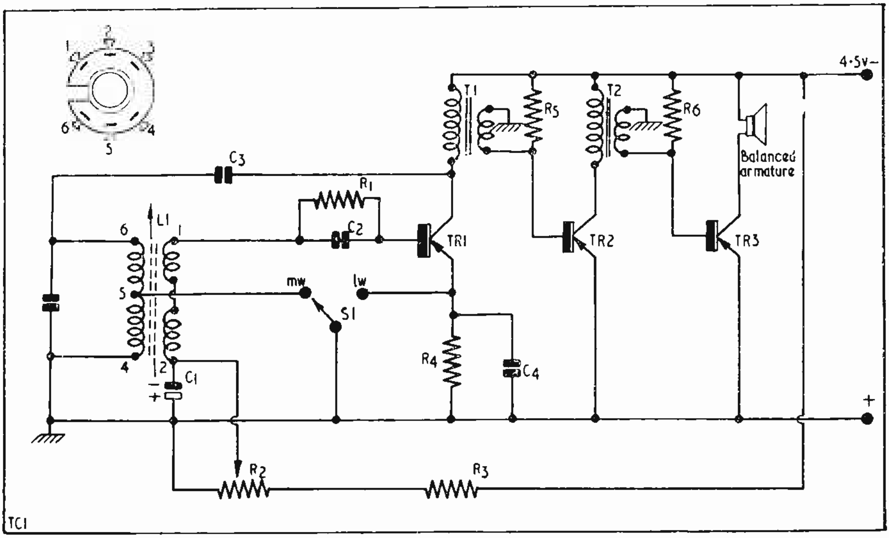


Fig. 1. The circuit of the "Companion" printed circuit receiver

Parts List

Condensers
- C_1 2 μF electrolytic
- C_2 500 pF, miniature
- C_3 20 pF, miniature
- C_4 0.01 μF, (Hunts type W99)

Resistors

All fixed resistors are ⅛ watt
- R_1 2.2kΩ
- R_2 25kΩ, volume control with switch. (Egen type 105)
- R_3 100kΩ
- R_4 100Ω
- R_5 3.3kΩ
- R_6 4.7kΩ

Coils and Transformers
- L_1 Medium and long wave coil (Teletron type FX25)
- T_1 Transformer (Ardente type D240)
- T_2 Transformer (Ardente type D239)

Transistors
- TR_1 Mazda XA102 or Red/Yellow spot
- $TR_{2,3}$ Yellow/Green spot or equivalent

Miscellaneous
- 1 Wavechange switch (Teletron)
- 1 Printed circuit panel (Teletron)
- 3 1.5V batteries (Ever-Ready type U16, or Vidor type V.0036)
- 1 Cabinet (Teletron)
- 2 Knobs, ¼in. spindle

The Circuit

The circuit of the "Companion" receiver is illustrated in Fig. 1, and some notes on its functioning may be of interest before constructional details are given.

proportionately large mass of the core, the coil has the desirable property of a high Q factor. A further feature of the coil is that its core is adjustable, thereby enabling a control of inductance to be achieved. In consequence, it becomes possible to tune the receiver in which the coil is connected by means of the core adjustment, and there is no necessity to employ a variable tuning condenser at all.

In Fig. 1 the winding of L_1 which functions as the tuned circuit appears between terminals 4 and 6. The fixed condenser connected across these terminals provides the necessary tuning capacity, and is supplied as part of the coil assembly. For medium wave reception the wavechange switch S_1 connects terminal 5 to the earth line of the receiver, thereby short-circuiting the lower part of the winding. For long wave reception, the complete winding between terminals 4 and 6 remains in circuit. The winding between terminals 1 and 2 provides a low impedance coupling suitable for connection to transistor TR_1. TR_1 functions as detector, as well as r.f. and a.f. amplifier, in much the same manner as does a triode valve employed in a regenerative detector stage. Detection is achieved by the effective diode provided between base and emitter, whilst a feedback voltage, for purposes of regeneration, is taken from the collector and applied, via C_3, to the tuned circuit. Control of regeneration is obtained by means of the potentiometer R_2, this varying the bias between base and emitter of TR_1 and, thus, its gain. R_2 carries out the dual function of reaction and volume control. An r.f. junction transistor is specified for the TR_1 position.

The collector of TR_1 is connected to the primary of transformer T_1, this component providing an a.f. coupling, with correct matching, to transistor TR_2. The collector of TR_2 is, in its turn, coupled by transformer T_2 to the third transistor TR_3. Both TR_2 and TR_3 function in the earthed emitter mode, and a.f. junction transistors are specified. The collector of TR_3 couples into a balanced-armature reproducer, this functioning as a "speaker" and having the added advantage of requiring no output transformer.

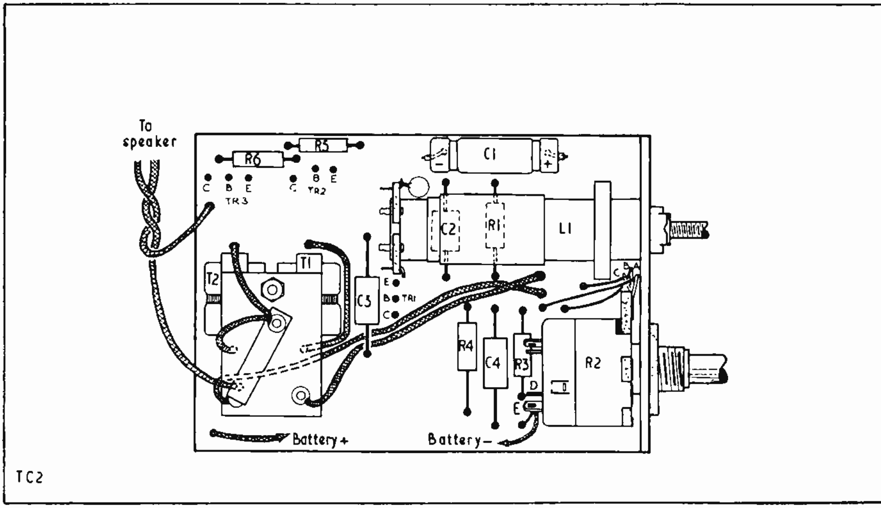


Fig. 2. Layout of the chassis

Construction

As may be gathered, construction of the receiver is a relatively simple matter, and the few steps necessitated are described in full in the text which follows. It might be advantageous at this stage to point out to constructors who are unfamiliar with printed circuits the ease with which connections to the circuit board may be made.

As with all soldering processes, the main requirements are that the soldering iron should be clean and well-tinned, and that a reliable cored solder is employed. The circuit copper should tin without any trouble, and there is little point in keeping the iron on any joint after it has been reliably made.

The first components to be fitted are C_2 and R_1. The marking on the upper surface of the board illustrates clearly the positions these components take up, and the holes through which their lead-out wires pass.

After these wires have been inserted in their holes they should be cut such that a small portion protrudes, and bent over so that they lay flat on the underside of the board. Where wires are bent over in this fashion it is advisable to do so in a direction which ensures that they remain on the copper conductor to which they connect. This will assist soldering and will obviate risks of "bridging" between conductors.

Coil L_1 comes next, this being fitted to the metal bracket eyeletted to the board in the manner illustrated in Fig. 2. The mounting hole for L_1 is notched to ensure that the latter is fitted with correct orientation. The potentiometer R_2 is next fitted, and its tags should take up the position illustrated in Fig. 2, i.e. volume control tags pointing towards L_1. At this stage the locking nut for R_2 need not be tightened further than is needed to hold it in position during winding, as it will need to be removed later when the chassis is fitted into its cabinet.

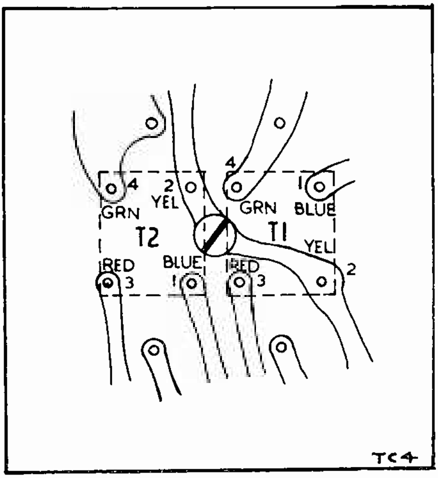


Fig. 3. *Detail illustrating the print around transformers T_1 and T_2*

L_1 is now wired into circuit. Fig. 1 illustrates the coil tag numbering, the view given in this diagram corresponding to the case where the core-adjusting screw is away from the reader. Tag No. 1 of the coil should be wired to circuit point 1 (indicated in the copper print) near the edge of the board. Tag No. 2 of the coil connects to the adjacent circuit point 2, tag No. 4 to circuit point 4, tag No. 5 to circuit point 5, and tag No. 6 to circuit point 6. All these connections should be made with tinned copper wire insulated with sleeving. Tag No. 3 of the coil is not connected into circuit. The circuit points 1, 2 and 4 just mentioned should not be confused with the similarly numbered points in the groups around transformers T_1 and T_2 which are illustrated in Fig. 3.

Transformers T_1 and T_2 are next mounted and wired in. Mounting is achieved by means of a 6-BA nut and bolt whose head, on the copper side of the board, is shown in Fig. 3. Secured under the 6-BA nut is the wavechange switch, S_1, the panel of this switch helping to secure the transformers in position. Both Fig. 2 and the photograph of the chassis illustrate the method of assembly employed here. Fig. 3 shows the manner in which the transformer lead-out wires connect to the board and this diagram should be carefully followed. In order to ensure that no excessive strain is placed on the transformer lead-out wires these should be initially wound in the form of a spiral on a piece of 18 s.w.g. wire. When the 18 s.w.g. wire is removed the transformer lead-out wires will retain their spiral form, whereupon they may be lightly stretched, as required, to reach their appropriate circuit points.

The remaining resistors and condensers, C_1, C_3 and C_4, and R_3 to R_6, may next be fitted to the board and soldered. As with C_2 and R_1, the positions of these components are clearly indicated on the upper side of the board. It will be noted that the inner lead-out wire of R_3 connects to a small isolated section of the copper print. The remaining hole of this section takes a tinned copper wire connected to tag A of potentiometer R_2 (see Fig. 4), and it would prove helpful if both this wire and the lead-out from R_3 were soldered at the same time. The lead from the circuit point to tag A of the potentiometer should be insulated with sleeving.

The remaining tags of potentiometer R_2 may now be connected up. Again, tinned copper wire, with sleeving, is required. Consulting Fig. 4, tag B of the potentiometer should be connected to circuit point P (identified on the copper side of the board), and tag D (on the switch section) to the point designated "-4.5" on the copper side of the board. Tag C of the potentiometer connects to the earth line conductor, this being that in contact with the metal bracket. A hole close to the bracket accepts the connecting wire (see Fig. 2). Tag E connects to the negative tag of the battery holder; and sufficient lead length should be provided to enable the battery holder to be removed from the cabinet when changing batteries. The photograph of the chassis indicates the position taken up by the battery holder when the chassis is fitted in the cabinet.

Final Steps

The connections to the wavechange switch have next to be made. Reference should be made to Fig. 2 whilst wiring this component. The centre tag of the switch, that connecting to the arm, has two wires, insulated with sleeving, soldered to it. One of these wires passes through the hole immediately behind transformer T_2, whilst the other passes through the hole immediately in front of T_2 and below the switch panel. These two leads are, of course, soldered to the circuit copper at the holes through which they pass. It will be noted that there are two holes having a disposition similar to those just mentioned immediately behind and immediately in front of transformer T_1. The circuit copper at these two points should be linked by a short length of wire insulated with sleeving.

The underside of the board should next be examined and the two circuit points on either side of the reference "S1" located. The left hand tag of the wavechange switch, that immediately in front of transformer T_2, connects to the "S1" circuit point which is nearer reference P. The remaining tag of the switch connects to the other "S1" circuit point, this being that nearer the letter S of "S1". Again, the wiring employed should be covered with sleeving.

The reproducer leads are next fitted, these connecting to the circuit points designated "O.P.". A positive battery lead is next required, this being connected to the earth conductor at the hole in the bottom left hand corner. (See Fig. 2.) This battery lead should be soldered to the positive tag of the battery holder, sufficient lead length being provided to enable the battery holder to be removed from the cabinet when changing batteries.

The transistors are the final components to be connected. There should be no necessity to shorten the transistor lead-out wires, and care should be taken to avoid excessive heat when soldering. It is advisable to insulate the lead-out wires with sleeving. The transistors may be positioned over the circuit points to which they connect, as shown in the photograph of the chassis.

The final process consists of connecting up the reproducer and of fitting the chassis in the cabinet. The latter may be carried out by primarily removing the bush-securing nut which was temporarily fitted to the potentiometer during wiring. A fibre spacing washer (or a spacing washer made of similar material) is next fitted over the bush, whereupon this is passed through the appropriate cabinet hole. The securing nut is then re-fitted and tightened up, thereby securing the potentiometer and the chassis. The final process consists of inserting the batteries in the battery holder, taking especial care to obtain correct polarity, and of fitting the knobs. If necessary, the linking tags at the rear of the battery holder should be soldered over to provide good contact. A reducing bush is supplied with L_1 so that a normal $\frac{1}{4}$in. knob may be used on the threaded spindle.

continued on page 910

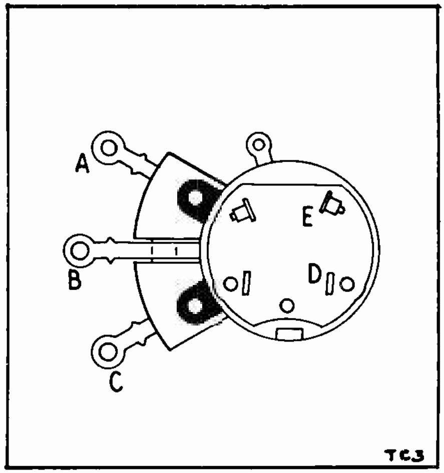


Fig. 4. The volume control, viewed from the rear. This diagram shows the tag references discussed in the text

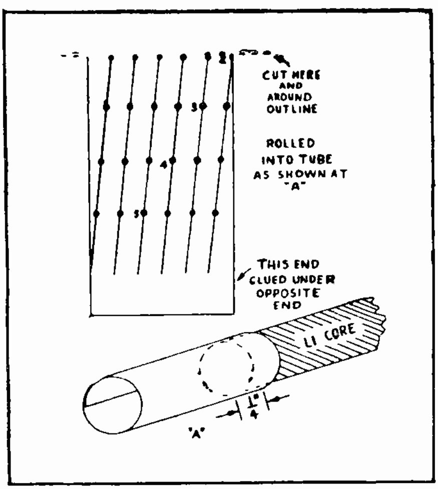
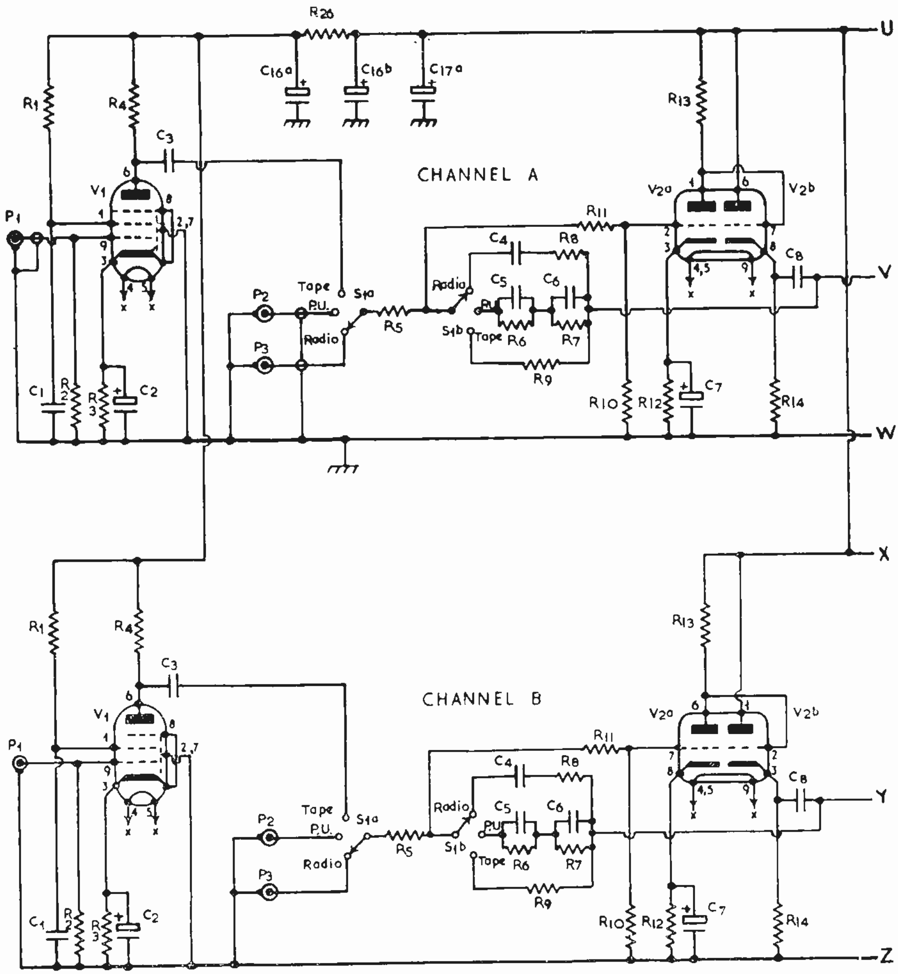


Fig. 5. The tuning scale

The JUPITER

Stereo Pre-Amplifier

A Jason Design, by G. Blundell



The Pre-Amplifier Circuit

THE TONE CONTROL CIRCUIT IS THE ONE developed by P. J. Baxandall and published in *Wireless World*. The stage gain is low but the circuit works very effectively with linear controls and for simplicity has much to recommend it. Ganged potentiometers are used to allow simultaneous adjustment of both channels, and a separate balance control altering the gain of one channel allows adjustment of centring. The matching accuracy of the potentiometers should be quite close and 1.6dB or better is required. This is equally important on tone as well as volume controls.* Lack of balance in the volume control would cause apparent position to alter when the volume level is altered, while variation in the tone control will cause a disembodied effect. It is important to have good frequency balance not only in the tone controls but also throughout the whole chain. Otherwise a frequency originating at one point, e.g. violin string, and its harmonics will appear to be nebulous; or alternatively the instrument will appear to move position according to the note played. Therefore it should be stressed again that the systems should be identical, and that also tweeters should be situated at the same point as the low frequency loudspeakers. In this respect the type of tweeter which seems best has a broad diffusion of sound, otherwise the "two loudspeaker" effect will be apparent.

* These controls are now made by Morganite who have shown foresight in developing this type of control.

