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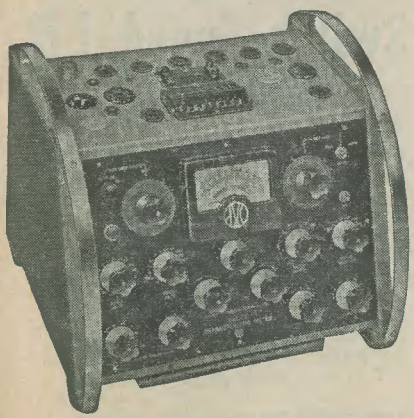

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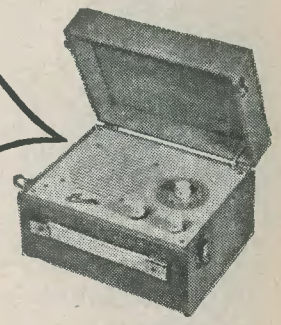

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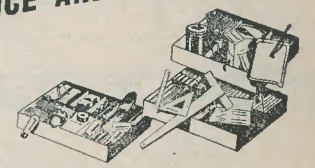

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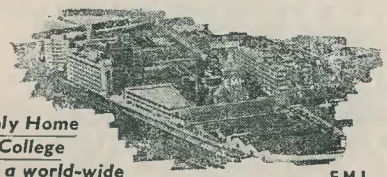

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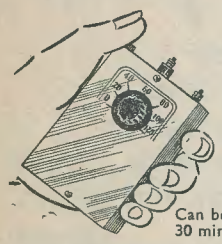

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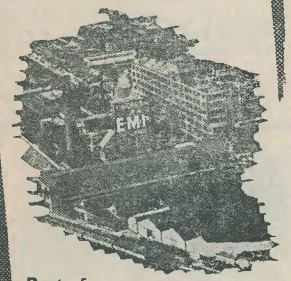

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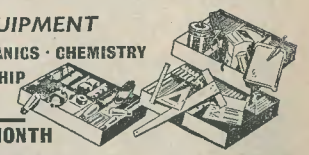

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9 × 7 × 2	6/6	12 × 7 × 2½	8/–	14 × 7 × 3	9/6	17 × 10 × 2½	11/3
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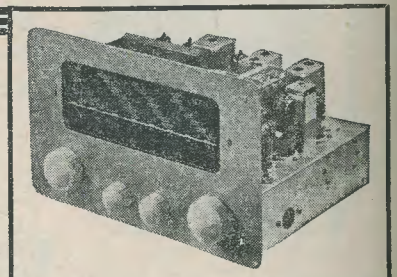

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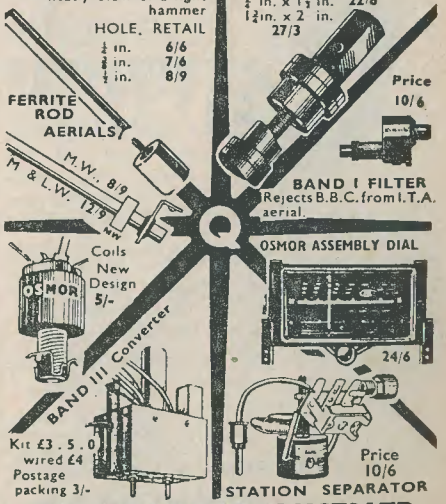

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CONTENTS FOR MAY

NOTICES

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.

All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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

QUERIES. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine: nor can we advise on modifications to the equipment described in these articles.

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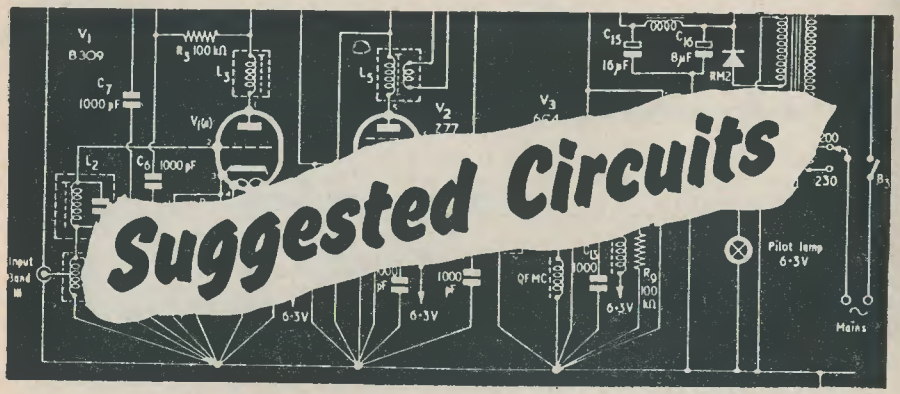


The circuits presented in this series have been designed by G. A FRENCH, *specially for the enthusiast who needs only the circuit and essential relevant data*

No. 78. A RELIABLE PROCESS TIMER

IT FREQUENTLY HAPPENS, IN PHOTOGRAPHIC work and similar pursuits, that the ability to automatically time an operation assumes considerable importance. Various devices can be pressed into service for automatic process timing, and it is possible for these to use quite a number of different operational techniques. However, what is probably the most elegant method of time control employs electronic principles, and a discussion on these forms the introduction to this month's article. The article also describes a suggested circuit for a practical process timer which may be constructed at home by the amateur.

Timing Principles

The normal method of timing a process by electronic means consists of switching the process circuit on or off over a pre-determined period of time. It is usual for the switching operating to be carried out by the contacts of a relay, the length of time this relay remains energised (or de-energised) being governed by the charge or discharge of a condenser in combination with a resistor. The former may be referred to as the "timing condenser." In conventional arrangements the relay coil is connected in the anode circuit of a valve, whereupon the anode current of this valve can be controlled by applying the potential on one of the plates of the timing condenser to its grid.

At first sight it would appear that the only requirement of an electronic process timer is merely that the grid potential of the relay valve should be controlled by the timing condenser potential. In practice, however, this does not represent a complete picture and, for reliable and accurate timing periods, it becomes necessary to pay careful attention to a number of subsidiary design features. The first parts of the timing circuit which require consideration in this context are the relay, and the valve in whose anode circuit it is connected. It is essential that the relay contacts should always operate, at the end of successive timing periods, for exactly the same timing condenser potential.

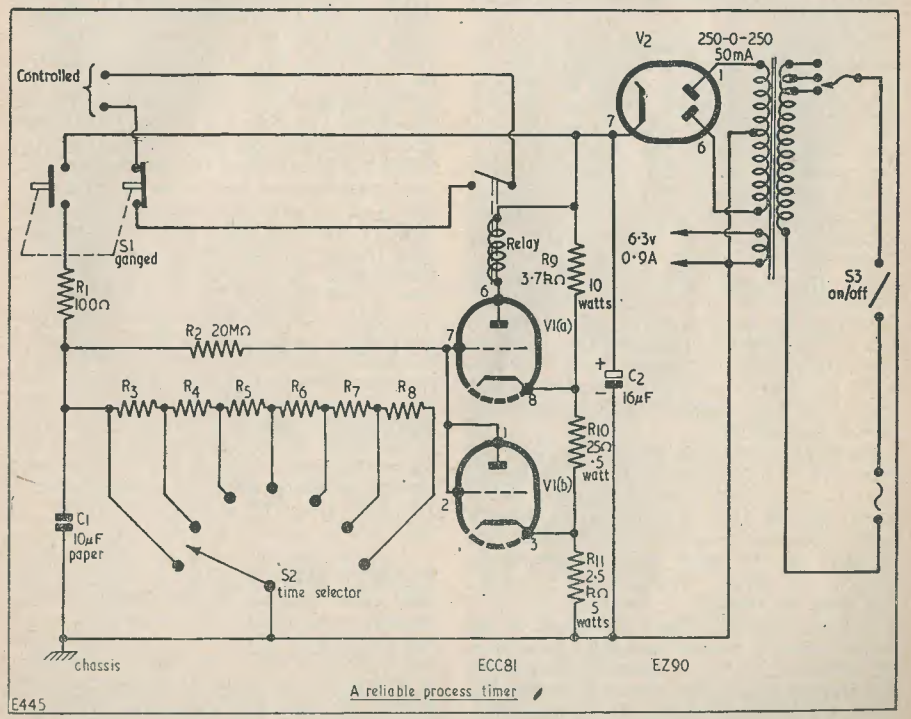
Unfortunately, conventional relays cannot be relied upon to operate at the same energising current over a large number of operations. The reasons for this are mainly mechanical: the pressure exerted on the armature by the contact springs may vary with time, the friction opposing the movement of the armature may vary, and so on. In a good electronic timer it therefore becomes necessary to ensure that, at the end of the timing cycle, the change of energising current in the relay coil occurs as rapidly as possible. Ideally, the relay energising current should change instantaneously from an "on" to an "off" condition (or vice versa).

In practice, a rapid change in relay energising current may be obtained by using a thyratron as control valve. However, thyratrons raise minor difficulties in their train and do not, in the writer's opinion, represent an ideal choice for a simple home-constructor timing circuit. A good alternative to the thyratron may be given by a hard valve having a very short grid base. Such a valve is capable of passing from the conducting to the non-conducting state for quite a small change in control grid potential.

only over the steeper part of its charge/discharge characteristic. Taking arbitrarily chosen figures, a sufficiently rapid rate of change can, in fact, be obtained when the condenser has charged to approximately 63% (or has discharged to approximately 37%) of the voltage applied to it. The length of time occurring before the condenser reaches such potentials is, of course, equal to the time constant given by its capacity and the associated resistance. Working to these figures provides the incidental advantage of easing the calculations needed for the timing circuit constants.

This Month's Circuit

This month's Suggested Circuit takes advantage of the points just detailed. Care has been taken to keep the circuit reasonably uncomplicated and to avoid the use of an excessive number of components. The circuit does not employ any h.t. voltage stabilisation, as it is felt that such a feature is liable to



In order to keep the period of transition in the control valve, and hence the relay, to a relatively low figure, it next becomes necessary to ensure that the potential of the timing condenser is still changing rapidly at the end of the timing cycle. This condition may be achieved by operating the timing condenser considerably increase cost without providing any commensurate advantage. Although it is desirable to operate the unit from supply mains of reasonably steady voltage, this is not essential. The circuit has a self-compensatory action (given by the potentiometer network supplying the switching valve), which helps to

reduce the effect of heavily fluctuating mains voltages, provided that such fluctuations do not occur during a timing cycle.

The operation of the device is extremely simple. After it has been switched on and allowed to warm up, a timing cycle may be initiated by pressing the spring-loaded switch S_1. When depressed, the "make" contacts of S_1 connect the top plate of the timing condenser C_1 to the full h.t. voltage via the limiting resistor R_1. The voltage appearing on the top plate of C_1 is applied via R_2 to the grid of $V_{1(a)}$, thereby causing this valve to conduct. The relay in the anode circuit of $V_{1(a)}$ energises, and its contacts close. The external, controlled, circuit is not completed yet, however, due to the fact that the "break" contacts of S_1 are open whilst this switch is depressed. As soon as S_1 is released, its "break" contacts complete the external circuit; whilst its "make" contacts break the h.t. connection to C_1. It is at the instant of releasing S_1, therefore, that the timing period commences.

Immediately S_1 is released, condenser C_1 starts to discharge into the resistor network, R_3 to R_8. When the potential on the top plate of C_1 drops to approximately 40% of the initial energising voltage it reaches the same value as that on the cathode of $V_{1(a)}$. The potential on C_1 still continues to fall rapidly, whereupon it quickly reaches a value sufficiently negative to that on $V_{1(a)}$ cathode for this valve to cut off, whereupon the relay de-energises. The contacts of the relay then break the external circuit and the timing period is finished. C_1 continues to discharge into R_3 to R_8, but this fact is now unimportant, as the operational cycle of the timer has been completed. Whenever S_1 is actuated again in order to commence the next timing cycle, C_1 will be charged to full h.t. potential almost immediately.

It will be noted that the timer *completes* the external circuit over the duration of the timing period. If a particular application necessitates that the timer should *break* an external circuit over the timing period, the appropriate contacts of the relay and S_1 should be altered to have "break" and "make" functions respectively.

There are several points of interest in the circuit which have not been fully covered in the brief description of operation just given. The first of these is the reason for fitting the low-value limiting resistor, R_1, in series with C_1 and the "make" contacts of S_1. R_1 is inserted in order to limit the instantaneous current which flows at the moment of operating the switch. If R_1 were not in circuit the switch contacts would be liable to burn after a number of operations. The time needed to charge C_1 via R_1 should normally be negligibly small.

The potentiometer network across the h.t. supply given by R_9, R_{10} and R_{11} in series is designed to maintain the cathode of $V_{1(a)}$ at a potential of approximately 40% of the total h.t. supply. Such a potential is sufficiently close to the 37% (time constant) potential referred to earlier to ensure that the condenser potential is changing rapidly at the end of the timing cycle. The resistors R_9, R_{10} and R_{11} need, in practice, have a tolerance of 20% only as any effect on the timing period which divergences from their nominal values may give can be taken up in the network R_3 to R_8. Assuming a 250 volt h.t. line, R_9, R_{10} and R_{11} draw a standing current of some 40mA from the h.t. supply, and maintain the cathode of $V_{1(a)}$ at approximately 100 volts above chassis. The relay connected in the anode circuit of $V_{1(a)}$ should be capable of operating at an energising current of 6 to 7mA. A coil resistance around 2,000 ohms would be quite satisfactory.

The valve chosen for V_1 is an ECC81 (12AT7), this being a double triode having a short grid base in either triode. It will be noted that only one of the triodes is employed for directly operating the relay, the other being connected as a diode. The purpose of the diode $V_{1(b)}$ is that of preventing excessive grid current and cathode emission in $V_{1(a)}$. When the potential on the top plate of C_1 is more positive than that at the junction of R_9 and R_{10}, the grid potential of $V_{1(a)}$ is prevented from rising higher than 1 volt negative with respect to its cathode because of the presence of $V_{1(b)}$. (The cathode of $V_{1(b)}$ is held 1 volt negative, by means of R_{10}, to $V_{1(a)}$ cathode.) Apart from preventing excessive current in $V_{1(a)}$, the presence of $V_{1(b)}$ in the circuit assists in ensuring a quick and positive transition from the "on" to the "off" condition at the end of the timing cycle. When the top plate of C_1 is 1 volt negative to the cathode of $V_{1(a)}$ this valve is "on" and passes the same anode current as it has done throughout the period; but a further drop of 1 to 1.5 volts in C_1 is enough to make $V_{1(a)}$ "off."

Although the values of the resistors R_3 to R_8 may be worked out approximately, their final values should be considered as being experimental. This is due to the fact, as was just mentioned, that tolerances in R_9, R_{10} and R_{11} need to be taken up; plus the fact that it is difficult to obtain a close tolerance component for C_1. The high-value resistor R_2 has a slight effect on timing operation, it tending to increase (by a constant amount) the rate of discharge of C_1.

The resistors R_3 to R_8 may consist of a network of switched resistors, as is shown in the diagram, or of a single potentiometer calibrated in seconds. Due to inaccuracies introduced by track wear the first alternative, that using the switched resistors, is the more preferable. The number of switch positions employed need not, of course, be the same as is shown in the circuit.

The final values of the resistors R_3 to R_8 may be found in the following simple manner. Let us assume that we wish to select timing periods of 5, 10, 15, 20, 25 and 30 seconds with the aid of S_2. It first becomes necessary to find the resistance required for the overall timing period of 30 seconds. We know from the basic circuit design that the resistance required will be approximately that needed to give a time constant of 30 seconds in combination with C_1. (The time constant of a CR circuit in seconds is equal to the product of the capacity in μF and the resistance in MΩ.) We may start, therefore, by temporarily connecting a 3MΩ resistor across C_1 and measuring the resultant operating cycle. This temporary resistor may then be experimentally altered in value until a period of exactly 30 seconds is obtained. Should the resistance finally obtained be, say, 3.5MΩ, all the resistors R_3 to R_8 may be made equal to one sixth of this value. S_2 will then select timing periods in 5 second steps up to 30 seconds. As will be appreciated, other timing periods incorporating, if desired, a different number of switch positions may easily be catered for by means of the same technique.

Power Unit

The circuit illustrates a power supply circuit employing a 250–0–250 volt mains transformer. Although an isolated power supply is desirable in a unit of this type it is by no means essential, and a simple a.c./d.c. arrangement can be employed in its place if desired. It must be emphasised, however, that if this is done the normal precautions against shock must be observed. It is important, also, to ensure that mains potentials do not appear on the external switching connections. Care is needed here due to the fact that the insulation of relay contacts from their associated metalwork is frequently inadequate for mains voltages.

The Timing Condenser

Before concluding this article, a few words concerning the timing condenser C_1 would not be out of place. The circuit depicts this condenser as a 10μF paper component. A paper condenser is preferable to an electrolytic component in this position due to the unstable capacity value of the latter. Unfortunately, paper condensers of the value specified are liable to be somewhat expensive if purchased new, and the constructor is advised to examine the surplus market before spending an excessive amount of money on this component. It may frequently, for instance, be found cheaper to parallel up a number of smaller capacity condensers obtained from surplus sources than to buy a single new unit of the requisite value.

The writer understands that a particularly suitable condenser is available from H. L. Smith (Edgware Road). This component has three sections (2.5 + 2.5 + 5μF) 450V working, and retails at 10s.

Can Anyone Help?

Reauests for information are inserted in this section free of charge; subject to space being available

D. EDWARDS, Allens Drove, Gorefield, near Wisbech, Cambs., wonders if anyone has any data or a service sheet on a German midget (it is less valves) marked Teti. Apparatebau Dr. Daniel K-G, Potgdei Köln, Type GWZ131, No. 7143.

L. DUNCAN, 3 Lyndsays Wynd, Oakley by Dunfermline, Fife, would like to obtain the circuit diagram of the Cossor T.V. models 900 and 900A, and information on where he could purchase the Cossor 4TSP, 4TPB and DDL4 valves.

P. J. JARUIS, Wilby, 80 Chalklands, Bourne End, Bucks, wishes to buy or borrow the circuit for the Transmitter type 1396 and the Receiver type 1139.

W. P. R. GIBSON, Whickham Lodge, Dawlish, Devon, wishes to obtain a circuit for the T1154 transmitter, and is willing to pay a small sum. Not every reply can be answered.

G. SPICER, 52 St. George's Road, Aldershot, Hants, is anxious to obtain a copy of *The Radio Constructor* for September 1954.

J. D. SCROGGIE, 82 Chapel Street, Pemberton, Wigan, Lancs, wishes to obtain copies of *The Radio Constructor* for December 1953, January 1954 and March 1954.

R. KIRK, 74 Tower Road, Epping, Essex, would like to buy or borrow any literature on the T1154/R1155 (Marconi 87B/8882B).

G. FELTHAM, 16 Beaumont Road, London, E.13, is in need of servicing data for an R.A.P. Continental receiver. All expenses paid.

R. J. CANAWAY, 71 Oaken Grove, Maidenhead, Berks, asks if an owner of a tape recorder operating on lower track, left to right (i.e. Grundig 700 or early Truvox, etc) within reasonable distance of above address, could assist in transcribing short recordings of sentimental value onto new standard type recorder.

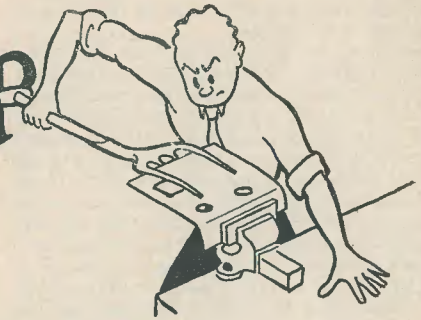
Cpl. MOLLARD H, Air Radar Section, R.A.F., North Cuffenham, Rutland, would like to obtain a copy of Data Book No. 4, *Inexpensive Television*, or any information enabling the R25, R1355, and Indicator 62A to be converted into a B.B.C. t.v. set.

J. MCQUE, ZS5GV, Power Station, Kokstad, East Griqualand, S. Africa, wonders if any reader can supply information on the R.1116A receiver, and also if it is possible to convert to a.c. working. All letters answered and costs refunded.

C. V. LYND, 37 Northumberland Place, Bayswater, London, W.2, requires the circuit, the manual or any information on the "AVO" Universal Bridge, ranges 0.5Ω–55MΩ, 5pF–55μF, and 5mH–55H. Circuit or manual returned if requested.

P. A. LAST, Whitecote Farm, Ulleskelf, Yorks, requests information, circuit or manual on the RA–10 Bendix receiver (Frequencies—i.f.'s and wavebands). Expenses willingly defrayed.
Information offered on the BC–659Tx/Rx; BC–625 Tx; BC–624 Rx; Receivers model 6000A and 6000B; BC–454; BC–455; Modulator Unit BC456; Tx BC–696; BC–458; BC–459; Valve Tester model 314.

IN YOUR WORKSHOP



This month, Smithy the Serviceman discusses soldering and wiring problems, dealing also with some particular sound receiver circuits which he has encountered

"WELL," SAID DICK HEATEDLY, "THIS IS just plain ridiculous!"

Dick's comment, unprompted and unexpected, came suddenly in the middle of a morning's hard work, during which both he and Smithy had been engrossed, without respite, over their benches. It was an early summer's day, and the bright sunshine outside the Workshop made both the Serviceman and his assistant feel a little disgruntled at having to spend their time indoors.

"What's the trouble?" asked Smithy, a little testily.

"I've got a resistor here which may or may not be off-value," replied Dick in an aggrieved tone, "but I can't measure the value of the darned thing until I've unsoldered one end of it. The trouble is that I can't disconnect either of its wires because the set-maker has made certain that they're twisted at least three times round a pair of the flimsiest solder tags I've ever seen. I'm almost certain to cook up the resistor if I attempt to unsolder it, and I shall probably damage the tags and other components as well."

"I should snip one end of the resistor as close to the tag as you can," advised Smithy. "There should still be enough wire left to re-connect it again afterwards, if you want to."

"Okay," said Dick, still somewhat disgruntled. "I'll do that. But I must remind you that you ticked me off the other day for not 'clenching' a wire to a tag and making a cold joint."

Solder Joints

Smithy sighed.

"There's the world of difference between a cold joint and a good joint, whether it's clenched to its tag or not. If it is possible, it is always worth while twisting a wire round its tag before you solder it or, at least, popping it through the tag's central hole when such a hole exists. When you have no alternative but to make a 'laid-on' joint, such a joint is obviously all you can do. There isn't any great strain on most of the joints used in radio work, but they must always be *electrically* sound. That's why I hate to see a cold joint.

"In any case," Smithy continued, soothingly, "I think it's about time we had a break for a few minutes. It's a lovely day outside and we're both of us getting a little hot and bothered in here!"

Whereupon Smithy lit a cigarette and perched himself on the edge of the bench. Dick put his soldering iron on its rest and busied himself with the teapot.

"To return to your original remark," continued Smithy after a thoughtful pause, "I must agree with your comments concerning the resistor you were trying to check. It definitely is infuriating to be presented with a solder joint where the wire has been wrapped umpteen times round the tag when all you want to do is quickly unsolder and re-solder the connection. I'm not terribly keen on snipping the wire close to the joint, but sometimes it's unavoidable. By the way, there's a useful answer to this problem, which you can use sometimes provided that the joint concerned hasn't too much solder on it. (You can, in any case, remove excess solder with a quick application of the soldering iron.) The dodge consists of pushing out enough of the wire end with the soldering iron to enable you to grip it with a pair of taper-nosed pliers. (Fig. 1 (a)). You then remove the soldering iron and 'peel off' the remainder of the wire by turning the pliers. (Fig. 1 (b))."

"Do you do this 'peeling' operation with the joint cold?" asked Dick.

"Oh yes," replied Smithy. "What happens, presumably, is that you leave the outer surface of the wire's tin plate in the joint. With a little practice you can carry out this operation quite quickly, and without imposing any great strain on the tag. The great advantage of the idea is that you only use the iron for initially freeing a short length of the wire, with the result that heating time is kept to a mimimum. Despite the fact that the wire has possibly lost some of its outer covering it can usually be re-soldered again quite easily."

"I must remember that," said Dick. "Incidentally, have you ever encountered wires or tags which simply refuse to take solder?"

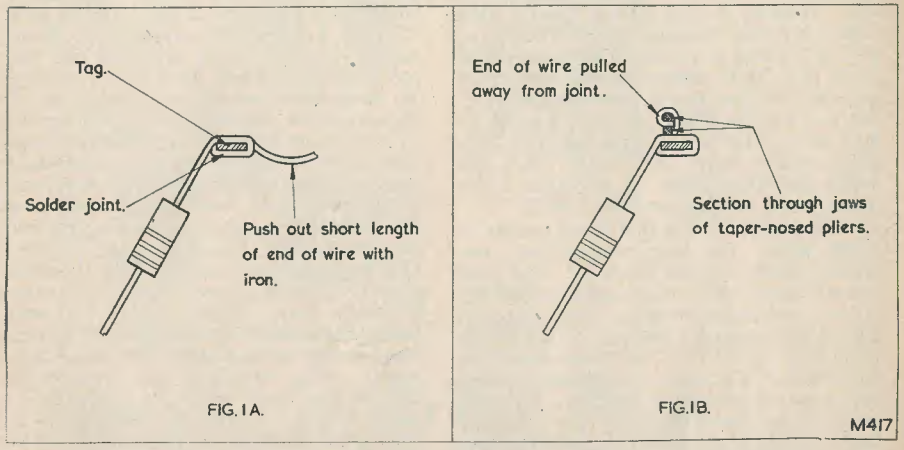


Fig. 1 (a). When wires are twisted a number of times around a tag before soldering, they may sometimes be removed by initially freeing a short length with the iron. (b). The wire is finally removed by gripping its free end with a pair of taper-nosed pliers and twisting the wire away from the joint

"I have indeed," replied Smithy. "In fact, I have sometimes wondered if there isn't a factory located somewhere in the country whose operators all have horns on their heads, and whose entire output consists of solder tags which won't solder and tinned wire which won't tin! To be serious, however, there is usually a reason for this state of affairs: either the wire or tags have been badly stored or they have been badly plated. When I meet really obstinate cases I usually apply a small amount of paste flux to the surfaces. There are a number of very active non-corrosive paste fluxes available these days, and it is worth while keeping a tin of such flux on hand for cases of this sort."

"But, surely," Dick protested, "there is no need for paste flux if you use cored solder?"

"Normally there wouldn't be," agreed Smithy, "because the fluxes available in modern cored solders are very active indeed. Nevertheless, if you use cored solder on a very stubborn tag or piece of wire you are liable to find yourself applying rather more solder than you need in order to get enough flux, and this is not a state of affairs I would recommend. Mind you, it is very rarely that you need to use the paste flux, but it is still worth while keeping it on hand, just in case."

