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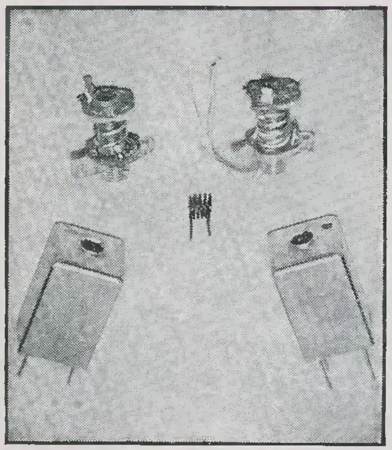

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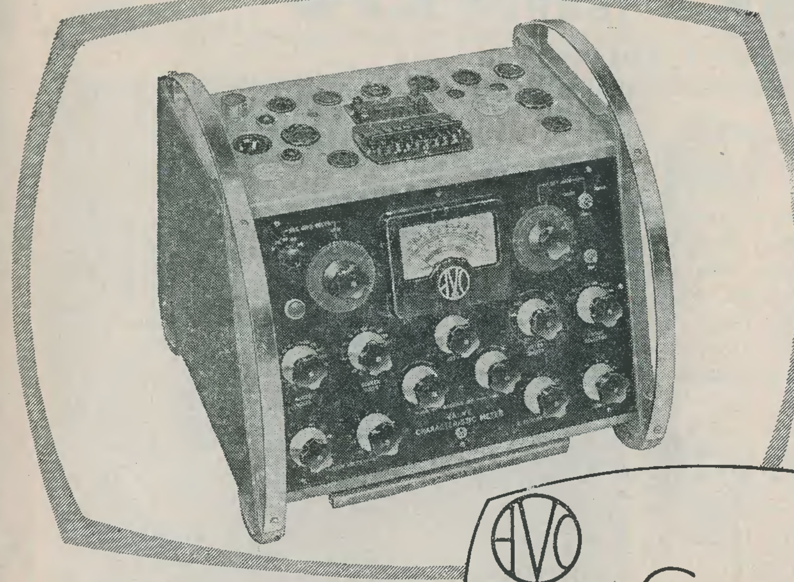

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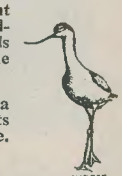

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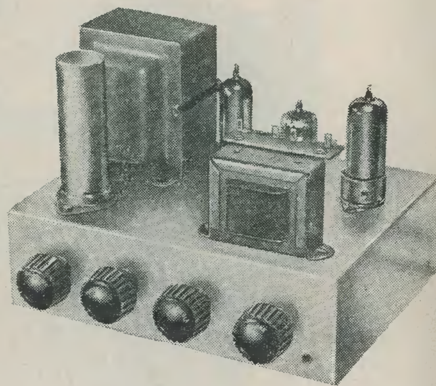

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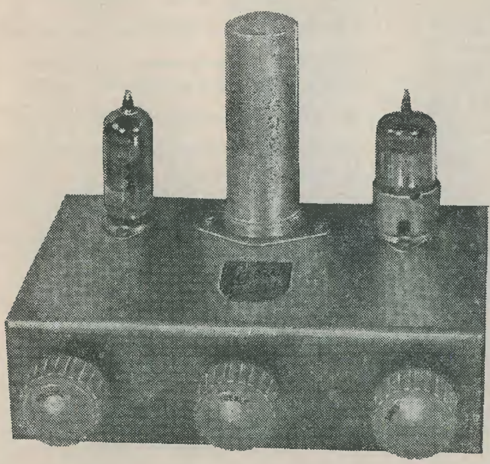

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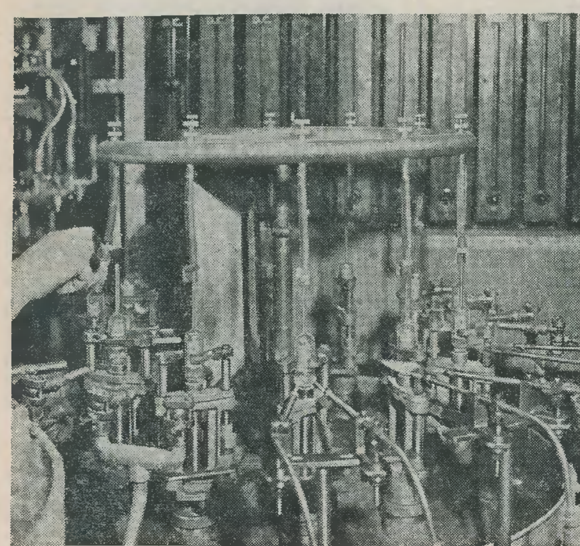

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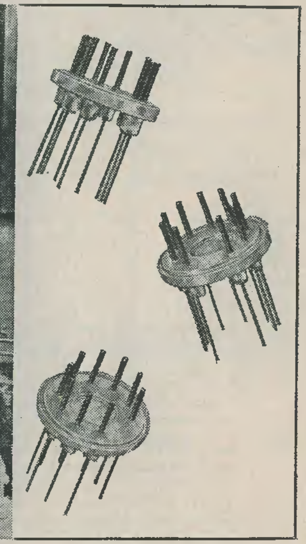

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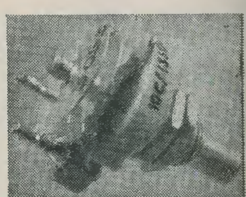