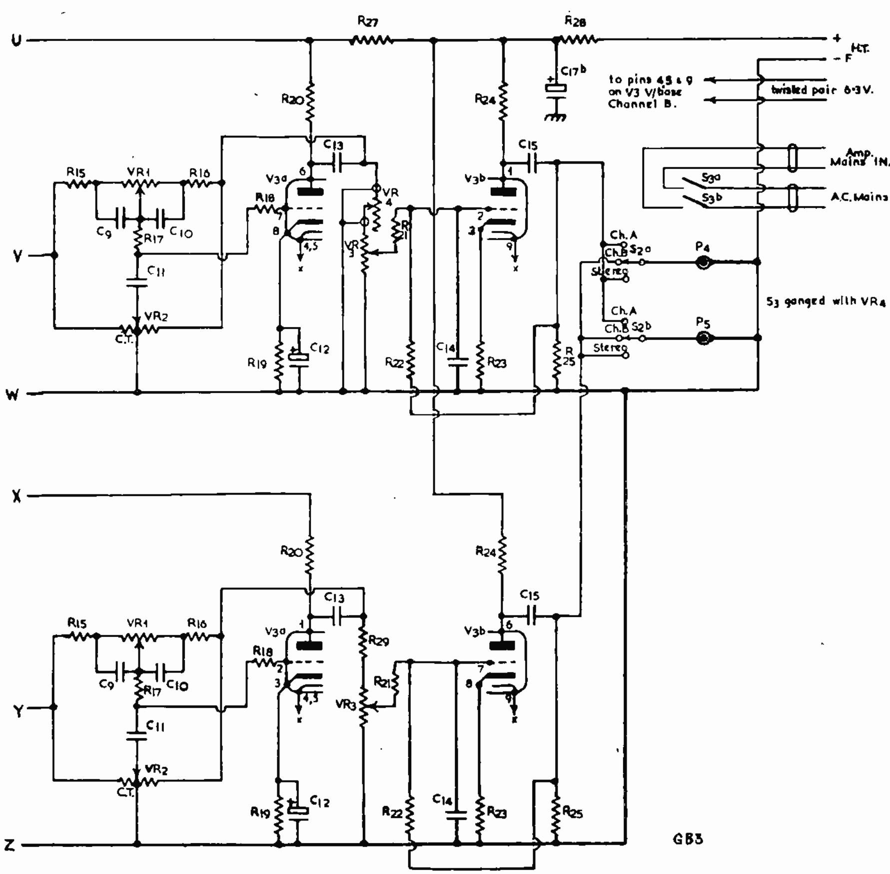


Fig. 5. Circuit of the Jupiter Pre-Amplifier

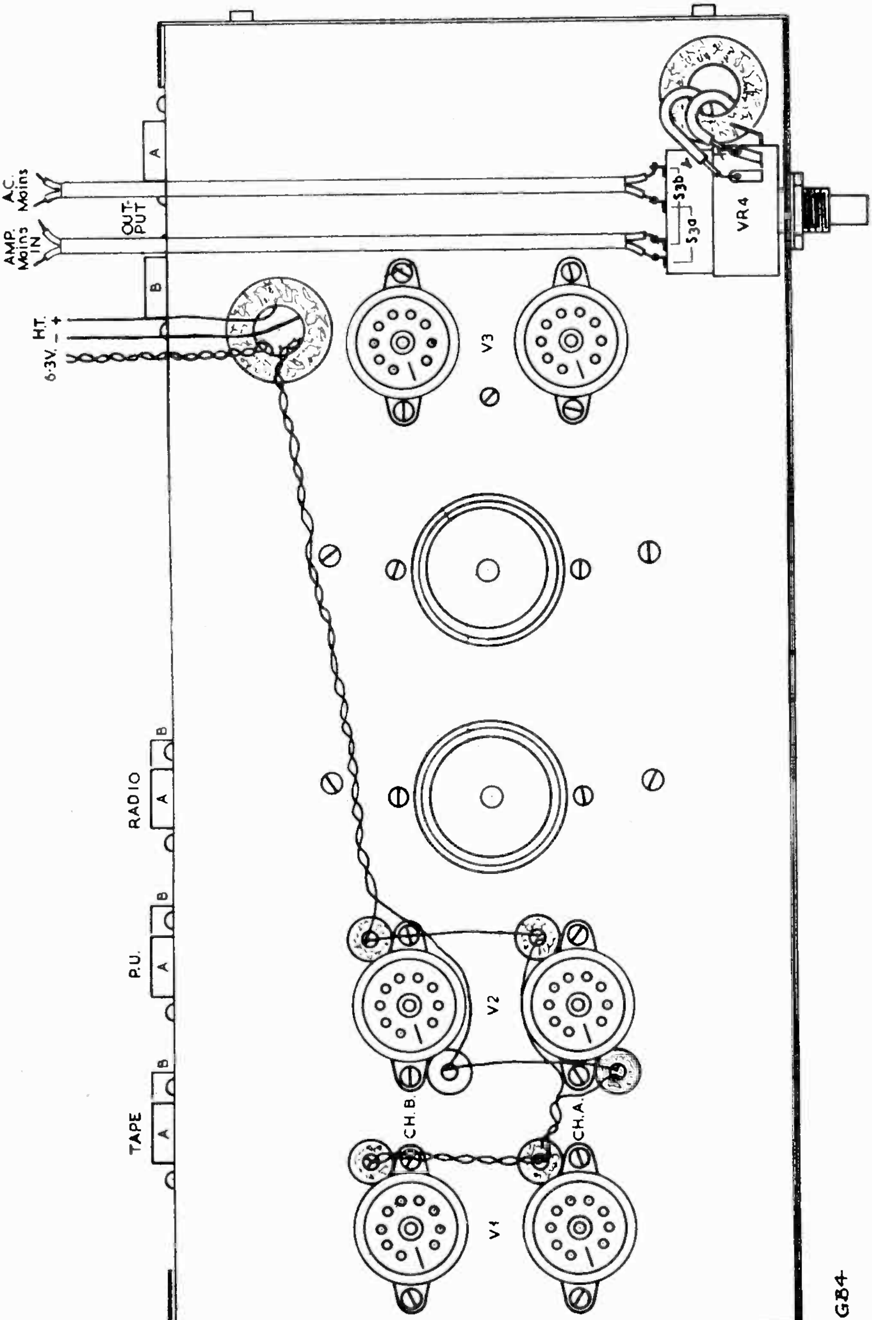


Fig. 6. Top-of-chassis diagram

COMPONENTS LIST

One off R_1 to R_{25} required for each *channel.*

R_1 270kΩ H.S. 10%
R_2 1MΩ H.S. 10%
R_3 1.2kΩ H.S. 10%
R_4 100kΩ H.S. 10%
R_5 100kΩ H.S. 10%
R_6 10MΩ carbon 10%
R_7 470kΩ H.S. 10%
R_8 220kΩ H.S. 10%
R_9 100kΩ H.S. 10%
R_{10} 1MΩ H.S. 10%
R_{11} 1kΩ carbon 20%
R_{12} 1.2kΩ H.S. 10%
R_{13} 100kΩ H.S. 10%
R_{14} 47kΩ H.S. 10%
R_{15} 100kΩ H.S. 10%
R_{16} 100kΩ H.S. 10%
R_{17} 470kΩ H.S. 10%
R_{18} 1kΩ carbon 20%
R_{19} 1.2kΩ H.S. 10%
R_{20} 100kΩ H.S. 10%
R_{21} 100kΩ H.S. 10%
R_{22} 1MΩ H.S. 10%
R_{23} 1.2kΩ H.S. 10%
R_{24} 100kΩ H.S. 10%
R_{25} 220kΩ H.S. 10%

One each of the following components is required, these being common to both channels.

R_{26} 10kΩ H.S. 10%
R_{27} 10kΩ H.S. 10%
R_{28} 10kΩ H.S. 10%
R_{29} 100kΩ H.S. 10%
VR_1 1MΩ+1MΩ linear Morganite bass control
VR_2 500kΩ+500kΩ c.t. linear Morganite treble control
VR_3 250kΩ+250kΩ log. Morganite volume control
VR_4 250kΩ with switch Morganite balance

One off C_1 to C_{15} for each channel

C_1 0.25μF 300V wkg
C_2 100μF 6V wkg
C_3 0.05μF 300V wkg
C_4 500pF $\pm$10%
C_5 500pF $\pm$10%
C_6 150pF $\pm$10%
C_7 100μF 6V wkg
C_8 0.05μF 300V wkg
C_9 0.005μF $\pm$10%
C_{10} 0.005μF $\pm$10%
C_{11} 100pF $\pm$10%
C_{12} 100μF 6V wkg
C_{13} 0.05μF 300V wkg
C_{14} 200pF
C_{15} 0.005μF 300V wkg

One each of the following components is required, these being common to both channels.

C_{16a} 16μF 450V wkg
C_{16b} 16μF 450V wkg
C_{17a} 16μF 450V wkg
C_{17b} 16μF 450V wkg
Two sets of valves required.
V_1 Mullard EF86
V_2 Mullard ECC81
V_3 Mullard ECC81