"What exactly is the purpose of flux?" Dick asked.

"It breaks down the oxides on the surfaces you are soldering," replied Smithy, "thereby leaving pure metal available for the solder. The molten solder itself prevents any further oxidisation taking place whilst the joint is being made; this being due to the fact that it covers these surfaces and excludes air. When the joint cools you have solder covering the joint with, usually, a film of flux covering the solder. However, that's only part of the story, as the business of soldering is really a science all on its own. We take soldering very much for granted in radio and electronic work, but there are other trades in which soldering is an extremely skilled operation. The plumber's trade is a typical example; especially when he has to do such work as join two pipes together with a wiped joint."

"Why is it that all simple things seem to get more complicated whenever you start looking into them?" said Dick, despondently. "If I'd been born a thousand years ago, life would have been very much simpler!"

"You'd have found that people were nearly as conscious of the finer points of soldering then as they are now," chuckled Smithy. "The art of soldering is at least 1900 years old."

"And here we are still carrying on the good work!" said Dick. "Incidentally, I've noticed that, although we always use 60/40 solder in the workshop, you still keep a reel of 20/80 in the cupboard. Why is that?"

"Well, 60/40 solder means, as you know, an alloy of 60% of tin with 40% of lead. This ratio of tin to lead is the best for radio work because, when the solder is heated, it goes almost directly from the solid to the liquid state. An alloy of 20% of tin to 80% of lead—that is, 20/80 solder—does not do this. Instead, it goes into a "pasty" state before it finally becomes fluid. The correct way of looking at the situation is that both 60/40 and 20/80 solders go into the 'pasty' state at the same temperature—actually, it's 183°C.—but the 60/40 then carries on to the fluid state after a negligible interval. The 20/80 solder leaves the 'pasty' state and enters the fluid state at a much higher temperature, at approximately 290°C.

"It is because of this that many people use 20/80 solder for high temperature components, such as heater droppers. The 20/80 doesn't confer much advantage over the 60/40 in this application so far as operating conditions are concerned, because both leave the solid state at 183°C. The advantage of the 20/80 is that, if you go over this temperature, the solder still remains in the joint. It doesn't go fluid and leave the joint free of solder. Nor do drops of solder fall from the joint and cause short-circuits elsewhere."

"In other words, it's worth while using 20/80 solder on heater droppers and the like as a form of insurance policy?"

"You *could* put it that way," agreed Smithy. "The 20/80 does no harm and it could do some good. There are, in point of fact, one or two proprietary solders which are specially intended for use at high temperatures, and which still melt at soldering iron temperatures. But you don't bump into these very often in the servicing game."

Wires

"This brings me to another question," said Dick. "Why do manufacturers use such thick inter-connecting wire on their chassis?"

"Well, this particular trend seems to be on the point of dying out these days," commented Smithy, "although you still bump into a set wired up with fencing wire every now and again. Personally, I have always thought it a bit ridiculous to use wire as thick as 20 s.w.g. or thereabouts for circuits which carry only a few milliamps. If I'm making up any gear in a hurry I usually use quite thin wire, say 28 s.w.g., for everything except tuned circuits or heater and similarly relatively heavy current circuits. Thin wire like this is very easy to handle, does the job quite adequately, and saves a lot of time.

"Anyway, I shouldn't worry too much about set wiring if I were you because, in a few years time, many of the sets coming in for repair will have printed circuits. That'll give you an entirely different set of problems to tackle altogether."

"Now you mention the subject, I'm surprised at the small number of printed circuit sets that are being made at present," commented Dick. "I would have thought that, considering all the advantages that printed circuits offer, British manufacturers would have used them almost 100% by now."

"Yes, it is rather surprising," Smithy agreed, "but you must remember that there are a lot of different sides to the question. To begin with, printed circuits do not offer advantages to manufacturers which are quite as obvious as they may appear at first sight. The cost of wiring up, say, a television set by conventional methods represents only a small proportion of the total cost of such a set. Far more of the cost is eaten up by components, cabinet, tube and valves. There is also the fact that changing over to printed circuitry is liable to involve manufacturers in a pretty heavy capital outlay. I would hesitate to rush in where angels fear to tread, but I should think it pretty safe to say that if you're going to make sets with printed circuits you have to go the whole hog to make it pay. I can't see there being any spectacular saving in production costs if you use printed circuit boards and have operators fitting individual components by hand and soldering each joint with a soldering iron."

"So what's the alternative?"

"The alternative is to use automatic machinery to do the job for you. There have been one or two articles recently in the technical press describing typical installations for carrying out this type of work,* these being capable of automatic component insertion, transfer operations, and so on. Which brings up that word which has been in the news so much recently."

"Automation?" queried Dick.

"Yes, that's it. But so far as the radio industry is concerned, I don't think there's anything to fear from automation. It will be a long time before *component* production can be made dramatically more automatic than it is now. Indeed, it is very possible that *more* components will be needed to maintain the necessary printed production. So I don't think that the future carries any heavy clouds for the radio industry."

* For instance, "Automatic Component Assembly," by K. M. McKee, *Wireless World*, February 1957

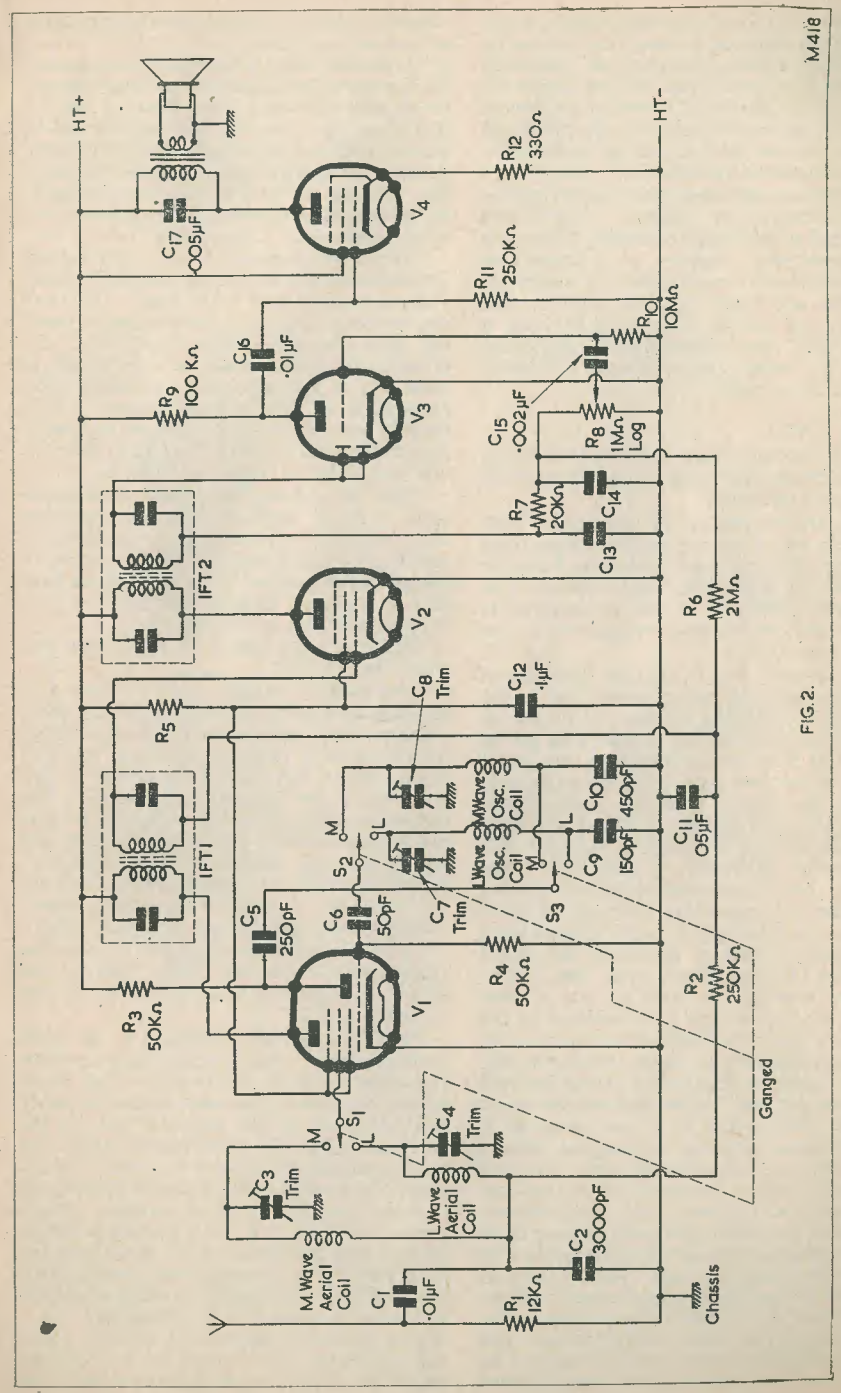


FIG. 2.

Fig. 2. A circuit illustrating some of the cost-saving arrangements which may be encountered in commercial broadcast receivers. Where values of particular components are not shown, these are discussed in the text.

"There are times," remarked Dick, as he thoughtfully returned his emptied cup to the tray, "when I feel that things are becoming just a little too much like science fiction for my liking. The idea of a row of machinery churning out radio sets by the thousand without any attention at all seems rather—well—*inhuman* to my mind."

"Automatic machinery has been in use for years," commented Smithy. "All that's happening is that it is becoming more and more developed. Besides, don't forget that such machinery needs quite a corps of engineers and fitters to look after it; not counting the people who have to keep it loaded with circuit boards and component parts. We haven't reached Capek's 'Robots' yet by a long chalk!"

Cutting Costs

Dick and Smithy returned to their benches and resumed their work. After a while Dick spoke up again.

"You know, Smithy," he remarked, "your comments about cutting manufacturing costs have reminded me of a sound radio I had on the bench the other day, Quite honestly I've never seen a set with as few components as this one had, yet it seemed to perform just as well as any other."

"It is certainly true to say that the common or garden radio is becoming simpler as the years roll by," Smithy replied. "As a matter of fact I spent some time a few years ago in seeing just how few components you could use in a medium and long wave receiver without drastically reducing performance. I think I've still got the circuit of the set I eventually evolved somewhere around." He searched in a drawer. "Ah, here it is. (Fig. 2). Now if you look at this you will see that quite a considerable economy of components has taken place in all stages except the frequency changer oscillator and signal frequency circuits. There *is*, in fact, just as great an economy in these circuits as elsewhere, but in this case it is confined to the coils only, and a few more resistors and condensers appear here to enable the simple coils used to function adequately. I think it would be interesting and rather instructive to go through this circuit with you, because it employs many of the cost-saving dodges which you are liable to encounter in some present-day sound receivers. For instance, the aerial input circuit is bottom-end coupled, whereupon there is no necessity to have more than one switch pole to change ranges. The signal input from the aerial tuned circuit is then applied to the appropriate grid of the mixer valve, V_1. The oscillator circuit I've used here is a conventional bottom-end coupled Colpitts type. This requires an extra resistor and condenser (R_3 and C_5) but dispenses with the need for feedback windings on the oscillator coils.

"The mixer stage is normal enough, except for the fact that the cathode connects straight to chassis. So also does that of the i.f. amplifier, V_2. You will note that V_1 and V_2 share a common screen-grid decoupling condenser, C_{12}, and a common dropping resistor, R_5. So long as the two valves are mounted fairly near each other this arrangement can work quite well.

"The detector circuit is also very simple. The diode load is R_8, which also functions as volume control and a.g.c. load. The two condensers C_{13} and C_{14} have values depending upon what you can get away with! C_{13} is well nigh essential, but you may be able to omit C_{14} if you have, say, screened cable connecting to the volume control. Why connect a condenser in parallel with capacity you can get for nowt? The a.g.c. circuit is also just about as simple as it can be.

"Like V_1 and V_2, the double-diode-triode runs without cathode bias, it receiving leaky-grid bias by reason of the values of C_{15} and R_{10}. The a.f. signal is finally applied to the grid of the output valve; and all we have here is a simple cathode bias resistor, R_{12}, without a bypass condenser."

"But don't you lose a lot of volume that way?" asked Dick.

"Not really," Smithy said. "There *is* a loss, but it's not all that serious. If you liked, you could say that you are improving quality by introducing negative feedback into the output stage, but such a statement in this context is rather suggestive of 'flannel.' The output stage amplifies the signal on its grid and applies it to the output transformer; our old friend, the tone-correction condenser, appearing across the primary. And that's the set complete. I haven't shown any power supply circuits as these can be conventional."

"Your circuit certainly seems to use few components," remarked Dick. "But are you sure that it's good practice to run V_1, V_2 and V_3 without bias?"

"The arrangement around V_3 is quite conventional," said Smithy, "and is used frequently. V_1 is not 'caned' too badly either, because its electron stream is partly held in check by the negative bias on the oscillator grid. The valve which receives the worst treatment is V_2, but by careful adjustment of the value of R_5 it should be possible to keep it within maximum ratings. Don't forget that there is a small contact potential provided by the diodes of V_3, this giving the a.g.c. line a potential of approximately half a volt negative with respect to chassis, so that V_2 doesn't receive zero bias entirely. And, of course, as soon as you've tuned in a signal and obtain an a.g.c. voltage the set becomes biased in just the same manner as is any other

receiver. As a matter of fact, the circuit is liable to give you something approaching quiescent a.g.c. because, until an a.g.c. voltage appears, V_2 damps the secondary of the first i.f. transformer. Incidentally, this circuit is not necessarily the sort of thing I would recommend to, say, a beginner in home-construction, but that's not the point. What I'm really trying to show you are some of the cost-saving dodges you are liable to run into during servicing."

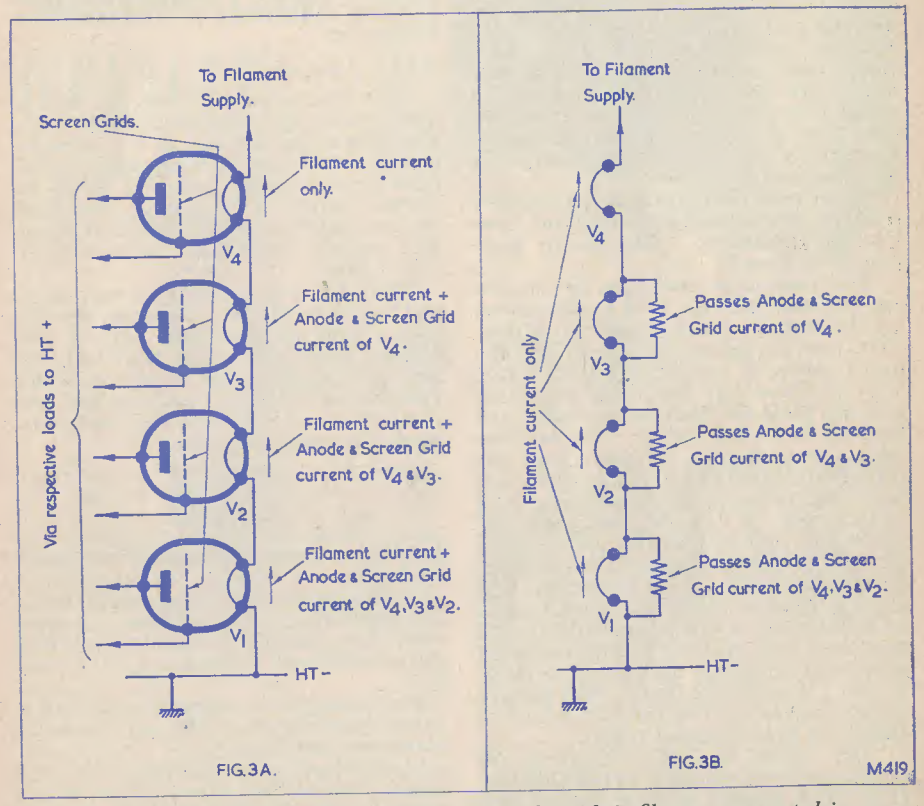


Fig. 3 (*a*). *When a number of battery valves have their filaments connected in series, the anode and screen-grid currents of those higher up the chain flow through the filaments of those below*

(*b*). *The additional current passing through the lower filaments of the chain may be bypassed by fitting additional resistors, as shown here*

Battery Receivers

"I wonder if the same sort of component economy you have just described could apply to battery receivers as well," queried Dick.

"It could indeed," Smith said, "only in this case it would be inadvisable to start taking liberties with bias values. Fortunately, apart from output valves, most battery valves can obtain enough standing bias by returning their grid leaks to the negative ends of their filaments, with the result that the problem of obtaining correct bias for each stage is easily solved, regardless of whether the filaments are connected in series or in parallel. So far as decoupling circuits are concerned, the average battery set requires very few components. Sometimes, too few are used. For instance, you may find in some battery portables that when the internal impedance of the h.t. battery rises above a certain level, due perhaps to age or similar causes, the receiver goes unstable. A very old dodge with sets of this type consists of connecting a condenser of 4μF or so across the h.t. supply, such a condenser reducing the source impedance of the h.t. supply and enabling the set to work with batteries which would otherwise have to be

discarded. Indeed, an additional condenser across the h.t. supply, if one is not already fitted, sometimes improves the performance of the set even with new batteries.

"The snag with fitting the additional condenser is that, if it is an electrolytic component, it must be switched out of circuit whenever the set is turned off, or it will otherwise gradually discharge the h.t. battery. If the receiver has the on-off switch in the l.t. circuit only this can cause some quite awkward complications, and it may even be necessary to fit an on-off switch which has the extra pole required. Often, however, the additional condenser need only have a value around 0.5μF or so, whereupon a paper condenser can be connected permanently in circuit. Such a condenser must, of course, be of good quality and have no leakage; the best types in this application being moulded or metal-cased."

"I have often noticed that battery sets have resistors connected across the filaments," was Dick's next question. "What exactly is the purpose of these?"

"Such resistors are used when the filaments are connected in series, as in a conventional a.c./d.c./battery receiver," replied Smithy. "You may, for instance, have a string of filaments connected up like this (Fig. 3 (a)). The top filament of this string passes the ordinary 50mA or 25mA, as applicable, and heats up in normal fashion. The next filament down, that of V_3, also passes the regulation filament current but, in addition, it has to pass the anode and screen-grid current of V_4 as well. If V_4 passes 5mA anode and screen-grid current, then this current flows through V_3 filament in addition to the ordinary filament current. V_1, at the bottom of the chain, is the worst off of all the valves, because its filament has to pass not only the normal filament current, but the combined anode and screen-grid currents of the other three valves as well. When you're dealing with filament currents as low as 50 or 25mA an extra 5 or 10mA can have disastrous results.

"The easiest way of overcoming the difficulty consists of doing something like this. (Fig. 3 (b)), wherein we have resistors connected across each of the lower three filaments. These resistors then carry the anode and screen-grid currents of valves further up the string. In particular receivers the resistors may not be connected up in exactly the same manner as I have shown here, but they should still be somewhere in the circuit. Incidentally, if V_4 happens to be a valve which passes a very low anode and screen-grid current, such as a diode-pentode, a resistor across V_3 may not be needed. In practice, the design of series-connected filament sets is surprisingly complicated and covers far more ground than I can possibly deal with here. From the purely service point of view it is always worth while checking the values of shunt filament resistors against the figures given in the service manual if valves have a noticeably short life in a particular receiver using series-connected filaments. In such a case, a check of anode and screen-grid currents does no harm either."

Hocus, Pocus, Presto

"The design of series filament sets must be quite interesting," commented Dick. "I'm always intending to knock up a portable for myself, and it might be worth while making it an a.c./d.c./battery type. So far as the filament string is concerned, this can't involve much more, surely, than working out the requisite resistances mathematically. Child's play!"

"Well, it's still not quite so easy as all that," persisted Smithy. "Anyway, if you're such a good mathematician here's a little problem which—so I have been told—has been set in an eleven-plus examination with a time limit of 5 minutes. Let's see how long you take over it! In this 'sum' each letter stands for a different number:

HOCUS
POCUS
PRESTO

Just work out what number each letter stands for."

"It should be simple enough," said Dick, a little guardedly. "Let's see now. To begin with, it's obvious that P is equal to 1. Which means that H must be equal to 9. Or it could be 8."

Dick broke off for a moment and looked at Smithy suspiciously. "Do you know the answer yourself?" he asked.

"I do indeed," grinned Smithy, "and I can assure you that there is no catch in it. I'll tell you the answer the next time we have a get-together."

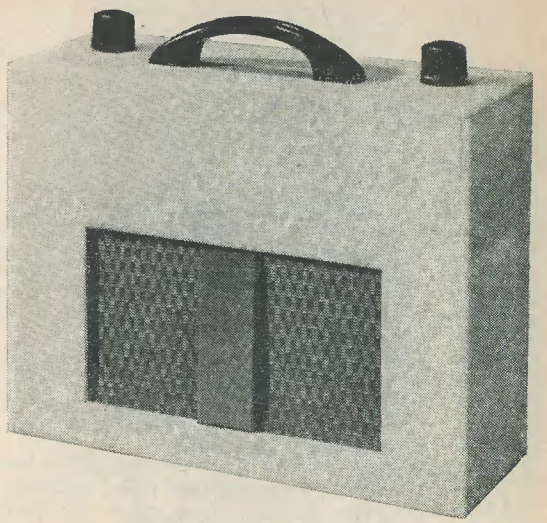
Errata. Two errors occurred in *In Your Workshop*, April issue. In Fig. 3 the resistance element of the 5kΩ potentiometer was omitted, and in Fig. 5 the 50μF condenser C_2 should have been placed on the potentiometer side of the smoothing resistor R_1.

Next Month . . .

The RADIOSETTE & NURSERYETTE

TRANSISTOR RECEIVERS

PORTABLE PRE-TUNED TRANSISTOR SUPERHET



as described

by **F. MARSH**

Details of a sensitive 7-transistor medium wave superhet portable which may be built, at reasonable cost, by the home-constructor.

ALTHOUGH THE COMMERCIAL MANUFACTURE of transistor receivers in this country appears to be lagging somewhat, the same cannot be said for equipment which is built at home by the amateur. In the home-constructor sphere a number of successful designs have been made by amateurs, and it is interesting to mark the fact that *The Radio Constructor* has been foremost in presenting designs in this particular field.

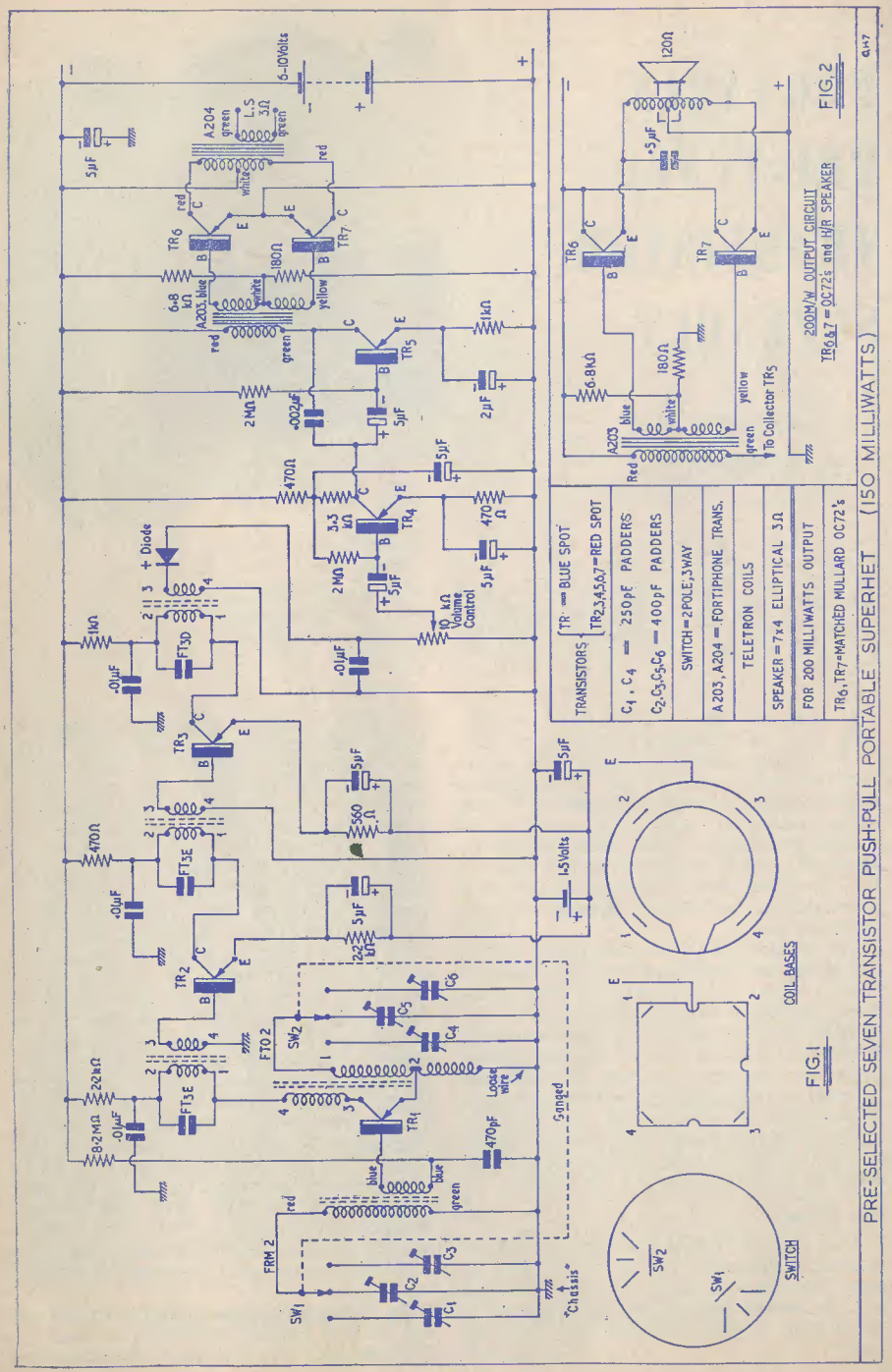
The receiver which is described in this article has been developed and is presented by Henrys Radio Ltd. and employs some of the more advanced design features which are feasible with components at present available. It should be noted that all the component parts for the receiver may be obtained through normal channels; and the constructor is not expected to wind his own coils, or anything of that nature. The writer understands that the receiver may be obtained, in kit form, from advertisers in this issue.

The Circuit

The circuit of the portable transistor receiver is illustrated in Fig. 1. As may be seen, care has been taken to keep the number of components required to a low figure, this simplifying layout problems and reducing cost.