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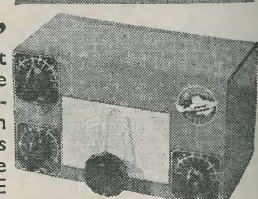

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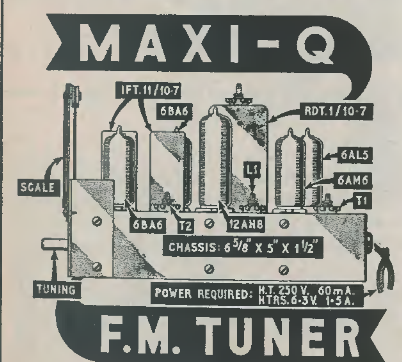

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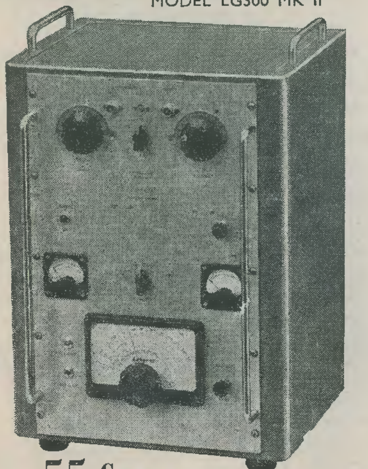

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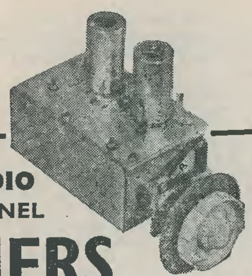

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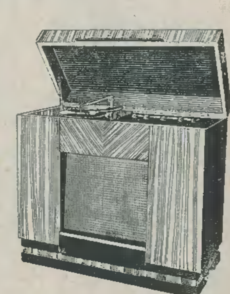

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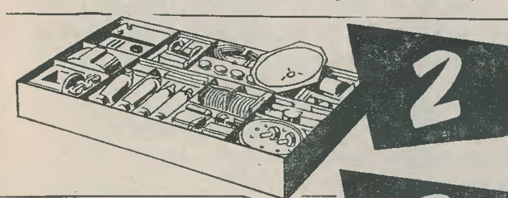

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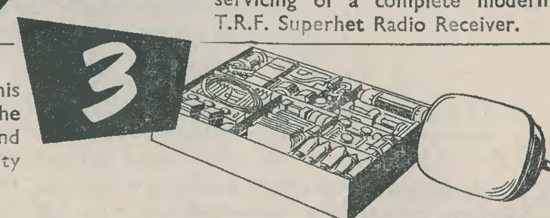

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VOL. 9 NO. 6

JANUARY 1956

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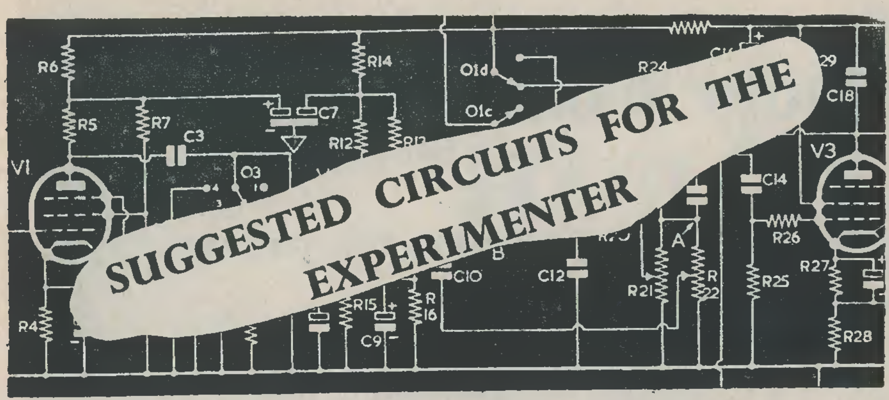


The circuits presented in this series have been designed by G. A. FRENCH, *specially for the enthusiast who needs only the circuit and essential relevant data*

No. 62. A MINIATURE A.C./D.C. SUPERHET

One of the most fascinating aspects of radio construction is the making of miniature equipment. An especially attractive circuit, and one that is eminently suitable for miniaturisation, is given by the conventional "4 plus 1" sound radio superhet. This particular circuit has considerable advantages, these being its high sensitivity, its inherent stability, and its ready adaptability to "midget" receiver technique.

Unfortunately, the conventional 4 plus 1 mains receiver requires, by definition, five valves, or four valves plus a metal rectifier. This is rather a large number of valves to encompass in a small space. The problem of reducing the number of valves needed has been overcome to some extent in the past by omitting the a.f. amplifying stage which follows the second detector, relying instead upon an output valve with a very high mutual conductance to make up for the loss of gain thereby sustained. Such an arrangement can give quite satisfactory results, but it suffers from the fact that every circuit in the receiver has to function at its most efficient, there being little latitude allowable in the way of loss of gain. Furthermore, the three-valve circuit is not attractive for portable work, owing to its reduced sensitivity.

A New Valve

The situation at the present time has been considerably alleviated due to the recent introduction by Mullard of a new valve. This valve is the PCL83, and it consists of a low-mu triode and an output pentode in the one envelope. The pentode is capable of supplying an output power of 2.5 watts at 215 volts h.t. (maximum anode dissipation equals 5.4 watts). Apart from its usefulness in television circuits, the PCL83 represents a perfect choice for miniature sound superhets, since it enables a four valve circuit (excluding rectifier) to be made around three actual valves. A PCL83 is used in the a.f. and output stages of the receiver to be described in this article.