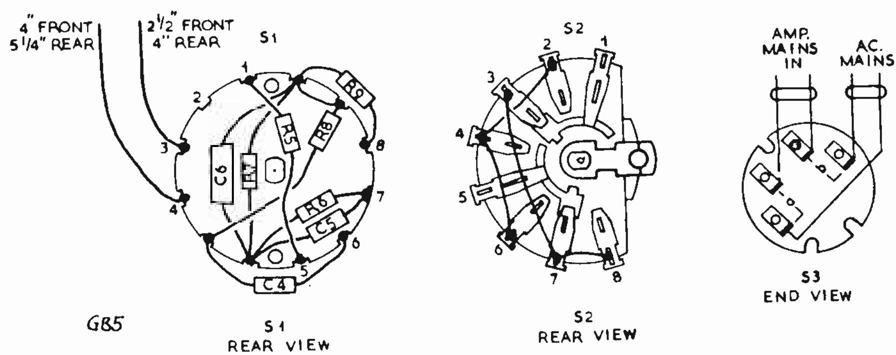


Fig. 7. Diagram of switch wiring

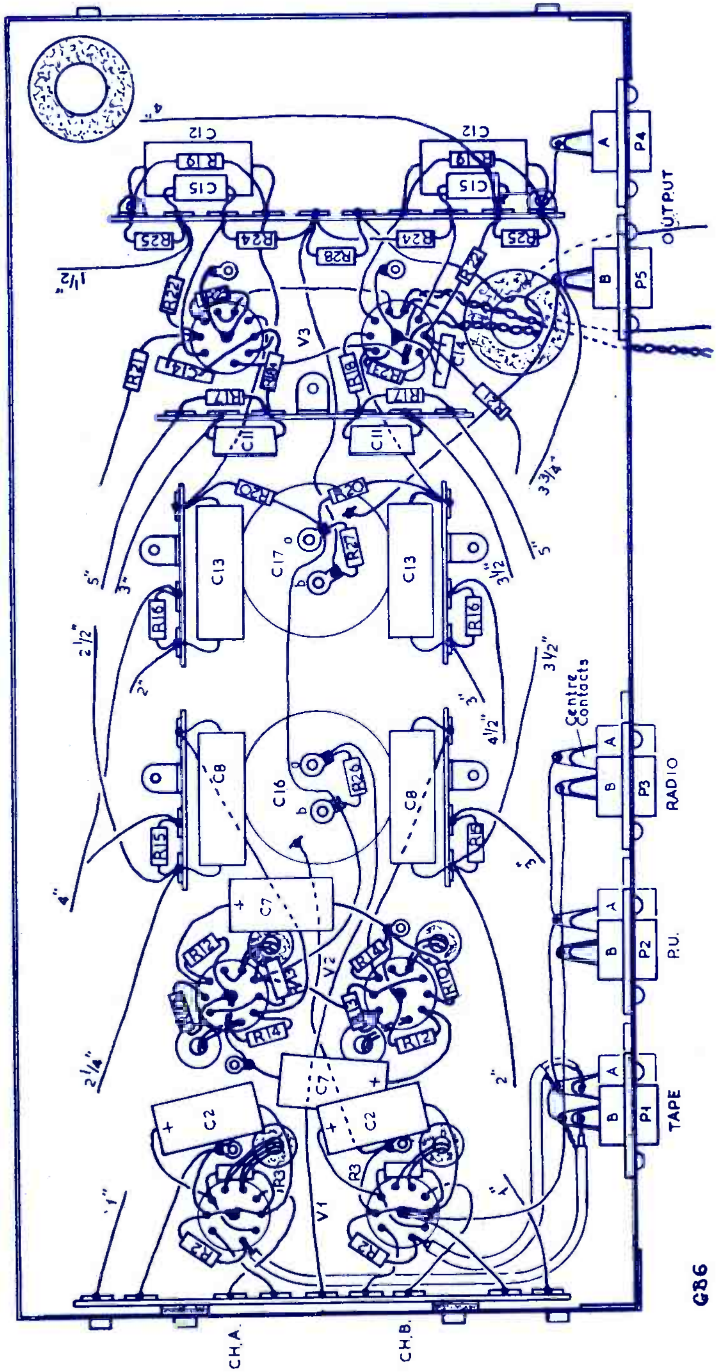


Fig. 8. Stage 1 point-to-point wiring

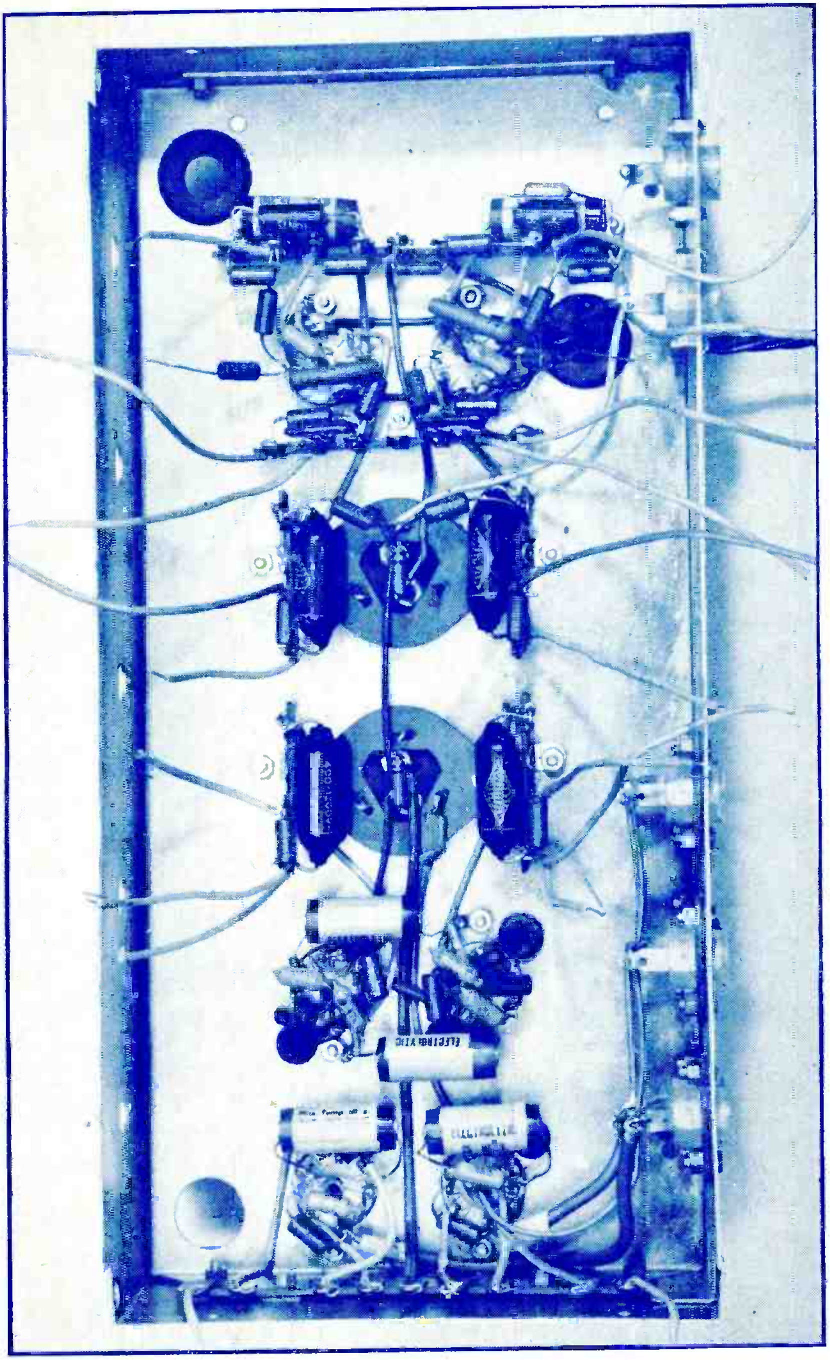


Fig. 9. Stage 1 point-to-point wiring—compare with Fig. 8

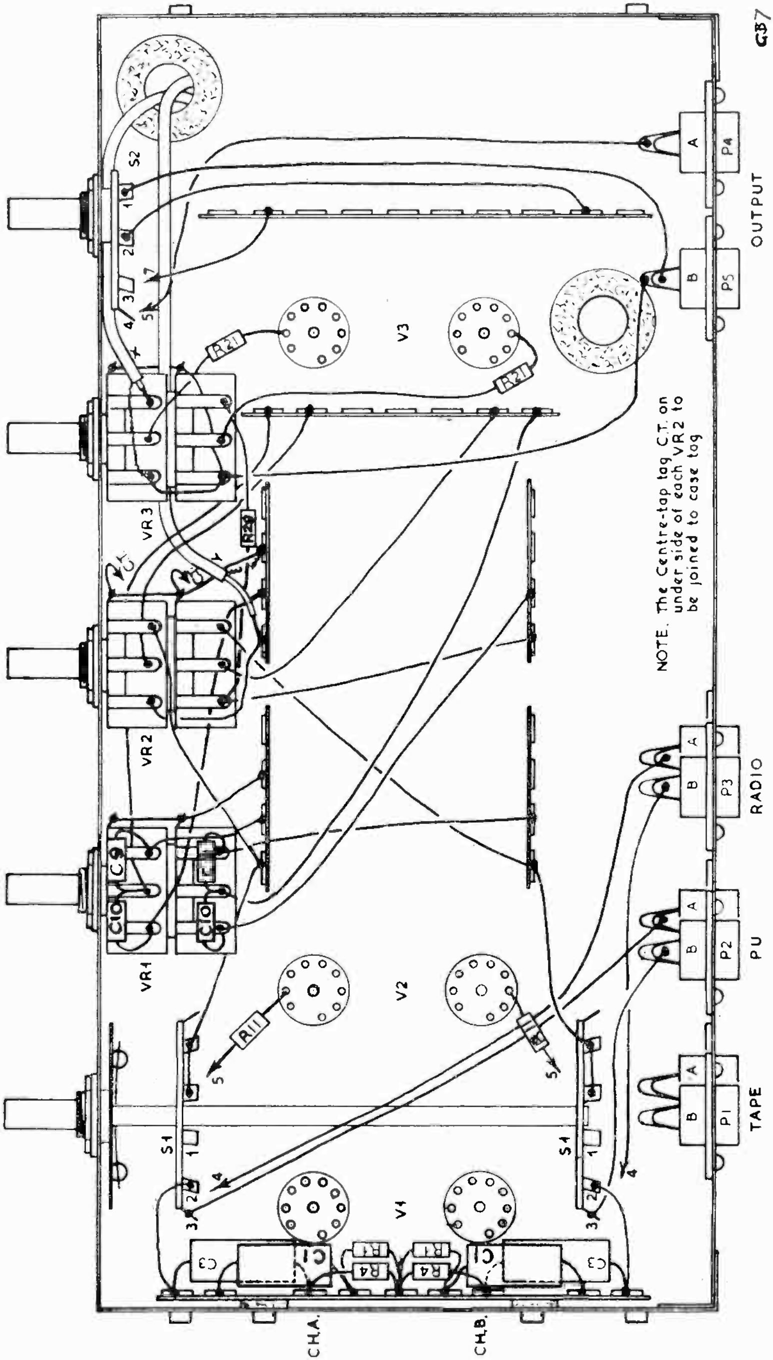


Fig. 10. Stage 2 point-to-point wiring

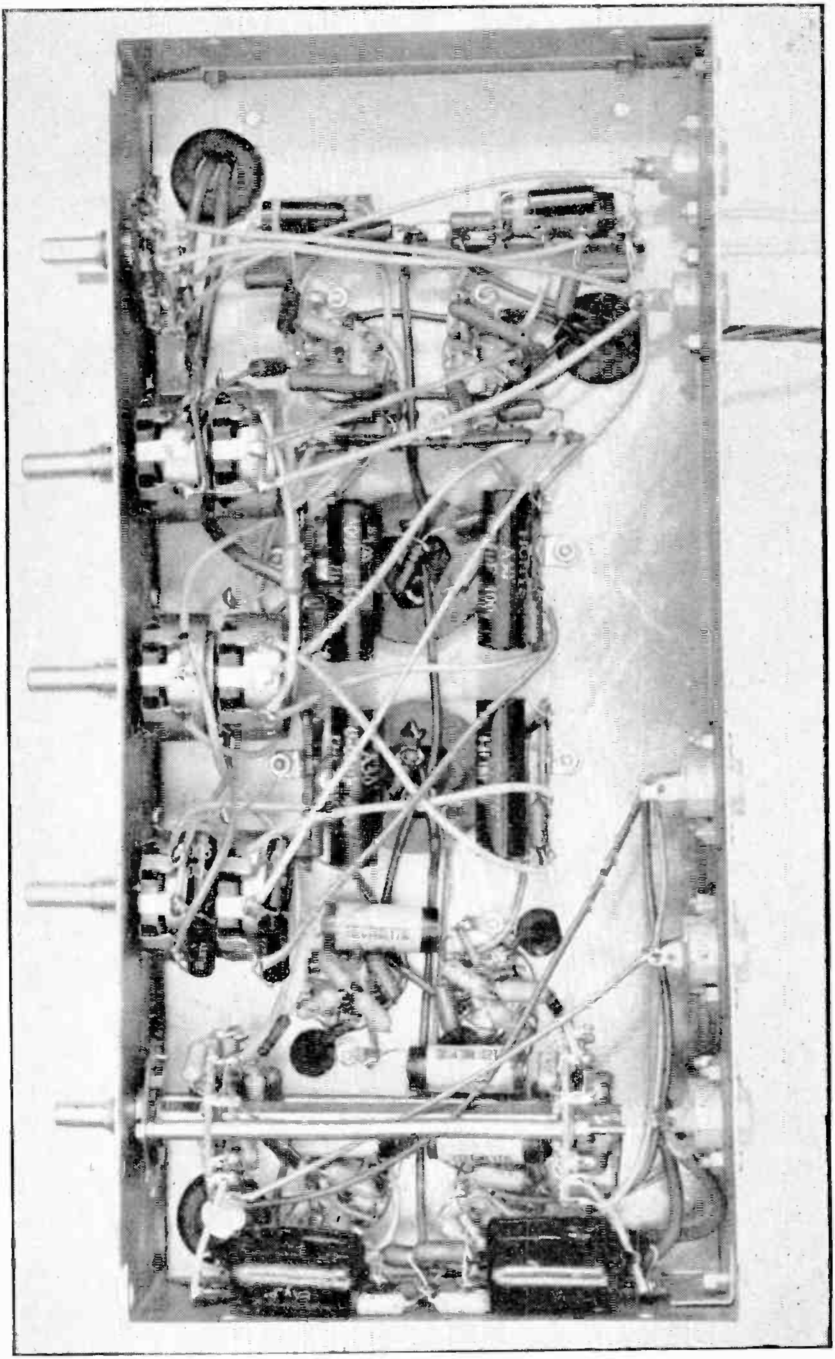


Fig. 11. Stage 2 point-to-point wiring—compare with Fig. 10

Sensitivity
Radio 0.5 volt for 1 volt output at 1000 c/s
P.U. 50 mV for 1 volt output at 1000 c/s
Tape 2mV for 1 volt output at 1000 c/s

Tone Control

Treble	+16dB at 10 kc/s	
	−17dB	
Bass	+10dB at 100 c/s	
	−10dB	
	+13dB at 50 c/s	
	−16dB	

Rumble filter
50 cycles 0dB
20 cycles −3dB
15 cycles −6dB
10 cycles −13dB
5 cycles −27dB

At the same time this diffusion of sound must not be obtained by reflection from walls or again the apparent source will be dependent on the accidents of sound reflection and therefore on the frequency.

The Baxandall tone control circuit is fed from a cathode follower, and the same point may be used to feed a tape record unit, using the first stage of the pre-amplifier to correct the signal; for example, when making a tape recording from a gramophone record.

Around the last stage is built a rumble filter. As its name suggests, the primary object of this stage is to attenuate very low frequencies which may be generated from the gramophone motor. When using crystal pick-ups this circuit is even more essential. A further object of this circuit is to prevent low frequencies, which may be recorded, from entering the main amplifier and causing overload at inaudible low frequencies. For example, the amplifier is only capable of delivering one watt of power at 10 cycles, therefore a signal of only 1/10 normal can cause overload and, even though itself inaudible, will cause anything being reproduced at the same time to also suffer overload.

The second stage uses normal frequency correcting methods in the form of feedback networks. One position only is provided for gramophone correction, and the same position may be used for 78 records. The difference between the responses required is only a few dB and most of this can be corrected on the tone control circuits.

The first stage may be omitted, and the sensitivity of the unit is then sufficient to use with the usual crystal stereo pick-ups, such as Ronette, Acos, etc. If a variable reluctance pick-up is to be used, then the tape pre-amplifier may be connected to the pick-up channel; details of this will be supplied in a later article. The unit will then be suitable for such pick-ups as the Decca, Goldring and Tannoy, which have outputs between 3 and 7 millivolts. The first stage as shown on the unit is intended as a tape pre-amplifier and the equalizing on the second stage is set to suit pre-recorded tapes which are made to C.C.I.R. standards (100 microsecond time constant). This stage is a straightforward low noise amplifier using an EF86, but particular care must be taken with the wiring of this stage and the layout diagram should be followed exactly if hum troubles are to be avoided. High stability resistors must be used where specified, this point being important in achieving a low background noise.

The gain of one channel is made variable to compensate for differences in the two chains, whether it be difference actually recorded on the record or in the pick-up or amplifier or in the sensitivity of the loudspeakers. The balance control may be set at first using a single channel record and adjusted so that the resultant sound appears to come from a point halfway between the speakers. If this cannot be achieved, reverse the connections of one speaker and balance should then be possible.

The channel switch allows the unit to be operated as a single channel amplifier connecting both the main amplifiers to either pre-amplifier channel, and the whole unit then operates as a single 20-watt amplifier. This switch is also useful when checking the system, since either channel can be listened to separately and any defects noted.

Compatibility of Records

It cannot be emphasised too strongly that many standard single channel pick-ups will cause damage to stereo records because the vertical stiffness of the pick-up movement is too great and permanent damage will be caused to the records. The opposite, however, is satisfactory, and a stereo pick-up can be used to play normal L.P. records.

Construction of the Unit

Note that the electrolytic condensers are mounted on spacers approximately $\frac{3}{16}$in long in order to reduce the overall height of the unit; and the cans should not touch the chassis, the earthing being wired separately to the appropriate points in the circuit.

Firstly, mount the valveholders and complete the wiring to chassis. Inspect the joints to solder tags carefully, particularly if a small iron is used to make the joints. The heater wiring may then be completed, this being taken over the top of the chassis to achieve some electrostatic shielding. The wires should be twisted to give magnetic cancellation of the 50 cycle field.

As can be seen from the point-to-point drawing and photograph, the majority of the wiring can be completed before the mechanical assembly of the frame with the potentiometers is commenced. The lead lengths are given allowing this stage to be completed as far as possible. The switch wiring should then be completed as in the drawings and carefully inspected. It is a good plan to arrange all the resistors so that the value can be read in order to make for ease of inspection. As a result of using these resistors, the writer is now wholeheartedly in favour of colour coding instead of writing as a means of marking resistors, since it is otherwise so difficult to find a mistake quickly.

The unit may easily be tested operationally on all channels, but even if all appears to be functioning correctly, the voltages in the circuit should be checked. The figures given in the table were obtained from a 1,000 ohm per volt instrument, but even if any other sensitivity is used it can be seen that all the triodes should measure the same within 10%. If variations are found, inspect the values of the anode and cathode resistors. If a condenser is suspect, this may be disconnected and the voltage measured in its absence. The most likely faults are in fact wiring faults, and as there are two channels the performance can be compared.

Note that the treble control has a centre tap and this should be wired to the earth screen of the potentiometer; as this is underneath the potentiometer, the wiring is not very clear in the second stage point-to-point drawing and photograph.

Voltage Measurement Table

V supply 275

	Pin No. Channel A	*Pin No. Channel B*	*Voltage*
$V_3\ k_2$	3	8	1.1
$V_3\ a_2$	1	6	95
$C_{17}B$	—	—	215
$V_3\ k_1$	8	3	0.9
$V_3\ a_1$	6	1	75
C16B	—	—	170
$V_2\ k_2$	8	3	85
$V_2\ A_1$	1	6	84
$V_2\ k_1$	3	8	1
$C_{16}A$	—	—	150
$V_1\ g_2$	1	1	72
V_1 a	6	6	45
V_1 k	3	3	1.3

The JASON MOTOR AND ELECTRONIC COMPANY

An associate company has now been formed in France known as "Jason (France)" 19 Boulevard des Capucines, Paris, 2e.

The object of the company is to manufacture high fidelity equipment in France, and the first products to be launched are the Jason J10 amplifier and the C.Q. speaker which is being made under licence from C.Q. Audio Ltd.

TRANSISTOR RADIO COSTS REDUCED

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The usual coding has been dropped and the five lines are colour coded for different numbers of transistors and circuit arrangements. Each transistor carries a number, identifying its position in the receiver. The transistor complements are offered complete with diode at very competitive prices. Production quantities are immediately available.

TELEVISION SOCIETY PREMIUMS

The Television Society has awarded the following Premiums, for outstanding papers read before the London meetings in 1956/57:

The WIRELESS WORLD Premium to DR. D. GABOR, F.R.S. (Imperial College) for his paper on "A New Picture Tube."

The MERVYN Premium to DR. E. L. C. WHITE, M.A. (E.M.I. Research Dept.), for his paper on "Alternatives to the N.T.S.C. Colour System."

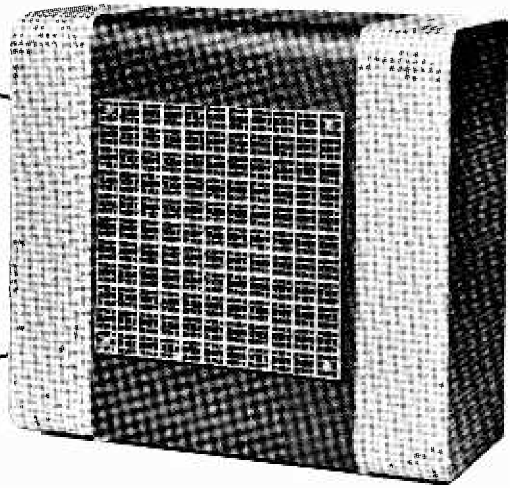
The MULLARD Premium to MR. S. N. F. DOHERTY, B.SC., and MR. P. L. MOTHERSOLE (Mullard Research Labs.) for their paper on "Automatic Gain Control Circuits in Television Receivers."

The E.M.I. Premium to DR. J. A. SAXTON, M.I.E.E. (D.S.I.R. Radio Research Station) for his paper on "Scatter Propagation and its Application to Television."

The ELECTRONIC ENGINEERING Premium to DR. R. PEARCE, B.SC., A.M.I.E.E. (E.M.I. Research Dept.) for his paper on "The Return of Electrostatic Focusing."

The PYE Premium to MR. IAN ATKINS (Senior Dramatic Producer, B.B.C. Television) for his paper on "Studio Production Techniques."

The CRY BABY Alarm



described by E. GOVIER

DESIGNS FOR BABY ALARMS ARE NOT IN themselves over-numerous, but where they exist an examination of the circuitry will reveal to the radio hobbyist that such units are little more than simple audio amplifiers. As such, with the usual microphone input and speaker output, etc., they are by the nature of their design liable to reproduce in an amplified form any audio input over a fairly wide frequency range. In essence this is unnecessary where the baby alarm is to be used purely as such, most noises from the nursery consisting of high-pitched audio cries emanating from the vocal chords of the young genus homo-sapiens. (Who amongst us is not only well aware of this but has also taken his turn at "sentry-go" in the small hours?)

Ordinarily, baby alarm circuits are designed as multi-purpose units, in addition to their primary function also serving as audio amplifiers, audio signal tracers and as receiver test "back-ends", etc. The components necessary to achieve this end are more numerous and expensive than would otherwise be the case where the unit is designed primarily as a baby alarm only. In the circuit about to be described, both of the above considerations have been borne in mind. Designed simply as a baby alarm only, with no unnecessary frills, the components required for completion, and therefore the total cost, have been kept to a minimum consistent with a high level of efficiency, safety and reliability.

The unit has been specially designed to emphasise any high pitched audio sounds, therefore cries, etc., are amplified more than those of the unlikely low register sounds. A balanced armature earpiece is used both for the microphone and the speaker. The alarm is intended for use on a.c. mains and for this purpose utilises a double-wound mains transformer, thus completely isolating the chassis from the mains supply. This ensures that no possible harm will be caused to the infant should it possibly open the microphone unit or disconnect the connecting wires.

Circuit

This is shown in Fig. 1 from which it will be noted that two valves, an SP61 (VR65) and an EL32 (CV1052), plus a contact cooled rectifier having a rating of 250V at 50mA, are used. A volume control (R_3) is combined with the a.c. mains on/off switch, it being merely necessary to adjust this to the required audio level when in operation. The input is via T_1, the microphone matching transformer, the secondary of which is fed into the grid of the first amplifying stage (SP61). The small cathode bias required for this stage is supplied via R_1 decoupled by C_1. Voltage for the screen grid is taken from the following output stage cathode, this being in the order of some eight volts. Using this method of screen supply, a considerable saving is effected by the elimination of the usual voltage drop resistor and bypass condenser.

The resultant output from this first stage is fed, via C_2 and R_3, into the grid of the output valve. The balanced armature earpiece, connected into the anode circuit, functions as the speaker unit. The power supply section is conventional.

Assembly

The aluminium chassis and combined panel is supplied completely pre-punched, and all that is required of the home constructor is to firmly and securely mount into position the main components before wiring the actual circuit.

The best method of assembly is to first mount the two valveholders and the three earthed solder tags, two with V_1 and one with V_2; these are fitted under the securing screws as shown in Fig. 2. The two valveholders are of differing types, and to ensure that correct positioning is obtained, check each holder with the actual valve before securing. Next, fix the volume control R_3 to the rear chassis wall, and the microphone input sockets likewise. The transformer T_1 should now be mounted in position together with the associated tag-strips (see Fig. 2).

Following the above, the capacitor unit C_4/C_5 should now be secured to the chassis. This unit is of the prong fixing type and it should be secured by bending over the three tags so that they clamp tightly to the underside of the chassis. An alternative method of achieving the same object is to twist these tags slightly with a pair of pliers. At a later stage, these tags should be soldered to the

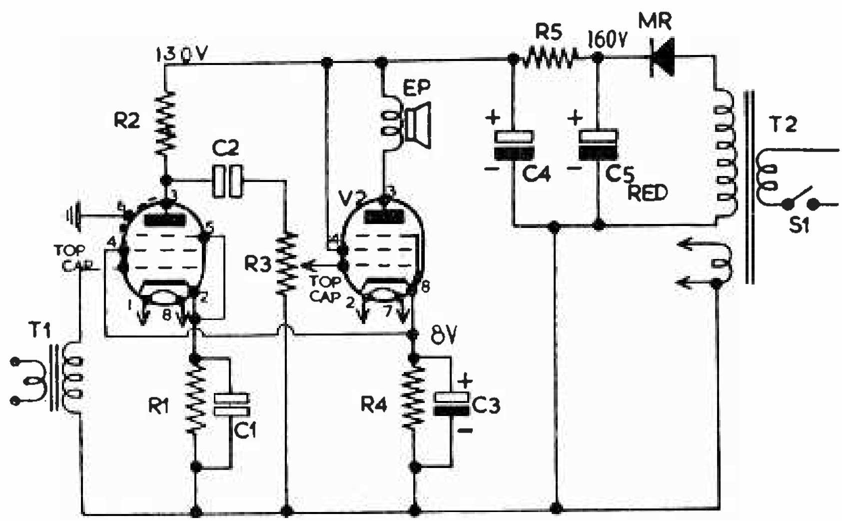


FIG. 1.

Circuit of the "Cry-Baby"

Resistors		*Colour Code*
R_1	5.6kΩ $\frac{1}{4}$W	Green, blue, red
R_2	1MΩ $\frac{1}{4}$W	Brown, black, green
R_3	250kΩ potentiometer	
R_4	680Ω $\frac{1}{4}$W	Blue, grey, brown
R_5	2.2kΩ $\frac{1}{2}$W	Red, red, red

Condensers

C_1 0.1μF, 350V wkg.
C_2 100pF, mica, 350V wkg.
C_3 25μF, 25V wkg. electrolytic
$C_{4/5}$ 32+32μF, 250V wkg, electrolytic

T_1 Mic. Matching Transformer (Clyne Radio Ltd.)
T_2 Mains Transformer 200V at 20mA, 6.3V at 1A (Clyne Radio Ltd.)
V_1 SP61 (VR65)
V_2 EL32 (CV1052)
Speaker—Balanced Armature Unit
MR—Contact Cooled Metal Rectifier type E250/C50 250V at 50mA
Chassis (Pre-punched) (Clyne Radio Ltd.)
Cabinet (Clyne Radio Ltd.)
Valveholders, one I.O. and one M.O.