A pre-set tuning arrangement is employed in the frequency-changer stage, this helping to eliminate the difficulties incurred when signal strength has to rely on very accurate tracking. Three pre-tuned stations may be selected, and the use of trimmers ensures that these are received under conditions of optimum sensitivity. The frequency-changer stage is built around TR_1, this being an r.f. junction transistor (blue spot). The ferrite frame tuned coil is connected, via switch SW_1, to any of the pre-set condensers, C_1, C_2, or C_3, as required. A low-impedance secondary coil on the ferrite frame applies the desired signal to chassis and the base of transistor TR_1. TR_1 also functions as an oscillator, the oscillatory circuit employing a feedback winding instead of relying on conditions of negative resistance in the transistor. This method of operation ensures that reliable oscillations of adequate amplitude are provided. The oscillator coil is tuned by either of the pre-set condensers C_4, C_5, or C_6; these being selected by SW_2. SW_1 and SW_2 are ganged and, together, form the station selector switch. The ferrite frame and oscillator coil are designed to cover the medium waveband.

By reason of the bias applied to its base via the 8.2MΩ resistor connected to the h.t. negative rail, TR_1 functions in a non-linear



mode. In consequence frequency-changing takes place, and the intermediate frequency of 315 kc/s is applied to the first i.f. transformer. The secondary of this transformer connects to the base of TR_2 which operates as an earthed emitter amplifier. TR_3, also earthed emitter, follows TR_2 in similar manner, the two transistors in cascade forming the i.f. strip of the receiver. It will be noticed that a separate 1.5 volt cell, connected in series with the main h.t. supply, feeds the emitters of TR_2 and TR_3. The use of a separate cell in this fashion confers several advantages, one of these being that a higher h.t. potential is available at a point where a high degree of amplification is required. The major advantage, however, is that the use of the cell enables a considerable simplification to be effected in the i.f. biasing arrangements and eliminates the necessity for an automatic bias resistor. Automatic bias circuits are rather wasteful in receivers of this type. The current drawn from the 1.5 volt cell is low, and it should need to be replaced only infrequently.

The third i.f. transformer feeds into the crystal diode and thence to the 10k Ω volume control which forms its load. Audio frequency from the slider of the volume control is next applied to TR_4. This transistor, with TR_5, makes up a relatively high gain a.f. amplifier. The h.t. feed to TR_4 is decoupled. TR_5 drives the output transistors, phase inversion being provided by the transformer in its collector circuit.

The Output Stage

The output transistors, TR_6 and TR_7, work in Class B, thus enabling a relatively high power output to be obtained without excessive battery drain. In the circuit shown in Fig. 1, TR_6 and TR_7 are of the same type as is employed in the i.f. and a.f. stages of the receiver, and they provide an output power of approximately 150mW. The speaker transformer recommended for use with these transistors is the Fortiphone unit type A204. The secondary of this transformer should be connected to a speaker of 3Ω voice coil impedance. It is worth mentioning that both the transformers just mentioned are miniature types intended especially for transistor circuits.

An alternative output circuit is shown in Fig. 2. This uses two Mullard OC72's and provides an output power of 200mW. The input circuit to the OC72's is the same as that illustrated for TR_6 and TR_7 of Fig. 1, but the output circuit differs somewhat insofar that no speaker transformer is required, the two transistors feeding directly into the centre-tapped voice coil of the speaker. The speaker used here is an Elac 7in by 4in elliptical model having a 120Ω centre-tapped voice coil. As will be realised, the direct coupling into the loudspeaker ensures that a very high degree of efficiency is realised.

Constructional Details

Although the receiver contains a relatively large number of amplifying stages, problems of layout are not necessarily as difficult as they would be in a receiver of similar gain employing valves. The main reason for this is that, since transistors are low impedance devices, unwanted capacitive couplings have less effect so far as the transference of energy from one circuit to the next is concerned. From the constructional point of view, all that is needed is a sensible and logical layout which keeps leads carrying r.f. and a.f. voltages reasonably short. A minor precaution to observe is that i.f. transformer and coil cans should be spaced from each other by a distance greater than $\frac{3}{4}$in.

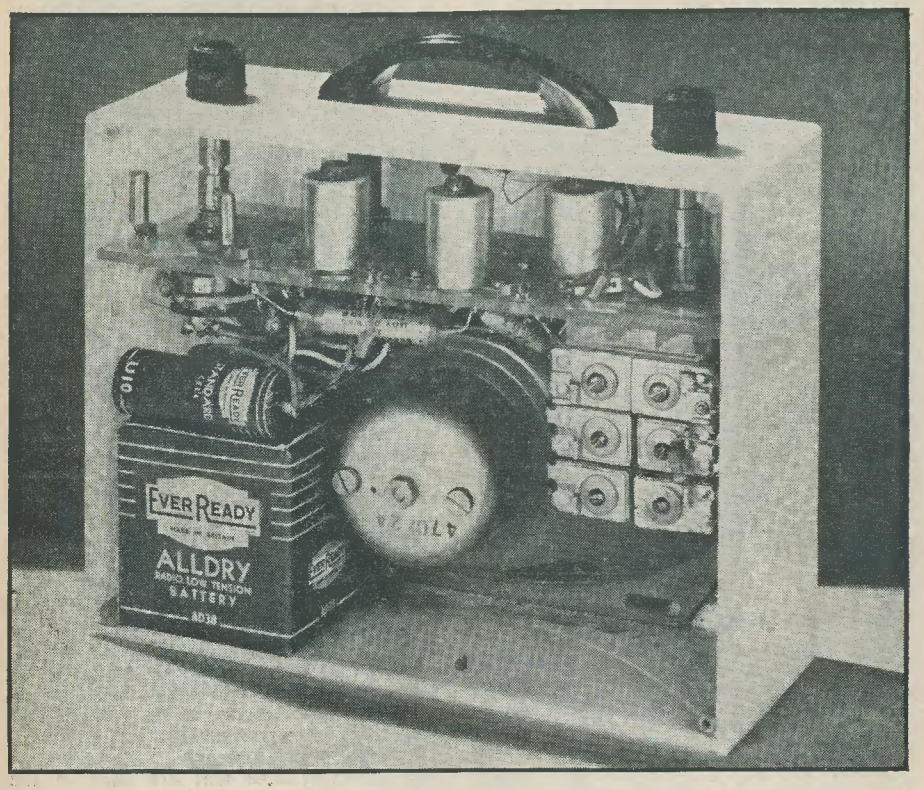
The construction of the receiver chassis is liable to incur the use of techniques which differ slightly from those encountered in valve equipment. This is due to the fact that it will be found most convenient to mount the components on a sheet of insulating material such as Paxolin or Perspex rather than on a metal chassis. A single plane chassis is all that is required, and connections to the various components and transistors may be made with the aid of solder tags, these being directly bolted to holes drilled in the chassis. Such holes may be made exactly where required. So long as care is taken to ensure that a low resistance earth path exists for the various stages, this method of construction allows quite an efficient layout to be achieved. When a chassis made of insulating material is used, it is advisable to see that the metalwork of such components as switches and volume controls is connected to the earth line. The same remark also applies, of course, to any screening cans that are used in the circuit.

The two photographs accompanying this article illustrate a prototype receiver fitted into a Perspex cabinet, and provide a typical example of the professional appearance which can be given by the receiver. The cabinet shown is one supplied by Henrys Radio Ltd. as an assembly kit.

In the photograph showing the back of the receiver it will be noted that the frequency-changer stage is at the right-hand side. The six station selector trimmers are readily visible, the selector switch being fitted directly behind these, with its spindle protruding through the top of the cabinet. The layout then proceeds in logical fashion to the left-hand side of the chassis, the volume control being mounted at this point. The knobs of the volume control and station selector switch appear symmetrically on either side of the carrying handle.

Alignment

The alignment of the receiver is a relatively simple operation, and may be carried out either with or without the aid of a signal generator.



Rear view of Pre-tuned Transistor Portable

If a signal generator is available its output should be coupled, via a 0.01μF condenser in the "hot" lead, between the h.t. positive line and the lower end of the ferrite frame coupling coil (i.e. at the junction of the 8.2MΩ resistor and the 470pF condenser). The frequency of the signal generator should then be adjusted to 315 kc/s and the three i.f. transformers adjusted for maximum output, attenuating the signal generator as alignment proceeds.

I.f. alignment without a signal generator may be carried out with the aid of an external aerial of reasonable sensitivity. This aerial should be connected to the "red" tag of the ferrite frame and any of the oscillator trimmers adjusted until a station is heard. The i.f. cores are then adjusted for maximum volume. If it is desired to reduce signal strength during alignment this may be done by inserting a condenser of some 100 to 300pF in series with the temporary aerial lead.

The oscillator and aerial trimmers may also be set up with the aid of an aerial. This should first of all be connected to the "red" tag of the ferrite frame as above, after which the appropriate oscillator trimmer should be adjusted until the desired station is heard. The aerial is then removed and the appropriate ferrite frame trimmer adjusted for maximum volume. If necessary, the oscillator trimmer can then be given a final slight adjustment for optimum tuning. Since the three pairs of trimmers have different values of maximum capacity it is advisable to ensure that the station with the highest frequency is selected by the trimmers with the lowest capacities.

TELEVISION for the HOME CONSTRUCTOR

PART 11 *by* **S. WELBURN**

This month S. Welburn, our popular contributor on television topics, devotes his space to some of the less frequently discussed aspects of the design of sound i.f. systems

WHILST CASTING AROUND IN HIS MIND for a suitable subject to which he could devote this particular contribution in the present series, the writer suddenly realised that he has not yet dealt in any detail with that important part of a television receiver—the sound i.f. strip. One reason for the lack of reference to this particular section of the television receiver is that the circuits employed are usually fairly simple and, in consequence, cause little trouble. Despite this fact, however, the sound i.f. strip is not always quite as innocent as it appears on the surface, and it might be worth while, therefore, to devote some space to possible difficulties which the home-constructor may encounter in this portion of the receiver.

The I.F. Strip

Basically, the sound i.f. strip consists of a combination of valves and coils tuned to the sound i.f. of the particular set under consideration. Sound intermediate frequencies may be anywhere between 10 and 40 Mc/s, although it is nowadays conventional to use the "standard" frequency of 38.15 Mc/s.

Although the sound i.f. strip of a television receiver may appear at first to be not very different from the sort of thing we have grown used to in broadcast receivers, there are a number of important differences which have to be taken into account. The first of these is that the i.f. transformers in a broadcast receiver are bandpass coupled, whilst it is unlikely that such a type of coupling would be used in the i.f. strip of a televisor. The broadcast receiver uses bandpass coupling because the relatively low i.f. employed (around 465 kc/s) is not a large multiple of the bandwidth required, with the result that peak-tuned circuits would cause attenuation of the higher audio frequencies. A typical broadcast receiver sound i.f. response curve is shown in Fig. 1 (a). As may be seen, this allows roughly equivalent amplification to be given to the carrier and its sidebands up to approximately 3 kc/s. Fig. 1 (b) illustrates the effect that might be given by a 465 kc/s i.f. amplifier assuming that no bandpass couplings are employed and that all coils are tuned to a peak. The higher audio frequency sidebands in this curve are, obviously, heavily attenuated.

Fig. 1 (c) illustrates the sort of curve likely to be given by a television sound i.f. strip working at 38.15 Mc/s. From an academic point of view it is rather interesting to note that this curve is identical to that of Fig. 1 (b), the only difference being that the frequencies represented are higher. In point of fact, the various parts of the curve of Fig. 1 (c) represent frequencies which are scaled up on those of Fig. 1 (b) by the same ratio; i.e. 465 kc/s to 38.15 Mc/s. Due to the higher frequencies involved, the curve of Fig. 1 (c) now becomes quite suitable for handling a.f. modulated signals, whereas that of Fig. 1 (b) is obviously of little use in this application.

As we have just seen, the response given by peak-tuned circuits is quite adequate for television sound i.f. strips. Even if it were considered worth while using bandpass couplings in sound i.f. strips, there are a number of further factors which would make their use undesirable. One of these is that, for the relatively small bandwidths required, the design of suitable bandpass coils would be extremely difficult and expensive. A typical example of the many difficulties which would be encountered by the coil designer when tackling a problem of this type would be the necessity of ensuring that the coupling factor between the coils of each bandpass assembly remained constant for each receiver in which they were fitted. Fig. 2 illustrates a well-known difficulty in the design of bandpass coil assemblies. Fig. 2 (a) shows an i.f. transformer in which the dust cores are in the correct position for resonance when they are approximately half-way into their coils. The mutual inductance between the two coils then consists of the mutual inductance between the two windings, plus the coupling given by the

mutual interaction of the fields concentrated in the cores. Let us next assume that our coil of Fig. 2 (a) is fitted to a receiver which, for some reason (say, low valve inter-electrode capacities) presents lower tuning capacities to the coils. In this receiver we would find that, to bring each coil to resonance, the cores would have to be set further into the windings, as in Fig. 2 (b). The result is that we would obtain an increase in the mutual interaction of the fields concentrated in the cores, and the overall mutual inductance between the coils would increase in consequence. In practice it might be difficult to say just how great an increase in mutual inductance would be given by going from the state of Fig. 2 (a) to that of Fig. 2 (b), but it would probably be quite noticeable, and it *could* be embarrassingly large. If, for instance, the assembly of Fig. 2 (a) provided coupling between the coils that was just short of giving a bandpass response, that of Fig. 2 (b) would almost certainly go "over the top" and give quite a definite bandpass characteristic. The bandwidth of such a curve may quite easily be greater than that desirable in a sound i.f. strip.

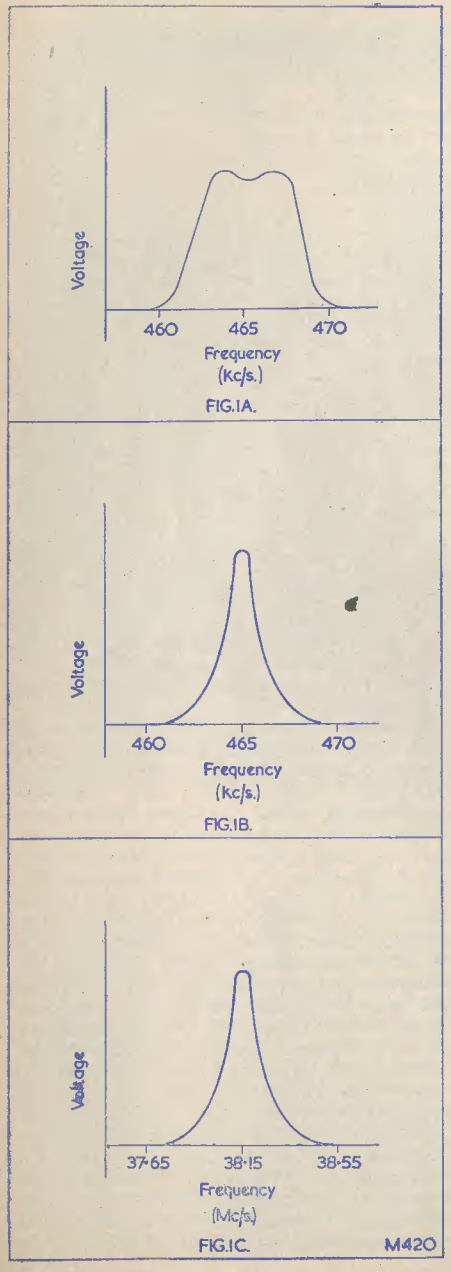


Fig. 1 (a). The bandpass response given by the 465 kc/s i.f. stages of a broadcast receiver. (b) A peak-tuned response at 465 kc/s. This curve would cause heavy attenuation of the higher audio frequencies. (c) The curve of (b) transferred to the frequencies encountered in television sound i.f. strips. In this case the curve would handle audio frequency sidebands quite adequately

To stray slightly from the main line of argument, it might be advantageous to devote a few sentences to the assembly of Fig. 2 (c). In this diagram the top core has been set to resonance incorrectly, insofar that it is on the wrong side of the coil. The mutual inductance between the two coils will, in consequence, be considerably higher than it was originally intended to be, and the response curve of the transformer will be much distorted. The core setting shown in Fig. 2 (c) can often be obtained accidentally, and it is a point which should be guarded against when aligning i.f. transformers of this type. Unless otherwise stated in the appropriate literature it may almost always be assumed that an i.f. transformer whose two coils are wound on the same former should be set up on the "outside" core positions.

Although some of the problems given by the coil assembly of Fig. 2 would be eradicated by having the two coils mounted parallel to each other, the difficulty of obtaining closely-held coupling factors for all coils of the same design would still make the idea of a bandpass coupled sound i.f. strip untenable.

Another reason for the undesirability of wide bandwidths in sound i.f. strips (whether caused by bandpass couplings or low-Q tuned circuits) is that it is always necessary to obtain a high degree of amplification of sound channel energy in order to minimise the possibility of video signal, mainly frame buzz, appearing in the reproduced output from the loudspeaker.

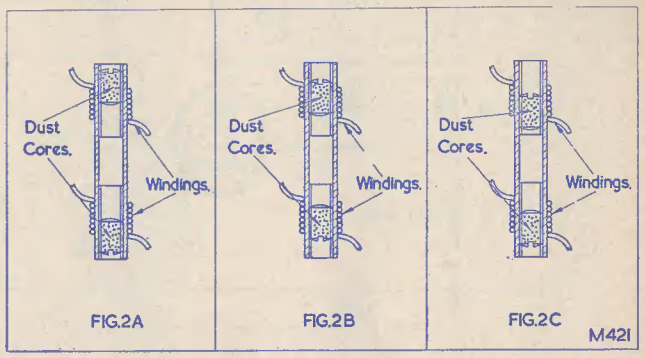


Fig. 2 (a). Two windings of an i.f. transformer with dust cores inserted. (b) If the cores are inserted further into the windings, as shown in this diagram, the mutual inductance between the two coils increases. (c) When a core is set incorrectly, in the manner illustrated here, the mutual inductance between the coils is further increased

the central plate is connected to earth via an impedance Z, as in Fig. 3 (c), an alteration takes place in the operating conditions. This is because voltages may now appear across this impedance, thereby enabling a measure of capacitive coupling to exist between the anode and the control grid via the plate. The higher the impedance of Z, the greater is this coupling.

Instability

Since relatively high degrees of selectivity are required in the sound i.f. strip, correspondingly high values of Q are needed in the associated tuned circuits. High-Q tuned circuits can occasionally cause quite a lot of trouble in sound i.f. strips.

The major snag likely to be encountered is that of instability, this being usually far more troublesome in the sound circuits than in the video strip, where coils are usually fairly heavily damped. Apart from elementary errors of layout, etc., instability in the sound i.f. strip is almost always caused by unwanted capacitive couplings, these usually appearing between the anodes and control grids of individual i.f. amplifying valves. A typical i.f. amplifier stage is shown in Fig. 3 (a), in which diagram the unwanted capacities are shown as C_{ag}, the internal self-capacity of the valve, and as C_{ext}, the stray capacities existing externally to the valve.

So far as C_{ag} is concerned, this can only be kept to a low quantity by decoupling the screen-grid of the valve to chassis by an impedance having a very low value. The necessity of ensuring that this low impedance is obtained is often of considerable importance in practical sound i.f. strips. As readers may appreciate, the effect of the screen-grid of a valve is similar to that of the earthed plate shown in Fig. 3 (b). Both "anode" and "control grid" in this diagram have a capacity to the earthed plate but, as this is connected directly to earth, no voltage resulting from such coupling can appear on it. The outcome of the arrangement is that no capacity exists between the anode and the control grid. If

In a practical valve amplifier, in which the earthed plate is replaced by the screen-grid, it is impossible to finally eradicate the presence of Z. Apart from the fact that circuit design necessitates the use of a condenser between sereen-grid and chassis, there is also the fact that unavoidable lead lengths inside and outside the valve introduce additional inductive impedances. We can, of course, take the obvious precaution of keeping lead lengths as short as possible, whereupon the remaining important factor is the capacity of the decoupling condenser. It is, unfortunately, rather easy to fall into the habit of thinking that 1,000pF is a "dead short" at 30 Mc/s; but this is not exactly true. In point of fact, a 1,000pF condenser has a reactance of slightly more than 5 ohms at this frequency. Because of the existence of this small amount of reactance it sometimes happens that a sound i.f. amplifier stage may be made more stable by increasing the screen-grid decoupling condenser from 1,000 to 2,000 or 3,000pF. It should be emphasised, before concluding on this particular point, that the calculated reactance of a condenser does not entirely represent its true impedance; this being qualified by the small amount of inductance present in the condenser and its leads. Nevertheless, practical experience supports the fact that an improvement in stability can sometimes be given by increasing decoupling capacities in this manner.

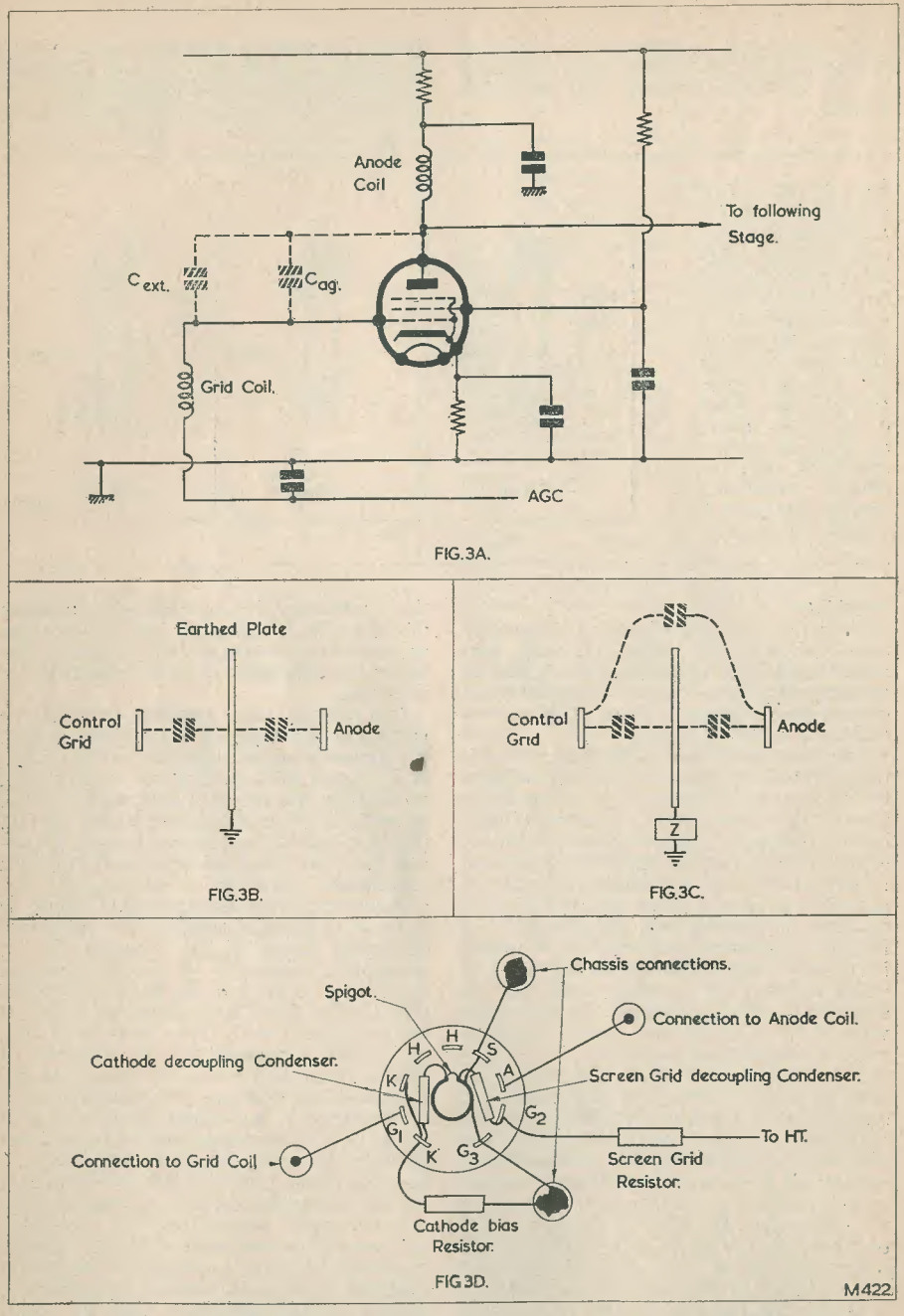


Fig. 3 (a). A typical amplifying stage in a sound i.f. strip. (b) If a large earthed plate is fitted between two electrodes, the capacity between them reduces to zero. (c) If an impedance is inserted between the central plate and earth, a capacity will exist between the two electrodes. (d) A practical i.f. layout using the EF80

Before carrying on to the question of keeping unwanted external capacities to as low a value as possible, it might be advisable at this stage to consider some practical aspects of the decoupling problem. Although it may not always represent an ideal choice for this application, the EF80 is frequently employed in sound i.f. strips, and is capable of giving very high degrees of amplification. Because of the frequency with which it appears in sound i.f. strips, it might be of interest to examine the problems involved in adequately decoupling the screen-grid of a valve of this type. A layout which the writer has found to give very good results at frequencies around 30 Mc/s is illustrated in Fig. 3 (d). This diagram is largely self-explanatory, although it should be pointed out that the control grid and anode leads from the valveholder to the adjacent coil tags need to be kept fairly close to the chassis in order to take advantage of the partial screening provided by the valve pins and spigot. Having two connections to chassis instead of one causes a noticeable increase in stability in some layouts, the second chassis connection sometimes making all the difference between a perfectly stable sound i.f. amplifier stage, and one that is violently unstable. The connections to chassis should, where possible, be soldered direct.

The layout illustrated in Fig. 3 (d) keeps the C_{ext} of Fig. 3 (a) to quite a low value, but it can usually only be employed when the associated i.f. coils are mounted in their own screening cans above the chassis. When unscreened coils are used below the chassis, a somewhat more effective form of inter-stage screening may become necessary. When used, such screening should preferably lie across the appropriate i.f. valveholder, with the control grid pin on one side and the anode pin on the other.

The writer mentioned just now that the EF80 may not be an ideal choice for use in sound i.f. strips wherein high-Q tuned circuits appear in both anode and control grid circuits, and where instability is, in consequence, likely to be difficult to clear. The EF80 is, of course, an excellent valve for video i.f. strips where wide bandwidths are required. A valve which might be found to give less trouble in sound i.f. amplifiers is the EF91.