This Month's Circuit

The circuit of the receiver is shown in the diagram. It consists of a miniature medium-wave superhet portable, using a ferrite frame. All valves, including the PCL83, are miniature types, using B7G or B9A bases. The sensitivity will be at least as good as any conventional superhet, and it should be possible to build the set into a very small space indeed. The circuit is suitable both for a.c. or d.c. mains. In common with normal miniaturisation technique, a certain amount of "pruning" has been undertaken in order to simplify the circuit and limit the number of components required.

Signal pick-up is achieved by means of the ferrite frame, L_1. This is, of course, a normal tuned coil mounted on a rod of ferrite material, such as Ferroxcube, and it is tuned by condenser C_3. The signal input is applied to g_1 of V_1. The oscillator circuit is conventional, a tuned-grid arrangement being employed. The oscillator feedback coil, L_3, connects directly between the triode anode and the h.t. rail, no decoupling being employed. The padding condenser, C_9, is shown as a preset component in the diagram, although it may, in practice, be replaced by a fixed condenser. For most commercial oscillator coils the padding capacity required will be 400 to 425pF, but it is advisable to check that the value fitted does, indeed, give accurate tracking. Sensitivity will be forfeited if tracking is poor. In many cases padding may be carried out, with the fixed condenser in circuit, by means of adjusting the core of the oscillator coil (assuming that such a core is fitted). Adjustment of tracking should not be carried out by adjusting the position of the coil of the ferrite frame on its core unless it is checked that such adjustment does not reduce the tuning coverage of the receiver below the normal 200 to 550 metres minimum medium-wave range.

Long-wave coils could also be fitted, if desired, the necessary switching points in the circuit being shown by circled crosses.

The i.f. stage is quite conventional, and it feeds into the second detector circuit in normal fashion. As a thermionic diode is not now available for rectification, a germanium diode is used instead. This diode is connected such that the upper end of its load, R_7 and R_6, becomes negative with respect to chassis. An i.f. filter is provided by C_{15}, C_{16} and R_6. R_7 is, also, the volume control of the receiver.

An economy in components is effected at the triode $V_{3(a)}$ by dispensing with cathode bias components. The valve is biased instead by the leaky-grid bias developed by C_{17} and R_8. This is a technique frequently employed in commercial receivers, and the component values shown should prove quite adequate for the volume range to be anticipated in the receiver. In the occasional possible instance of complete absence of a.f. signal from the volume control, $V_{3(a)}$ still receives a slight bias by reason of its own contact potential. In such a case, its anode current is also limited to a maximum of 2mA by the anode load R_9. A 200pF condenser, C_{18}, is connected between the anode of $C_{3(a)}$ and chassis. This condenser bypasses any i.f. voltages which may appear in the triode and, in addition, helps to reduce any high frequency instability which may be present in the $V_{3(a)}$-$V_{3(b)}$ circuit due to stray capacities between the two valves.

The output stage is conventional. A small amount of negative feedback is provided by R_{11}, and this helps to improve the tonal response and reduce distortion in the receiver at full volume. It also increases stability. A tone-correction condenser, C_{20}, is connected across the speaker transformer primary.

The rectifier circuit follows normal practice, employing a half-wave rectifier feeding into the filter C_{23}, R_{13}, C_{22}. A limiting resistor, R_{14}, is provided to safeguard the rectifier against surges and to reduce the ripple current passed by this valve and C_{23}. V_4 may be replaced by a metal rectifier, if desired.

A resistive dropper, R_{15}, is specified in the diagram for the series heater supply, but an 0.3 amp line cord could be substituted in its place should this be considered more attractive. If the line cord is used, on-off switching would best be accomplished by a single-pole switch in the mains lead to the chassis only. (This form of connection has the disadvantage that the chassis is always live, whether the set is switched on or off.)

An optional anti-mains-modulation condenser, C_{24}, is included in the diagram. This condenser may only prove to be necessary in some districts. If the receiver is intended to be used as a portable in several localities, it would be advisable to include C_{24} in order to provide against the differing conditions which may be encountered.