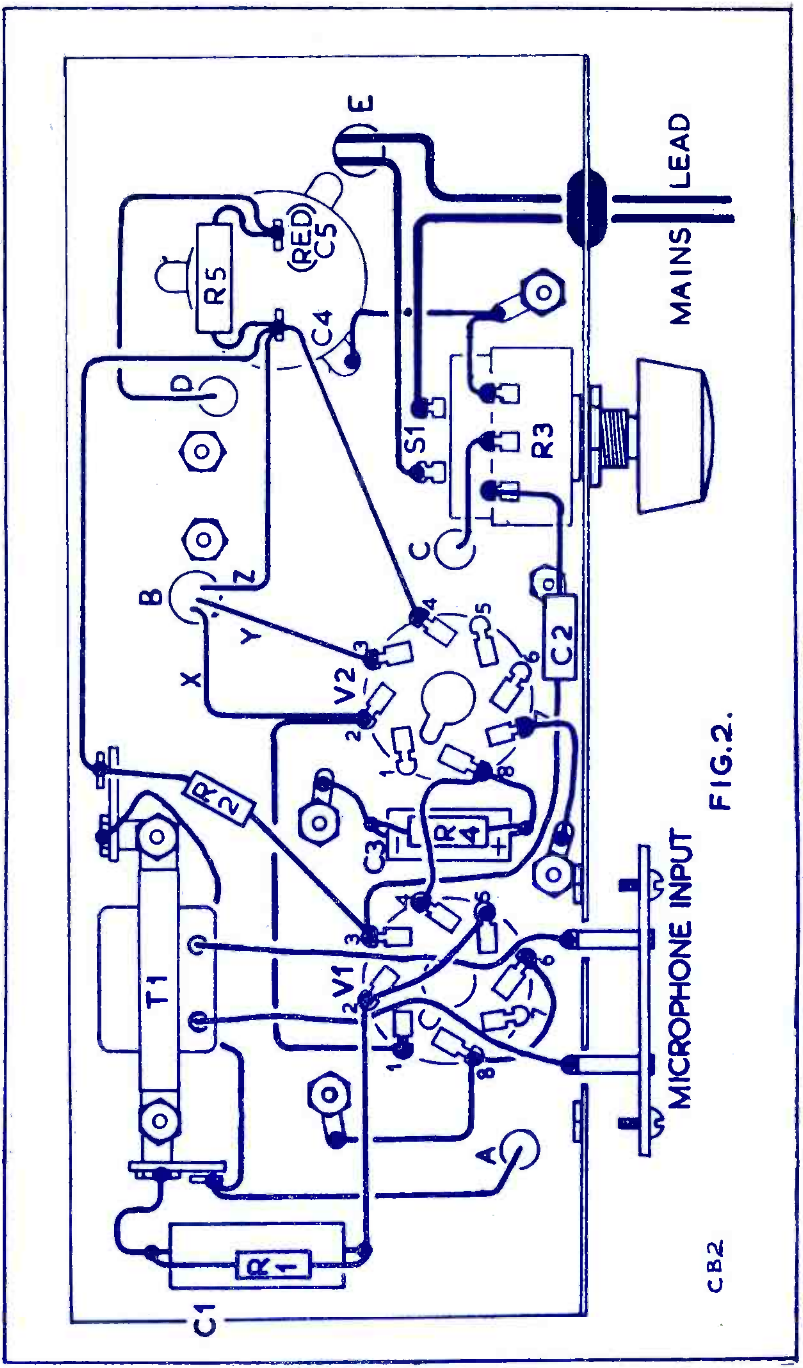
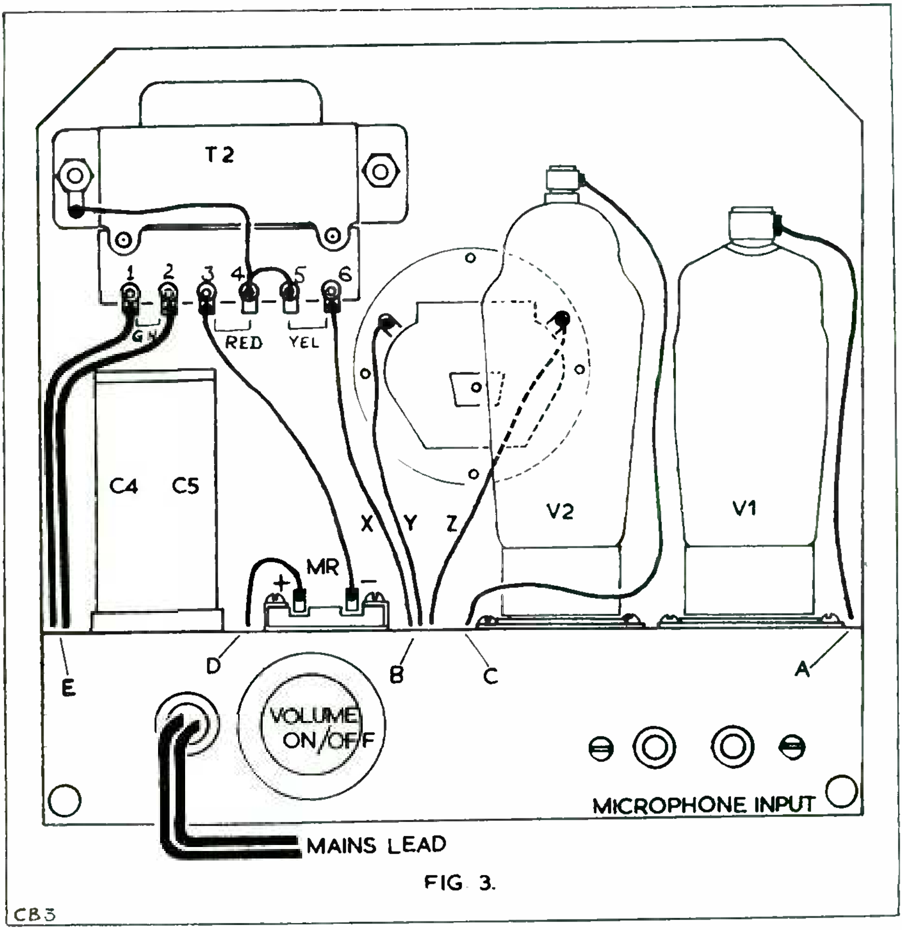


FIG.2.

Under-chassis point-to-point wiring



Above-chassis wiring

chassis both in order to achieve a good electrical earth return and to finally fix the capacitor in a secure manner.

The metal rectifier must next be firmly bolted to the chassis, this being followed by the mains transformer T_2 and the speaker unit—the latter two components being secured to the front panel. Note here that the speaker unit is secured by means of two small screws, each threading into the unit from the front of the panel. The remaining two diaphragm screws *should not* be disturbed, being used only for locating purposes.

The rubber grommet should now be fitted in position on the rear wall of the chassis.

Wiring the Circuit

Wiring the circuit is best carried out by firstly completing the power and heater supplies and secondly by including the remainder of the components.

Pass the mains input leads through the rubber grommet, soldering one wire to the switch S_1, contained on the rear of the volume control. Pass the other wire through hole E and solder to the left hand green tag of the mains transformer. (See Figs. 2 and 3.) It should be noted here that one of the mains wires will have to be cut somewhat shorter than the other in order to fulfil the above instructions. From the remaining tag of the switch S_1, connect a length of p.v.c. wire to the green 2 tag of the mains transformer, first passing this wire through the hole E.

From tag red 3 of the mains transformer, solder a short length of wire to the minus (−) tag of the contact cooled metal rectifier. From the plus (+) tag of the rectifier, solder a length of p.v.c. wire to connect to the red tag of C_5, first passing this wire through the hole D. (See Fig. 2.)

Connect, by means of a suitable length of p.v.c. wire, the mains transformer tag yellow 6 to pin 2 of V_2 valveholder, first passing this lead (X) through the chassis aperture marked B. From pin 2 of V_2, take a small length of wire to pin 1 of V_1.

Using a short length of bare wire, join together pins 6 and 8 of V_1, ensuring that this wire does not touch any other valveholder tags, and solder the appropriate end of this bare wire to the solder tag as shown in Fig. 2. Connect pin 7 of V_2 to chassis by soldering a short length of bare wire to the nearest solder tag.

Returning to the mains transformer, join together red tag 4 and yellow tag 5, connecting these tags to chassis by soldering a length of wire to that earthed tag fitted to the panel with the transformer itself.

From the positive of condenser C_4, solder two lengths of wire to connect with pin 4 of V_2, and the free tag of the nearest tag-strip mounted with T_1. Between the tags of C_4 and C_5, connect the resistor R_5. Dealing with the speaker unit, it will be noted that there are four solder tags contained on this—only two of which are used. In order to indicate the correct pair of tags, the unit is supplied with the two lead wires already soldered to these tags. The right hand lead (Z) (see Fig. 3) should pass through the aperture B and be connected to the positive solder tag of C_4. The remaining speaker lead (Y) should pass through the aperture B and should now be soldered to pin 3 of V_2.

Proceed to complete the wiring of V_1 as follows: Solder together pins 2 and 5 of the valveholder. To pin 2, solder one end of C_1, the other end of which is connected to the earthed tag of the tag-strip. Across C_1, connect the resistor R_1. To pin 3 solder one end of both C_2 and R_2, the other end of the former being connected to the nearest tag of the volume control and that of the latter to the appropriate tag of the tag-strip as shown in Fig. 2. Connect together pin 4 of V_1 to pin 8 of V_2. Solder the lower left hand wire of T_1 to the free tag of the tag-strip mounted at the left of the transformer and from this same tag, connect a length of p.v.c. wire to the larger of the valve top cap clips, first passing this wire through the aperture marked A in Fig. 3. Solder the lower right hand wire of T_1 to the earthed tag of the tag-strip mounted on the right of T_1. The upper left hand wire of T_1 should now be soldered to the left hand input strip tag and the remaining wire of T_1 to the other tag of the same strip.

From pin 8 of V_2, solder the positive (+) end of C_3, the other end of this being now connected to that earthed solder tag mounted with V_2 valveholder. Across C_3 should now be soldered the resistor R_4.

The right hand tag of R_3 should now be soldered to the earth tag mounted on the chassis near this component. From this same earthed tag, a short length of wire should now be soldered to one of the fixing clips of C_4/C_5. To the centre tag of R_3 connect one end of a length of p.v.c. wire and, passing this through the aperture marked C in Fig. 2, solder the other end to the remaining valve cap clip (Fig. 3).

This completes the wiring of the baby alarm. The next step is to connect the respective valve grid clips, having inserted the valves, connect the microphone, plug into the mains, switch on and test the unit. Provided the above instructions have been carried out, with frequent references to the diagrams shown herewith, no trouble should be experienced in getting the alarm to work immediately.

It now remains to insert the completed unit into the attractive red and grey cabinet supplied. The chassis assembly is held in position by two wood screws, these also holding the bottom of the cabinet back in position. Two wood screws also hold the top of the cabinet back in position.

RADIO AMATEURS' COURSE

For several years a highly successful class for radio amateurs has been held at the Brentford Evening Institute. Brief details are as follows:

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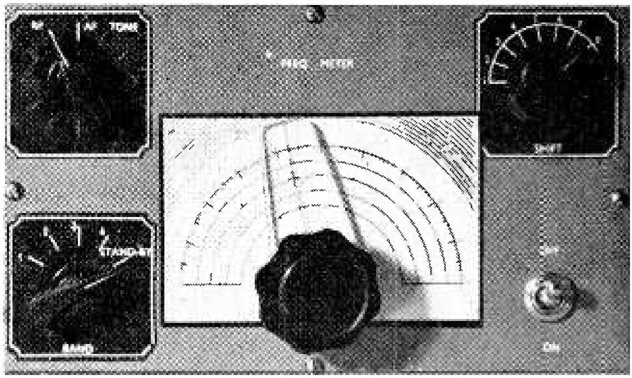
By JAMES S. KENT

Part 2



LAST MONTH THE CIRCUIT OF THE FREquency meter was discussed, and in this issue the constructional method is dealt with in some detail. The description is arranged in logical sequence so that the beginner may read each paragraph and, following this, carry out the work so described in the correct order.

Drilling the Panel and Chassis

It is assumed that the reader has the few simple tools necessary for the purpose, these being a hand drill, centre punch, hand brace, three drills, $\frac{1}{8}$in, $\frac{11}{64}$in, $\frac{7}{16}$in, and a small vice if available. The first item to be dealt with is the front panel.

(1) With the panel face uppermost on the bench, carefully measure and centre punch the painted surface to the dimensions shown in Fig. 2. If using a different variable condenser from that specified, allow for the possibly differing fixing screw holes. Next, drill through the panel at each centre punch mark using the $\frac{1}{8}$in drill. Following this, using the brace fitted with the $\frac{7}{16}$in drill, bore through holes A, B, C, D and E, first fixing the panel in a vice. (Note: When fixing in the vice, protect the painted surface by using a thick piece of paper or card within the actual vice jaws; blotting paper is ideal for this purpose.) The remaining holes, F, G, H and I, are left at $\frac{1}{8}$in diameter as first drilled.

(2) The next task is to drill the chassis front drop. This may be simply done by using the front panel as a template, allowing for the $\frac{1}{4}$in overlap of the panel at each end, and centre punching the holes B, C and D, taking care that the true centres are marked. Also, the variable condenser fixing screw holes should also be marked in this manner. This completed, drill first with the $\frac{1}{8}$in and then the $\frac{7}{16}$in. drill. The panel and the chassis drop apertures should now coincide. Fig. 3 shows both the chassis front and rear drop, the holes on the former being designated B, C and D to coincide with those on the front panel. The rear drop drilling details are clear enough, holes J and K being similarly treated as those for the front drop. The remaining holes are left at $\frac{1}{8}$in clearance.

(3) The chassis deck is next dealt with by following the details of Fig. 4. All holes are of $\frac{1}{8}$in diameter, except L which is to accommodate the valveholder, and M which is $\frac{1}{4}$in diameter (mains input to transformer). The actual diameter of L is $\frac{3}{4}$in and, if possible, the beginner should obtain an Osmor chassis cutter of this size for the purpose. The purchase of this useful tool is a worthwhile investment as it will save hours of hard work drilling and filing valveholder apertures. Failing this, holes may be drilled around a diameter of $\frac{3}{4}$in and an "Abra-File" used to complete the work.

(4) Having completed the foregoing, the cabinet lid is next treated by drilling three $\frac{11}{64}$in holes as shown in Fig. 5. These are for ventilation purposes and are necessary to ensure stability of the oscillator, in that the small amount of heat generated may easily be dispersed.

This completes the drilling details except for holes F, G, H and I of Fig. 1, insofar as matching these to the actual cabinet front flanges are concerned. This, however, may be done at a later stage once the chassis is fixed to the panel. (See below.)

(5) In the following sequence, all the main components have to be mounted in their respective positions. Commencing with the front panel and chassis, fix to B (Fig. 2) the two-pole six-way Yaxley switch; and to D the single-pole single-throw switch. These two will hold the chassis and panel together while the remaining Yaxley is fitted to A and the small variable condenser to E. Next, position and secure the main variable condenser. (Note: The holes for this will, of course, have to be drilled according to the type and make of component). As many types are available, drilling details of this have not been given. The main point to note is that the moving vanes, once the component is mounted, should have a free space in which to rotate—see under-chassis illustrations, where it will be noted that the condenser is mounted sideways, i.e. top nearest the coils.

(6) The valveholder should now be screwed into position, first ascertaining that the earthing tag is fitted under one nut and that the orientation of the holder is correct. (See point-to-point wiring diagram, Fig. 6.) Next, the tag-strip, output socket—with earth tag fitted, intervalve transformer, coils and mains transformer (with earthing tag fitted above chassis), should be screwed into position. From Fig. 6 take particular note of how these have been mounted in the prototype.

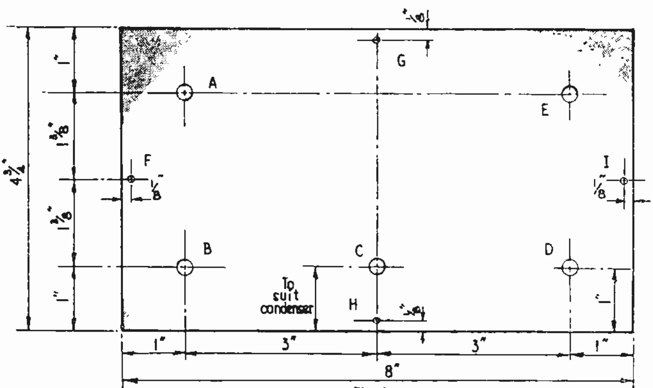
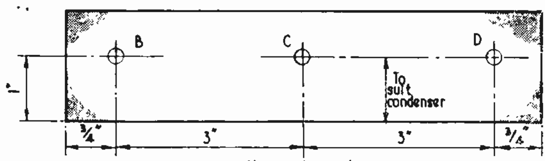
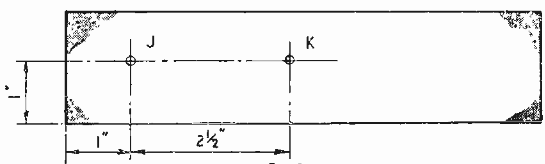


Fig. 2
Drilling details of front panel



Chassis front drop



E558

Fig. 3
Chassis rear drop

We have now completed the drilling and mounting of the main components. Following this, we continue with the actual wiring details.

Wiring Details

Commence by wiring the valveholder and allied components in the following sequence.

Valve tags 7, 8 and the centre metal lug should be joined with a length of bare tinned copper wire and soldered, one end of the wire being soldered to the valveholder earthed tag.

Tag 1 should be joined to tag 6 of the mains transformer via a length of PVC wire, this being taken through the chassis aperture previously drilled.

To tag 2 of the valveholder, solder one end of both R_3 and C_4, the other end of the former being fixed to tag 2 of the paxolin tag-strip and the other end of C_4 to tag 3, from where a short length of wire is soldered direct to the output socket.

To tag 3 of the valveholder solder one end of R_1, C_3 and R_2. The other end of R_1 is then joined to tag 1 of the tag-strip; C_3 to the main tuning condenser tag and R_2 to tag 6 of the valveholder.

C_6 should now be taken from tag 4 of the intervalve transformer to chassis by soldering the earthy end to the earth tag mounted with the output socket. Tag 3 of the intervalve transformer should also now be joined to the same earth tag. Tag 2 of the same transformer should then be soldered to tag 2 of the paxolin strip (the h.t.+ line) via R_5.

Tag 4 of the valveholder should now be joined to SW_2 (see Fig. 7). To the main tuning condenser tag, solder a length of wire, the other end of which should be joined to C_2. From the same tag of C_1, solder a length of wire to SW_1 (see Fig. 7).

The mains input lead should now be brought through a rubber grommet, which should be mounted on the chassis backdrop, through the small rubber grommet on the chassis deck, and then soldered to tags 1 and 2 of the mains transformer; one lead to each tag, of course. At a point near the on/off switch (SW_4), cut one lead only. Bare the severed ends and solder to the switch, one lead to each tag of the switch.