Intercoupling

It is very desirable, when designing sound and video i.f. strips, to ensure that no unwanted couplings exist between the two strips. Usually, when such couplings appear, energy is transferred more readily from the video i.f. strip to the sound i.f. strip than in the reverse direction. The reason for this is that the sound i.f. strip control grid and anode circuits normally work at relatively high impedance, whilst those of the video i.f. strip operate at low impedance. The existence of unwanted couplings between strips can usually be assumed if the response curve of the sound i.f. strip has something of the shape shown in Fig. 4, wherein one of the skirts spreads out into the video i.f. passband. A good method of *confirming* the existence of the unwanted coupling then consists of temporarily putting the video i.f. strip out of action and re-examining the sound i.f. response. If this now approximates to that shown in Fig. 1 (c) then the presence of the unwanted coupling may be considered as being certain.

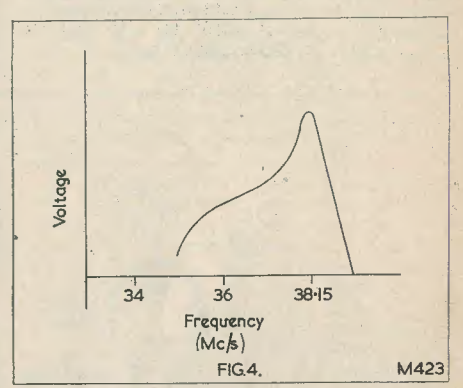


Fig. 4. A typically distorted response curve, which could be given by interaction with the sound strip by the video strip

The solution to the undesired couplings consists of adding judicious screening, checking on h.t. and heater decoupling, or, if things are really bad, altering layout. However, the writer must hasten to point out that there is no necessity to cancel out the unwanted coupling if its effect on the reproduced sound output is small. The usual effect of video appearing in the sound strip is that frame buzz becomes audible. If the frame buzz level is considered low enough to be acceptable there is little point in carrying out extensive alterations.

Before concluding on this particular topic, it is worth while mentioning that a small amount of video i.f. sometimes finds its way on to the video amplifier anode of the average receiver. It is difficult to completely eradicate this without endangering video response unless special filters are employed. Normally, the presence of video i.f. at this point is of small importance, although an eye should be kept open for this particular source when looking for unwanted couplings into the sound i.f. strip.

As was just discussed, i.f. energy is normally passed less readily from the sound strip to the video strip than in the reverse direction, due to the low impedance circuits employed in the video strip. Nevertheless, if such a transfer does occur the result will be reduced sound rejection with, if sufficiently severe, sound-on-vision. The source of the trouble may in this case be isolated by putting the sound i.f. strip out of action and seeing if the trouble clears. The existence of the unwanted coupling may then be finally confirmed by returning the sound i.f. strip to working conditions and putting the a.f. amplifier stage or stages out of action. If the trouble clears once more, the cause lies most probably in unwanted couplings from the a.f. circuits rather than from the sound i.f. strip.

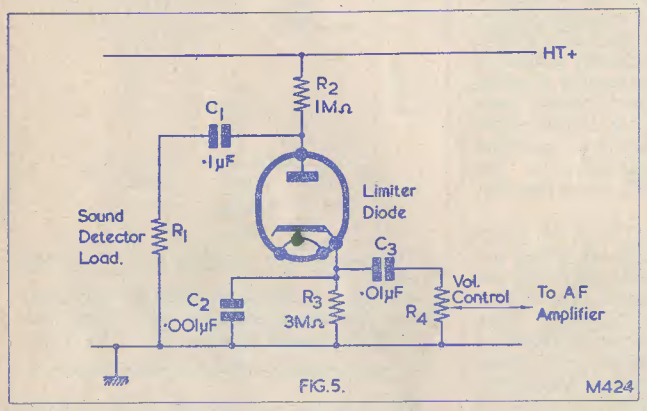


Fig. 5. A practical sound noise limiter

Interference Limiters

All the best television sound systems have interference limiters, even when such limiters provide only partial relief to the interference problem. A typical pulse interference limiter is illustrated in Fig. 5. In this diagram the limiter diode appears immediately after the sound detector load, to which it is connected via the 0.1μF condenser C_1.

Due to the presence of R_2 and R_3 the diode conducts in normal fashion and, in the absence of interference, enables a.f. to be passed to the volume control R_4. The 0.001μF condenser C_2 charges up to a voltage equivalent to the average value of that appearing across R_3 and, apart from giving a small amount of top-cut, has little effect on the rest of the circuit. On the arrival of a sharp-fronted pulse of interference, C_2 charges up to a higher value than normal, with the result that the diode, whose anode is held at a relatively steady potential by C_1, becomes cut off and passes no further a.f. signal. The diode remains cut off until C_2 discharges into R_3 and regains its previous voltage. The length of time that the diode is cut off is intended to be slightly longer than that of the average interfering pulse.

In practice, interference limiting circuits of the type shown in Fig. 5 function quite well and incur little trouble. Minor difficulties are raised by the fact that, if the heater of the diode has a high a.c. potential with respect to chassis, hum may be introduced into the a.f. stages. Another minor point is that the circuit involves the use of a few components which all operate at fairly high impedance, and these could conceivably pick up unwanted radiation from the video i.f. strip. Yet a third factor is that the relatively high-value resistors R_2 and R_3 occasionally go open-circuit after a period of time, if they are not of reliable manufacture. Because of this possibility it might be worth while using half-watt resistors of good manufacture in these two positions.

Inexpensive Screening

Before concluding this month's contribution, the writer would like to turn to a subject which is somewhat removed from sound i.f. strips. This subject concerns screening and is the basis of an interesting letter from reader E. E. Wilkinson of Windsor, Berks.

With his letter Mr. Wilkinson encloses a sample of metal foil. "This foil would enable anyone to shield the inside of a TV cabinet or a converter very cheaply," he says in his letter. "The foil may be bought at Boots the Chemists, and no doubt other places, and costs 2s. 3d. for 15ft. If desired it could be used doubled for extra strength and fixed with drawing pins."

(*continued on page 689*)

Radio Miscellany

ONE VERY WELCOME RESPONSE TO MY recent commiseration with the reader who had made numerous unsuccessful calls at South London shops to buy self-tapping screws, came from K. R. Whiston, 8 Watford Bridge Road, New Mills, near Stockport. He sent along a generous sample of assorted sizes, many of which have already been put to good use. A quantity of them disappeared in transit, but not through the fault of the Post Office. Our Editor and the Advertising Manager both got their fingers into them before the remainder reached me. Undoubtedly the temptation was great. There are so many useful purposes to which they can be put. In any case, it gives one a feeling of confidence to have a small stock of them on the shelf against future requirements.

Mr. Whiston's firm, by the way, supply these as well as a wide range of hardware sundries such as all type of screws, nuts, bolts, rivets, pulleys, Allen screws, ballraces, shim-stock, foil, screwed roddings, as well as tools, etc. The smaller size self-tapping screws (assorted) are 2/6 per half-gross, or 4/– per gross. Sizes ⅝in long upwards are 4/6 a gross, while those of ½in and shorter are 3/6. His list suggests that readers sending for any of the numerous useful items stocked, should enclose 2/6 to cover the cost of postage (for orders under £1). Any surplus will be refunded, while if the cost is greater he will pay it.

CENTRE TAP *talks about* *Items of General Interest*

Warning

The rustle of spring and bright sunshine stirred me into a faint urge to do something about smartening up my shack-cum-worshop. The annual spring flick-around-with-a-duster would not, this year, satisfy the feminine side who grimly stuck out for a complete re-decoration. From the local newsagent I collected a number of do-it-yourself magazines so that I could study the advertisements in order to choose the quickest and easiest of ways. Nowadays there is a spate of do-it-yourself books, and according to the advertisements plenty of tools and materials which, even if they don't do *all* the work for you, turn the small effort required of you into a pleasure. It's a pity such ingenuity cannot be put into instruments for servicing radios and t.v.'s. Mine only give an indication, and they leave all the puzzling out and the manual work to me.

With everybody so busy doing it themselves one might reasonably suppose that there would be scarcely time for anyone to see what the rest of us were up to. Not so in Centre Tap Villa. I wasn't even consulted about the method, and nothing less than the old-fashioned scrubbing and elbow grease would suffice. Nor were my views sought on the colour scheme. My role was to pay for the paint and put it on. I nearly curled up in horror when I was handed tins of Oyster Pink, Dove Grey and Pale Lemon complete with details of which part was to be painted with each colour.

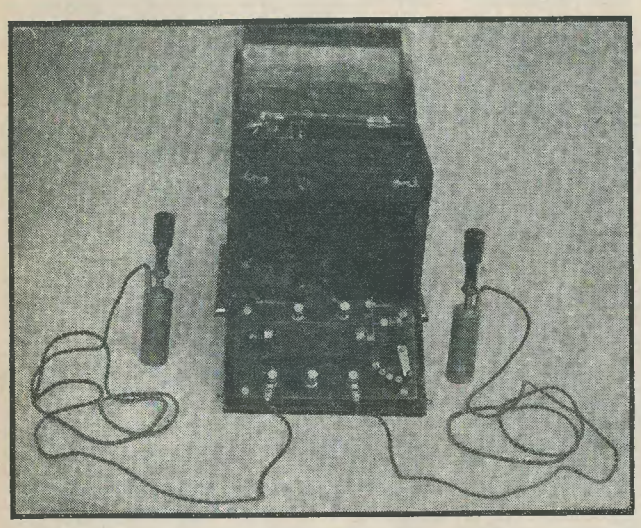
I felt it must be a conspiracy—an undisguised attempt to make me feel ashamed to have my friends (who, it has often been alleged, encourage me to waste hours in there smoking and talking, and playing with bits of wire—even dark hints that beer drinking sometimes goes on).

Surprisingly enough the final effect, after ten days hard labour, turned out to be quite pleasing. So much so that now my friends don't dare let their wives see it, for fear that they will also have to serve a sentence of ten days hard in order that their radio dens are similarly re-decorated in "modern" style.

NOTE: For the particular attention of bachelor readers. When you do eventually decide to get married, make sure you get one of the Do-it-Herself type, not one of the Do-it-Yourself-for-Her sort.

Friends Indeed

Many tributes have been paid to the bonds of fraternal friendship, loosely spoken of as the Ham Spirit, that have become part of the tradition of amateur communications radio. So much so that the fact that an equally strong sense of good fellowship exists among radio constructors and enthusiasts generally is overlooked. Many readers who have used our "Can Anyone Help" column have later written to tell of their pleasurable surprise at the kindness and willingness to help which resulted from their appeal. Maybe this sense of "belonging" as well as mutuality of interest becomes more highly developed because radio is a hobby in which one "shares."



A shocking coil made by Mr. Brewer some fifty years ago

Further instances of kindly thoughtfulness came about following my recent mention of the Radio Amateur Invalid and Bedfast Club. I am asked by Bill Harris, the Hon. Sec. to pass the Club's grateful thanks to a couple of generous friends who didn't give their addresses in their covering letters and may not otherwise know that their donations arrived safely. To John Critchell (who mentions he is also interested in music and photography) somewhere in or near Hornchurch, Essex, who sent £5.

Also the Coventry reader from whose cheery letter I quote: "Dear Bill, I have read about your club in *R.C.* I've got good health, a good job, good eyes and I'm very thankful. I also like to fiddle with soldering iron, valves, etc., . . . but an extra pleasure is to be able to part with my pocket money to those whose need is greater than my own. . . . Keep smiling, but let me remain Anonymous."

Bill also mentions that St. Dunstans, who have loaned him the typewriter on which he does his club secretarial work, are going to give him one to keep as his own if he passes their test. From the specimens I have seen, Bill, you'll have a machine O.K. Remember that readers everywhere as well as R.A.I.B.C. members will be rooting for you when you take that test.

Long Service

One of the most pleasing points about our hobby is the fact that with many it lasts a lifetime—from schooldays to retirement. I can think of no other hobby in which such a phrase as "Old-timer" has become part and parcel of its vocabulary. An Old-timer, of course, need not be elderly. The title is conferred after a long association with the hobby, maybe twenty years or so. Thus many an Old-timer still hasn't celebrated his fortieth birthday. Hobbyists of fifty years standing would more aptly be termed Radio Veterans and I imagine a remarkably high number would qualify for the title.

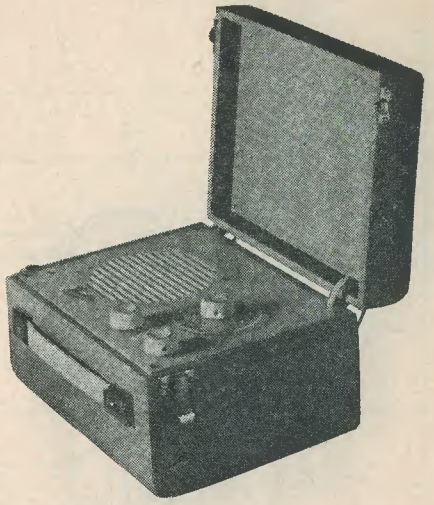
Perhaps because this column sometimes grows nostalgic about the good old days, Veterans take me for one of themselves and write me nice friendly letters. Although even under my nom-de-plume I have earned an Old-timership title, I have still a long way to go before achieving Veteran status. Hence my pleasure at these letters is often tinged with a feeling of guilt by not really being one of them at all.

Once again a nice letter has arrived from our old friend Charles Brewer of Wood Park Road, South Shore, Blackpool, a hobbyist of some sixty years standing and a french polisher by trade. His latest constructional effort is the All-Dry Portable, which is giving very satisfactory results and comes in for regular use. This time he sends along a photograph of a Shocking Coil—also known as a Medical Coil, as it was once popularly supposed that a series of mild shocks, growing stronger as some sadist speeded up on the handle, were a Good Thing! This he made up and photographed over fifty years

(*continued on page* 701)

The "RAMBLER" PORTABLE SUPERHET

A Receiver for Home and Countryside



PART 1. *by* JAMES S. KENT

WITH THE OUTSET OF SPRING, OR OF summer, most of us turn to the wide open spaces as a welcome relief from the cooped-up confines of the shack in which we have laboured, listened, or operated over the period of dark winter nights and cold wet days. Most of us set out with high hopes that the sunshine will last out for the day and that we shall have an enjoyable trip—whether it be by foot, train or car. These are, of course, admirable sentiments and, in themselves, constitute part and parcel of the seasonal merry-go-round in which most radio enthusiasts take a part. The great outdoors, however, can be a lonely place for the radio hobbyist—particularly when the absence of a radio receiver causes one to miss that favourite programme—or the result of the latest Test match! To fill this void one must turn to the obvious—a portable receiver.

A portable receiver is regarded by many as a seasonal acquisition, and although true that it is at the present time of the year that the need of one is, perhaps, greatest, it is none the less a fact that such a receiver is a great boon throughout the seasons. It may be used not only out-of-doors but also in every room of the house—well, almost!

A well-designed portable receiver must not only be portable, as its name implies, but it must also be comparatively light in weight, of high sensitivity, reasonably small current consumption, good selectivity and, last but not least, attractive to the eye—the last-mentioned attribute being of paramount importance to the female side of the family.

With the above in mind, no apologies are offered for once again presenting in this volume of the magazine a portable receiver of thoroughly proven worth, which is available not only in kit form, but which is also obtainable at a very reasonable cost indeed. The "Rambler" was designed and has been marketed specifically for the home constructor (see advertisements). It is supplied to the trade as a kit and is thus available from many of the regular advertisers in this magazine. Purchase of the complete kit of parts, therefore, does not entail any difficulty on the part of the intending constructor from this angle.

The "Rambler Circuit

This is shown in Fig. 1 from which it will be seen that it is a two waveband battery superhet with an internal frame aerial feeding into a L.W. loading coil, thus enabling a high performance to be obtained on both wavebands. The aerial, of course, is contained within the lift-up lid. Four valves are incorporated in the circuit: these are 1R5 as the frequency changer; 1T4 as the intermediate frequency amplifier; 1S5 as the detector, a.v.c. and first audio amplifier; and a 3V4 high sensitivity output beam tetrode. The 3V4 output tetrode has been selected in place of the more usual 3S4 type by virtue of the fact that it has increased power sensitivity and reduced harmonic distortion. The rated output power for the 3V4 is some 0.27 watts, this being adequate for most needs associated with a portable receiver of this type.

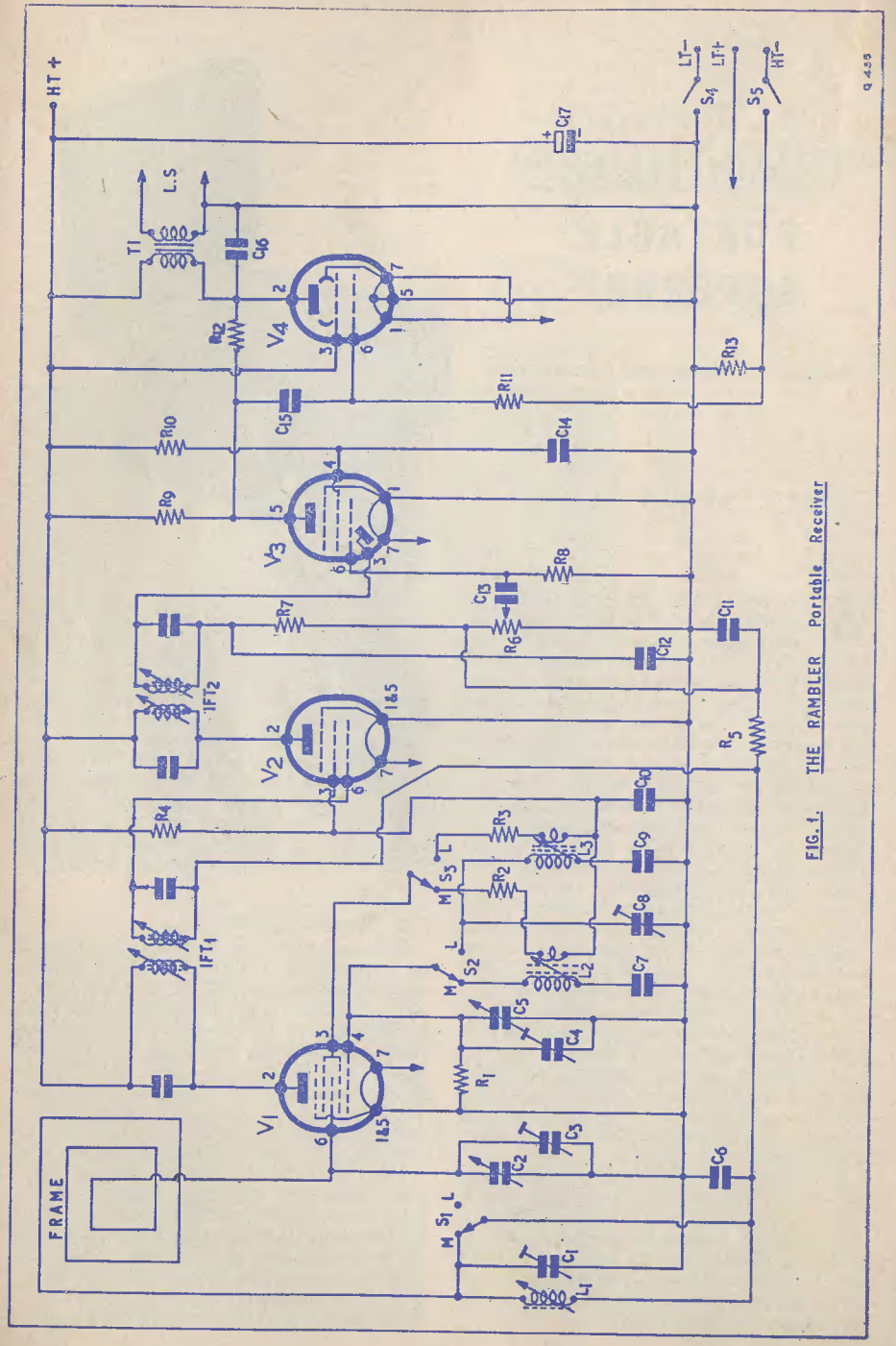


FIG. 1. THE RAMBLER Portable Receiver

Distortion has been very greatly reduced by the introduction of negative feedback into the circuit.

Automatic volume control (a.v.c.) is applied both to the 1R5 frequency changer and also to the 1T4 i.f. amplifier. The i.f. transformers, aerial and oscillator coils are all dust-cored tuned for maximum sensitivity. The i.f. transformers are all prealigned to 470 kc/s in order to simplify the lining-up process once the receiver has been completed. The lining-up details, both with and without a signal generator, are discussed later.

The output from the 3V4 tetrode is fed, via a suitable transformer, into a 5-in permanent magnet loudspeaker, this producing excellent tone and volume for a receiver of this type. Bias for the output stage is obtained via R_{13}. The negative feedback component is R_{12}. The numbers shown around each individual valve represent the actual pin numbers of the valveholders themselves.

Little else need be said about the circuit, it being perfectly straightforward, easy to follow and simple to construct. The receiver covers both the Medium and Long-wave bands—190 to 560 metres and 800 to 2,000 metres. The dial is engraved in both red (MW) and green (LW) and this, mounted on to the cream plastic top panel, imparts a very attractive appearance to the set. The cream and grey attache-case type cabinet, complete with cream plastic "spring-back" handle, measures only 9in × 7in × 5¾in. The weight of the receiver and cabinet, less batteries, is 4¾lb; complete with batteries it only weighs some 6¼lb. The cabinet is suitably protected by rubber feet both in the playing and the carrying position.

Assembly

Dealing with the assembly of the receiver, all the main components, except the panel and speaker, are fitted to the chassis in the first instance. The panel and speaker are left until construction has otherwise been completed. To commence the assembly, therefore, fit the four valveholders as shown in Fig. 2, using 6BA × ¾in screws. Note that the valveholders are fitted from the top side of the chassis and that 6BA solder tags should be fitted with each valveholder as shown in Fig. 4. Having completed this, next mount the i.f. transformers, ensuring that these are located correctly with regard to pin numbers as shown in Fig. 3. Use 6BA × ¼in screws to hold these i.f. transformers in position. Fix into position T_1, the output transformer, on to the chassis deck in the same position as that shown in Fig. 2. Note that two solder tags are required to be fitted with T_1, one tag below and one above the chassis (see Figs. 2 and 3). Secure the 6-way tag strip under the chassis as shown (Fig. 3).

Component List

R_1	100kΩ, ¼ watt
R_2	1.5kΩ, ¼ watt
R_3	2.2kΩ, ¼ watt
R_4	4.7kΩ, ¼ watt
R_5	4.7MΩ, ¼ watt
R_6	1MΩ pot
R_7	68kΩ, ¼ watt
R_8	10MΩ, ¼ watt
R_9	1MΩ, ¼ watt
R_{10}	4.7MΩ, ¼ watt
R_{11}	2.2MΩ, ¼ watt
R_{12}	5.6MΩ, ¼ watt
R_{13}	560Ω, ¼ watt
C_1	50pF trimmer
C_2	500pF, ganged, variable
C_3	50pF trimmer
C_4	50pF trimmer
C_5	500pF, ganged with C_2
C_6	0.01μF, paper
C_7	460pF, silver mica, 1%
C_8	50pF trimmer
C_9	150pF, silver mica, 2%
C_{10}	0.01μF, paper
C_{11}	100pF
C_{12}	100pF
C_{13}	0.01μF, paper
C_{14}	0.01μF, paper
C_{15}	0.01μF, paper
C_{16}	0.005μF, paper
C_{17}	8μF, 150V wkg., electrolytic
T_1	Output transformer
Valves	
V_1	1R5
V_2	1T4
V_3	1S5
V_4	3V4
S_1, S_2, S_3	Wavechange switch
S_4, S_5	On/off (R_6)
Coils	
QL1	L_1
QO8	L_2
QO9	L_3
IF transformers	470 kc/s
Frame aerial	150μH loop
Batteries Type B126	90V h.t.
AD35	5V l.t.
Speaker	5in
Cabinet, chassis and panel	

Mount C_8 under the chassis and C_1 above the chassis, both being held by the same 6BA × ¼in bolt, with a solder tag on the underside as shown in Fig. 3. Next affix both coils L_3 (QO9) and L_2 (QO8) under the chassis by means of 8BA × ¼in screws. Note the position of the slot in the tag rings from Fig. 3.