Miniaturisation

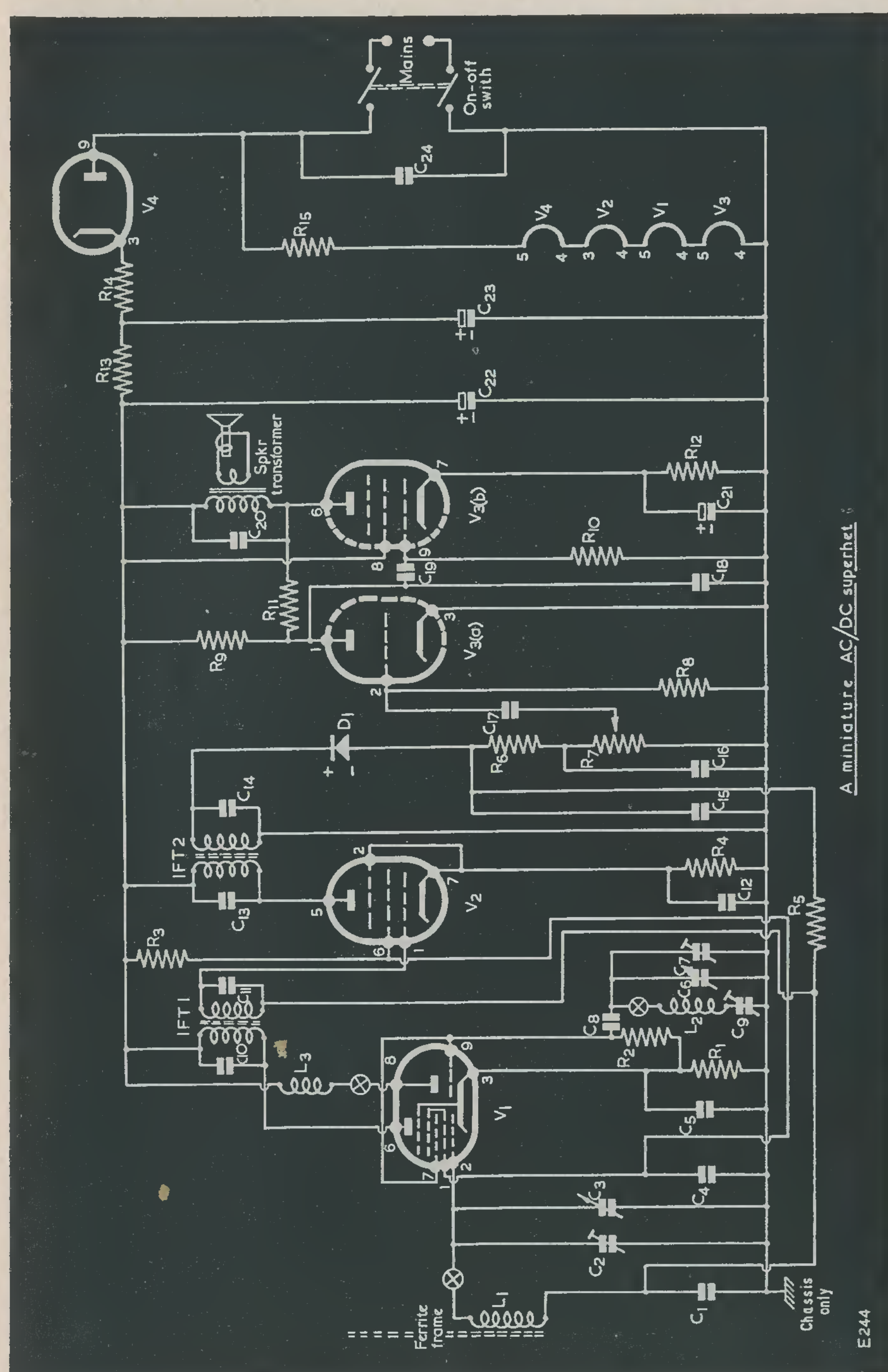
As was mentioned earlier, one or two "pruning" operations have been undertaken in the circuit in order to reduce the number of components required. An instance is given by the fact that no h.t. decoupling is used in the receiver. Such an omission is, of course, somewhat common in larger receivers as well; but the fact is pointed out here in order also to stress the necessity of ensuring that the smoothing condenser C_{22} is a good quality modern component with low internal resistance. The slight saving of bias components for $V_{3(a)}$ has already been discussed.

Another economy is effected by using a single decoupling resistor and condenser for the screen grids of V_1 and V_2. This arrangement is perfectly satisfactory so long as the lead joining the two screen grids is kept short, and C_4 is mounted close to V_1. R_3 should be mounted close to V_2 or to V_1.

A common a.g.c. decoupling condenser is also employed, this being a frequent practice in larger receivers as well. Due to the fact that L_1 will be connected into the circuit by means of fly-leads it might be advisable to mount C_1 close to IFT_1, and to take the appropriate fly-lead from the i.f. transformer itself. This fly-lead should not approach too closely the other components of the receiver.

Conclusion

In conclusion it must be stated that this little receiver will give excellent results if built with reasonable care. *It must be emphasised that it employs a live chassis, and that the normal precautions are, in consequence, applicable.*



A miniature AC/DC superhet

E244

COMPONENT VALUES

Condensers	
C_1	0.1μF
C_2	Trimmer
C_3, C_6	500pF, 2-gang
C_4	0.1μF
C_5	0.1μF
C_7	Trimmer
C_8	50pF
C_9	Pad (see text)
C_{10}, C_{11}	I.F. parallel condensers
C_{12}	0.1μF
C_{13}, C_{14}	I.F. parallel condensers
C_{15}	200pF
C_{16}	200pF
C_{17}	0.002μF
C_{18}	200pF
C_{19}	0.01μF
C_{20}	0.01μF
C_{21}	25μF, 25WV
C_{22}, C_{23}	16+16μF, 350WV
C_{24}	0.01μF, 250 VACW (optional)
Resistors (all ¼watt unless otherwise specified)	
R_1	470Ω
R_2	47kΩ
R_3	22kΩ, ½watt
R_4	470Ω
R_5	2MΩ
R_6	22kΩ
R_7	250kΩ, log.
R_8	5MΩ
R_9	100kΩ
R_{10}	250kΩ
R_{11}	1MΩ
R_{12}	470Ω
R_{13}	1kΩ, 1 watt
R_{14}	120Ω, 1 watt
R_{15}	620Ω, dropper
Valves	
V_1	ECH81, Mullard
V_2	EF93, Mullard
V_3	PCL83, Mullard
V_4	PY82, Mullard
Inductors	
L_1	M.W. ferrite frame
L_2, L_3	M.W. osc. coil
IFT_1, IFT_2	Miniature i.f. transformers
Miscellaneous	
D_1	OA61, Mullard
On-off switch—fitted to R_7	

New Philips A.M./F.M. Signal Generator

Philips type GM.2889/01 is an a.m./f.m. generator with an unusually wide frequency range which makes it ideal for aligning i.f. amplifiers, discriminators and filters in either the development laboratory or service department. Frequencies from 5 to 225 Mc/s can be covered without switching, thus enabling work to be carried out on either Bands I, II or III.