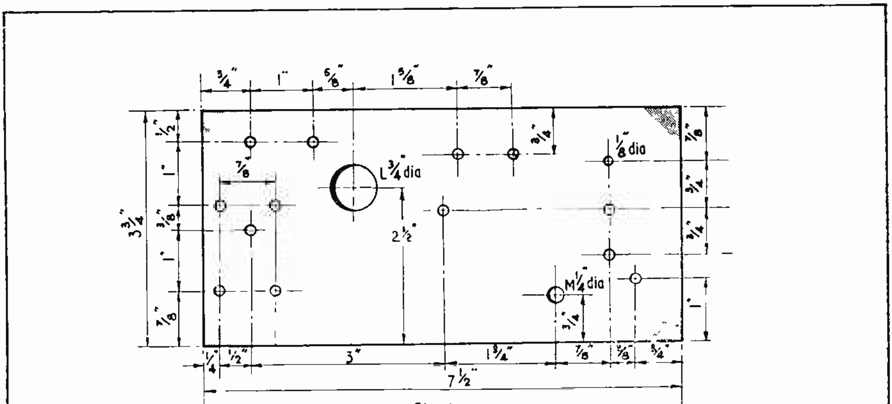


Fig. 4
Chassis deck drilling details

Join tag 5 of the valveholder to tag 1 of the intervalve transformer.

To tag 6 of the valveholder solder one end of R_6, the other end of which is taken to tag 1 of the paxolin strip. To the same valve tag solder one end of C_5, the other end of which goes to tag 5 of the intervalve transformer. (Note: In the prototype, one section of the tuning condenser has been removed in order to position C_5. This is not, however, strictly necessary; C_5 could be sited along the rear of the component if so desired.) Next, join tag 5 of the intervalve transformer to SW_3 (see Fig. 7). Solder one side of SW_3 to chassis.

Except for the coils, this completes the under-chassis wiring and we now continue with the above-chassis details, leaving the coils till last.

Tags 1, 2 and 6 of the mains transformer are already wired, leaving the remainder to be dealt with as follows:

With a short length of bare tinned wired, join tags 4 and 5 to the earthed tag of the small variable condenser. (See illustrations.) Ensure that this wire does not come into contact with any other tag of the mains transformer other than those stated.

Tag 3 of the transformer now remains to be connected into circuit. To the rear upright portion of the tag solder one tag of the RMO metal rectifier (*NOT* the red-painted tag). The rectifier itself must be so fixed to the tag that it is positioned on its side but *NOT* touching any other tag or metal part of the transformer. If the rectifier were to be mounted upright, the unit, when completed, would not fit into the metal cabinet.

The two electrolytic condensers C_7 and C_8 should now be soldered to the earthed tag on the mains transformer fixing bolt. Take particular care that the negative connections to these condensers are the ones soldered to the earthed tag. With the condensers mounted upright and close together (see photographs), join the two positive ends via R_6. Join the positive tag of the metal rectifier (coloured RED) to the positive connection of the condenser nearest the front panel (C_8). To the positive end of C_7 solder a length of PVC wire, and take this wire through the chassis and fix the other end to tag 2 of the paxolin strip mounted on the back drop of the chassis.

This completes the above chassis wiring, and we now continue to wire into circuit the coils.

Close attention to the following and frequent reference to Fig. 7 will ensure that this is done correctly. Fig. 7 shows both the Yaxley switch tags and connections and the coil tag ring positions.

All the No. 1 tags of the coils should be joined to earth via a single length of bare wire, taking care that this does not touch any other coil connection. Next, wire SW_1 as shown in Fig. 7, this being a rear view of the Yaxley switch. Follow this by wiring SW_2 exactly as shown. The numbered tag connections of the coils are shown and it should be noted that tag 4 is left blank. All wires should be as short and direct as possible, using PVC wire throughout.

The connections to SW_3 are clearly shown.

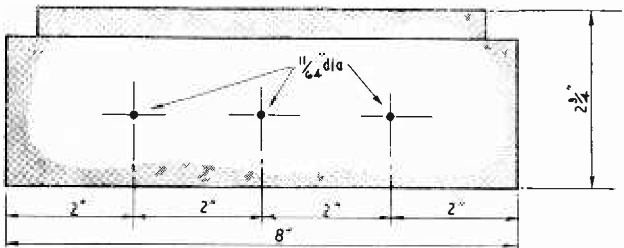


Fig.5
Cabinet lid details

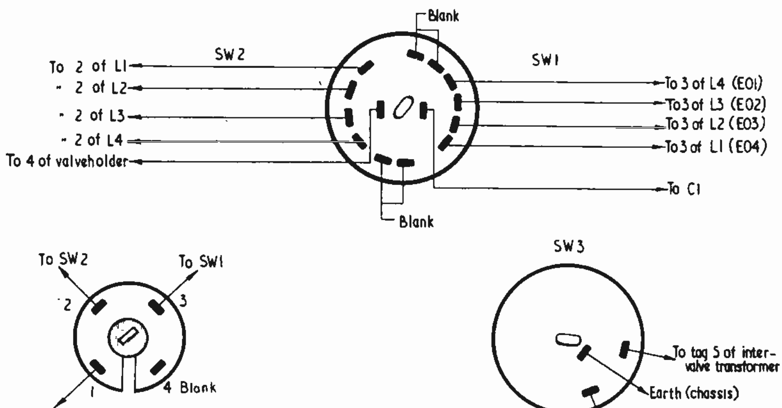


Fig.7
Coil & switch details

E560

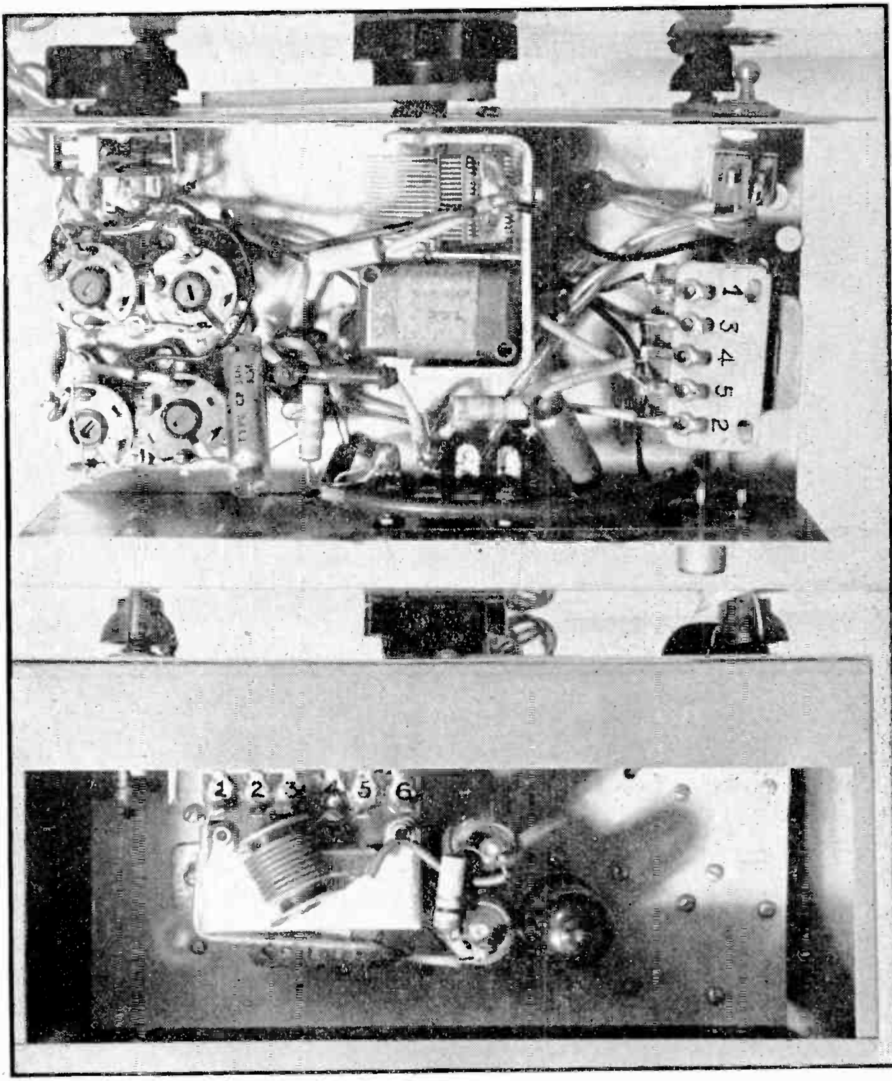


Fig. 6. Above, the underneath view of chassis; and below, view looking down on top

One point worth mentioning, however, is that the earth connection should be made to the switch metalling itself in order to avoid a long earth wire.

The unit is now completely wired, and the next step is to test the voltages before placing the valve into position. The following approximate voltages should be obtained: h.t.+ output (junction R_5 and R_6) 165V; tag 1 of intervalve transformer, 142V. With the valve in position and the audio modulator switched off, the h.t.+ output should read 140V; with the modulator on it should be 135V.

Next month we will deal with the calibration of the unit.

Radio Miscellany

SOME YEARS AGO WHEN A NUMBER OF points dealing with t.v. problems occupied the attention of this column, a reader with obvious anti-t.v. leanings bitterly complained it ought to be re-named "T.V. Miscellany." In recent months the gramophone and records have been taking up an increasing amount of space. I hope no reader feels so strongly about it that he, in his turn, will suggest re-christening it "Gramo. Miscellany." It is odd how often when this column picks up a topic it seems to become "news" a month or two later. Since we started it, disc reproduction has attracted more and more attention. Even the B.B.C. had a special Radio Record week and ran a Gramophone Supplement in the *Radio Times*.

The great revival of interest in the gramophone is due to the extremely high level reached by modern pick-ups, amplifiers and recordings. This, together with impending developments in two-dimensional recording, has brought to light a very extensive interest among our readers, particularly in technical developments. With regard to dual recordings (in the same groove) to produce stereophonic effects, I think I made it clear that the leading manufacturers did not intend to market them until a uniform system had been agreed upon.* But the recent demonstration in stereophonic reproduction by the B.B.C. in special transmissions during broadcasting hours has whetted the appetite not only of the hi-fi enthusiasts but also the experimenter. This, I believe, is the first time the B.B.C. (who at last are getting a little more enterprising) have done anything like this during normal broadcasting periods. Many, many long years ago they broadcast a number of musical tones of even intensity so people could tell how good their reproduction was. Instead, everybody found out how bad it was, and they were so inundated with enquiries and complaints they seem to have steered clear of doing anything like it since.

* These notes were written just before the announcement that the Pye group were to issue the first British stereo discs on the 2nd June—EDITOR.

Realism

No doubt many readers will have attended stereophonic demonstrations and have been most impressed, not so much at the quality of the reproduction and frequency range, but at its feeling of spaciousness and the sense of positioning it gives. Under ideal conditions the sounds seem to be coming from anywhere except the actual position of the loudspeakers! One of the earliest really effective ones I heard was nearly ten years ago at Philips (in Eindhoven) where I went as a guest during their jubilee celebrations. Since then, of course, there have been many new developments and, naturally, I have since been to even more impressive demonstrations over here. I hope to have the opportunity of visiting Philips again to see the further progress they have made in this respect. There were just three of us (and two engineers) in the demonstration theatre at the time and the loudspeakers were concealed. It was quite impossible to tell where the sound was coming from. As you moved towards the spot where you suspected one might be, the source of sound seemed to move away from you to a quite different point. It was rather like trying to chase an echo. This was, of course, a permanently arranged demonstration theatre—not one planned for just the duration of an exhibition as were the more recent ones I have heard. These have been quite good enough to feel, if you close your eyes, that you are standing among the various instrumentalists of the orchestra. To go back to one loudspeaker with all the sound coming from a single source (however good it is) leaves the keen experimenter vaguely dissatisfied. It seems rather like listening with one ear only.

Effective results are obtained by using loudspeaker systems employing a network of filters, etc., but the chief virtue of such an arrangement is the extension of the frequency range. When, as in the B.B.C. stereophonic transmissions two separate channels are used (and two separate receivers at the listening end) remarkable results can be achieved with normal, inexpensive equipment. However, the B.B.C. made it clear that it was merely an experiment and was not to be taken as an indication that stereophonic broadcasting is likely in the foreseeable future. Nor could entirely satisfactory reception be obtained by listeners on one channel only, of course. Hence, as I mentioned a couple of months ago, it is to the gramophone with two channels in a single recording groove that those with a taste for stereophonic reproduction must look.

Through Other Ears

I was rather hoping to have heard from readers situated in more distant regions on their reception of these transmissions. They may well have got poorer reproduction than from the normal single channel transmissions. I did, however, manage to induce a number of friends to specially listen to the re-broadcast in their own homes under the conditions recommended by the B.B.C. and to give me their opinions.

These varied from those whose only

and their original title was the Columbia Graphophone Co. Ltd.

The second informative letter comes from R.G.W. (Coventry) on the question of the life of modern L.P. records. Using standard Collaro 3-speed changer units with Studio "O" pick-ups arranged for continuous "repeat," the records are found to give 2,500 playings before the signal/noise ratio has noticeably depreciated when heard over a high fidelity monitor.

The conditions were perhaps a little exceptional as the turntable cabinets were baize lined to prevent the ingress of dust, and the stop/start switch could be operated from outside the box. This figure was obtained using a sapphire stylus, which was found satisfactory for 1,700 hours playing (about 8 months all-day use). Now a diamond stylus has been fitted to each of the heads. At the time of writing they had only been in use for two months, but a longer life than with the sapphire type is expected. Many thanks to both for the information.

"Two-way" Radio

Thinking of "dual" reception to obtain special effects reminds me of the years just before the superhet receiver became usual.

Centre Tap talks about items of general interest

reaction was to hear the sound "more spread out over the room" (only natural with two loudspeakers going) to those who claimed to hear the ping-pong ball being hit from one loudspeaker to the other. They also felt the train was rushing in on the first and out of the second loudspeaker. They all agreed that the noises were much more effective than the musical items. Personally, I thought the operatic selection was the most realistic and that there really was a space between the orchestra and the singers.

Incidentally, the programme was planned by the gramophone companies—hence the gramo. invasion into this column is particularly strong this month!

Still in the Groove

Continuing with the gramophone as the main theme, there are a couple of interesting letters from readers. The first, from R.E.B., of Stockton-on-Tees, on the origin of the word *gramophone*. It was the trade name of H.M.V. Columbia called theirs the Grafonda

Three-valve, sometimes four, straight receivers were the order of the day, the keen types using bandpass tuners and the still keener types experimenting hopefully with various forms of a.v.c. Multi-electrode valves were still to come. Hence the superhet was both cumbersome (with numerous triodes) and costly. The less knowledgeable constructors didn't like them, alleging poorer quality than the "straight." This was often true, due to overloading in the various stages; but it was even more true, although not admitted, that they were more than a little scared of the complication.

The straight receivers, although very sensitive, suffered badly from the effects of fading when tuned to the more distant stations, and as the straights did not have sufficient gain a.v.c. was hardly a worthwhile proposition. So to overcome fading the keen types used "diversity receivers." This simply meant that two tuning circuits were fitted to one receiver. Thus, to overcome the effects of fading one simply found another station broadcasting the same programme and tuned the second circuit to that. It was economical and gave the keen types another knob to play with. The belief that the more knobs you had the better (called "having everything under control") was a long time dying. Incidentally, the business of "simultaneous" broadcasting by virtually all B.B.C. stations was even more general then than it is now. Hence the signals reinforced each other, each being on different wavelengths as they were then known. As fading rarely occurred on both frequencies at the same time, a reasonably constant level of volume could be obtained. The snag was that the signals wouldn't keep in phase—but it made a very pleasant change from dressing up the same old circuits in different clothes!

Dry Subject

When a couple of correspondents recently wrote of the difficulties of garden shed hobbyists, I put up the subject for airing. The response was unusually small with only one practical suggestion—Rustfoe paper. Arriving too late to include in last month's issue was a letter from L.G. (Deansgate Terrace, Grimsby), also drawing attention to Rustfoe V.P.I. (Vapour Phase Inhibitor) papers. He has found them effective for the storage of drills, screws, etc., which are fully protected even if left in cartons in a dampish cupboard after a period of two years. He also mentions a dodge which he has found useful to a lesser extent. A piece of camphor in a closed tin will help to protect iron articles from rust.

On this subject I had hoped to hear of some novel method of automatically ventilating damp workshops. For some years a neighbour, a heated greenhouse fan, has pestered me to "invent" him something which will automatically ventilate his hot-houses by opening and shutting the windows according to the outside temperature.

Thermostatic control of the inside temperature is easy and certain, and he was sure a clever bloke, like me, could devise a means of fluctuating the window opening if I put my mind to it. "There's a fortune in it," he used to urge me. He conceived the idea I was a clever bloke since I twice diagnosed the trouble with his t.v. with lucky first-time shots and once restored his thermostat to working order. He is a grape-growing enthusiast; and for those who know nothing of the tribulations of grape-growers in a variable climate like ours, I should point out that they must not be subject to rapid changes in temperature and yet require plenty of air. This entails shutting them up at night and opening the ventilating windows notch by notch as the daytime temperature rises and closing them down (also notch by notch) as it falls. This rather knocks the fun out of it, so most people would rather nip round the corner and buy a bunch. Not so with the keen types. The greater the odds against them the more determined they become to grow their own grapes. But, after all, even the keenest among them cannot spend their whole lives hovering round the hot-house with a thermometer in one hand. Apparently none of our readers are also grape-growers, otherwise we might have had automatic window wagglers years ago.

By the way, I have never disillusioned him about his belief in my cleverness. On the contrary, I encourage it by luring him into my shack where under his very eyes he sees things working "automatically" (by relays) and neons that light up without connections. It's nice to have someone who really believes you are the cat's whiskers and that the invention of an automatic window waggler is a mere matter of routine if only you could be induced to bring your great mind to bear on the matter. Certainly, as far as I could trace, no one had ever marketed such a device, which, since I have come to think of it, would also be useful to those with damp workshops.

Now, oddly enough, since we touched on the point in this column, an automatic ventilator has appeared on the market. I have not been able to go into it yet; perhaps when I get back to normal routine . . . Incidentally, you may have guessed by my references to the B.B.C.'s stereo transmissions, that I am out of hospital and dashing off these notes during a short spell of home convalescence before going off for some sea air—and hoping there will be no need for closing windows where I am going!

However, I gather that this device is purely mechanical and is operated by a push rod which opens or shuts the window as required. If any reader has a bright idea for an improved electrical model there is apparently still an opportunity to cash in on that fortune which my grape-growing neighbour believes merely awaits picking up by a "bloke who's a bit clever with electricity."

SELF-CALIBRATING TRANSISTOR TESTER

We are advised that the Westinghouse M-3 rectifier specified for use in this tester is unsuitable for the purpose, and that the Westinghouse 14D/133 should be substituted.