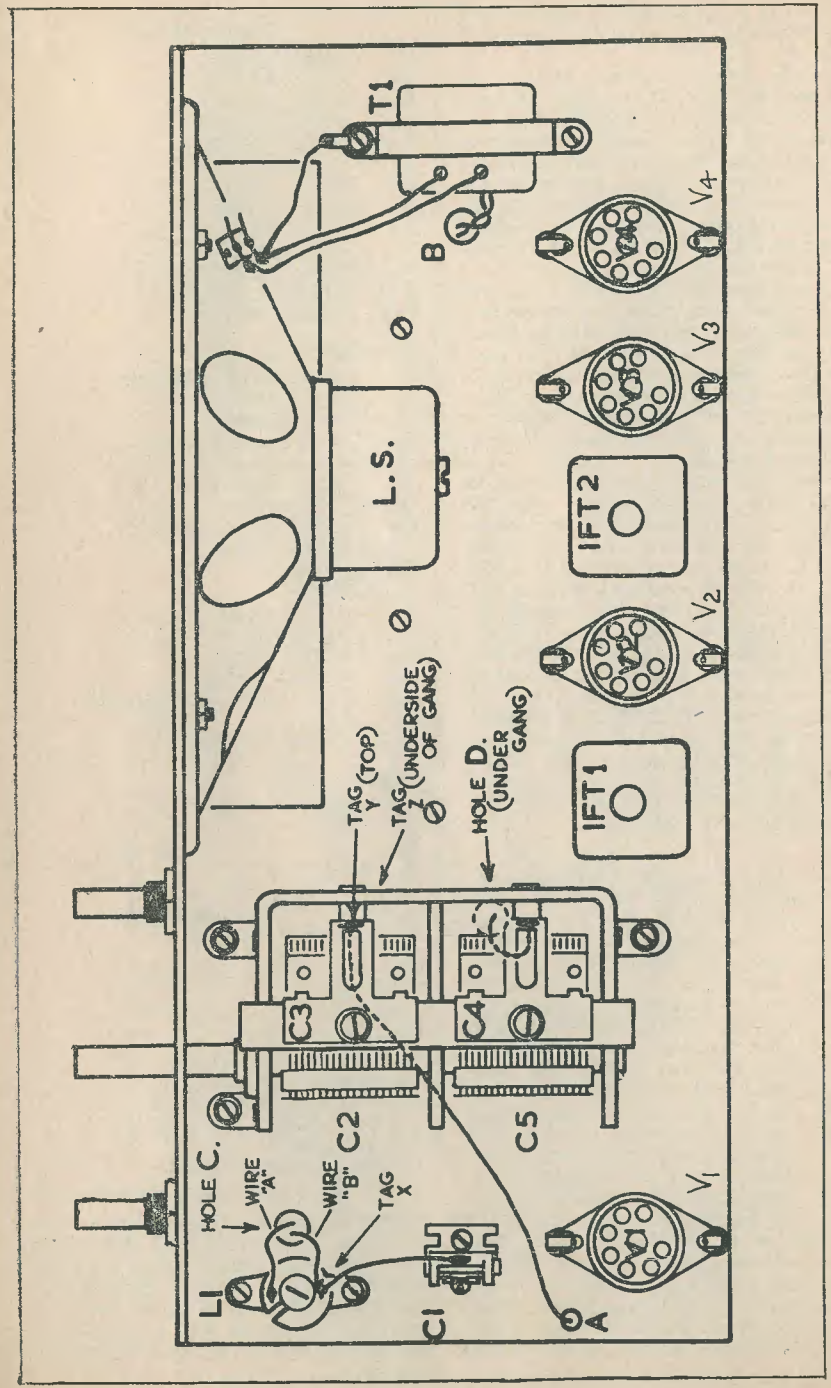


Fig. 2. "Above" chassis layout of components

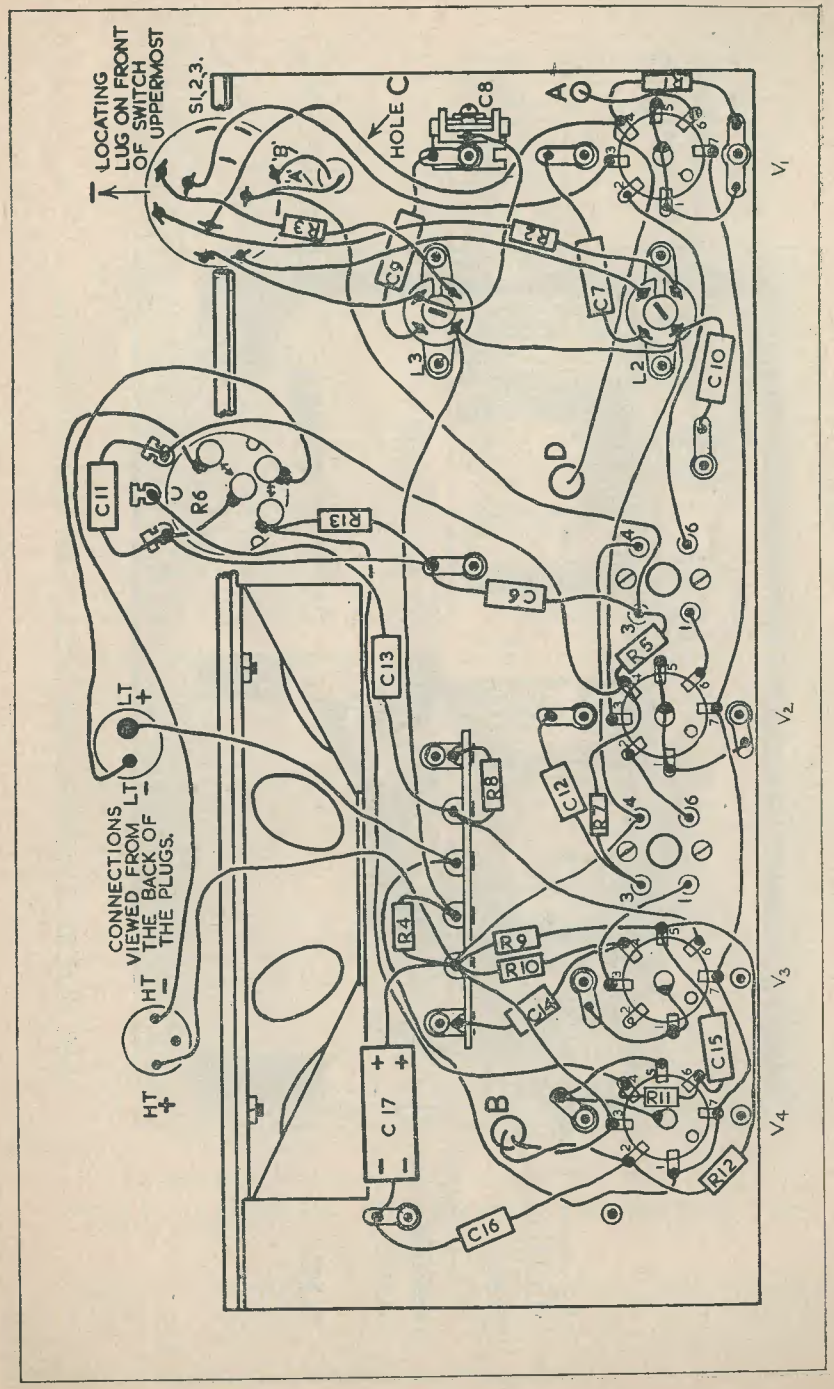
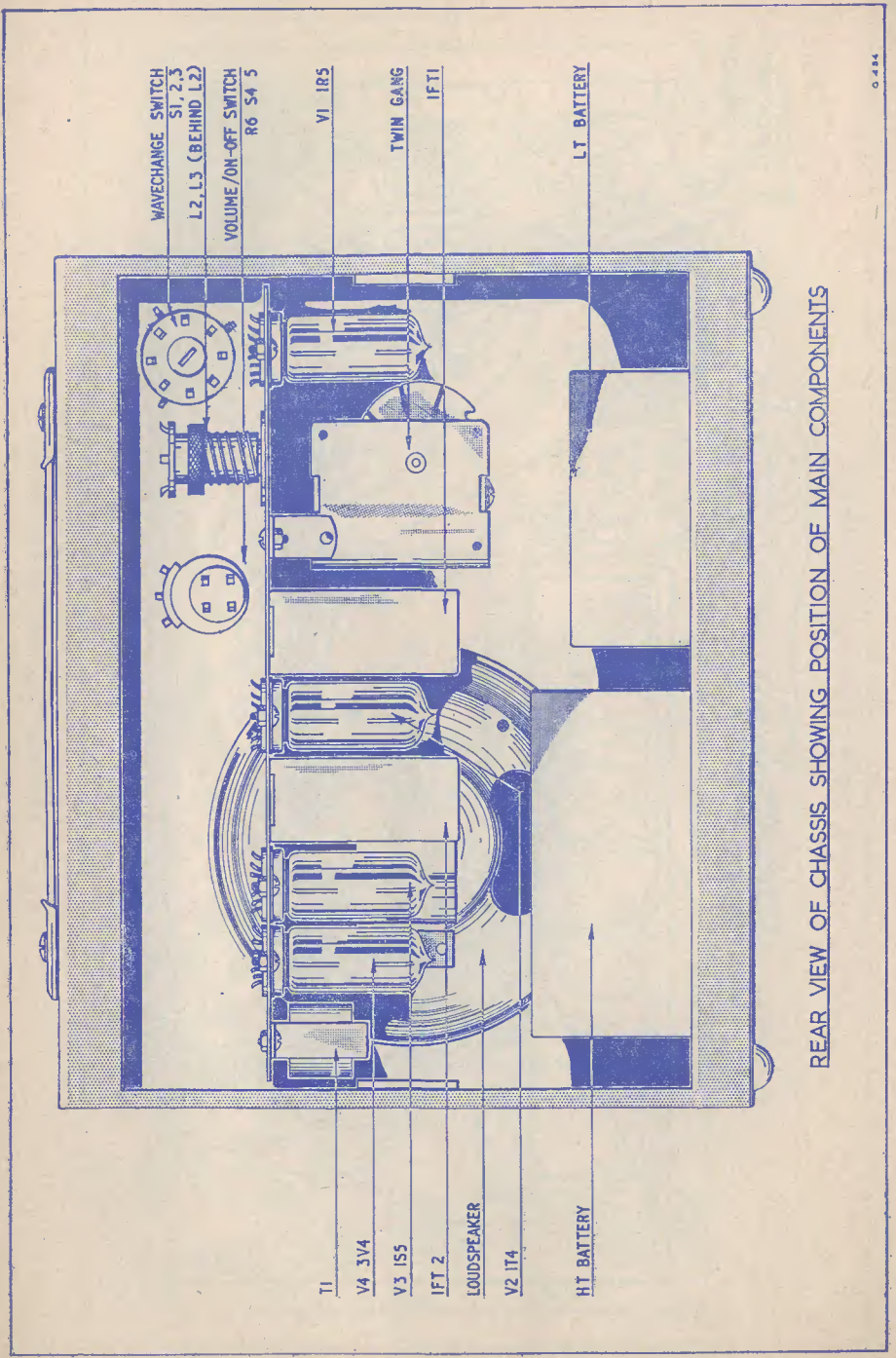


Fig. 3. "Underneath" of chassis layout and wiring



REAR VIEW OF CHASSIS SHOWING POSITION OF MAIN COMPONENTS

Having completed the above, it will now be necessary to fit the two-gang tuning condenser C_2, C_5, but before doing so it would be advisable to solder the two leads which go to the underside of the condensers into position, as this may be rather difficult once the component has been fitted into place (see Fig. 2). Fit the ganged condenser using 6BA × ¼in screws, using washers under the heads and a solder tag under the nut of the rear fixing bolt (see Fig. 3).

Next, fit R_6, the volume control, and the wavechange switch (S_1, S_2 and S_3) to the chassis; but do not tighten the nuts because the panel will have to be fitted under them at a later stage. Finally, mount L_1 (QL1), the loading coil, in the position shown above the chassis. This coil stands away from the chassis and is mounted on 8BA × ½in screws. Reference to Fig. 4 will make this clear. It has been found necessary to space this coil from the chassis deck because the "Q" of the coil would have been lowered had this been fixed in the more usual manner and this, in turn, would have resulted in an inferior performance to that obtainable when mounted as shown. With coils L_2 and L_3, this method of mounting is, of course, not necessary as these two coils are not themselves in the signal circuit.

With the assembly now completed except for the panel and speaker, the wiring-up process may be commenced. It is best to do this by commencing with the earthed connections; these are clearly shown, as are all other connections, in Figs. 2 and 3. It is a good plan to deal with these connections logically, commencing with the earthed wiring points of V_1 and continuing to V_4; and from there to other similar points of the circuit. The earthed solder tags are clearly shown and no difficulty should be experienced—even by the veriest beginner—with regard to these solder connections. Note that the centre spigots of each valveholder are contained within the earthed wiring plan. Having completed all of these points except, of course, that of the speaker which has not yet been mounted, proceed next with the valve heater chain. These connections are from the l.t. + pin of the battery plug (largest one), to the tag strip and from there to pins 1 and 7 of V_4, from there continuing to pin 7 of each valve in turn and ending at V_1.

The fitting of the resistors and capacitors may be in any order, the layout of these components not being unduly critical. In order to avoid confusion, however, it would be best for beginners to solder into position those components contained around each valveholder, commencing with V_1, and marking out with ink on Fig. 3 each item as it is soldered into position. In this way, the wiring-up process is considerably simplified for the novice.

Note the leads that go through the chassis via hole C; these have been marked "A" and "B" in order to avoid confusion (see Figs. 2 and 3). The leads from the tuning condenser, previously soldered into position before mounting the component, go via holes A and D respectively. The correct polarity of the condenser C_{17} should be noted when soldering this into position. The leads that go via hole B are from the underside of T_1.

Careful attention to Fig. 3 will ensure that no possible mistake is made with respect to the wiring up of the circuit; the drawing is self-explanatory and no further textual guidance is therefore required.

Fitting the Speaker and Panel

Mount the speaker to the back of the panel, using 6BA × ¼in screws for the purpose. Ensure when mounting the speaker that the tag connections of this are on the same side of the chassis as T_1. Remove the nuts from the volume control and the wavechange switch, fit the panel and refit the nuts, taking care to tighten these with due regard for the plastic panel. Make sure, at the same time, that the small 6BA clearance hole towards the opposite bottom edge aligns perfectly with the small hole in the chassis. Next fit a 6BA × ¼in screw through this hole and lock the nut on the inside, thereby fixing the front panel firmly to the chassis. Having proceeded thus far, fit the plastic cursor and the two knobs to the other controls.

Fitting the Frame Aerial

Remove the inset to the cabinet lid by unscrewing the four corner screws. Fit the frame aerial with about 6 inches of lead left for connecting to tag "X" and "Y" indicated in Fig. 2. Four wood screws are provided for holding the completed receiver in the cabinet.

(*To be continued*)

TELEVISION for the HOME CONSTRUCTOR

(*continued from page 680*)

The sample which Mr. Wilkinson has sent along is known as "Polyfoil Wrap" and consists of a pure aluminium foil. Its original intention is that of providing an airtight and moisture-proof wrapping for foodstuffs, but it would also prove ideal for cabinet screening and similar purposes. Connection to the screening should, of course, be made with the aid of a wood screw and metal washer, or solder tag.

Technical Forum

Stage Gain

CONSTRUCTORS WILL, NO DOUBT, HAVE met the feeling that after many weeks, and possibly months, of constructional effort the performance of the finished equipment does not quite come up to expectations. Whilst it must be conceded that in some instances the gear is, in fact, giving of its best, there are many occasions when the performance is just not quite so good as it could be. Unfortunately this is usually not an easy matter to correct, because to squeeze the best from a receiver often calls for fairly expensive equipment which the average constructor is unlikely to possess. It is the purpose of this article to assist in such cases, in demonstrating a relatively simple method by which a good approximation can be made of the gain of both individual stages in a receiver, and its overall gain. The information will also be useful to the less fortunate constructors who are at a loss to explain the almost complete lack of sensitivity of a set.

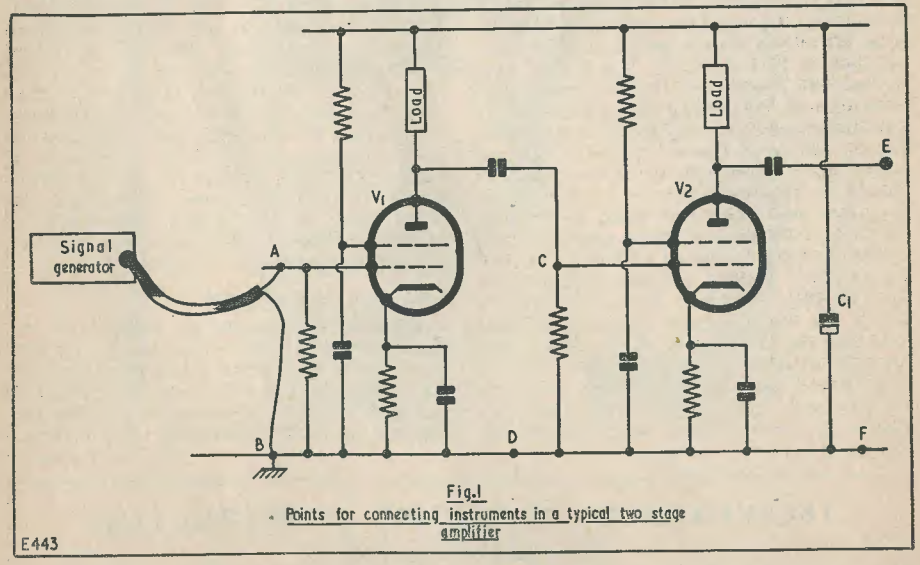


Fig.1
Points for connecting instruments in a typical two stage amplifier

To obtain a reasonably accurate indication of stage gain, two simple pieces of test gear are required. The first is a valve voltmeter, and the second is a source of signal. This latter may be eliminated if the signal can be obtained from a local transmitter, but in this case tests must be made during periods when the carrier is being radiated without any modulation, or when the modulation consists of a single tone such as is used during test transmissions. On the other hand, the simplest type of oscillator may be used as a signal source, and one can frequently be made from parts found in the junk box. The same could very nearly be said for the valve voltmeter, and many suitable designs for both these pieces of test gear have appeared in our pages during the past few years. However, it is not the equipment we are concerned with here, but the method in which it is used.

Making Measurements

When making gain measurements there is one golden rule which must not be overlooked whatever happens. It is that in connecting up the voltmeter and signal generator to the receiver, its operating conditions must in no way be changed. In making this point let us refer to the two-stage amplifier circuit shown in Fig. 1: blocks have been used to indicate the anode loads so that the diagram can serve equally well for either resistive or tuned circuit coupling.

Commencing with the example of an R–C coupled audio amplifier, the gain is given by the formula:

$$\text{Voltage gain} = \frac{\mu R}{R + r_a}$$

where R is the value of the load resistor, μ the amplification factor of the valve and "r_a" its internal impedance.

Now, to actually check the gain we must feed a signal of known amplitude into the grid circuit of one stage and measure the resultant a.c. voltage across the load resistor. The importance of ensuring that the voltmeter does not shunt the load and reduce its effective value should now be more obvious, as any reduction will also reduce the gain and lead to a false measurement.

The value of R will seldom exceed 200kΩ in mains receivers, and to give a reasonable accuracy the input impedance of the voltmeter should be at least ten times this value, that is 2MΩ. A value in excess of this would be desirable and, in fact, essential where really accurate results are required.

To measure the gain of V_2, connect the signal source across the input of V_1 and the voltmeter across the input of V_2 (C–D). Adjust the signal voltage until the meter reads between 0.25V and 0.5V. Then transfer the meter to the output of V_2 (EF) and take the reading. The stage gain is then obtained by dividing the output voltage by the input voltage. Note that the voltmeter need not be connected directly across the load, and is usually joined between anode and chassis (E–F). This is permissible because from the a.c. point of view the h.t. line is at earth potential because it is decoupled by C_1.

When making measurements at audio frequency, a signal between 400 and 1,000 c/s is usually selected.

The gain of the first stage V_1 is measured in the same fashion, but if feedback is applied to the grid circuit, care must be taken that it is not shorted by the signal generator. This will only occur if the generator has an output impedance of less than 47kΩ; and if this is the case, a series resistor of about this value should be included in the lead from the generator to the grid of V_1. This is another case where it is important to ensure in connecting the measuring equipment to the amplifier that its operating conditions are not disturbed.

We turn now to the precautions which are necessary when making gain measurements at radio frequencies, such as in the r.f. and i.f. stages of a superhet. Here it is advisable not to connect the voltmeter through fairly long leads directly to the receiver under test, but to use a diode probe.

This is an accessory fitted to most valve voltmeters which serves to reduce the input capacitance of the instrument. The probe contains an h.f. diode which rectifies the signal so that the resulting d.c. may be fed through longish leads to the main instrument.

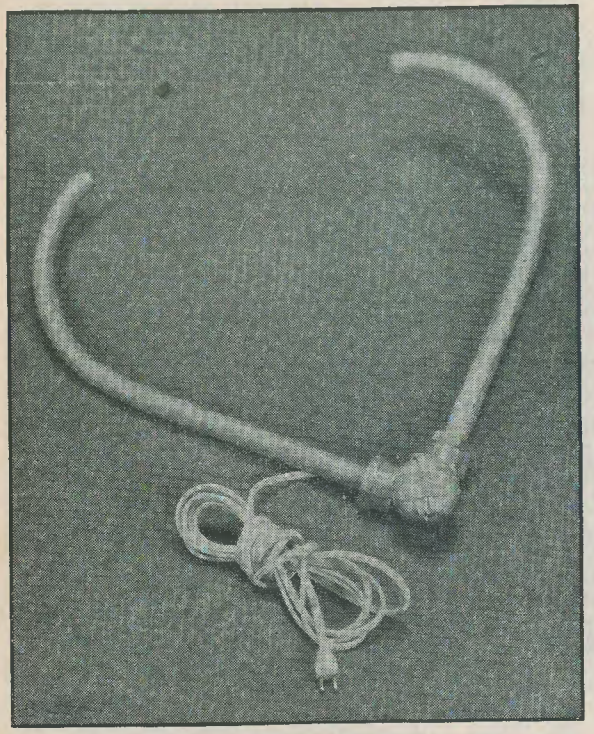
Without the probe, r.f. current would flow in the leads and might easily cause instability, and would most certainly detune the anode circuit of the valve under measurement.

Referring back to Fig. 1, the gain of V_2 may be measured in the manner already described, but the signal source must be carefully tuned to the same frequency as that of the load circuit. This is simply achieved by adjusting the frequency of the generator until the maximum reading is obtained on the valve voltmeter. When working on r.f. or i.f. stages it is always advisable to feed the signal into the grid of the valve preceding that under measurement. This avoids the possibility of the generator damping the grid circuit, which at the higher frequency can substantially alter the working conditions. It is, therefore advisable to commence with the last i.f. stage and work back to the first r.f. stage, measuring the gain of each in turn. Having completed this series of measurements, it will be apparent if any stage is not contributing its maximum performance.

The following table has been compiled as a guide to the gain figures which should be obtained from the various types of amplifier stages.

Type of Amplifier Stage	*Voltage Gain* (times)	*Voltage Gain* (*db*)
R–C coupled Audio Triode:		
Medium μ	30	30
High μ	70	37
Audio Pentode..	100–180	40–45
Transformer coupled i.f. stage (470 kc/s)	220	47
Transformer coupled i.f. stage (10.7 Mc/s)	50	34
Transformer coupled i.f. stage (wide band 19 Mc/s) ..	25	28
Transformer coupled i.f. stage (wide band 34 Mc/s) ..	20	26
Frequency changer (Medium wave)	50	34
RF stage (Medium wave)	150	43.5

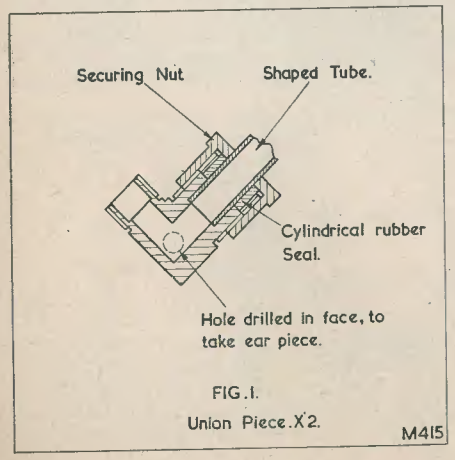
(*continued on page* 693)



Headset for Miniature Radio Receivers

by **B. L. WILKINSON**

DOUBTLESS THE EXPERIMENTER WHO builds himself a miniature radio receiver will suffer disappointment when he discovers that a normal pair of headphones is many times the size of the set itself. The use of a single earphone is not recommended on the grounds that as only one ear is receiving the output from the set, the lack of hearing balance is mildly uncomfortable. Also, a single earphone, if it is of the normal size, is somewhat bulky.



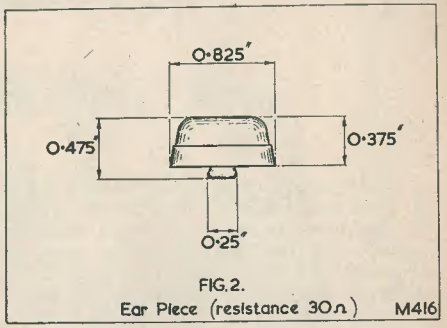
There are available, for a very reasonable price, deaf-aid earpieces from various shops. Fig. 2 shows the dimensions of the earpieces, one of which can be used to make, quite simply, a very light weight, comfortable and efficient stethescope earpiece. As can be seen from the photograph, the action of the unit is straightforward. The output from the receiver is converted into sound by the crystal earpiece. From then the system resembles closely a doctor's stethescope, the sound waves travelling up the two tubes to the ears. Fig. 1 shows the general construction of the union piece which forms more or less the frame of the system. Before proceeding further, it would be well to state that although dimensions given, and materials referred to, are straightforward to work with, there is no reason why the reader should limit himself to the author's design. It is possible, even probable, that more suitable union pieces can be found with which a superior headset can be produced. This work, then, is intended more as a guide, than a set of definite, cut-and-dried instructions.

The system consists essentially of the following components:—

(*a*) Earpiece and lead
(*b*) Union piece
(*c*) Shaped tubes.

Enough has already been mentioned concerning item (*a*). Dimensions (Fig. 2) are accurate and can be used when making the union piece. This latter component is best made from a small right-angled union intended to link 0.3in (outside diameter) tube. A suitable hole drilled in the face will take the earpiece as a press-fit. Fig. 1 shows the union piece of the author's headset. It has the disadvantage that being in one piece, and the tubes being rigid, putting the headset on could be painful. However, this aspect is simply overcome by loosening slightly one securing nut, and swivelling the respective tube through a small angle. The headset will now pass easily over the head, whence the displaced tube can be tightened in its original position.

The photograph shows clearly the shape of the tubes leading to the ears. Here, of course, dimensions depend upon the individual, but all headsets of this nature, regardless of their dimensions, should fulfil the following requirements. They should fit comfortably into the ears, the actual ends of the tubing being rounded slightly to avoid chafing the skin. They should hang so that the distance between the chin and the union is approximately one and a half to two inches. They should be as light as is possible. This latter requirement is, of course, dependent upon the material used in construction. Aluminium or its alloys are admirable materials. If, however, aluminium or alloy tubing is not available, perspex or glass tubing can be used. The perspex tubing can be shaped after immersion in hot water, while glass requires to be heated considerably (here a gas-ring is important). As to tube size, one-quarter inch internal diameter is admirable. Whereas with the normal type of headset the clamping action of the band soon produces discomfort, the stethescope type can be worn for much longer periods without the slightest inconvenience.



Technical Forum

(*continued from page* 691)

The 10.7 Mc/s i.f. value has been included to cover f.m. receivers, whilst the two wide-band conditions refer to the intermediate frequency stage of t.v. receivers. The gain of a frequency changer stage is measured in the same fashion as that of an i.f. circuit, except that the input is at signal frequency, usually 1 Mc/s, for a m.w. receiver, and the output is measured at the intermediate frequency (usually 470 kc/s). The i.f. transformer, if correctly tuned, will in fact select this frequency in the anode circuit, so that it will represent the greater part of the voltage appearing at the anode.

In conclusion, it is worth noting that the overall gain of two or more stages may be obtained by multiplying together their individual gains. Thus, two stages each with an amplification of 20 times will together give 400 times.

Scottish Radio Show

The Scottish Radio and Television Exhibition will be held at Kelvin Hall, Glasgow, from May 22 to June 1, 1957.

The exhibition will be the first to be organised by the radio manufacturers since television began in Scotland and will precede by a few months the opening of the first Scottish commercial television station.

All the leading manufacturers of radio and television receivers and sound reproduction equipment are expected to exhibit. Exhibitors will also include wholesalers (or factors), and it is expected that the B.B.C. and Independent Television will participate.

The only previous exhibitions held in Scotland by the radio manufacturers were at Kelvin Hall in 1933, 1934 and 1935. The Scottish Radio Retailers' Association, however, have organised two very successful exhibitions since the war at St. Andrew's Hall, Glasgow.