An extremely stable marker oscillator with a range of 15–30 Mc/s and an accuracy of ±50 kc/s is incorporated. There is also a built-in crystal oscillator to provide reference points against which the carrier and marker oscillators can be checked, and this accommodates crystals (not provided) in the range 0.2–15.0 Mc/s.

Three continuously adjustable sweeps are available: ±7.5 Mc/s, ±0.75 Mc/s and ±125 kc/s, with 50 c/s, 50 c/s and 400 c/s modulation respectively. In each case there is ample voltage for horizontal deflection on the c.r.o.

The r.f. output voltage can be internally amplitude- or frequency-modulated and is arranged to cover a variety of possibilities; for example, the marker oscillator can be amplitude modulated internally or the carrier frequency modulated up to 10 Mc/s.

Both main dials of the instrument are individually calibrated. It is housed in a robust steel case finished in grey hammered enamel and measuring 17½in long by 13½in high by 9½in wide. Weighing 38lb it is fitted with a carrying handle. The generator operates from 110–245V a.c. mains.

Full technical specification, etc., may be obtained from the Instrument Department of Philips Electrical Limited, Century House, Shaftesbury Avenue, London, W.C.2.

IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest based on Letters from Readers and his own experience

GREAT BRITAIN WAS THE FIRST COUNTRY in the world ever to have a high-definition television service. According to present-day ethics, I suppose that the fact of my being just a little proud of this achievement immediately brands me as a Chauvinist. Nevertheless, I am not ashamed of the fact that we did, at one time, lead the world in television. I only wish one or two of our present politicians could remember this fact.

High-Pressure Advertising

The reason why I introduce this month's contribution in such a manner is because I have just been reading in my newspaper of yet another attack on the I.T.A. A certain quarter criticises the I.T.A. because, at a time when credit restrictions are being applied, the public is being exhorted to spend far too much money by "high-pressure advertising" on television.

One would presume from all this that the continual advertisements in the daily and magazine press have no effect on the public whatsoever. However, if thirty seconds of television time is devoted to advertising Blogg's Dentifrice, then millions of housewives will sally forth and start filling their attics with cartons of Blogg's Dentifrice. The whole idea is, of course, so absurd that one wonders how people find the time to voice such opinions. In actual fact, practically all advertisements, whether in print or on the air, have *some* result. Their main effect is that a few people who used to use Blogg's Dentifrice may try a tube of Blogg's Tooth Paste for a change next time, just to see what it is like. The money spent by the public still remains the same—it just goes to a different firm.

We've had the I.T.A. on the air for some time now and so we can get a fair idea of what it provides. The entertainment is quite good, and compares fairly well with what the B.B.C. provides. The advertisements are innocuous enough; sometimes, indeed, they are plain boring. They certainly could not be described as "high-pressure."

Perhaps the real reason behind the attacks on the I.T.A. is because it is the opinion of some people that the public are a lot of gentle idiots who must be kept continually blinkered from the blandishments of wicked salesmen, and who cannot be trusted to switch a television set off when a programme they dislike is being transmitted. The fact that many people obtain a great deal of pleasure from I.T.A. programmes is, of course, ignored. Pleasure and politics don't mix.

The Engineer's View

At the start of this article I pointed out that we were the first country in the world to have a high-definition television service. We are also one of the last to have a secondary programme in Band III.

I have recently been given to understand that, in Germany, it is anticipated that Bands I and III will be entirely devoted to television by 1957; and that plans are now in progress for Band IV. Indeed, some German sets are at this minute being manufactured with provision and space for their future Band IV converters. No further comment seems to be needed.

I think it is fairly safe to say, at the time being, that one of Great Britain's most urgent requirements is given by the need to export her engineering products. At present a very large percentage of these products consists of electronic equipment. We naturally want to increase the quantity of electronic equiment exported and, also, its range. One of the more obvious types of equipment which can be added to the electronic range is television receivers.

An export television receiver must, naturally, reproduce pictures on the standards employed in the country to which it is sent. It must also receive the transmitted frequencies used in such a country, There is no export customer country in the world to-day which does not have, or is just about to have, transmissions in Band III. Band III televisors are, therefore, essential.

Unfortunately, the managing director of a radio company in this country cannot turn round to his back-room boys and say: "Starting from scratch, please design me an export television set which is at least as good as anyone else's, and which will work on Band III. Let me have your design in three months' time, and we'll run 10,000 off!" The director cannot say that for the simple reason that he doesn't know if he will ever be able to sell 10,000 sets in the export market; or even 100, for that matter. The very high cost of development, of tooling, and of design, cannot be borne by a highly unpredictable export sale; a sale, moreover, which may be killed completely by such things as the sudden imposition of tariffs by the consumer country. Instead, the cost of introducing a new design has to be spread over both the home market, where sales can be foretold fairly accurately, and the export market, where sales are anybody's guess.