The DOUBLE SUPERHET

by F. G. RAYER

THE USUAL TYPE OF SUPERHET WITH 465 kc/s intermediate frequency can be perfectly satisfactory for long and medium wave reception, but tends to suffer from second channel interference on the short wave bands. To overcome this, a tuned r.f. stage is frequently used to increase second channel rejection. Alternatively, a higher intermediate frequency may be employed. Indeed, one of these methods (r.f. stage, or high intermediate frequency) will be found in all communications and similar highly efficient receivers.

How second channel interference (or "image" interference, as it is also called) arises will become clear from Fig. 1. A portion of a s.w. band tuning scale is shown, and the receiver is assumed to be tuned to 30 metres, or 10 Mc/s. With a 465 kc/s i.f., the oscillator will be operating at 465 kc/s above the signal frequency. That is, at 10,465 kc/s. A station at 10,000 kc/s (10 Mc/s) will beat with the 10,465 kc/s oscillator, producing the 465 kc/s i.f. signal which is amplified by the i.f. stage, and heard in the speaker. However, stations around 10,930 kc/s, or 465 kc/s *higher* in frequency than the oscillator, will also produce a 465 kc/s i.f. signal. This constitutes second channel or image interference. Highly selective i.f. stages cannot reduce it, or serve any useful purpose in eliminating it, though they will, of course, reduce interference from stations on an *adjacent* frequency.

With a simple superhet, only one tuned circuit (the aerial circuit) is able to combat such second channel interference. This is insufficient, so that stations around 27.4 metres (or 10.93 Mc/s) can cause serious trouble. The same difficulty exists as the receiver is tuned throughout the band, second channel interference always being found 930 kc/s (twice the i.f.) above the point to which the receiver is tuned. Even with a selective r.f. stage, some second channel interference remains, and can become more troublesome as wavelengths below 20 metres are tuned. Because of this, many high-class communications receivers do not rely upon the r.f. stage to remove image interference.

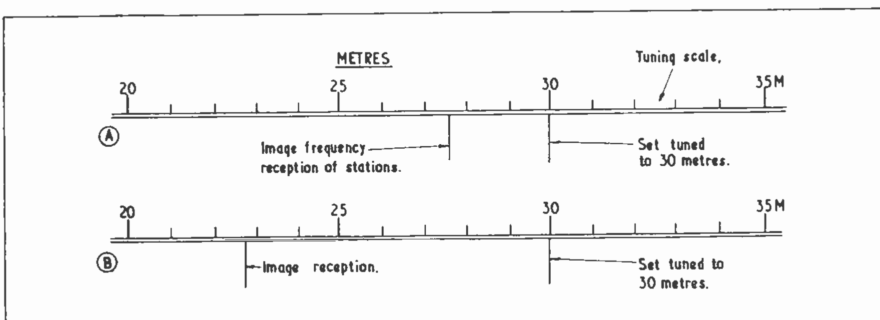


FIG. 1. IMAGE FREQUENCY RECEPTION.

Higher I.F.

By using a high intermediate frequency, the point at which second channel interference arises can be shifted well away from the wavelength to which the receiver is tuned. This is shown at "B" in Fig. 1, which is for an i.f. of 1.6 Mc/s. With the receiver still tuned to 30 metres, the image reception point has become approximately 22.7 metres. Even a single tuned circuit can give almost complete rejection of signals so far removed

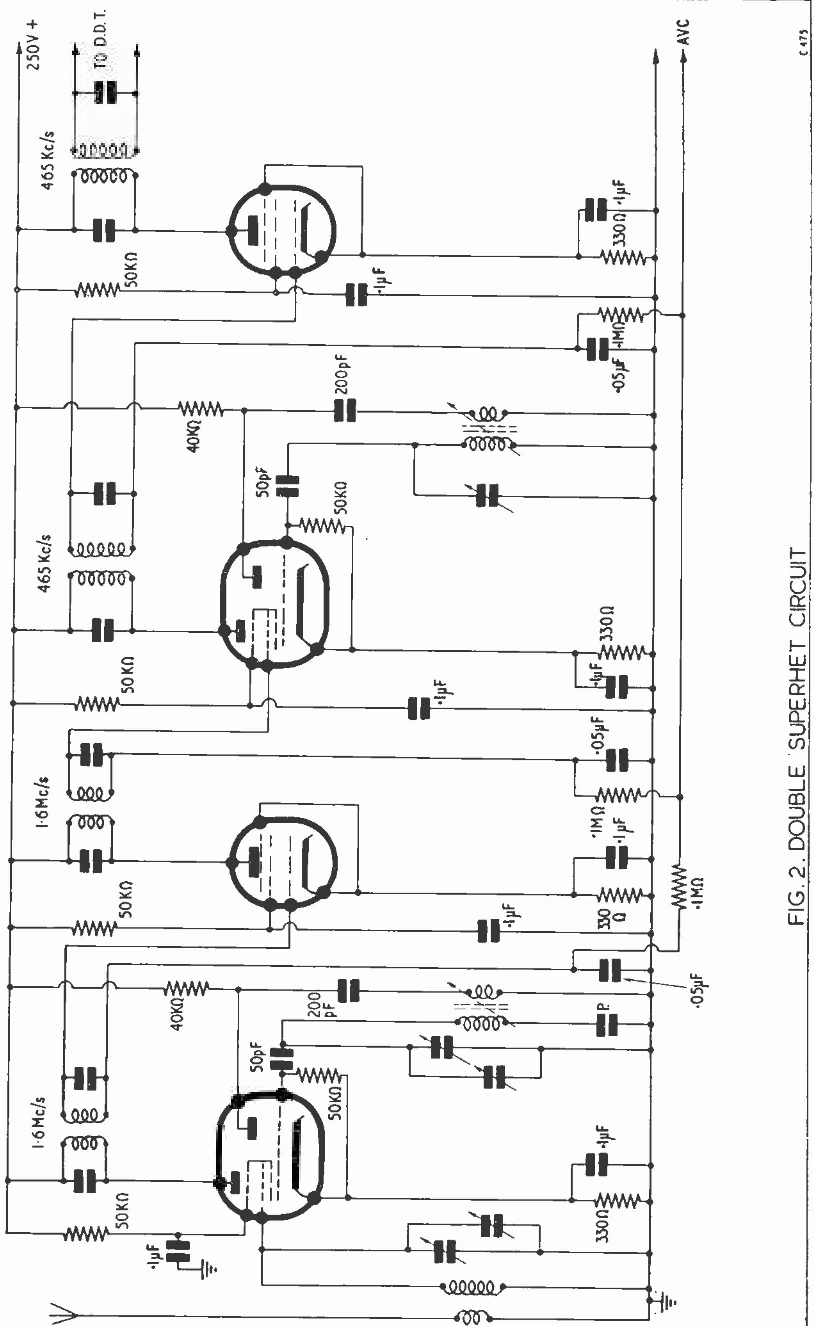


FIG. 2. DOUBLE SUPERHET CIRCUIT

from the tuning point. With an r.f. stage, rejection would be so good that all second channel interference would have ceased.

Such high intermediate frequencies are not required for l.w. or m.w. receivers, where 465 kc/s will normally be adequate. If a high i.f. is employed, adjacent-channel selectivity will fall, so that interference may arise from stations of *near* wavelength. With high efficiency s.w. equipment, the double superhet circuit is consequently often used. This has the advantages of high second channel rejection, and excellent adjacent-channel selectivity. Furthermore, as several stages are not required to operate on the same frequency, stability is easily maintained. This type of circuit is thus well worth trying, and can give excellent results.

Two F.C. Stages

A typical double-superhet circuit appears in Fig. 2, the usual double-diode-triode and output stages conforming to normal pattern. A 1st i.f. of 1.6 Mc/s is not essential, but is suggested because oscillator coils for this frequency may be obtained. An oscillator coil intended for 465 kc/s cannot be employed. "P" is the usual padder, of the value recommended by the coil maker. Other bands can be selected by switching in the usual way.

The 1st frequency changer stage operates exactly as with a simple superhet, except that the oscillator tunes 1.6 Mc/s (1,600 kc/s) above the aerial frequency. The 1st f.c. stage output is amplified by one i.f. stage at 1.6 Mc/s. The 1.6 Mc/s signal is then fed to the signal grid of the 2nd f.c. stage. It is convenient to use a 2nd i.f. of 465 kc/s, which means that the 2nd f.c. oscillator must be tuned to 2,065 kc/s (465 kc/s higher than 1,600 kc/s). The resultant 465 kc/s signal is amplified by a 465 kc/s i.f. stage, after which it reaches a conventional double-diode-triode stage.

No variable tuning is required in the 2nd f.c. stage, so that a 2-gang tuning condenser is sufficient. Extra i.f. stages, at either 1.6 Mc/s or 465 kc/s, may be added in the usual way. An r.f. stage can also be provided if desired, a 3-gang condenser then being employed.

Practical Construction

Its inherent stability makes such a circuit relatively easy to build. Home-constructed s.w. superhets with some free chassis space may be modified by adding the extra valves, and converting the 1st f.c. stage for 1.6 Mc/s working. To secure a good layout, it may be best to use these transformers in the positions previously occupied by the 465 kc/s components. The two 465 kc/s transformers, with 2nd f.c. and i.f. stages, can then be placed near the double-diode-triode stage.

The 2nd f.c. oscillator coil will have to be tuned to 2,065 kc/s, or a little under 150 metres. A 465 kc/s m.w. oscillator coil is therefore suitable. As frequency drift will be serious, a small air-spaced trimmer is recommended for use with the coil. The padder will usually be unnecessary.

Values shown in Fig. 2 are for 6K8's in the f.c. stages, with 6K7's in the i.f. stages, but other valves are satisfactory, the cathode, screen grid and oscillator anode resistors being adjusted in value to suit, if necessary. It is possible to use common cathode and screen grid resistors without causing instability.

With such a circuit, correct alignment is very important. Wrong alignment alone can result in no signals whatever being heard. If any difficulty arises, the secondary of the 2nd 1.6 Mc/s transformer may be taken to the detector stage. This will allow the 1st f.c. stage to be dealt with by trimming at a low wavelength, and adjusting coil cores at a high wavelength, on each band. The 1st pair of i.f.t.'s can also be aligned. The full circuit is then restored, and the 2nd f.c. oscillator coil core and trimmer adjusted for maximum sensitivity. Complete and careful adjustment of all tuned circuits throughout can then follow.

If local ship or shore transmitters around 465 kc/s (645 metres) are troublesome, the 2nd i.f. can be shifted a little, and the set re-aligned. In some areas this is well worth while.

110 kc/s 2nd I.F.

The double superhet circuit may be used with 465 kc/s transformers in the first stages, and 110 kc/s components in the later stages. This will not increase second channel rejection, for the reasons shown in Fig. 1, but will give very high adjacent-channel rejection, without the instability which so easily arises with several stages all working on one intermediate frequency.

For such a receiver, 1st f.c. and i.f. stages remain unchanged, with the normal 465 kc/s oscillator coil and padder. The 2nd f.c. oscillator circuit will be tuned to 575 kc/s, or about 522 metres. A 465 kc/s type oscillator coil intended for the l.w. band will thus be satisfactory. Suitable transformers will sometimes be found in rather old receivers where intermediate frequencies of around 90 to 120 kc/s were employed, or may be obtained from Denco (Clacton) Ltd.

When making up a new receiver with such a circuit, 1.6 Mc/s and 465 kc/s transformers can generally be chosen with advantage, for the reasons explained, though there is of course no reason why these exact frequencies should be employed.

TRANSISTORISED MICROPHONE PRE-AMPLIFIERS

By C. M. Pearson, B.Sc.

A TRANSISTOR MICROPHONE PRE-AMPLIFIER built into the microphone case can be of great benefit, particularly in the reduction of hum pick-up. The transistor pre-amplifier may give considerable voltage gain and a low output impedance, thus permitting the use of long microphone leads without loss of volume or loss of high frequency response.

An amplifier designed for operation from a moving coil microphone may have a voltage gain of the same order as the step-up ratio of the normally used microphone transformer, but have only a fraction of the output impedance of the transformer. Furthermore, the microphone circuit no longer contains any transformer to pick up hum from mains wiring.

If the microphone amplifier is required to work into very long lengths of coaxial cable, an additional transistor stage will permit the correct termination of the cable at its far end so that there will be no high frequency losses.

It may not be generally realised how short a length of coaxial cable is needed to restrict the high frequency response of a crystal microphone or a moving coil microphone with built-in step-up transformer. Four feet of 75Ω coax. will cut the former off at approximately 2 kc/s and the latter at approximately 10 kc/s. With a single transistor amplifier (Figs. 1 to 4) the high frequency cut off will be raised to approximately 200 kc/s, and 100 feet of coax. would be necessary to restrict the response to 10 kc/s. If an emitter follower stage (Figs. 5 and 6) is added and the cable is correctly terminated at its far end with a 75Ω resistor, the gain will be reduced, but any length of cable may be used with no loss of top notes.

Referring to the circuit diagrams, Fig. 1 is the simplest possible circuit for a moving coil microphone and will give a gain of approximately 80 (38 dB). Fig. 2 is suitable for crystal microphones and will give a gain of approximately 4 (12 dB). Figs. 3 and 4 are improved circuits giving temperature compensation and have the same gains as Figs. 1 and 2. Fig. 5 is a grounded collector stage for 75Ω output and may be applied to the circuits shown in Fig. 1 or Fig. 2. Fig. 6 is a grounded collector stage for the circuits in Figs. 3 and 4. The input of the grounded collector stage should be connected to the lower end of R_L.

The more complicated circuits of Figs. 3, 4 and 6 should be used for preference, and can be operated from a 15V deaf-aid battery.

The Teletron "Companion"

continued from page 883

Operating the Receiver

As was mentioned above, tuning of the receiver is carried out by adjusting the position of the core of L_1 inside the coil former. The simplest method of tuning consists of setting the volume control to not more than half-way along its track and adjusting the core of L_1. A whistle will then be heard as the required station is tuned in. The volume control should next be carefully adjusted until the whistle disappears, whereupon some slight final adjustment of both controls will enable the signal to be received at the desired volume.

It is possible that a number of readers may wish to fit a tuning scale to the receiver. A suitable scale is illustrated in Fig. 5, wherein the method of fixing is also illustrated. The scale is glued around the core of L_1, as shown, whereupon it may be observed through the cabinet aperture.

In areas of poor signal strength, sensitivity may be improved by connecting a short aerial to the receiver. This aerial may be connected to either tag 1 or tag 6 of L_1. Although the risk is low, there is a slight possibility that audio howl may occur when the set is operated. This trouble may be cleared by reversing the secondary connections (green and red), of transformer T_2.

There is, finally, the point that some constructors may wish to connect headphones to the receiver. When high impedance headphones are employed these may be inserted in series with the collector of TR_3. Low impedance deaf-aid phones should be connected across the secondary of transformer T_2.

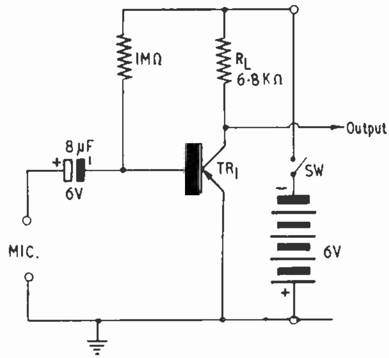


FIG 1.
Amplifier for moving coil microphone.

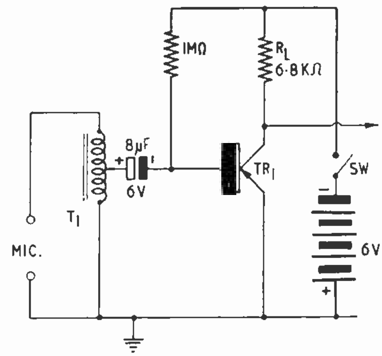


FIG. 2
Amplifier for crystal microphone.

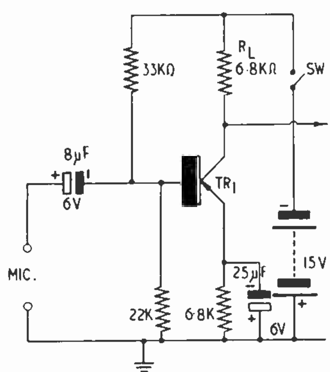


FIG. 3.
Amplifier for moving coil microphone.

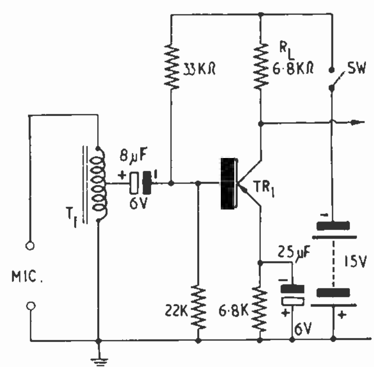


FIG. 4.
Amplifier for crystal microphone.

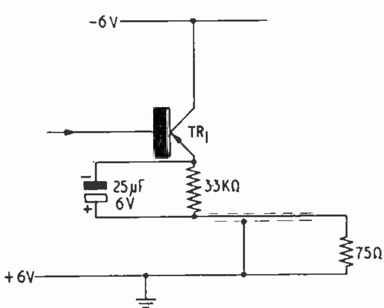


FIG. 5.
Grounded collector stage for FIGS. 1 & 2.

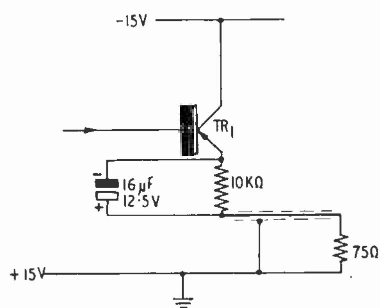


FIG. 6.
Grounded collector stage for FIGS. 3 & 4.

TR_1 = OC71 or equivalent

T_1 = Ardente T1075 transformer.