A GENERAL PURPOSE OSCILLOSCOPE

by W. E. WOODHEAD

IN PAST ISSUES OF THIS MAGAZINE THERE HAVE been published a number of articles describing the construction and use of the cathode ray oscilloscope, and it must be admitted that the subject has had its full share of space in this and other periodicals.

In submitting the present instrument, however, it was thought that the comparative simplicity, together with the compact design, would appeal to those readers who had contemplated the building of an oscilloscope but who had not done so, on the grounds that most designs had either only the bare essentials or else were too complex.

This instrument is for general purpose use, and in the writer's opinion serves that purpose to good effect.

Waveform analysis, frequency comparison, receiver alignment and an indicator with high impedance input are some of the uses to which the instrument may be put.

The diagram of the chassis and layout are self-explanatory and, as it is assumed that most constructors have a working knowledge of metalwork, no detailed description of this part of the job is given.

The main frame consists of ¼-in square steel bar bent to the required shape and supported at the ends by the front and rear panels. The front panel holds all the main controls and terminals, while the rear panel is plain with the exception of a ⅜-in rubber grommet through which the mains lead passes.

All components, apart from those on the front panel, are situated on both sides of a platform which passes down the centre of the main frame. The platform also holds the main double-sided tag panel and rear support for the c.r.t. The outer casing consists of aluminium panels, with ventilation louvres in the top section and circular holes in the bottom section to permit the entry of cool air.

The side panels are screwed to the main frame, and the top and bottom panels are fixed to the side panels. This fabrication of the case was considered easier to construct than a one-piece box.

Designation of the front panel terminals and controls can be made with Panel Sign Wording No. 3.

H.T., E.H.T., and Tube Network

The h.t. and e.h.t. supplies are all provided by a standard transformer modified to suit the requirements of the instrument. The writer was fortunate to have in the spares box a transformer of the older type which possessed a bobbin with side cheeks and a 350–0–350V h.t. secondary. The next job was to strip the heaters and h.t. secondary from the bobbin, care being taken to ascertain the number of turns-per-volt of the heater windings, as a basis for the calculations needed for the modified h.t. and heater windings.

The primary winding was checked and found to be satisfactory, so a start was made on the h.t. secondary. This was wound with S.S.E. wire two gauges smaller than the original, as the loading was lower, and the single silk covering disposed of the need for interleaving. As the total over-all voltage of the winding (300–0–300–400) was the same as the old one, it occupied approximately the same space, and left plenty of room for the three new heater windings required. Reference to the power pack schematic will give details of the loadings to provide for.

Winding A, Tube Heater, 4.0 volts, 1 amp, 22 s.w.g. S.S.E.

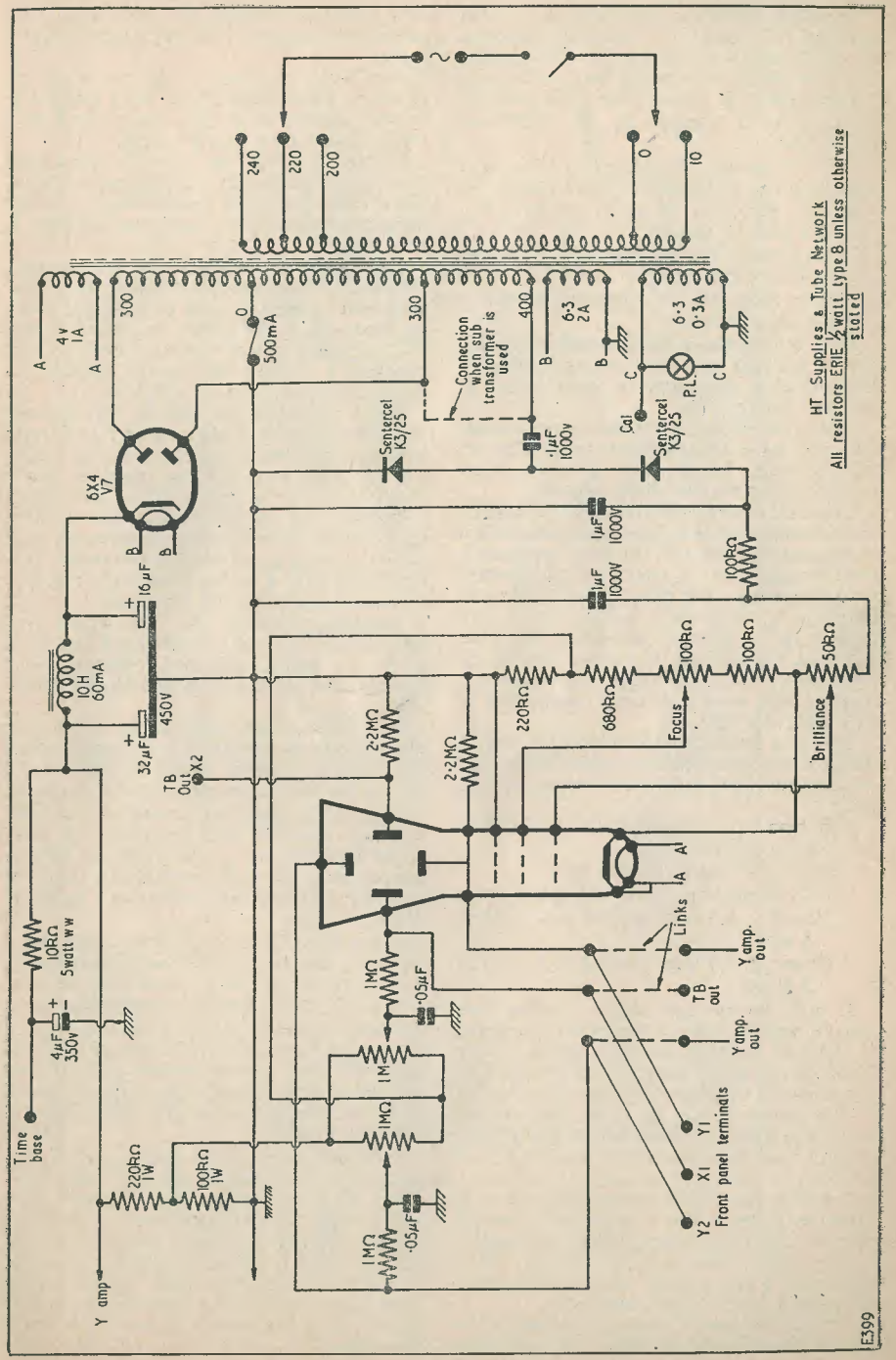
Winding B, Valve and Rectifier Heaters, 6.3 volts, 2 amps, 20 s.w.g. S.S.E.

Winding C, Pilot Lamp and Calibration, 6.3 volts, 0.3 amps, 28 s.w.g. S.S.E.

The rectifier used is a miniature 6X4, the cathode-heater insulation of which is high enough to enable it to be used on the winding supplying the other valves.

The pilot lamp winding also serves the purpose of supplying a calibration voltage, which is brought out to a terminal on the front panel.

For those constructors who would prefer to wind a transformer complete and have the facilities to do so, the necessary details and winding data are given.



The first materials required are a 1¼in stack of "T" and "U" Silcor laminations No. 475A, and a bobbin to suit. When these have been obtained, winding may commence.

The primary is wound with 1,490 turns of 30 s.w.g. with tappings at 60, 1,250 and 1,370 turns.

H.T. Secondary: 4,430 turns of 36 s.w.g. with tappings at 1,900 and 3,800 turns.

Heater Secy. (1) 40 turns of 20 s.w.g. (6.3 volts, 2 amps).

Heater Secy. (2) 40 turns of 22 s.w.g. (6.3 volts, 0.3 amps).

Heater Secy. (3) 26 turns of 22 s.w.g. (4.0 volts, 1 amp).

Wire used is single silk-covered enamelled copper with no layer interleaving insulation. Inter-winding insulation is three layers of 0.010in Empire cloth.

It is possible that a number of enthusiasts will not have the facilities to modify an existing mains transformer, or wind a new component to the specification given.

There are others who do not feel capable, or who consider that they have not had sufficient experience, to cope with the work involved in modifying or winding their own transformer.

Constructors, therefore, who desire to purchase a ready-made article which will provide a satisfactory substitute for that specified, are advised to contact Messrs. H. Ashworth, 676 Gt. Horton Road, Bradford 7, Yorks., who have a suitable component in their advertised list.

This is a half-shrouded job which will fit into the space provided on the chassis, and requires no alteration before being put into use.

The type no. is HS30, and it is to the following specification:

Normal Primary 200–250 volts.

H.T. Secondary 300–0–300 volts.

Heater 1, 6.3 volts tapped at 4 volts at 4 amps.

Heater 2, 5.0 volts tapped at 4 volts at 2 amps.

It will be noticed that in using this transformer the half h.t. secondary connected in the e.h.t. voltage-doubling circuit is only 300 volts instead of the 400 volts provided by the extended winding on the specified design.

This will result in a fall in the final voltage applied to the c.r.t. anode, which will, in turn, slightly alter the operating characteristics of the tube.

It will be found that the spot size, when in optimum focus, will be enlarged, and that the overall maximum brilliance will be diminished.

One point, however, in favour of a decreased e.h.t. supply is the subsequent increase in the deflection sensitivity.

The 6.3 volt heater winding supplies all the valves, including the rectifier. In the absence of a separate winding the pilot lamp and calibration voltage are also supplied from this source.

The 4-volt tapping on the 5-volt heater winding, which normally is used to feed a rectifier heater, is in this case pressed into service as the c.r.t. heater supply.

Finally, it should be borne in mind that this transformer is only a substitute, and some slight deterioration in performance is to be expected if the original design specification is not used.

The 6X4 is employed in a full-wave circuit, and smoothing is effected by a conventional condenser input filter which needs no comment. The supply is passed to the "Y" amplifier direct, but the timebase rail contains a further decoupling network to drop the voltage to a suitable level.

E.h.t. current is supplied by the 400-volt extended winding on the mains transformer in conjunction with a voltage doubling circuit. The rectifiers used are the selenium pencil type and are "Sentercel" K3/25's. Smoothing is provided by an RC combination suitable for high voltage-low current supplies, the final potential being approximately 800 volts. This was found to give sufficient brilliance together with adequate deflection sensitivity.

The tube diameter is 2 in, which was considered to be not only the ideal size for a scope but easy to obtained from ex-service sources, and modest in its operating requirements.

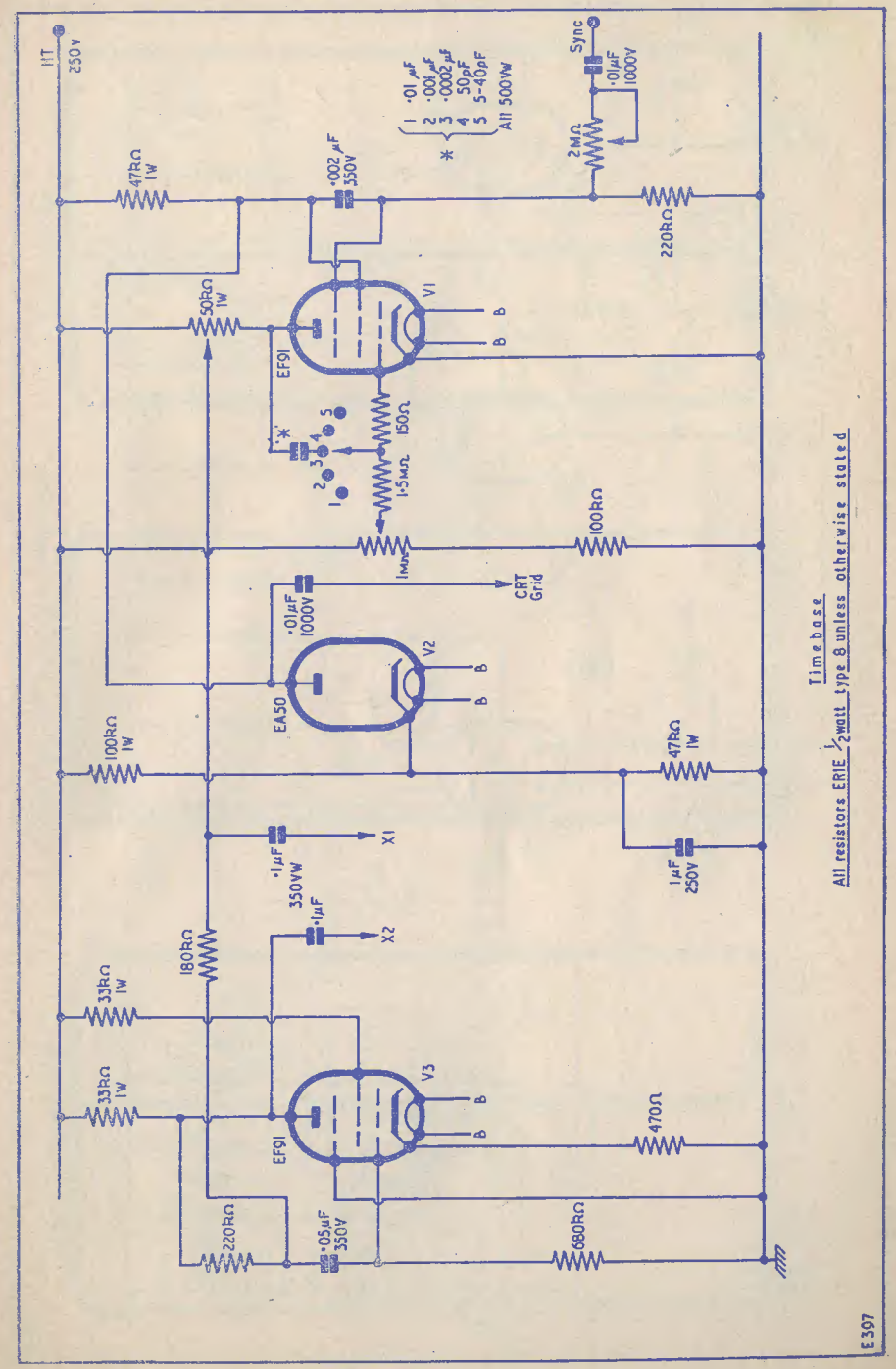
It should be mentioned at this point that when a tube is purchased it is essential that the mumetal screen, which in most cases covers the tube, is bought at the same time.

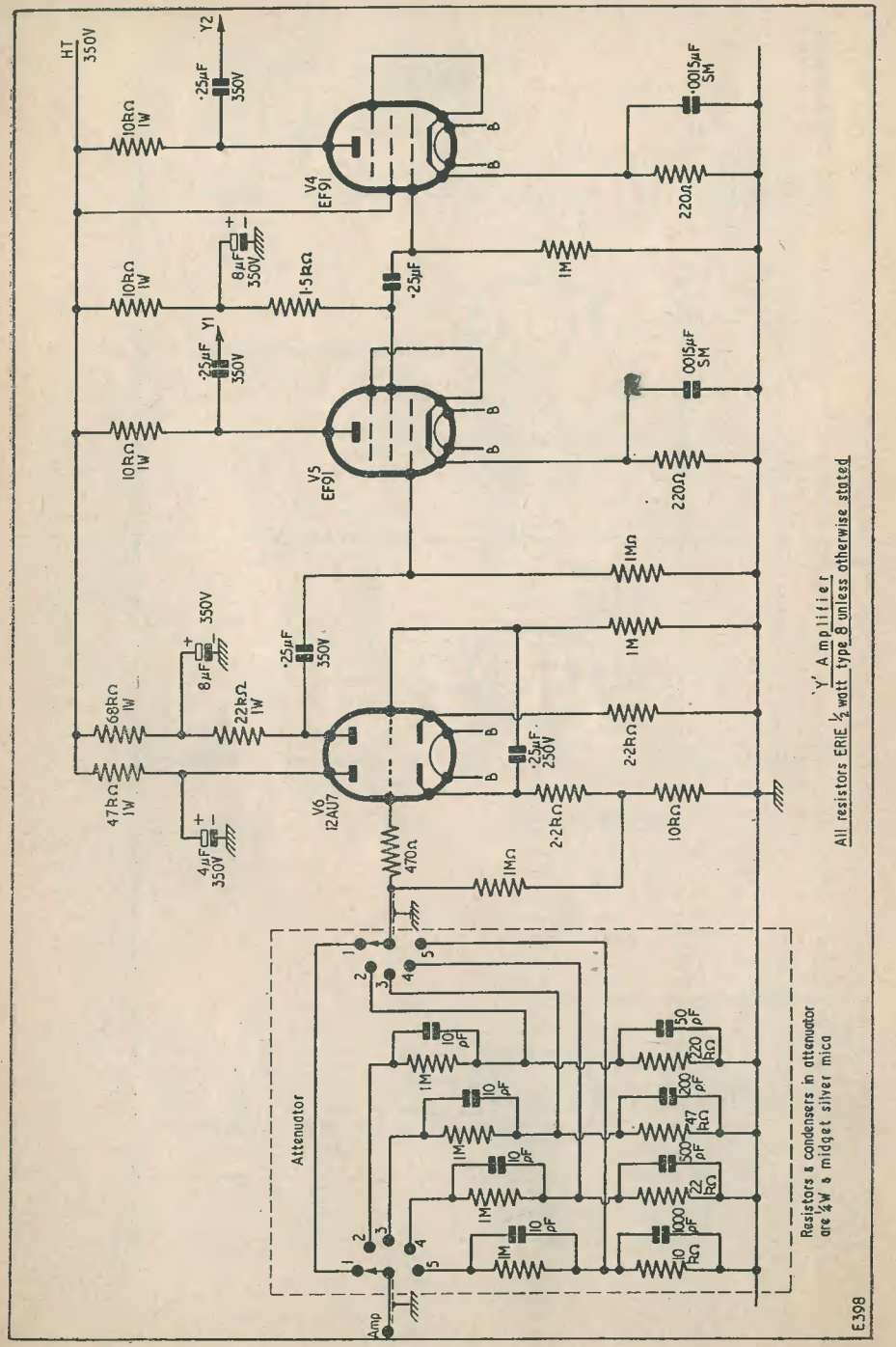
Due to the compact nature of the construction and the close proximity of iron-cored components to the tube, it will be impossible to avoid the undesirable effects of external magnetic fields unless this screen is fitted.

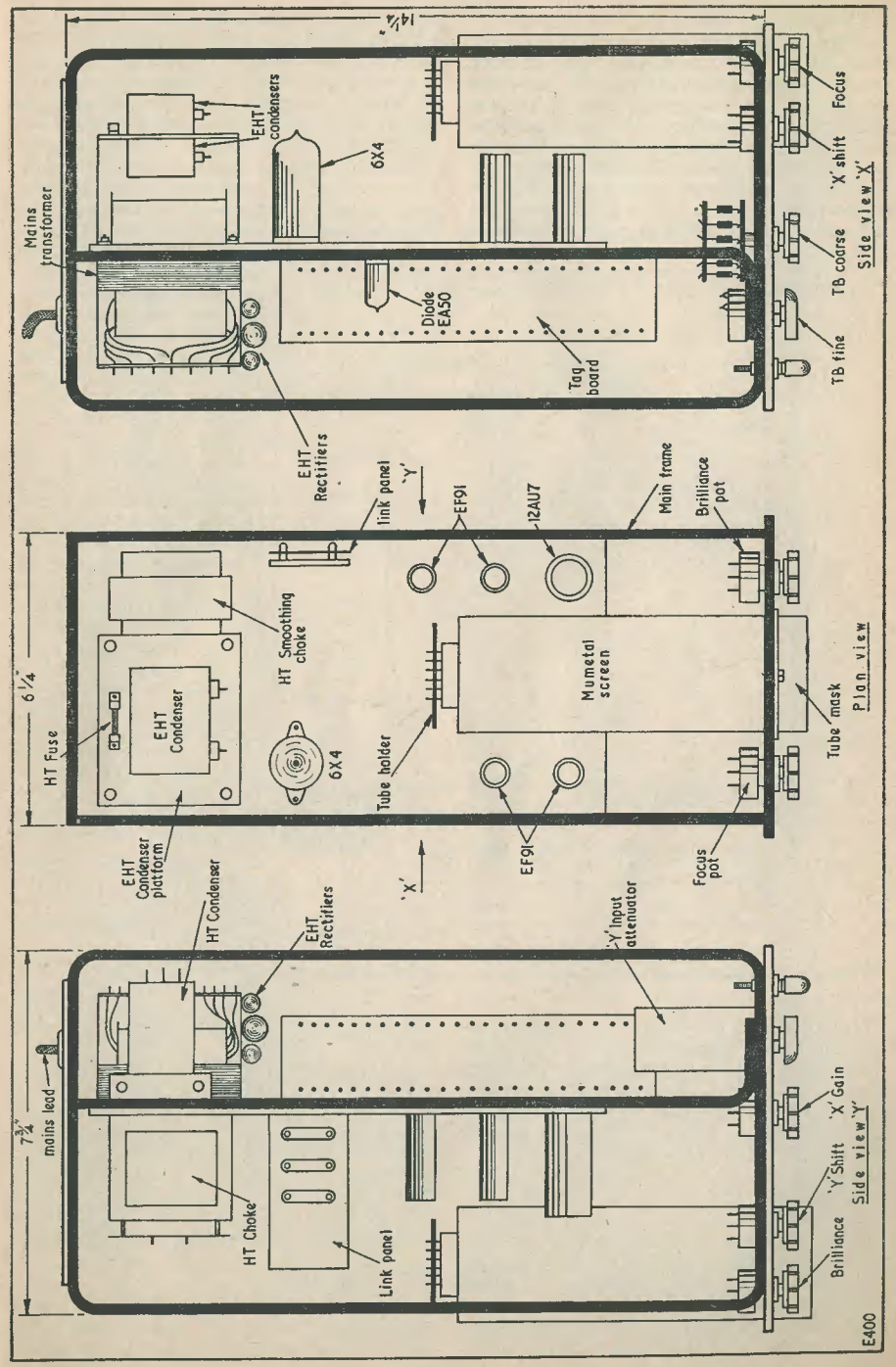
The normal "X" and "Y" shift controls are included, the d.c. voltages being supplied by a network across the h.t. and e.h.t. sources.

It should be noted that extra insulation in the form of paxolin bushes is provided on the front panel for the spindle bushes of the focus and brilliance potentiometers. This precaution was considered necessary in view of these components being at a high negative potential to earth.

Provision is made to enable direct connection to be made to the "X" and "Y" plates by removing the links situated on a small panel on the right-hand side of the chassis. When the links are in position, amplifier and timebase outputs are available on the front panel terminals. Access to the links is provided by an opening in the side panel which is normally closed by a small cover plate.

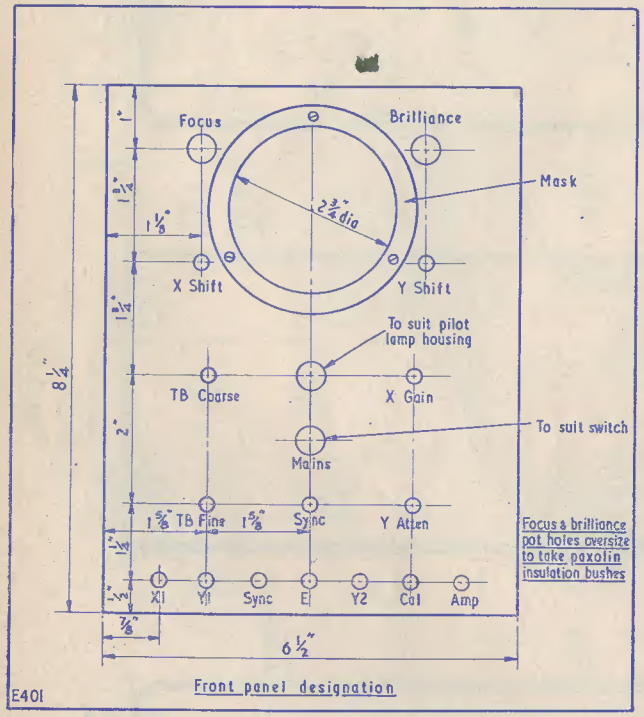






Timebase

After a considerable amount of work involved in the construction and trial of various timebase circuits, that due to Miller was finally decided upon. This is a combination of a transitron oscillator and the Miller integrator, which gives good linearity with ample amplitude. To obviate deflection defocusing and other forms of distortion which are possible with a single-ended deflection system, use was made of a push-pull arrangement.



The output of oscillator V_1, in addition to feeding the X_1 plate, also supplies a signal to V_3 working as a floating paraphase amplifier. Due, however, to heavy feedback the gain at this stage is approximately unity, and the sawtooth voltage fed to the X_2 plate is an equal but inverted version of that given by V_1.

Against the many advantages which this timebase has for the home constructor, there are two faults which are inherent in the design. The first is an increasing amplitude, for a given anode load, as the frequency is increased, and the second is that at the highest scan speeds the flyback time is rather slow.

In the first case, a 50kΩ wire-wound potentiometer was used as a variable anode load, thus enabling the scan length to be adjusted when the coarse timebase selection had been made.

The second defect is taken care of by a circuit involving the diode V_2, which suppresses the tube beam current during the flyback period.

During the linear sweep of the tube beam, the screen of V_1 is positive going, but the positive level is determined and clamped by the voltage on the cathode of diode V_2. This has the effect of squaring the positive pulse which, when applied to the c.r.t. grid, uniformly brightens the trace during the scan period. During the flyback portion of the cycle the screen of V_1 goes negative, which cuts off the diode and the c.r.t. beam current.

The brightening and blanking pulse is, of course, superimposed on the level selected by the brilliance control on the front panel.

It is essential during the scan period at the higher frequencies that the waveform under examination should remain stationary on the screen. This is achieved by applying a fraction of the work voltage to the suppressor grid of V_1, which effectively locks the picture in position. The voltage is taken from the Y_1 terminal and fed into the sync terminal on the front panel. The amount of sync signal fed back is controlled by the variable potentiometer provided.

Care must be taken that only sufficient voltage is applied to just lock the timebase, as excessive sync signal will distort the trace.

No trouble was experienced in getting this circuit to work satisfactorily over a range of 12 c/s to 50 kc/s. It is not quite linear at the lowest frequency, but the defect was so slight that it was not worth while doing anything to correct it. The six-way "Coarse" timebase switch selects any of the five ranges required; and the sixth position earths the oscillator grid, thereby rendering the circuit inoperative.

"Y" Amplifier

The "Y" Amplifier was designed to give sufficient gain together with a reasonable frequency response. It is a.c. coupled throughout, and large capacitors are provided to give minimum phase shift. The signal input is fed into a frequency compensated attenuation network which has four steps providing approximate divisions of 5, 25, 50 and 100. The first switch position provides a straight-through connection to the grid of V_6, so that altogether a wide range of input voltages are catered for.

The switch is a miniature ceramic type, which is encased with the necessary condensers and resistors in a copper screening can.