This is where the inception of the I.T.A. has conferred an excellent service on the country. As soon as it became apparent some time ago that transmissions in Band III were to commence, manufacturers were able to start work straight away on the design of Band III "front ends," confident in the fact that home sales would help to cover the consequent development and tooling costs. This is, in fact, just exactly what has happened over the last two years.

There is another point which is of equal importance. This concerns what I could best describe as "manufacturing experience" or—perhaps—"know-how." After the design and tooling on a new project has been completed, it is still necessary to find the quickest and cheapest method of manufacturing it, and of testing it. And there is no better way of finding that method than by actually doing the job. It must surely be true that the manufacturing experience British companies have obtained since they first commenced making Band III television equipment will stand them in excellent stead for future export markets.

So, in view of all this, even if the I.T.A. *does* interrupt its programmes with advertisements every now and again, it has still proved to be of considerable assistance to the country as a whole. Indeed, so far as I can see, all we are waiting for now are transmissions (I.T.A. *or* B.B.C.) in Band IV!

Colour Television

It might seem from the above that I am praising the I.T.A. at the expense of the B.B.C. This is very far from the truth. The I.T.A. is carrying out its job very successfully. So also is the B.B.C.; but it has to be remembered that the B.B.C. has a function which covers a much wider compass than does that of the I.T.A.

Since it first came into being the B.B.C. has always been an ambitious body, the only limitation on its advancement being the facts that its funds are obtainable only from licence fees and that it is responsible for its actions to the P.M.G. and to Parliament, and by its own self-imposed rules of good taste.

To give a typical example of the aspirations of the B.B.C. in the engineering field, the Corporation is at present carrying out experimental transmission in colour from Alexandra Palace. Those who care to tune in, incidentally, will find these being transmitted on most evenings from 11 o'clock onwards. By the time this article appears in print the present series of tests may be reaching completion, but there is every possibility of their continuation in a further series. The standards employed in the tests are similar to those used in the American system, in which the colour sub-carrier lies inside the video bandwidth of the luminance signal. It would be interesting to see if televisors exhibit the same "crawling dot" patterns which are reported to occur when monochrome receivers are used with colour transmissions in the U.S.A. (The "luminance signal," by the way, corresponds roughly to what would be given by a black-and-white camera viewing the same scene.)

The B.B.C. has carried out a considerable amount of work with colour television, and it would seem from the nature of the tests that when colour television arrives in this country it will employ the best system possible in the light of the experience gained. The B.B.C. is to be congratulated on the way in which it has forged ahead in this matter.

It seems possible that one or two readers may raise an eyebrow at the fact that colour t.v. is apparently so near at hand. Nevertheless, this is quite true. Indeed, with one provision, I would go so far as to say that there is nothing whatsoever to stop us from having colour television transmissions in two years time. This would include regular transmissions from the B.B.C. on a compatible colour system together with something approaching full-scale production of colour receivers for the domestic market. We have the drive, and we have the engineering ability to carry this out.

However, there is the single provision I have just mentioned. This is that to get colour transmissions going we would probably have to sneak them out when the politicians weren't looking!

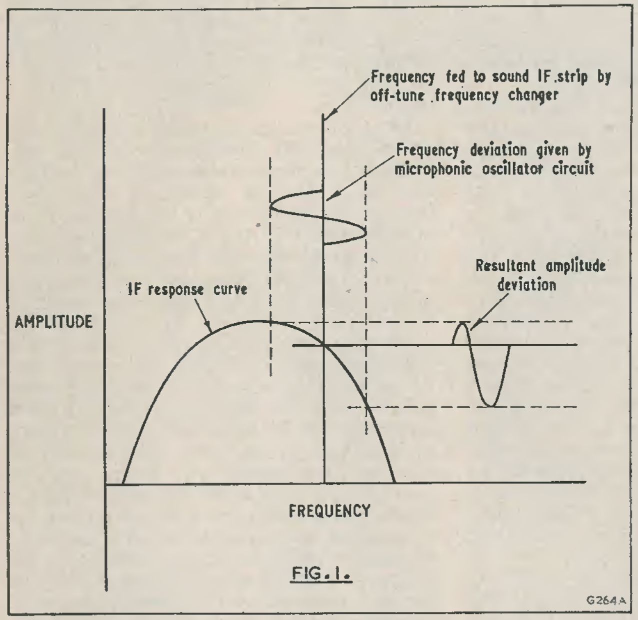


Fig. 1. Illustrating how acoustic feedback may be set up in an incorrectly tuned televisor (assuming a microphonic oscillator circuit). As the frequency from the frequency-changer is applied to a skirt of the i.f. response curve, frequency deviations result in relatively large deviations in amplitude

A Book for Beginners

As I said last month, there is a lack of suitable guidance for those beginners who are taking their first steps in electronics. Readers may recall that, in the last article, I invited those whose experience in the radio industry might be of help to novices to write to me; the intention being that their letters would be published in these columns. It is too early yet to predict the result of such an appeal (each of these articles has to be written quite some time before it appears in print), but I am very optimistic.

In the meantime I have been examining some of the books on the market to-day which are intended mainly for the novice. Amongst these I have yet to find one which really *explains* the basic concepts of radio. There are plenty of books which state bold facts and expect the reader to accept them as such, but I don't think that that is good enough.

I had a long chat with the Editor of *The Radio Constructor* about this. As a result I have just commenced writing a book myself which will, I hope, take the novice over the first very difficult steps of understanding the real fundamentals of radio.