C484

THE RADIO SHOW—EARLS COURT, 1958

26th AUGUST—6th SEPTEMBER

PRELIMINARY LIST OF EXHIBITORS

Name	*Address*	*Stand No.*
Admiralty	C.N.I. Dept., Whitehall, S.W.1	*
Aerialite Ltd.	Castle Works, Stalybridge, Cheshire	5
Air Ministry	Information 1, Parliament Square House, S.W.1	*
Ambassador Radio & TV Ltd.	Camp Bird House, 39 Dover Street, W.1	26
Antiference Ltd.	Bicester Road, Aylesbury, Bucks.	22
Argosy Radiovision Ltd.	Eastern Avenue West, Romford, Essex	39
AVO Limited	Avocet House, 92–96 Vauxhall Bridge Road, S.W.1	60
B.M.B. (Sales) Ltd.	High Street, Crawley, Sussex	122
Balcombe, A. J., Ltd.	52–70 Tabernacle Street, E.C.2	37
Barclays Bank Ltd.	54 Lombard Street, E.C.3	101
Belling & Lee Ltd.	Gt. Cambridge Road, Enfield, Middlesex	49
Bernards (Publishers) Ltd.	The Grampians, Western Gate, W.6	126
Bowmaker Ltd.	Bowmaker House, Lansdowne, Bournemouth, Hants	211
British Broadcasting Corp.	Broadcasting House, W.1	*
British Radio & TV (Publishers) Ltd.	46 Chancery Lane. W.C.2	124
British Railways	British Transport Commission, Pub. Div., 222 Marylebone Road, N.W.1	112
Broomhall Joinery Co. Ltd.	222 High Street, Uxbridge, Middlesex	103
Bulgin, A. F., & Co. Ltd.	Bye-Pass Road, Barking, Essex	56
Burwell Products Ltd.	116 Blackheath Road, S.E.10	219
Bush Radio Ltd.	Power Road, Chiswick, W.4	3 & 27
Champion Elec. Corp.	8A Eccleston Street, S.W.1	206
Channel Electronic Inds. Ltd.	Dunstan Road, Burnham-on-Sea, Somerset	213
Cole, E. K., Ltd.	Ekco Works, Southend-on-Sea, Essex	29
Collaro Ltd.	Ripple Works, Bye-Pass Road, Barking, Essex	35
Co-operative Wholesale Society Ltd.	1 Balloon Street, Manchester, 4	1
Cossor Radio & TV Ltd.	Cossor House, Highbury Grove, N.5	10
Dallas, John E., & Sons Ltd.	Dallas Building, Clifton Street, E.C.2	223
Decca Record Co. Ltd.	1–3 Brixton Road, S.W.9	25
Design Furniture Ltd.	Carnwath Road, Fulham, S.W.6	119
Dubilier Condenser Co. (1925) Ltd.	Ducon Works, Victoria Road, North Acton, W.3	55
Dynatron Radio Ltd.	St. Peter's Road, Furze Platt, Maidenhead, Berks	46
E.M.I. Institutes Ltd.	E.M.I. Advertising Div., Hayes, Middlesex	*
E.M.I. Sales & Service Ltd.	Hayes, Middlesex	48
Econasign Co. Ltd.	92 Victoria Street, S.W.1	225
Electric Audio Reproducers Ltd.	The Square, Isleworth, Middlesex	62
"Electrical & Radio Trading"	Sales Promotion & Service Dept., 96 Long Acre, W.C.2	123
Ever Ready Co. (Gt. Brit.) Ltd.	Hercules Place, Holloway, N.7	16
Ferguson Radio Corp. Ltd.	105 Judd Street, W.C.1	17
Ferranti Radio & TV Ltd.	41/47 Old Street, E.C.1	21
Fidelity Radio Ltd.	11 Blechynden Street, W.11	54
Fortiphone Ltd.	247 Regent Street, W.1	106
Garrard Eng. & Mfg. Co. Ltd.	Newcastle Street, Swindon, Wilts	51
General Electric Co. Ltd.	Magnet House, Kingsway, W.C.2	8
General Post Office	Headquarters Bldg., St. Martin's-le-Grand, E.C.1	*
Goodmans Industries Ltd.	Axiom Works, Wembley, Middlesex	34
Gramophone Co. Ltd.	105 Judd Street, W.C.1	45 & 118
Greater London Fund for the Blind	2 Wyndham Place, W.1	*
Hart, Alfred, & Co. Ltd.	243 Upper Street, N.1	227
Hill, Thomas H., & Sons Ltd.	Astra Works, Worcester Road, Kidderminster, Worcs	217
Hobday Bros. Ltd.	21–27 Great Eastern Street, E.C.2	121
Hunt, A. H. (Capacitors), Ltd.	Bendon Valley, Garratt Lane, S.W.18	47
Independent Television Authority	14 Princes Gate, S.W.7	*
Invicta Radio Ltd.	100 Great Portland Street, W.1	2
J-Beam Aerials Ltd.	Westonia, Weston Favell, Northampton	14
Keith Prowse & Co. Ltd.	90 New Bond Street, W.1	68
Kerry's (Gt. Brit.) Ltd.	Warton Road, Stratford, E.15	23
Kolster-Brandes Ltd.	Footscray, Sidcup, Kent	43
Labgear Ltd.	Willow Place, Cambridge	31
Linguaphone Institute Ltd.	207–209 Regent Street, W.1	205
Lloyds Bank Ltd.	Premises Dept., 71 Lombard Street, E.C.3	7
McMichael Radio Ltd.	Langley Park, Slough, Bucks	42
Marconiphone Co. Ltd.	105 Judd Street, W.C.1	33
Margolin, J. & A., Ltd.	"Plus-a-Gram House." 112/116 Old Street, E.C.1	107
Masteradio Ltd.	10/20 Fitzroy Place, N.W.1	4
Meadow Dale Mfg. Co. Ltd.	The Dale, Willenhall, Staffs	105
Mercantile Credit Co. Ltd.	Argyll House, 246/250 Regent Street, W.1	210
Midland Bank Ltd.	Head Office, Poultry, E.C.2	201
Mullard Ltd.	Mullard House, Torrington Place, W.C.1	41
Multicore Solders Ltd.	Maylands Avenue, Hemel Hempstead, Herts	63
Murphy Radio Ltd.	Welwyn Garden City, Herts	11

Name	*Address*	*Stand No.*
National Institute for the Deaf	105 Gower Street, W.C.1	*
National Provincial Bank Ltd.	15 Bishopsgate, E.C.2	102
Pam (Radio & TV) Ltd.	295 Regent Street, W.1	6
Perdio Ltd.	Dunstan House, St. Cross Street, E.C.1	65
Perth Radios Ltd.	Marten House, 39/47 East Road, N.1	204
Peto Scott Elec. Insts. Ltd.	Weybridge, Surrey	12
Philco (Overseas) Ltd.	30/32 Grays Inn Road, W.C.1	19
Philips Electrical Ltd.	Century House, Shaftesbury Avenue, W.C.2	52 & 53
Pilot Radio Ltd.	Park Royal Road, N.W.10	28
Portogram Radio Elec. Inds. Ltd.	"Preil Works," St. Rule Street, S.W.8	58
"Practical Wireless" & "Practical Television"	Tower House, Southampton Street, W.C.2	108
Pye Limited	Cambridge	44
Radio & Allied Inds. Ltd.	Langley Park, Slough, Bucks	50
Radio Gram. Dev. Co. Ltd.	Eastern Avenue West, Romford, Essex	24
Radio Society of Gt. Brit.	New Ruskin House, Little Russell Street, W.C.1	*
Record Housing	Brook Road, Wood Green, N.22	104
Regentone Radio & TV Ltd.	Eastern Avenue West, Romford, Essex	9
Roberts' Radio Co. Ltd.	Creek Road, East Molesey, Surrey	57
Rola Celestion Ltd.	Ferry Works, Thames Ditton, Surrey	30
Siemens Edison Swan Ltd.	155 Charing Cross Road, W.C.2	40
Slingsby, H. C., Ltd.	89, 95/97 Kingsway, W.C.2	215
Spencer-West Ltd.	North Quay, Gt. Yarmouth, Norfolk	218
Standard Telephones & Cables Ltd.	Connaught House, Aldwych, W.C.2	18
Stella Radio & TV Co. Ltd.	Oxford House, 9/15 Oxford Street, W.1	13
Taylor Elec. Instrs. Ltd.	Montrose Avenue, Slough, Bucks	212
Telegraph Condenser Co. Ltd.	Wales Farm Road, W.3	59
Telerection Ltd.	Antenna Works, St. Pauls, Cheltenham, Glos	36
Telesurance Ltd.	14 Windmill Street, W.1	207 & 214
Thompson, Diamond & Butcher Ltd.	5/9 University Street, W.C.1	15
Ultra Electric Ltd.	Western Avenue, Acton, W.3	20
Valradio Ltd.	Browells Lane, Feltham, Middlesex	61
Vidor Ltd.	Erith, Kent	32
Walter Instruments Ltd.	Garth Road, Morden, Surrey	115
Waveforms Ltd.	Radar Works, Truro Road, N.22	228
Westinghouse, Brake & Signal Co. Ltd.	82 York Way, King's Cross, N.1	114
Westminster Bank Ltd.	Premises Dept., Post Office Court, 10 Lombard Street, E.C.3	113
Whiteley Elec. Radio Co. Ltd.	Radio Works, Victoria Road, Mansfield, Notts	64
Wireless & Electrical Trader	Dorset House, Stamford Street, S.E.1	203
Wireless World/Electronic and Radio Engineer	Dorset House, Stamford Street, S.E.1	216
Wolsey Electronics Ltd.	Cray Avenue, St. Mary Cray, Orpington, Kent	38
Winston Electronics Ltd.	Govett Avenue, Shepperton, Middlesex	125

* *First Floor Exhibitors—numbers not yet allocated.*

DEMONSTRATION ROOMS/OFFICES

Ambassador Radio & TV Ltd.	Z.3
Bush Radio Ltd.	Z.24
Cole, E. K., Ltd.	Z.7 & Z.8
Cossor Radio & TV Ltd.	Z.34
Dallas, John E., & Sons Ltd.	Z.26 & Z.27
Decca Record Co. Ltd.	Z.2
E.M.I. Sales & Service Ltd.	Z.11
Ferguson Radio Corp. Ltd.	Z.36
Ferranti Radio & TV Ltd.	Z.21
General Electric Co. Ltd.	Z.35
Gramophone Co. Ltd.	Z.9
Hobday Bros. Ltd.	Z.10
Invicta Radio Ltd.	Z.19
Multicore Solders Ltd.	Z.14 & Z.17
Mullard Ltd.	Z.28, Z.29 & Z.30
Murphy Radio Ltd.	Z.1
Pam (Radio & TV) Ltd.	Z.33
Philips Electrical Ltd.	Z.16
Pye Ltd.	Z.6
Radio & Allied Industries Ltd.	Z.15
Radio Gramophone Dev. Co. Ltd.	Z.32
Siemens Edison Swan Ltd.	Z.31
Standard Telephones & Cables Ltd.	Z.4
Telegraph Condenser Co. Ltd.	Z.22
Vidor Ltd.	Z.25
Walter Instruments Ltd.	Z.12
Whiteley Elec. Radio Co. Ltd.	Z.18

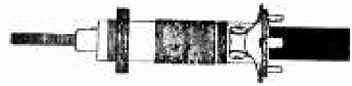
LIST OF EXHIBITORS IN THE "AUDIO HALL"

Name	Address	Stand No.
Allan, Richard, Radio Ltd.	Taylor Street, Batley, Yorks.	430
Altobass Ltd.	Percy Road, Leicester	439
Antony, Francis, Ltd.	Pennare House, Veryan, Nr. Truro, Cornwall	406
BTH Sound Equipment Ltd.	Reynold's House, 5 Gt. Newport Street, W.C.2	437
Balcombe, A. J., Ltd.	52/70 Tabernacle Street, E.C.2	427
Beam-Echo Ltd.	Witham, Essex	448
Brenell Engineering Co. Ltd.	1A Doughty Street, W.C.1	440
C.Q. Audio Ltd.	2 Sarnesfield Road, Enfield, Middlesex	411
Clarke & Smith Mfg. Co. Ltd.	Melbourne Works, Wallington, Surrey	403
Classical Record News Ltd.	99 Mortimer Street, W.1	407
Cole, E. K., Ltd.	Ekco Works, Southend-on-Sea, Essex	442
Collaro Ltd.	Ripple Works, Bye-Pass Road, Barking, Essex	414
Cosmocord Ltd.	Eleanor Cross Road, Waltham Cross, Herts	444
Cossor Radio & TV Ltd.	Cossor House, Highbury Grove, N.5	404
Decca Record Co. Ltd.	1/3 Brixton Road, S.W.9	425
Dynatron Radio Ltd.	St. Peter's Road, Furze Platt, Maidenhead, Berks	413
E.A.P. (Tape Recorders) Ltd.	Bridge Close, Oldchurch Road, Romford, Essex	416
E.M.I. Institutes Ltd.	E.M.I. Advertising Div., Hayes, Middlesex	401
E.M.I. Sales & Service Ltd.	Hayes, Middlesex	415
Electric Audio Reproducers Ltd.	The Square, Iselworth, Middlesex	431
Electronic Reproducers Ltd.	39 Dover Street, W.1	417
Expert Gramophones Ltd.	39/41 New Oxford Street, W.C.1	424
Ferguson Radio Corp. Ltd.	105 Judd Street, W.C.1	432
Ferranti Radio & TV Ltd.	41/47 Old Street, E.C.1	446
Garrard Eng. & Mfg. Co. Ltd.	Newcastle Street, Swindon, Wilts	438
General Electric Co. Ltd.	Magnet House, Kingsway, W.C.2	443
Goodmans Inds. Ltd.	Axiom Works, Wembley, Middlesex	434
Grampian Reprods. Ltd.	Hanworth Trading Estate, Feltham, Middlesex	435
Jason Motor & Electronic Co.	3/4 Gt. Chapel Street, W.1	441
Kolster-Brandes Ltd.	Footscray, Sidcup, Kent	402
Lustraphone Ltd.	St. George's Works, Regents Park Road, N.W.1	445
Magnafon Ltd.	3 Baggally Street, Bow, E.3	419
Multimusic Ltd.	Multicore Works, Maylands Avenue, Hemel Hempstead, Herts	418
Philco (Overseas) Ltd.	30/32 Grays Inn Road, W.C.1	449
Philips Electrical Ltd.	Century House, Shaftesbury Avenue, W.C.2	423
Pilot Radio Ltd.	Park Royal Road, N.W.10	428
Portogram Radio Electrical Inds. Ltd.	"Preil Works," St. Rule Street, S.W.8	412
Print & Press Services Ltd.	426 Camden Road, N.7	405
RCA Great Britain Ltd.	Lincoln Way, Sunbury-on-Thames, Middlesex	447
Rola Celestion Ltd.	Ferry Works, Thames Ditton, Surrey	410
Scientific & Technical Developments Ltd.	Melbourne Works, Wallington, Surrey	433
Soundrite Ltd.	82/83 New Bond Street, W.1	409
Sonomag Ltd.	2 St. Michael's Road, S.W.9	426
Tape Recorders (Electronics) Ltd.	784/788 High Road, Tottenham, N.17	420
Truvox Ltd.	15 Lyon Road, Harrow, Middlesex	421
W. & N. Electronics Ltd.	80/2 Uxbridge Road, Ealing, W.13	436
Walter Instruments Ltd.	Garth Road, Morden, Surrey	429
Whiteley Elec. Radio Co. Ltd.	Radio Works, Victoria Street, Mansfield, Notts	422

OFFICES

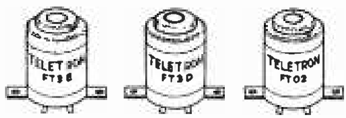
BTH Sound Equip. Ltd.	Z.458
Beam-Echo Ltd.	Z.452
E.A.P. (Tape Recorders) Ltd.	Z.455
Expert Gramophones Ltd.	Z.454
Grampian Reprods. Ltd.	Z.453
Jason Motor & Elec. Co.	Z.457
RCA Gt. Brit. Ltd.	Z.451
Tape Recorders (Electronics) Ltd.	Z.456
Whiteley Elec. Radio Co. Ltd.	Z.459

TELETRON Type FX.25



Self-tuned, dual wave Ferrite rod aerial. **15/–** each

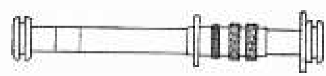
Specified for the "Companion" 3 Transistor regenerative pocket receiver.
Type 24 Inductor ... ... **3/6** each



TRANSISTOR I.F. TRANSFORMERS

High Q "potted" construction, with Ferrite screw cores. Mounted in screening cans 1" x $\frac{3}{4}$" dia., **6/6** each. Oscillator coil, **6/6**. Transistor type Ferrite rod aerial for MW band, **10/–**. Selective crystal diode coil type HAX, **3/–** each. Type HAX.L (for LW band), **3/6**. Dual wave TRF coils, type A/HF, matched pair, **7/–**, with adjustable iron dust cores.

FERRITE ROD AERIALS



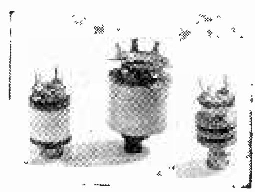
Wound on high permeability Ferroxcube rod. No external aerial required. Full sensitivity. Ideal for battery portable receivers. Medium wave, type FRM 4" x $\frac{5}{16}$", **8/9**. Dual wave type FRD, 8" x $\frac{5}{16}$", **12/9**. Miniature R.F. Chokes, wound on iron dust cores, with wire end terminations. 2.5 and 5mH, **3/–** each; 10mH, **3/6**.

TAPE OSCILLATOR COILS

Type TO.10, TO.10/1, TO.10/2 **8/6** each
(*as illustrated*)

Top Lift Inductor, 200mH,
type TL.2 ... ... **6/6** each

Bias Rejector Coil, type
BR.10 ... ... **4/6** each



BAND III PRE-AMP COIL SET

(*as featured in March issue*)
Types 20T, 21T and 22T **9/–** per set

Send 5d. in stamps for complete data and circuits. All types available from advertisers in this Magazine and local component stockists

THE TELETRON COMPANY LIMITED

266 Nightingale Road . London N9
Telephone HOW 2527

Trade enquiries to sole distributor
S. Mozer Ltd 288 Hedge Lane N13 *Telephone* PAL 1748 *or* EDM 7707

SUB-MINIATURE SPEAKERS
(By W.B.)

$1\frac{3}{4}$" round. Depth 1". Impedance 3Ω — 27/– tax paid
2" x 3" elliptical. Depth $1\frac{3}{8}$". Impedance 3Ω — 33/– tax paid
Sub-miniature Output Transformers for above:
Type A single ended, ratio 18.2/1
Type B push-pull, ratio 10.3/1
Type C push-pull, ratio 8/1
All $\frac{3}{4}$" x $\frac{7}{16}$" x $\frac{5}{8}$" — **12/6** each

TRANSISTORS

White Spot (r.f.)	**20/–**
Yellow/Red (2.8 Mc/s) ...	**21/–**
Blue Spot (1.6 Mc/s)	**15/–**
Yellow/Green (audio) ...	**10/–**
Red Spot	**9/6**

We have a large range of Ardente Sub-miniature components
Special Catalogue available 6d. post free

SUB-MINIATURE VOLUME CONTROLS

Spindle Type, $\frac{3}{4}$" diam., $\frac{1}{4}$" deep, 2" spindle. $\frac{1}{2}$, 1 or 2 MΩ. Log track **4/3**
Peripheral Ring Type. Totally enclosed, $\frac{3}{4}$" x $\frac{1}{4}$" deep. 47kΩ and 1MΩ only **2/6**
Preset Type. Skeleton assembly. $\frac{3}{8}$" diam., $\frac{3}{16}$" below panel, $\frac{3}{8}$" above panel (including knob). Suitable for manual or screwdriver operation. 5kΩ only **2/6**
(See *page* 705 *May* issue)

THE "COMPANION" 3 TRANSISTOR RECEIVER
(By Teletron)

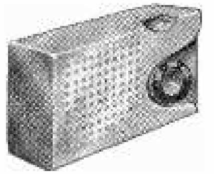
Now available with
PRINTED CIRCUIT
Complete kit **£5.15.6**
Details and Price List 6d.