The first stage is one-half of a double triode connected as a cathode follower, with its characteristic high input impedance and level frequency response. The low impedance output is fed into the other half of the valve, which is operated as a low gain amplifier.

The output of this double valve stage is fed into a fairly high gain push-pull paraphase amplifier which has a frequency response substantially linear up to 2 Mc/s, and a useful gain at higher frequencies.

This amplifier has been used in the observation of waveforms associated with television work and has proved entirely satisfactory. A trace of two complete line signals taken at the anode of a video amplifier shows the changing picture intelligence and a remarkably clear and square sync pulse. It is clear, therefore, that the completed oscilloscope will cater for most of the needs of serious experimenters.

In conclusion, it is hoped that the construction of this instrument will give a great deal of pleasure, and that substantial benefit will be gained when it is put to use.

Radio Miscellany

continued from page 682

ago with a home-made wooden camera fitted with a shutter operated by a piece of elastic. The print, reproduced here, is of course on daylight paper, and after fifty years still shows little sign of fading.

He says his most vivid recollection of the early days of broadcasting is the hunking of accumulators backwards and forwards to the charging station—and when getting them home finding they didn't last more than an hour. Can you wonder that most Veterans regard the introduction of the dull emitter valve as the most revolutionary thing that ever happened in the history of radio?

I know we have quite a number of Veterans among our regular readers. Is Mr. Brewer, with his sixty years, the most senior?

Points from Letters

Quite a number of Jason constructors, both Local and Fringe Area models, have written enthusiastic letters, some even suggesting that this column could well find space for follow-up news, possible modifications and suitable amplifiers! A couple of them who ran into trouble praised the Jason Motor & Electronic Co. for alignment assistance, and were delighted to see it done by C.R.T.

Mr. A. J. Felstead of Maidenhead, another pre-1914-er who started off in 1912 by helping an uncle with a coherer, but has allowed his interest to lapse at intervals since, and others, ask about amplifiers. I have suggested that as a matter of interesting experience they could well try using battery bias (instead of auto-bias) on their single-ended output stages. Others, too, might like to try this idea. They will be pleasantly surprised at the increase in undistorted output which they will obtain.

In consequence of readers' experiences regarding the excellent quality (and lack of availability in certain areas) of Radiospares components, Mr. H. G. Brown of 39 King Richards Road, Leicester, points out that his current catalogue, which he will be pleased to supply upon request, lists over 50% of their very wide range of products.

Mr. J. Ireland of Nantwich, Cheshire, says he is disgusted with my thoughtlessness and selfishness in wanting fewer t.v. hours in order that the standard of programmes might be improved. It is the first time a correspondent has ever said it, but he says he is not a regular reader, a fact which I might have deduced since he calls our magazine Radio Construction. He says 24 hours a day transmissions *could* be very welcome, for the benefit of those who are unable to view during conventional hours. I am unrepentant and still think stale ideas and programmes to which the vision adds little or nothing would be better reserved for steam radio, and the money thus saved given over to improving the main programmes. As no-one else wrote either for or against this point, opinion is evenly divided!

Finally, whilst agreeing with me about the lack of technical knowledge of the average radio showroom salesman, Mr. R. R. Hamilton of Ashtead, Surrey, expresses surprise that I should fall into the loose terminology of calling "mains lead resistors" by the all-too-commonly used term "line-cord." A great many terms used in radio are, I am afraid, not truly descriptive and have long since been a source of annoyance to purists. Line-cord is one of them. After consulting numerous lists and catalogues I have been unable to find it called by any other name. To R.R.H. and others who campaign for the purity of radio nomenclature, I can only plead that I unthinkingly followed the bad example of those who should know better and yet obstinately refuse to give it a more exact title.

DESIGN CHARTS FOR CONSTRUCTORS

No. 14 CAPACITANCE AND RESISTANCE VALUES FOR TONE CONTROLS

by **HUGH GUY**

AS PROMISED IN THE TEXT ACCOMPANYING chart number 13, dealing with simple tone control circuit responses, this month's chart facilitates the determination of suitable values of capacitance C and resistance R for components of the filters in question.

Readers will remember that chart number 13 yields the 3 dbV frequency f_o, for any specified response that the simple filters can give, and that the product of the resistance and capacitance values CR is related to this frequency f_o by the formula:

$$CR = \frac{1}{2\pi f_o}$$

Having determined the product, specific values then have to be assigned to the components to produce the 3 dbV frequency.

Now although this part of the design process is relatively simple, it is easy to make mistakes in the calculations due to the fact that the formula deals in impractical values, namely in cycles per second for frequency, ohms for resistance, and farads for capacity. This month's chart not only solves the CR products but facilitates the simple interpretation of the appropriate values of capacitance and resistance in the 10% preferred range of resistance.

The actual frequency scale coverage must necessarily be limited on the chart for the sake of clarity, but means will be explained for extending this coverage to any desired value. As it stands, the range covers the low frequencies from 200 c/s to 10 kc/s.

How to Use the Chart

Having determined the 3 dbV frequency f_o, the intersection of its value with the Key line on the chart is referred to the Base line. This latter is also the capacitance scale. A series of diagonal lines running parallel with the Key line will be seen on the chart, and the purpose of these is to act as guide lines for the interpretation of actual values for the capacitance and resistance. At any point on a guide line running from the point on the base line which has been found for the value of frequency in question, the value of capacitance and resistance, read on their respective scales, intersecting at this point will produce the appropriate frequency f_o.

To assist in understanding the chart an example is given:

Example

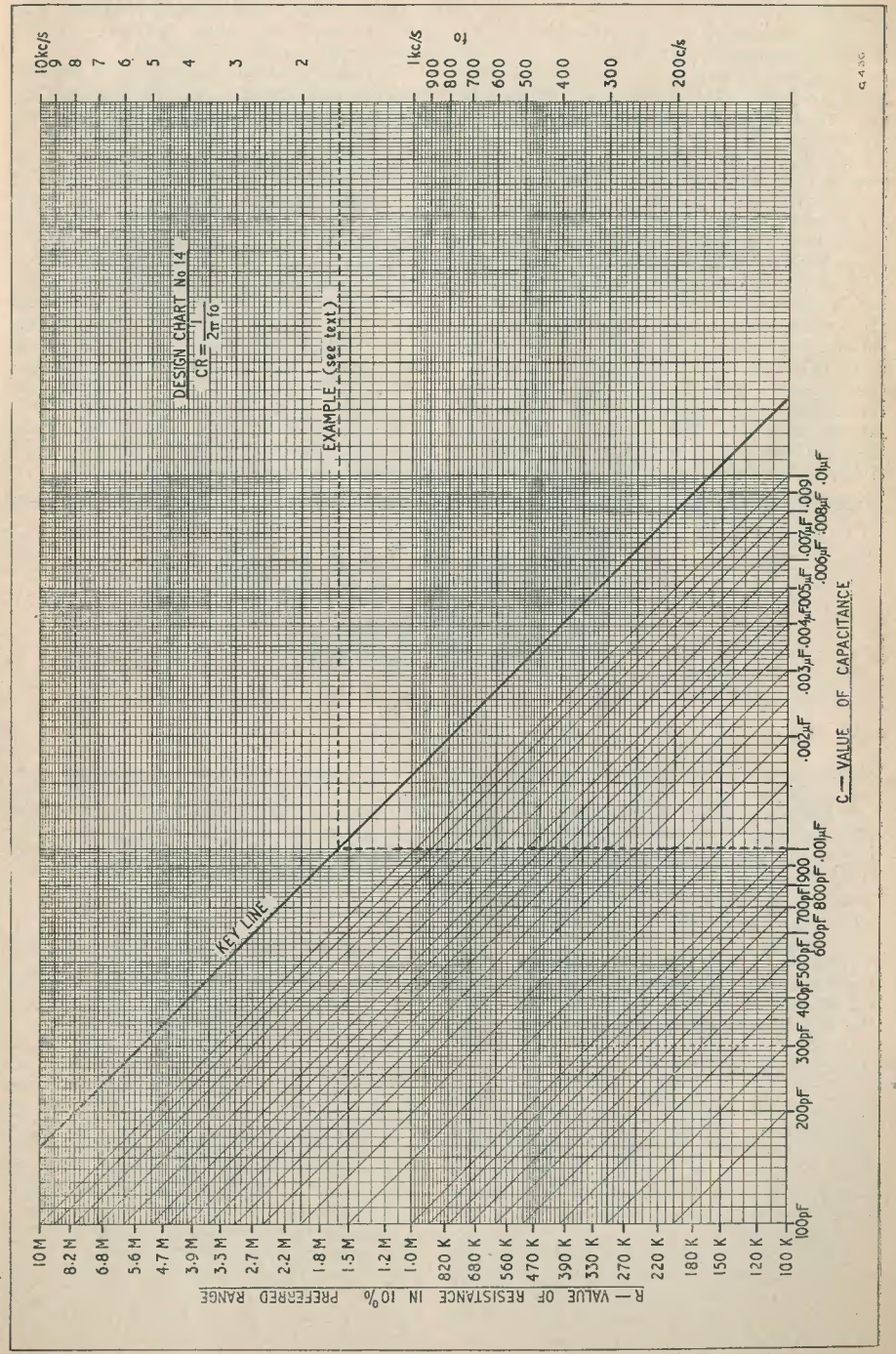
What components would be suitable for a filter with a 3 dbV frequency of 1.6 kc/s?

The steps necessary to produce the answer are shown in dotted form on the chart.

First, the 1.6 kc/s is traced horizontally to the Key line, and then this intersection referred vertically to the base line where it is seen to coincide with the Guide line starting at the capacitance value 0.001μF. Now any two component values intersecting on this guide line will be correct for the frequency of 1.6 kc/s. Thus right at the bottom of the scale the capacitance 0.001μF and the resistance 100kΩ would be suitable. Alternatively, at the other end of the Guide line, 1MΩ and 100pF would be equally suitable. Choosing a middle course, the dotted lines show that a solution could equally well be given by 330kΩ and 300pF. In actual fact, calculation will show that these last-mentioned values will result in a 3 dbV frequency of 1.61 kc/s, which shows that the chart is capable of giving accuracies of better than 1%, which is in excess of that realisable with the components themselves.

In practice it is seldom the good fortune of the user of the chart to find that the value of f_o in which he is interested actually produces a referred point on the Base line co-incident with an existing Guide line. In these circumstances the user must mentally interpolate the values or use a rule to assist in determining the position of the absent Guide line.

What happens when the frequency is outside the limits provided by the chart? Well, the chart can still be used if the required frequency is momentarily promoted to its corresponding value between 1 and 10 kc/s. The chart is used in exactly the same manner as already indicated, and the final values of capacitance or resistance adjusted by multiplying one or other of their values by the same factor that accompanied the frequency promotion. Here again an example may help.



Example

Select suitable component values for a 3 dbV frequency of 20 c/s.

The first step is to put the frequency on the map, or rather on the chart, and to do this we multiply it by 100 to make it 2 kc/s. Proceeding now as before, we find that a Guide line is required just to the left of the one starting at 800pF on the Base line. This is one of those occasions when a Guide line must be imagined, or simulated with a rule, and one of the many pairs of values resulting from such a Guide line show that 200pF and 390kΩ would be suitable—at least for 2 kc/s. We now have to make the adjustment for 20 c/s and this is achieved by multiplying one of the two component values by the factor 100. Thus we could use 200pF and 39MΩ, but the latter is too large a value to be found in common use. We could, therefore, choose as an alternative 390kΩ with 20,000pF (i.e. 0.02μF) which is a far better arrangement. Instead, we could share the product of 100 between both components, making one 3.9MΩ and the other 2,000pF. Either arrangement would be suitable.

This all shows that the values of capacitance and resistance are interchangeable, a fact which in turn emphasises that it is only their product in which we are interested for the previously determined 3 dbV frequency. In practice, some other consideration invariably makes the choice of one component more critical than that of the other, and an example of this is found in the simple resistive mains filter often used in h.t. supplies. Here the drop in h.t. voltage across the series resistance which forms part of the filter limits the value of the resistance to the bare minimum, and thus increases the value of the condenser. A compromise must be reached between the choice of values, weighing up the permissible drop in voltage and dissipation of power in the series resistance against the size and cost of the electrolytic condenser which invariably results in such a filter design.

A SINGLE-VALVE GRAM UNIT

by G3XT

THIS SIMPLE AND INEXPENSIVE GRAMOPHONE amplifier, intended for use with a modern electric-motored record player and crystal pick-up with sapphire stylus, has quite a number of unusual and attractive features.

Although the chassis is small and compact, every component is readily accessible for wiring, testing and, in the event of breakdown, easy replacement.

The use of a single valve reduces cost to a minimum, but still gives sufficient output for all ordinary domestic purposes, provided that the unit is used with a fairly large and sensitive speaker—say, a 10-in type in a good-sized wooden cabinet.

The valve is an ECL80, which is a combined triode and pentode, thus giving two stages of amplification. Despite its simplicity, the circuit incorporates a form of negative feedback, giving very pleasing quality—quite comparable with that obtained from some amplifiers of a much more expensive and ambitious type.

Most types of cabinet will readily accommodate the chassis, as it is small, light and radiates very little heat. It can be fixed in position by a single nut—that on the one-hole fixing bush of the volume control!

The power supply (for a.c. mains *only*) incorporates a double-wound transformer and uses a metal rectifier of the new miniature contact-cooled type, which runs beautifully cool if fitted in close contact with the chassis back, as shown in Fig. 5.

Chassis and Layout

The components are assembled on a simple, inexpensive chassis made to my specification by Denco (Clacton) Ltd., out of 16 s.w.g. aluminium (see Figs. 2 and 3). The two large holes, for valveholder and volume-control bush, can be punched very neatly by the manufacturers of the chassis. But the remaining holes are all small ones which you can very easily drill yourself; they are not shown in the diagrams, as their exact positions can be most accurately marked out by arranging the actual components on the chassis and scribing the fixing-hole centres direct on to the surface of the metal.

Construction is easy and straightforward. The transformers, volume control, 5-watt wirewound resistor (supported on stand-off insulators) and, of course, the valve, are mounted above the deck. The rest of the components are carried on the underside of the chassis. The large 3-in-1 electrolytic condenser (8 + 32 + 32μF) is mounted in a clip directly under the mains transformer, while the smaller condensers and resistors radiate from the valve holder in convenient positions for short wiring and easy access. The metal rectifier is bolted to the vertical rear portion of the chassis, on the inner surface, the connecting tags being led up to the upper side of the "deck" through large holes drilled to give *ample clearance* around the tags.

Although not shown in the diagrams, suitable fuses should be incorporated in this (as in all other radio apparatus) to protect the valve, metal rectifier, etc. There is room to mount small cartridge-type fuses, in holders, on the chassis between the mains transformer and the valve position. There is also ample space under the chassis, immediately below the output transformer position, for a pair of fuses in the mains leads, on their way to the double-pole switch. Any leads passing through holes in the metal chassis should be well insulated by rubber grommets.

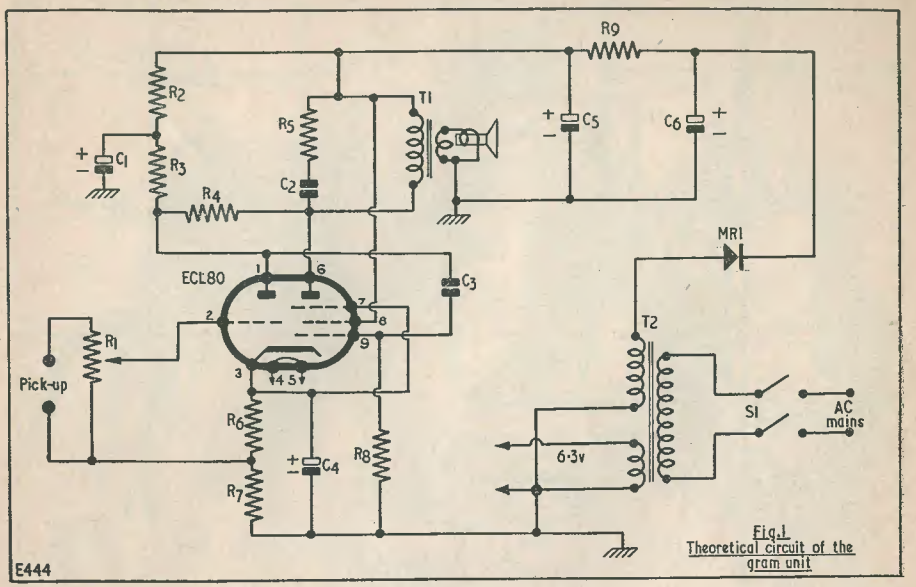
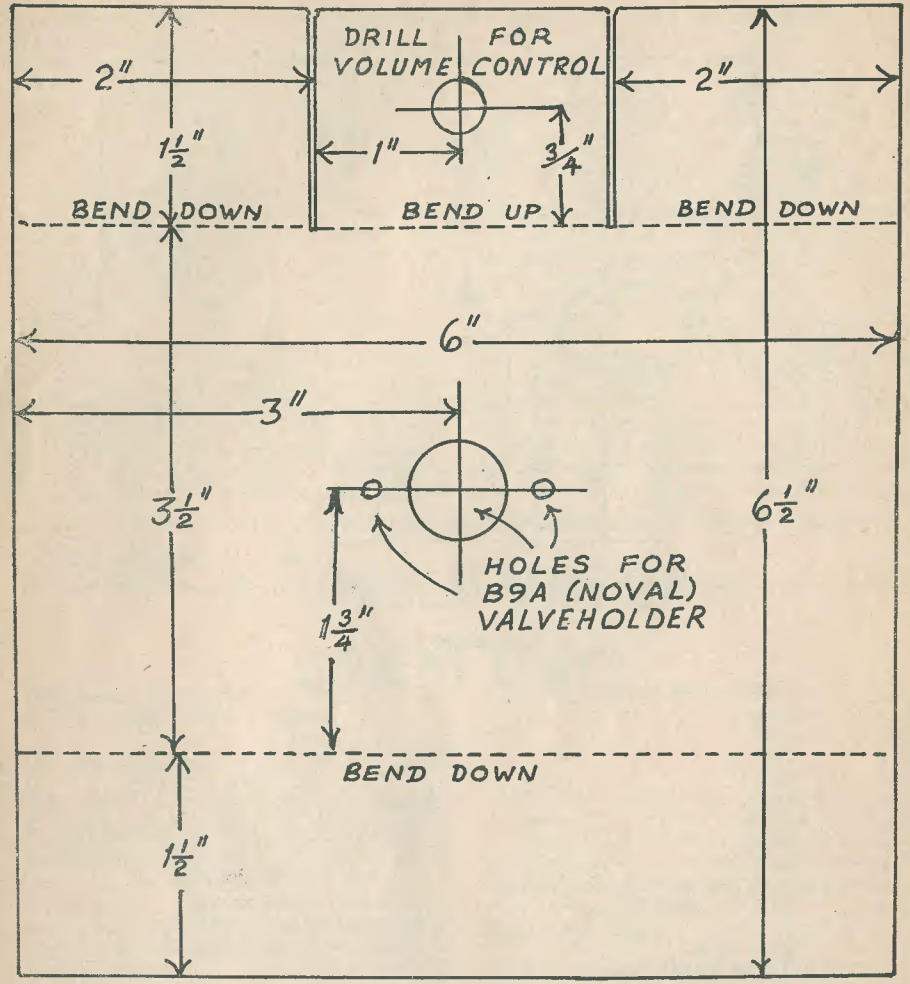


Fig. 1. Theoretical circuit of the gram unit

Component List

R_1	0.5MΩ volume control with D.P. switch
R_2	68kΩ
R_3	220kΩ
R_4	680kΩ
R_5	10kΩ
R_6	180Ω
R_7	220Ω
R_8	680kΩ
(R_2–R_8 inclusive are ½watt miniature type)	
R_9	5kΩ, 5 watt wirewound
C_1, C_5, C_6	8 + 32 + 32μF electrolytic, 450V wkg.
C_2	0.01μF tubular paper
C_3	0.005 μF tubular paper
C_4	100μF electrolytic
T_1	Output (speaker) Transformer 11kΩ primary impedance
T_2	Mains Transformer: input 230V, output 200V at 30mA, 6.3V at 0.6A
MR_1	Miniature contact-cooled rectifier, 250V at 50mA
Valve	Mullard ECL80
Chassis (see text)	Denco (Clacton) Ltd.
PVC connecting wire; 3-core mains flex; 3-pin mains plug	
1 knob for volume control	
2 miniature stand-off insulators	
1 B9A (Noval) valveholder	
Rubber grommets	
Accessories: Suitable record-player unit with electric motor, turntable and crystal pick-up; cabinet and loudspeaker	



L412 *Fig.* 2. **CHASSIS BEFORE BENDING**

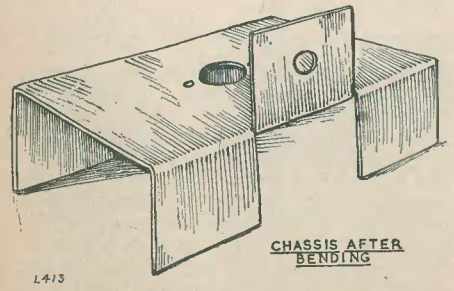


Fig. 3.

Safety Precautions

As there are "live" parts both above and below the chassis, the amplifier should *not* be used without being totally enclosed in a suitable cabinet of insulating material. If it is necessary to handle the amplifier during preliminary bench tests after construction, due precautions should be taken against risk of shock. The outer pair of tags on the mains transformer are connected to the mains input, and are therefore very much alive! The wisest plan is to cover the whole of this tag

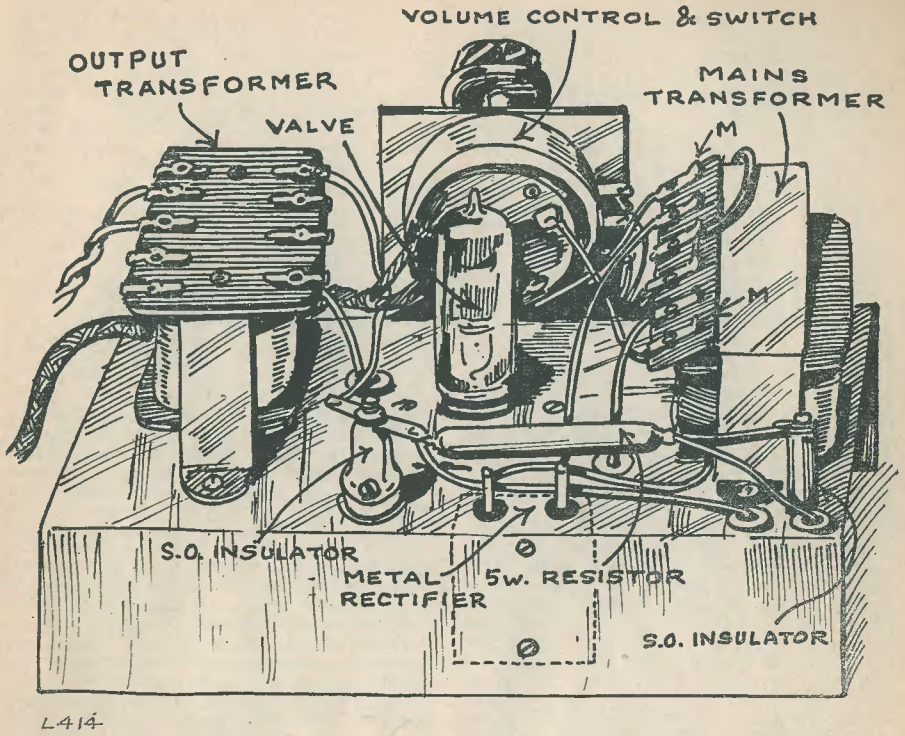


Fig. 4.

panel on the mains transformer with a strip of good quality 1in wide black insulating tape of the self-adhesive type, to avoid any risk of accidental contact with the live tags.

As the chassis is isolated from the mains by the double-wound transformer, it is not "live" (as in the case of a.c./d.c. amplifiers) and can, therefore, be properly earthed to the third (earthing) pin of the mains plug.

Screened wire, with the metal screening braid properly earthed to chassis, is used for the signal grid connection on the triode section of the valve. The lead to the signal grid of the pentode section need not be screened if it is kept very, very short—the feed condenser should be connected right up against the grid pin soldering tag.

Needless to say, the pick-up leads should also be of screened twin flex with the screening braid well earthed as a precaution against hum.

Although the two transformers were not mounted at right angles to one another (as they should be in theory!), no trouble was experienced from this source.

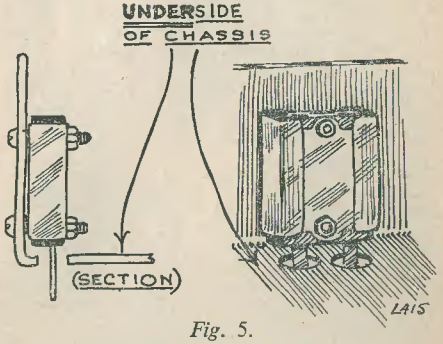


Fig. 5.

An efficient, up-to-date pick-up with sapphire stylus gives quite enough output for adequate volume from this simple amplifier. It won't shake the floor, of course! The ECL80 is rated at only one watt. But provided the loudspeaker is a good sensitive one, the reproduction is quite loud enough for the average room and the average listener's liking.

A Constructor Visits . .

THE R.E.C.M.F. EXHIBITION

THIS YEAR THE ANNUAL EXHIBITION OF THE Radio and Electronic Component Manufacturers' Federation overflowed its traditional quarters at Grosvenor House with the result that some of the stands were sited several blocks away at Park Lane House. The fact that an overflow occurred is symptomatic of the continuing expansive trend which exists today in British electronic equipment, whether such equipment is destined for the home or for the export market. Typical of this "bigger and better" atmosphere is the fact that 163 exhibitors appeared at the Show, this being the largest number ever to participate. A number of other, allied, factors are also worth quoting. For instance, so far as export figures are concerned, the overall sales of British components and sound reproducing gear for 1956 represented an increase of not less than 20% on the figures for 1955, the largest single purchaser of British equipment being the United States. Exports for 1956 to the States totalled nearly 2.7 million pounds (113% up on 1955), Australia following with a total of 1.31 million pounds. In the case of exports to America 2.4 million pounds worth of the total consisted of sound reproducing equipment. Provided that British electronic goods maintain their present high technical standards, there seems little reason to doubt that the figures for 1957 will represent just the same sort of increase as has been evident during 1956.

The Exhibition

The R.E.C.M.F. Exhibition always presents a fascinating display to the engineer, and this year was no exception. Whether one's attention wandered between the very large vibration generators on the Goodmans Industries stand to the tiny frost-crystal valve micas shown by Mica and Micanite Supplies, there was always something to capture the interest of the visitor.