This book represents something of a mammoth task, especially in so far that all the material in it will be new. I hope to have it finished in about six months from the present date, by which time it should have run to some 150,000 words! If all goes well, it will be published next summer.

Microphonic Oscillator

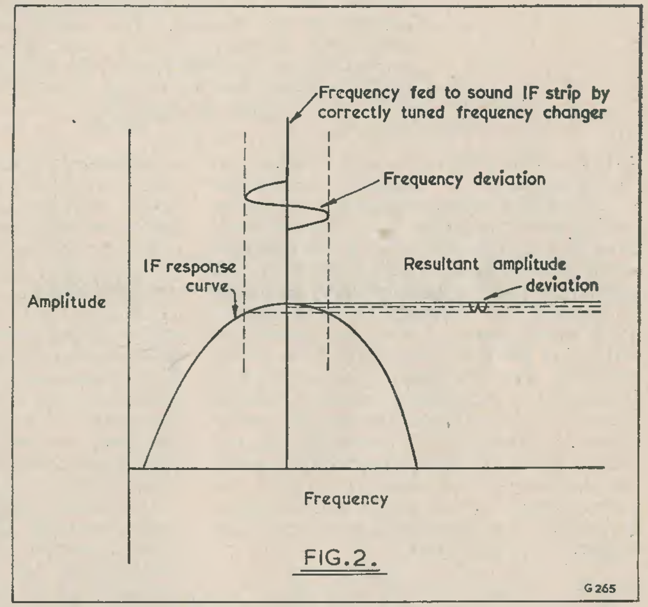
I ran into my first Band III "private" service job a week or two ago. By "private" service job I mean that it was carried out for a friend I happened to be visiting at the time, and did not incur any normal workshop routine. The fault, incidentally, was quite interesting and its description may be of value to readers who find themselves tackling a similar problem.

The trouble occurred when the televisor (a turret job, not a converted receiver) was set to Channel 9. After the set had warmed up a little it was liable to break into continual and

very loud audible oscillation (frequency somewhere around 200 c/s), this being accompanied by horizontal bars running down the picture.

My first guess was that the frequency-changer oscillator circuits were microphonic, and this proved to be correct. It was, in fact, quite simple to check this point because, in this particular case, the oscillation ceased when the turret fine tuner was carefully set to its correct position, What was happening was that the sound waves from the speaker were being picked up by one or more microphonic oscillator components in the turret, amplified by the i.f. strip and a.f. stages, and fed back to the speaker again. The reason why the oscillation disappeared when the fine tuner was correctly set was because the microphonic oscillator components caused the sound waves from the speaker to be converted to *frequency* deviations. When the fine tuner was set incorrectly these frequency deviations were applied to one of the skirts of the sound i.f. response curve, this resulting in amplitude modulation capable of detection by the sound detector. Adjusting the fine tuner brought the frequency deviations to the flat top of the sound i.f. response curve; whereupon only negligible amplitude modulation could result, and the feedback loop was broken. Figs. 1 and 2 may help to make this clear. The horizontal bars on the screen were merely the sound on vision to be anticipated when the oscillator frequency was varying as much as occurred in this instance.

Fig. 2. The conditions which exist in a correctly tuned televisor. In this case, the frequency deviations result in negligible amplitude deviation



I did not have any spares with me at the time but I advised my friend, as a temporary measure, to adjust the fine tuner such that the oscillation did not occur when receiving Channel 9. A few days later I was able to replace the frequency-changer valve in the turret and the trouble cleared completely.

Radio Miscellany

(*continued from page 369*)

equipment, so no doubt the ease with which professional-looking cabinet work can be undertaken will stimulate a revival in high-class work of this sort. There is something very satisfying in getting a silky finish on nicely grained wood simply by drawing an electric sander across it. Doubtless many readers have already discovered this, and built sleek, artistic cabinets as table models or radiograms to hold the receivers and hi-fi amplifiers described in this magazine. Perhaps, then, a few photographs with brief descriptions would be more widely appreciated than one might at first suppose. (*How about it?*—Ed.).

BAND III TELEVISION for the HOME CONSTRUCTOR

PART 7. *by* **S. WELBURN**

Another article in this very popular series written by S. Welburn. This month our contributor discusses, amongst other things, various aspects of Band III aerials, together with devices suitable for mixing Band I and Band III signals

JUST AFTER THE I.T.A. HAD COMMENCED transmitting a regular programme schedule, a report appeared in a London evening newspaper describing a home-made Band III aerial assembled by a non-technical television enthusiast. This aerial, which was apparently made to work more by luck than by anything else, consisted of an unconventional arrangement of wire and metalwork and it was stated to give excellent results on Band III. The newspaper report was somewhat spoilt by including a statement from an "expert" who said that the use of unconventional aerials could shorten the life, not only of the valves in the associated televisor, but also that of the picture tube itself. A correspondent later wrote to the newspaper challenging this statement; whereupon the "expert" kept very quiet.

Aerials

The non-technical gentleman who knocked up his peculiar aerial is, of course, to be congratulated for his initiative. If he lives in an area of good signal strength he may possibly get quite a reasonable picture from his arrangement, which could even be fairly reasonably tuned. (Quite a few people who live near Alexandra Palace have been receiving good pictures for a long time with "bits of wire" hanging down the backs of their sets.)