PRICES REDUCED! SUB-MINIATURE CAPACITORS
(By Mullard)

8μF 6V, 25μF 6V, 16μF 125V, 32μF 3V, 5μF 125V, 5μF 40V, 2.5μF 40V, 1.6μF 6V. All at **3/3** each. Also 100μF 6V at 3/– (T.C.C.)

PAPER SUB-MINIATURES
0.01, 0.001, 0.002μF, $\frac{7}{8}$" x $\frac{3}{16}$" diam., **8d.** each; and 0.005μF ($1\frac{1}{8}$" x $\frac{1}{4}$" diam.), **7d.** each

THE "MINI-7"
(*Page* 798) *June*



All parts as specified now in stock

All parts for Stage I ...	**£5.15.6**
All parts for Stage II ...	**£1.15.6**
All parts for Stage III ...	**14/3**
All parts for Stage IV ...	**£4.12.6**
Set of nuts, bolts, wire, etc.	**2/9**

Send S.A.E. for detailed price list or 1/6 for detailed constructor's envelope and price list

MINIATURE MAINS NEON INDICATORS

With built-in resistor. Domed front with chrome bezel. Only 1" length and $\frac{1}{2}$" diam.
Opal, red or amber **3/10**, green **4/7**

REPANCO I-VALVER
(*Page* 653 *April*)

Constructor's Envelope — **9d.**
Complete kit (less 'phones) **£2.8.0**
All parts sold separately
'Phones available at **14/–**

AJAX CRYSTAL RECEIVER

Complete kit **14/6**. Long wave version **15/–**. 'Phones **14/–** pair. Superior type **16/–** (see *R.C.* March)

CRYSTAL HEADPHONES (by Rothermel) bargain at **21/–** pair

HI-GAIN BAND 3 PRE-AMPLIFIER
(*See page* 568 *March*)

Resistor Set	**1/6**
Capacitor Set (with clip)	**8/9**
Valve ECC84	**17/–**
Rectifier (50mA) ...	**7/6**
Transformer	**13/–**
Coil Set (L_1–L_5)	**9/–**
Chassis (punched for coils, space for Power Pack) ...	**3/9**
Coax Sockets, V/holder, Tag Strip, Nuts, Bolts ...	**5/6**

COMPLETE KIT AS ABOVE £3 . 3 . 0

SPECIAL OFFER
Further Reduction

Recording Tape by famous manufacturer, 1,200ft on 7" standard spool
Limited Stock at 21/– each
(Normal price 35/–)

LITESOLD SOLDERING IRONS

Are specially suitable for those small assemblies. With $\frac{1}{8}$" non-wearing bit. Total weight $\frac{1}{2}$oz. Mains or battery (state voltage required), **21/6**
SOLDER (Multicore) 4d. yard. 20ft reel **2/6**, 1lb reel **14/9**. **PRINTED CIRCUIT CORED SOLDER,** 40ft fine gauge **2/6**

"THE MERCURY" FM SWITCHED TUNER
(All parts as specified)

Complete front end (ready built, with 2 valves) ...	**£6.5.0**
Coils, chokes and transformers	**£1.4.6**
Condenser set	**9/8**
Resistor set...	**5/–**
All other components (including valveholders, diodes, knob, wire, etc.)	**16/7**
Complete kit with 2 front end valves but less EF80's	**£9.0.0**
Complete Power Pack kit	**£2.1.9**

All other Jason components stocked

KNOBS. All types from **10d.** Send sketch and sizes for quotation. **TYGAN.** Assorted offcuts (none less than 3" x 3"). Parcels of 3 sq ft **10/–**; 5 sq ft, **15/–**. **CAPACITORS. Paper** from **10d. Silver Mica** from **7d. Assorted** mixed s/m and small paper **16/–** for 25. **RESISTORS.** All types and ratings from **3d. Wirewound** from **1/3. Mixed carbon resistors** $\frac{1}{8}$ to 1 watt, 20% to 5%, 50 for **7/–**. **Hi Stabs.** 10% $\frac{1}{4}$W **6d.**; 10% 1W **9d.**; 1% $\frac{1}{4}$W **2/–**. Most usual values available. (A few values in 5%, 2% and 1% available at **1/–**.) **P.V.C. WIRING.** Asstd. colours, **2d.** yd. **FILES. 6 in plastic wallet, 12/6. SCREWDRIVERS.** 2 blades, file and bradawl in hollow handle, **3/6. Mains-tester** type, **4/–. Flexible blade, 7/9. Wallet** containing 3 blades, 2 Philips blades, 2 bradawls and handle, **12/–. INSULATING TAPE** $\frac{1}{2}$" wide, 25 yds in tin, **1/6. SWITCHES. Toggle On/Off,** s.p. **2/3**, d.p **3/6**; **rotary** from **2/–. COIL FORMERS** with **CANS.** Having easily removable coil, $\frac{3}{8}$" x $\frac{3}{8}$" x $1\frac{1}{2}$" or $2\frac{1}{2}$". **1/6. SLEEVING,** p.v.c., from **$1\frac{1}{2}$d.** yd. **FERRITE RODS,** 8" x $\frac{5}{16}$" diam., **2/–. TRANSISTOR HOLDERS, 1/–** each, **5/9** for six, **11/–** per dozen

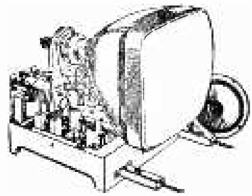
• *QUOTATION gladly given. (Please send S.A.E.)* • *Please add postage to above prices*

R. Fagelston (MAIL ORDER)

46 HARDWICKE ROAD · LONDON N13

TERMS AVAILABLE

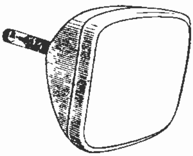
17″ TV CHASSIS, TUBE & SPEAKER — £19.19.6



17″ Rectangular Tube on modified chassis Supplied as single channel chassis covering B.B.C. channels 1-5, or incorporating Turret Tuner which can be added as an extra, at our special price to chassis purchasers. **50/–**, giving choice of any 2 channels (B.B.C. and I.T.A.). Extra channels can be supplied at **7/6** each. I.F.s 10.5-14 Mc/s. Chassis size: 12″ x 14½″ x 11″. Valve line-up: 6SN7G, 6P25, EY51, 2 6D2's, EL38, EL41 and 7 6F1's. Similar chassis were used by well-known rental and hire companies because of their stability and reliability. With tube and speaker, **£19.19.6.** With all valves, **£25.19.6.** Complete and working with Turret Tuner, **£28.9.6.** 12 months guarantee on the tube, 3 months guarantee on the valves and cha sis. Ins. carr. (incl. tube), 25/–

14″ TV CHASSIS, TUBE AND SPEAKER — £13.19.6

As above with 14″ Round Tube. Chassis, valves and tube guaranteed for 3 months. With tube and speaker, **£13.19.6.** With all valves, **£19.19.6.** Complete and working with Turret Tuner, **£22.9.6.** Ins. carr. (incl. tube) 25/–



RECTANGULAR TV TUBES

17″ £7.10.0 12 MONTHS GUARANTEE 14″ £5.10.0

6 months full replacement, 6 months progressive. Made possible by the high quality of our tubes. Ins. carr. 15/6. 9″, 10″, 14″, 15″ and 16″ round tubes. Our special offer of these sizes, **£5.** 12″ TV Tubes, **£6.** Three months guarantee on round tubes. Ins., carr. 15/6

End of Season SALE

(REDUCED TO CLEAR)

BOXED **VALVES** 3 MONTHS GUARANTEE

4D1	2/9	15D2	6/9	ECC81	8/9	EL91	3/9
6B8	3/9	45-1U	10/9	ECH42	8/9	EL84	10/6
6F12	5/9	77	1/9	EF37	4/9	KTW61	5/9
6H6M	1/9	2C22	2/9	EF39	3/9	PEN45	6/9
6P28	10/9	CV188	1/9	EF36	5/9	RL37	1/9
6SG7	3/9	6J5M	2/9	EF50	2/9	SP61	2/9
8D2	3/9	DF66	5/9	EF92	3/9	T41	8/9
12BE6	6/9	EB34	1/9	Z77	7/9	TT11	4/9

TRANSFORMERS

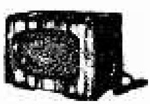
MAINS POWER TRANS. 350-0-350V, **9/9** 250mA, 6V heater at 5A, 4V at 5A, 4V centre tapped. Drop through type. Prim. 200-250V (4½″ x 5″ x 5″). Post 3/9

MAINS TRANS. 3/9. 350-0-350V 80mA, 4V, 4V heaters. 200-250V prim. Post 2/3

MAINS TRANS. 5/9. 280-0-280V 80mA 6V, 4V heaters. 200-250V prim. Post 2/3

O.P. TRANS. 1/3. Std. size. 2-5 ohms. Post 1/–. 20 for **£1.** Post 5/6

HOME RADIO—79/6 5 valve (octal) superhet. 3 wave band receiver. Can be adapted for your gram. p.u. at a little extra cost. A.C. size: 9¼″ x 20½″ x 11½″. Two a.c./d.c. sizes: 9¼″ x 18½″ x 11¾″, 9″ x 20½″ x 12″. Wooden cabinets. Ins., carr. 4/6. Please state mains and size required when ordering.



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8″ P.M. SPEAKERS—8/9

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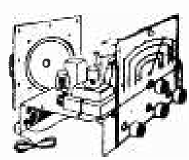

SUPER CHASSIS—99/6

5-valve superhet chassis including 8″ p.m. speaker and valves. Four control knobs (tone, volume, tuning, w/change switch). Four w/bands with position for gram. p.u. and extension speaker. A.C. Ins., carr. 5/6

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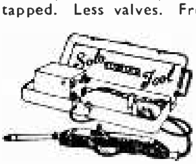
POWER PACK AND AMPLIFIER, 19/6. Output stage 6V6 with o.p. trans., smoothed h.t. 350V 250mA, 6.3V at 5A, 22V at 3A, 6.3V at 4A centre tapped. Less valves. Free drawings. Ins., carr. 5/6



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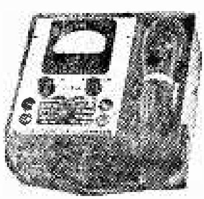

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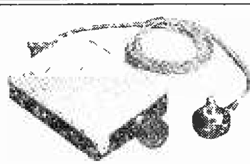

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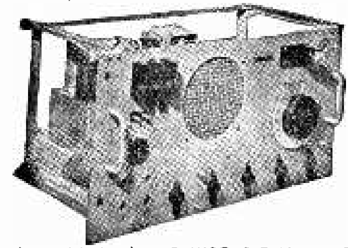

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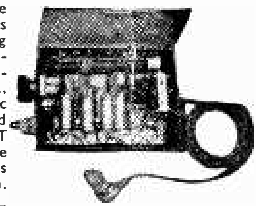

Medium wave, Variable tuning. Total cost, as specified, including Transistors, Transformers, Coils, Condensers and Battery, etc., with circuit and plastic case. All items sold separately. **70/–** POST FREE. With single 'phone **73/6.** With Acos Mike, **82/6.** With Min. Hearing Aid, **86/–**

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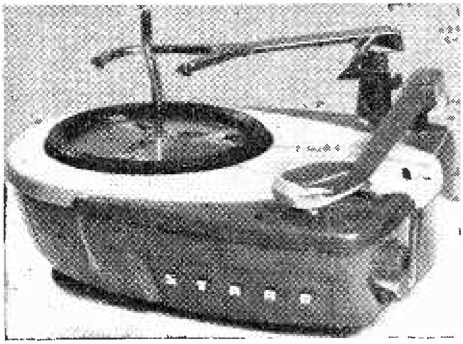

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HT/LT BATTERIES. 60V+1.5V, tested, **3/3**

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1LC6	4/6	6J5M	5/–	6U4GT	12/6	25L6GT	8/6	EBC33	7/–	EF50(AM)	4/9	HVR2A	5/–	PY81	8/6
1LN5	4/6	6J5GT	4/6	6V6G	6/–	25Z5	9/6	EBL31	15/–	EF80	11/–	KT44	12/6	PY82	8/6
2A7	7/6	6J5G	3/–	6V6GT	7/–	35Z4GT	7/6	EC52	5/–	EF85	7/–	KT45	12/6	SP4B	9/6
5U4G	6/6	6J6	4/–	6V6M	7/–	41	9/6	ECC31	9/6	EF89	9/6	KTW63	6/–	SP13C	11/–
5Z4	9/–	6J7G	5/–	6X4	6/–	42	9/6	ECC81	8/–	EF91	6/6	PEN45	15/–	SP41	2/6
6A6	4/6	6K7G	4/6	6X5GT	5/–	43	9/6	ECC82	6/6	EF95	8/6	PCC84	9/–	SP61	2/6
6AC7	5/6	6K7M	6/–	7B7	7/6	80	7/6	ECC83	8/6	EL32	4/6	PCC85	11/6	TDD4	15/–
6A8	9/–	6K8G	7/6	7C6	7/6	83	7/6	ECC84	10/6	EZ80	7/6	PCF80	12/6	TH41	12/6
6AL5	5/6	6L6G	8/–	12A7M	8/6	807(BR)	3/9	ECC85	9/–	HL41	8/6	PEN25	5/–	U16	9/6
6AM6	6/6	6L7	6/–	12AT7	8/–	807(AM)	5/6	ECF80	12/–	HL41DD	12/6	PL81	13/6	U22	7/6
6BA6	6/6	6N7	7/–	12AU7	6/6	CBL21	12/6	ECL80	13/6	HL42DD	12/6	PL82	9/–	U52	6/6
6BE6	6/6	6SA7M	7/–	12AX7	8/6	CCH35	15/–	EF36	4/–			PL83	11/–	VP41	9/6
6C4	4/–	6SG7M	5/6	12J5GT	4/6	EA50	1/6	EF37	7/–			PM12M	5/6	X81M	9/–
6C6	4/6	6SJ7M	7/6	12K7GT	6/6	EB34	1/6	EF37A	8/–					Z63	9/–
6D6	4/6	6SK7GT	5/–	12Q7GT	7/6	EB91	5/6	EF39	5/–						

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continued on page 927

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1A3	**2/6**	6L6M	**10/6**	803	**17/6**	EL84	**9/–**
1L4	**5/–**	6L7M	**7/6**	808	**17/6**	EL91	**7/–**
2A3	**8/6**	6Q7GT	**9/6**	830B	**15/–**	EM80	**10/–**
2X2	**3/6**	6SA7M	**7/6**	866A	**12/6**	EZ40	**8/6**
3A4	**5/6**	6SG7M	**7/6**	959	**5/–**	EZ80	**8/6**
3Q4	**7/6**	6SH7M	**5/–**	1616	**5/–**	HK24G	**25/–**
3S4	**8/6**	6SJ7M	**7/6**	1629	**4/–**	KT33C	**9/6**
5763	**12/6**	6SK7M	**6/6**	EA50	**1/6**	PCC84	**10/6**
5B/254M		6SL7GT	**7/6**	EABC80	**10/–**	PCF82	**10/–**
	21/–	6SN7GT	**6/6**	EAC91	**4/6**	PL82	**9/6**
5Y4G	**6/6**	6SQ7M	**7/6**	EAF42	**10/6**	PL83	**10/6**
6AC7M	**5/–**	6X4	**6/6**	EB34	**2/6**	PCL83	**12/6**
6AG5	**3/6**	6X5GT	**7/6**	EB91	**6/6**	PY80	**8/–**
6AK5	**5/–**	7B7	**9/–**	EBC33	**7/6**	PY81	**9/6**
6AL5	**6/6**	7C5	**9/–**	EBC41	**10/6**	PY82	**9/6**
6AM6	**7/6**	7C6	**9/–**	EBF80	**10/–**	PY83	**11/6**
6AQ5	**8/6**	7S7	**10/–**	EBF89	**10/–**	R19	**12/6**
6AT6	**8/–**	7Y4	**8/6**	ECC82	**9/6**	SP61	**3/–**
6AU6	**8/6**	12A6M	**7/6**	ECC83	**9/6**	TT11	**4/–**
6B8G	**4/6**	12AT6	**8/–**	ECC84	**11/–**	UAF42	**10/6**
6BA6	**8/6**	12AT7	**9/–**	ECC85	**10/6**	UBC41	**10/6**
6BE6	**7/6**	12AU6	**9/–**	ECF80	**12/6**	UBF89	**10/6**
6BH6	**7/6**	12AU7	**8/6**	ECF82	**11/6**	UCC85	**10/–**
6BJ6	**7/6**	12BE6	**8/6**	ECH42	**10/6**	UCH42	**10/6**
6BR7	**11/6**	12C8M	**7/6**	ECH81	**10/–**	UF41	**10/6**
6C4	**5/–**	12Q7GT	**9/–**	ECL82	**12/6**	UF89	**10/6**
6C5M	**5/6**	12K7GT	**9/–**	EF36	**4/–**	UL41	**10/6**
6F6M	**5/6**	12SC7M	**2/6**	EF39	**5/–**	UY41	**8/6**
6F8G	**4/6**	12SK7M	**7/6**	EF41	**10/6**	UY85	**10/–**
6G6G	**4/6**	12SQ7M	**8/6**	EF50	**3/–**	UABC80	
6J5GT	**5/–**	35L6GT	**9/6**	EF50(S)	**4/6**		**10/6**
6J5M	**6/–**	35Z4GT	**8/6**	EF55	**7/6**	VU39	**9/6**
6J6	**4/–**	35Z5GT	**8/6**	EF80	**9/–**	VR150/30	
6K7G	**5/6**	42	**7/6**	EF85	**10/–**		**7/6**
6K8G	**8/6**	50L6GT	**9/6**	EF89	**10/–**	VR116	**4/–**
6K8M	**10/6**	80	**8/6**	EF91	**7/6**	VS70	**3/–**
6H6M	**3/6**	446A	**10/6**	EL32	**4/–**	XP1.5	**3/–**
6L6G	**9/–**	801A	**7/6**	EL41	**10/–**	Z77	**7/6**

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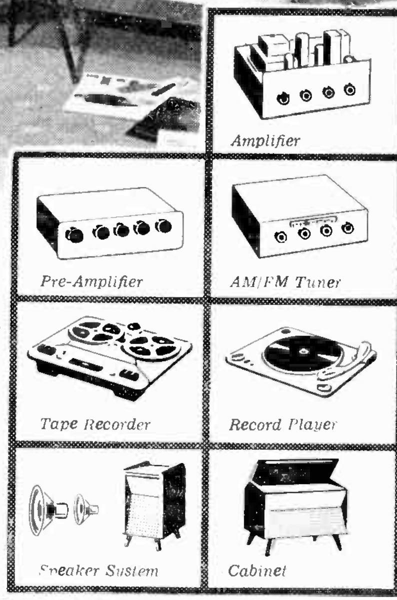

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SMALL ADVERTISEMENTS

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SMALL ADVERTISEMENTS

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