Printed circuits were very much in evidence, not only in complete assemblies fitted with components but also in the more basic form of copper-clad laminate (a layer of copper affixed to a board of insulating material) as displayed on the stands of the manufacturers of insulated sheet. Amongst their exhibits of circuit boards, Bakelite, Ltd. included flexible grades which enable circuits to be mounted in more than one plane. Bakelite circuit boards, both flexible and rigid, are used in the new Ferranti "Mercury" computor. The Telegraph Condenser Co. were well to the fore in this field, showing amongst other things printed circuits for battery/mains receivers, television tuner units, and filters. Aero Research exhibited circuits printed on a very thin flexible backing of "Araldite." These circuits are intended for use as strain gauges, the backing being affixed to the structure it is intended to test. Any strain in the structure then causes an alteration in the linear dimensions of the circuit, the consequent change in resistance being measured by suitable equipment.

Printed circuits require components which may be quickly inserted into the holes which are punched out for them. Here again, T.C.C. were well in evidence, exhibiting a new range of paper and electrolytic condensers developed specifically for this application. Plessey also had electrolytic condensers intended for printed boards, as well as a range of ceramic valveholders, and a miniaturised 2-gang condenser which could be similarly fitted. This latter has been designed for the r.f. and oscillator stages of transistor receivers, and it employs specially shaped vanes which eliminate the need for a padding condenser. Carr Fastener, who make the well-known "Cinch" range of components, exhibited valveholders designed for quick insertion and connection in printed circuits.

An interesting new development appeared on the stand of Fine Wires, Ltd. This firm exhibited what they describe as Easy-Solderable/Bonding Wires type T.N.A. The type T.N.A. wire—the initials presumably stand for Tin, Nylon and Acetate—consists of a normal tinned-copper wire covered with a layer of nylon followed by a thin lapping, in the reverse direction, of acetate (rayon). The advantages offered by the wire are twofold. Firstly, the wire may be wrapped around a terminal for soldering without having first of all to strip back the insulation. Both the nylon and the acetate melt at normal soldering iron temperatures, with the result that the tinned copper conductor can be soldered directly to the terminal. Secondly, the outer acetate covering can be readily dissolved by acetone. Thus, after a coil has been wound, it needs only to be lightly brushed or sprayed with acetone to fix the turns in position on the former. The acetone and the acetate coalesce to give a strong bond between turns, the whole drying out at normal temperatures in a matter of several minutes. T.N.A. wires are available in gauges between 26 and 45 s.w.g., and appear to have a slightly greater overall diameter (i.e. wire plus insulation) than their more conventional single textile-covered equivalents. The writer saw a demonstration on the Fire Wires stand of soldering through the nylon and acetate insulation, and he noted that it appeared to take little longer to make the joint than would be necessitated by plain tinned copper. The joints achieved were electrically and mechanically perfect.

So far as other *materials* (using the term as opposed to complete equipments) were concerned, there was evidence of steady development over the past year. Casting resins are now making themselves more apparent than ever. These resins are used for encapsulating or "potting" components or complete assemblies. "Araldite" (manufactured by Aero Research) is frequently employed for this purpose. The Shell Chemical Company exhibited a range of their "Epikote" compounds, these being thermo-setting resins. "Epikote" resins may be used for encapsulating or for the manufacture of insulated mouldings.

Radio and Television

Although it might be anticipated that a.m. radio should by now have settled down to a more or less standard range of components, this is by no means entirely the case. Two things combine to change the radio picture, one being the continual drive towards miniaturisation and the other the increasing reliance on transistors. Both these trends are assisted by the availability of high permeability ferrite materials in new shapes and designs.

The Weymouth Radio Manufacturing Co. showed some interesting components including especially a range of 470 kc/s i.f. transformers, these having outside dimensions of $\frac{13}{16}$in square by $2\frac{1}{4}$in high and providing the high Q factor for this size of 125. A similar transformer with the $\frac{13}{16}$in dimension reduced to $\frac{1}{2}$in square is also available from this company. Stratton and Co., makers of the well-known "Eddystone" components, need no introduction to short-wave enthusiasts. Their range of exhibits on display included their "Microdensers," these being miniature variable condensers suitable for v.h.f. and u.h.f. work in receivers and transmitters. "Microdensers" have ceramic insulation, capacities up to 390 pF, and meet Joint-Service specifications. Another company which is very well known in the home-constructor field is that of Jackson Bros. This firm showed a miniature 2-gang condenser having capacities up to 365 pF swing. The dimensions of this condenser, including sweep of vanes, is $1\frac{3}{8}$in by $1\frac{17}{32}$in, with a depth (excluding spindle) of $1\frac{1}{4}$in. An alternative 1-gang version is available. Jackson Bros. have also introduced a kit of parts for the construction of their SL15 cord drive for v.h.f. receivers, this being fitted with a scale calibrated directly in Mc/s for the f.m. band. The drive employs two drums and a flywheel.

So far as television was concerned, two new major developments were to be seen. One was the appearance in quantity of deflection components for 90 degree c.r.t.'s, whilst the other was the introduction of a new turret tuner.

90 degree tubes should soon be a "standard" item on commercial television receivers. Whilst these tubes enable shallower cabinets to be employed, their relatively wide scanning angle necessitates careful design of the associated deflection yokes. The biggest problem to be overcome in the design of 90 degree yokes is that of preventing corner shadow. All the 90 degree yokes shown at the Exhibition employed a "flared" construction, this enabling the deflecting centre of the yoke (situated roughly at the centre of gravity of its ferrite core) to be positioned well up the neck of the tube. In the "flared" yoke the coils are mounted either on, or inside, a ferrite cylinder or ring, their forward ends being opened out to nest against the flare of the tube bulb. The ferrite cylinder can then be placed well forward on the tube neck. Many 70 degree scan coils employed castellated cores, but such cores will almost certainly be "out" so far as 90 degree deflection is concerned.

Electro Acoustics Industries ("Elac") exhibited a well-designed 90 degree deflection yoke, this being made in the manner just described. The line coils in this assembly are those which are "flared," these having been wound to the shape required with self-bonding wire. (A wire covered with a thermo-setting glue. After winding, the coils are heated—by passing a current through them—whereupon the glue bonds the winding together.) The line coils on the "Elac" yoke are positioned inside the ferrite ring, but the frame coils are wound toroidally on this core. The writer understands that, to prevent the flux from the frame coils travelling through the high permeability core instead of through the air, the coils are connected in opposition to each other. The leakage field then leaves the core and provides vertical deflection of the tube beam.

The new turret tuner was exhibited by A.B. Metal Products, and this represented a very marked breakaway from present design. In size, the A.B. Metal turret is noticeably smaller than existing units, and its outside dimensions are those of a short cylinder mounted behind, and concentric with, its spindle. The diameter of the cylinder is approximately 4in, and the depth of the unit, excluding spindle, approximately 4 to 5in. The writer has been informed that the turret coils in this assembly are not mounted on a "drum" as in normal practice but radially on a flat disc, each coil former pointing inwards to the centre. As the disc rotates, actuated by the channel selector knob, the coils connect to contact fingers on the body of the unit. The new turret also appears to employ a "neutrode," instead of the more familiar cascode input circuit. The neutrode circuit, now becoming popular in the States, is a single neutralised-triode stage employing a valve specially designed to present a high input resistance between grid and cathode. The channel selector and fine tuner spindles are concentric, as in present practice, the fine tuner coupling mechanically to a variable element inside the assembly.

Mullard exhibited 90 degree electrostatic focus tubes. These tubes require no focusing magnets, the focusing electrode inside the tube providing this facility. Control of focus is then achieved by varying the potential on this electrode. The optimum focusing voltage is not critical. Electrostatic tubes have the advantage of

continued on page 714

A PLUG-IN POWER UNIT

by CYRIL NOALL

THIS BUSINESS OF PROVIDING POWER supplies for each newly-constructed piece of radio apparatus can develop into something like a nightmare. One is faced with the alternatives of either building a power pack into every unit, or else using a single, separate supply chassis which can be connected up as desired. The first is expensive —prohibitively so when the number of units is large; the second is cheap, and saves many "man-hours" at the construction bench, but yields results that are distinctly unpleasing from the aesthetic viewpoint.

Many constructors—myself amongst them —are obliged to keep their apparatus under what may best be described as "semi-domestic" conditions. Rack mounting then becomes impossible, and the separate power pack system, with its dangling cable connections, is only really tolerable where racks can be used. Nevertheless, such advantages are obtainable with the separate power pack system that the writer was driven to devise an adaptation of it which would be acceptable even in the drawing-room.

The accompanying diagrams show how the trick is done. Each radio unit, amplifier, etc., is provided with a wider cabinet and panel than is necessary to accommodate its chassis. A rectangular hole is then cut in the panel, through which the power pack chassis can be inserted. The power pack chassis is provided with its own panel which overlaps the cut-out by about $\frac{1}{2}$in. Two captive screws (or, if preferred, two sliding locks) suffice to hold it rigidly in place.

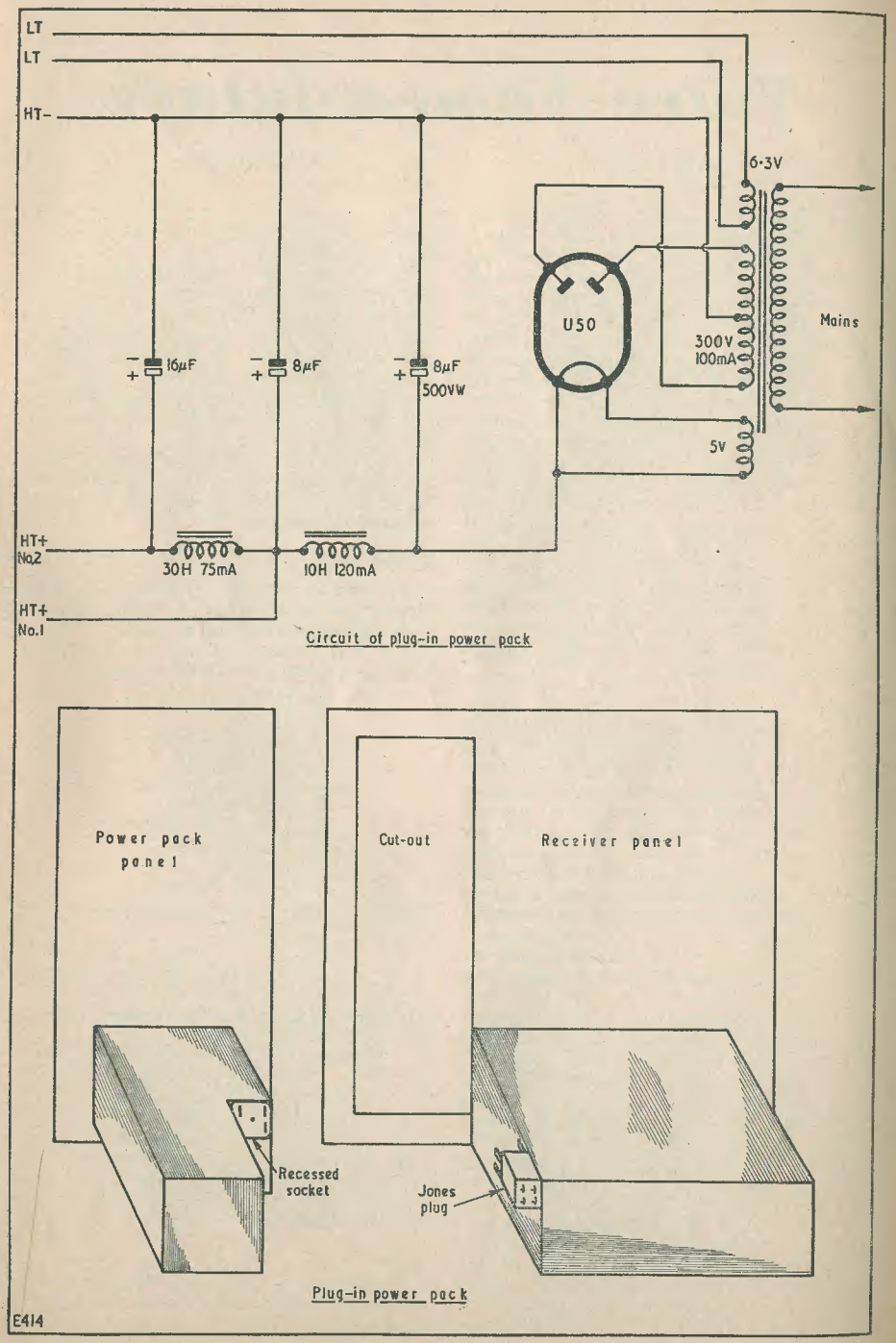
Electrical contact is made via a pair of the popular Jones plugs and sockets. The plug is affixed to the receiver chassis, the socket to the power pack. The socket should be recessed on the power pack chassis, otherwise a sizeable amount of space will be wasted inside the cabinet. It may take a little time and trouble to arrange for this recessed fixing, but the results will well justify the extra effort. The manner in which this recessed effect is achieved will be familiar to most readers from ex-W.D. equipment; and suitable fixing clips, pillars, etc., for the Jones plugs are readily available from this source.

It need hardly be stressed that very accurate positioning of the plugs will be necessary to produce a good "fit." Smooth and easy insertion of the power pack chassis will be greatly facilitated if suitable "guide rails" are fitted inside each cabinet; this will also greatly reduce any chance of damaging the plugs.

The design of the power pack will naturally be governed by the uses to which it is to be put. If it is only proposed to employ it in conjunction with moderate sized amplifiers, receivers, etc., the output could be fixed at 250V, 100mA and 6.3V, 4A. A circuit for such a power unit is shown in the accompanying diagram; but here the h.t. output has been divided, one source being suitable for driving single output valves (6V6, EL32, etc.) and the other for l.f. and r.f. amplifiers. In some sets h.t.— is not taken to earth; provision has been made for this here by isolating h.t.— from l.t.— and taking it to a separate Jones pin. (Where h.t.— and l.t.— go to the same rail, the connection between them should be automatically effected by the circuitry of the apparatus in use.) The smoothing condenser block, if metal cased, must be mounted on a paxolin board or insulated sub-chassis.

If all the appliances used with the power unit have approximately the same current consumption, voltage regulation should present few difficulties. However, if desired, a high wattage variable resistance could be inserted into the h.t. circuit, the h.t. output then being metered. It might also be worth while suggesting that the valve rectifier could be replaced by a pair of metal types if the power pack were to be subjected to a fair amount of rough usage.

If one chromium handle is fitted to the power pack panel and another to each of the receiver panels, a greatly improved appearance will result, whilst removal and insertion of the power pack unit will be made much easier.



Circuit of plug-in power pack

Plug-in power pack

Valve Nomenclature

PART 1.

by V. T. ROLFE

As there are about ten different valve manufacturers in this country, and the majority of these use their own system for numbering valves, we are faced with a situation in which an r.f. pentode, such as the Government type CV138, is known variously as the EF91, SP6, Z77, 6AM6, 6F12 or 8D6. All this is very confusing to the layman, and it is hoped that the following notes will serve as a guide to identifying various types and manufacturers of valves. It is not intended to discuss the relative merits of different systems, but simply to provide the reader with a key to understanding them. The picture is further complicated by the fact that the codes used by manufacturers at present are not the same as those used originally. Most of them seem to have had second thoughts at some time or other! For this reason the various makers will be dealt with alphabetically, the system in current use being discussed first, and previous systems mentioned afterwards.

Brimar

The majority of Brimar valves in the current range have American type numbers. This system will already be well known to most readers. Basically, a type number consists of a number, a letter group and a final number. The first number denotes the approximate heater voltage. The letter group itself does not appear to signify anything, but serves to distinguish between various types. The final number refers to the number of "active leads" into the valve.

Thus a 6J5 is a 6.3 volt valve having five "active leads"—anode, grid, cathode, two heater leads—i.e. a triode. The 6K7 is a 6.3 volt having seven "active leads"—anode, three grids, cathode and two heater leads—a pentode. Strictly speaking, a 6K7 is a valve with a metal envelope. The suffixes "G" and "GT" are used to indicate valves having "glass' and tubular glass envelopes respectively. There is a further variation. The 6K7 has the control grid brought out to a top cap. The 6SK7 has similar characteristics, but has no top cap, the grid being brought out to a pin on the base. These notes apply only to octal based valves. There is a later range of valves on the B8B base, commencing with the figure 7 or 14. The nominal heater voltages of these types are 6.3V and 12.6V respectively. These valves are primarily intended for car radio sets and the 7 and 14 refer to the maximum heater voltage, applicable with a fully charged battery.

The significance of the final figure would seem to have altered with the introduction of miniature valves. The 6C4 is a triode on a B7G base, the "four" referring to anode, grid, cathode and heater. Similarly the 12AX7 is a double triode on a B9A base. The 6J6 is also a double triode, but this has a common cathode. In miniature valves, therefore, the heater counts as one.

In general the letters do not appear to have any significance, but it will be noticed that X, Y and Z (used singly) appear to be reserved for rectifiers.

Earlier Code

Previous to adopting the American coding, Brimar used a different code. This consisted of a number, a letter and a number.

The first number referred to the type of valve, as shown in the following table.

1—Half-wave rectifier
4—Triode
7—Output pentode
8—R.F. pentode
9—Vari-mu pentode
10—Double-diode
11—Double-diode triode
13—Double-triode
15—Heptode
20—Triode hexode

The letter refers to the heater rating:

A—4V
B—2V
D—Indirectly heated, other than 2 or 4V.

The final figure is a serial number and distinguishes between types.

Examples: 1D5 Indirectly-heated half-wave rectifier
8D3 Indirectly-heated r.f. pentode (now re-coded 6AM6)

In addition to the above method of coding rectifiers, a letter R followed by a serial number was used. Thus R1, R2, R3, etc., are all Brimar rectifiers.

Cossor

Cossor use a number of American type numbers in addition to their own code. The Cossor code consists of a number group followed by a letter group. The number group gives the heater voltage and current, whilst the letter group gives the valve function.

Considering some of the older valves first, the 402 Pen is an output pentode having a 40V, 0.2A heater. The 402P has a similar heater, but is an output triode, the "P" indicating "power valve," and dating back to pre-pentode days.

The 2V battery valves are characterised by the numbers 210 or 220 at the start of the type number. The 4V mains types commence with either a 4, 41, 42 or 43, etc. There also seems to have been a move to introduce another system at one time, with the prefix M (presumably "Mains") for these valves. The MVS/Pen (Vari-slope pentode) and M/P Pen (Mains power pentode) are examples of this. Valves for a.c./d.c. operation start with a three figure group, such as 202, 402, etc. The system is fairly flexible, and if two types were developed fitting the same code number, a suffix letter would be added to distinguish between them (202VP and 202VPB, for example)

A selection of the letters used to distinguish valve functions is shown below:

BT—Beam tetrode
DDT—Double-diode triode
HF—H.F. triode
HL—Triode (for h.f. or l.f.)
LF—L.F. triode
ME—Magic eye
OT—Output tetrode
P, PA—Power triode
PG—Pentagrid
PT—Output pentode
QP—Q.P.P. valve
SG—Screen-grid valve
SPT—"Straight" pentode
VP—Variable-mu pentode.

With the introduction of the 6.3V Octal valves, a new but short-lived code was introduced, the prefix "OM" being used to indicate "Octal Mains." There are one or two other exceptions in the Cossor range, where the letters precede the numbers: PT4 and PT10 are two early examples; SP6 and VP6 are more recent types.

Like many other manufacturers, Cossor use the letter "U" to indicate rectifiers. The letter S used in this connection indicates a single anode (i.e. half-wave rectifier). Thus SU2150A is a 2V, 1.5A half-wave rectifier. The letter B appears to be used to indicate a directly-heated rectifier, as for example in the case of the 405BU (directly heated full-wave rectifier, 4V, 0.5A).

Ediswan Mazda

Present code numbers look rather like American types, and are liable to be confused with them. They consist of a numerical group indicating the heater voltage or current, followed by an alphabetical group denoting the valve type and a final number.

The numerical code for heater ratings is as follows:—

1—1.4V filament
6—6.3V heater (for parallel operation)
10—100mA heater (for series operation)
20—200mA heater (for series operation)
30—300mA heater (for series operation)

The valve type is taken from the following list.

C—Frequency changer
D—Diode (or double-diode)
F—R.F. pentode
K—Thyratron
L—Triode (or double-triode)
LD—Double-diode triode
M—Tuning indicator
P—Output pentode or beam tetrode

The final figure is used to distinguish between types (i.e. 6L1 and 6L19 are both 6.3V double-triodes, with different characteristics).

It will be noted that no mention is made of rectifiers in the above coding. These do not follow the code but are distinguished by the letters "U" for half-wave rectifiers and "UU" for full-wave types. This is followed by a number group. In the case of a full-wave rectifier this is merely a serial number and cannot be regarded as signifying anything. In the case of half-wave rectifiers, however, the number consists of 2 or 3 digits. The last one only is the serial number, the remainder indicating the heater voltage, e.g.

U25—2 volt heater
U404—40 volt heater
U281—28 volt heater.

Earlier Codes

The present code came into use after the 1939–45 war. Previous to that a different code was used. This code is used for all valves having the Mazda Octal base, and consists of a letter or letter group followed by a number.

The letter group indicates the type of valve, and the following are some examples.

*DD—Double-diode
HL—Triode (voltage amplifier)
ME—Tuning indicator (Magic eye)
P—Power triode (oscillator)
PEN—Output pentode or beam tetrode
QP—Quiescent push-pull valve
SP—"Straight" r.f. pentode
T—Thyratron
TH—Triode hexode
TP—Triode pentode
VP—Variable-mu pentode.

* Used as a suffix in the case of multiple valves (e.g. HL23DD, PEN45DD).

The number indicates the heater group. Battery valves with 2V heaters use numbers between 21 and 26, whilst a.c. mains valves with 4V heaters use numbers between 41 and 46. The majority of these are "41." Valves for series operation with 200mA heaters use a three figure code, the first two figures indicating the heater voltage (e.g. VP133, 13V heater; PEN383, 38V heater).

The rectifiers in this range use the same code as in the present system.

Earlier valves for battery operation, on British 5 and 7 pin bases, used the same nomenclature as the Mazda Octal series. The a.c. range used the prefix AC, and the same letter code as shown in the above table (AC/HL/DD, AC/PEN). A number is only used in this case to distinguish between similar types (e.g. AC2PEN, AC4PEN, AC5PEN).

A.C./D.C. valves of this era used a similar code to that used for the Mazda Octal range, except that there were four figures instead of three. The first two indicate the heater voltage as before, the third figure indicates the heater current (in units of 100mA), and the final figure may be regarded as a serial number (e.g. TH2321, Triode hexode 23V, 200mA).

Ever-Ready

American and Continental type numbers are used for all current types; the earlier types follow a code which is easy to recognise, as it consists of a single letter, two figures and a final letter. A11C, K23B, S30C are all Ever-Ready types.

The first letter indicates the heater voltage and follows the standard Continental code.

A—4V (indirectly-heated)
C—200mA
K—2V.

The exception is the letter S, not used on the Continent, which indicates 4V directly-heated valves.

The number indicates the type of valve, and follows a very simple code, the figures corresponding to the number of electrodes. A36C is a 4V triode (3) heptode (6). In the case of a single valve, the second figure is a nought. The S30C, for example, is a 4V (directly-heated) triode. The final letter merely serves to distinguish between similar types. For instance, the K30G and K30K are both 4V triodes, but have different characteristics. To distinguish between r.f. and output pentodes, a "5" is used for the former, and a "7" for the latter. Full-wave rectifiers are distinguished by "11" (e.g. A11C, A11D etc.), and double-diode triodes by "23."

(*to be continued*)

A Constructor Visits THE R.E.C.M.F. EXHIBITION

continued from page 709

providing sharp focus at all points of the screen, this being maintained despite such things as mains fluctuations and the like.

Other Exhibits

An interesting working exhibit was demonstrated by Dawe Instruments, this consisting of an ultrasonic cleaning equipment. In this device a cleaning fluid was agitated at a frequency of 40 kc/s by a barium titanate transducer fed from an ultrasonic generator. The power output of the generator was 125 watts and the equipment is intended for cleaning watch movements, hypodermic needles and similar piece-parts.

Some very tiny germanium photo-electric cells were in evidence on the Standard Telephones and Cables stand. These photo cells are housed in tubular metal containers, one end of which has a lead-out wire whilst the other is fitted with a glass window to allow the ingress of light to the cell. The diameter of one cell housing (type PG40B) was 0.080in only, its length being $\frac{3}{8}$in. This cell is intended for use in such applications as scanning perforated cards or perforated tape. Due to their small size a number of these cells may be grouped together for the examination of closely positioned holes.

The General Electric Company exhibits included a wide range of valves. A newcomer was the KT88, this being a worthy successor to the very well-known KT66. The KT88 is an output beam pentode having an anode dissipation of 35 watts. It is primarily intended for a.f. work, in which case two KT88's can provide an output up to 100 watts. Also now being manufactured by G.E.C. are polystyrene and terylene condensers. Apart from maintaining high capacity stability with age, the dielectrics used in these condensers provide exceptionally high values of insulation resistance, figures of 40,000MΩ per μF being common.

A Miniature Memory

To give an instance of what is possible with miniaturisation, the Ministry of Supply exhibited an electronic memory "cell" capable of storing 100 bits of information. (A bit is a binary unit, as used in calculators. A device capable of storing a bit does so by being capable of existing stably in either one of two conditions.) In the M.O.S. memory two groups of ten parallel lines were printed on either side of a very thin insulator such that the lines of one group crossed those of the other at right angles. Thus, at each crossing, a small-value condenser was formed, this being capable of existing either in the charged, or in the uncharged state. As 100 condensers were formed by the two groups of 10 lines the device was capable of holding 100 bits. When demonstrated, a number was fed to the memory whose appropriate condensers then became charged or not, as applicable. To obtain the number from the memory the condition of charge or uncharge in each condenser was determined by a second circuit. The very small size of the memory "cell" can be realised by the fact that the total surface area occupied by the 100 condensers was only some 0.3 of an inch square!

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continued on page 719

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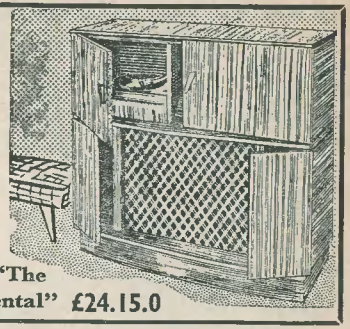

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6J5GT	6/6	DH76	8/6	EF85	10/6	UY41	8/–
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