Nevertheless, even in areas of high signal strength a reasonable aerial is still worth while if only for the obvious reason that the desired signal is, in consequence, sufficiently strong to override interference.

Splitting Aerial Inputs

Most viewers in the London area now have, or intend to have, conventional aerial arrangements, these consisting of two separate aerials, or a combined Band I-Band III aerial with a single coaxial down-lead. Unfortunately, such arrangements do not always fit in too happily with the televisors to which they are to be connected. The greatest difficulty is the fact that modern 12-channel receivers have a single aerial input socket, whilst converted receivers nearly always have two sockets, one for Band I and one for Band III. The situation then arises that it becomes necessary to split the output of a combined aerial so that it may feed two input sockets, or to combine two aerial outputs so that they may feed one single socket.

It is fairly easy, however, to overcome these problems, this being done by fitting devices capable of splitting one 75 ohm circuit into two. This splitting may be provided by a resistive pad or by tuned circuits. The resistive pad is extremely simple to make, but it involves a slight loss in gain. The tuned circuit splitter, frequently called a "diplexer," is somewhat more difficult, but it has the advantage of causing only a very slight loss in gain.

We may commence by considering the resistive type of splitter first. It might be of value at this stage to deal in some detail also with the method of calculating the values of resistance used in the splitter, as such devices can be used for many other jobs. A typical application consists of feeding two or more receivers from a single aerial or source of signal.

The circuit of a two-way splitter is shown in Fig. 1 (*a*). This is a symmetrical arrangement, the resistors all having the same value. The input source is intended to have an impedance of 75 ohms and the outlets feed

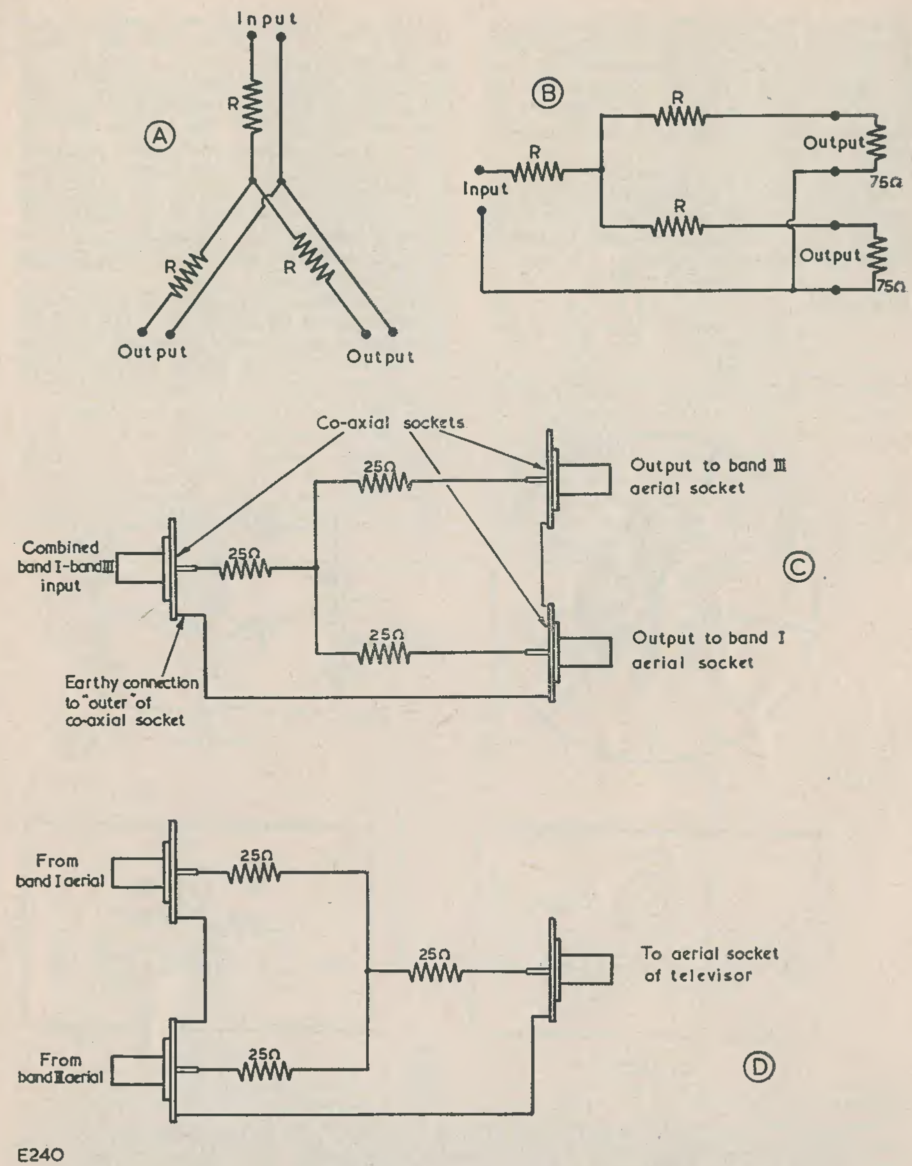


Fig. 1 (a) The basic circuit of a simple two-way resistive splitter. The resistors R all have the same value. (b) Fig. 1 (a) redrawn to show the input impedance more effectively. (c) A practical two-way splitter intended to feed the two aerial sockets of a converted televisor. (d) The same device, employed this time to combine a Band I and a Band III aerial

into loads whose impedances are also 75 ohms.

Let us now re-draw the circuit to resemble that shown in Fig. 1 (*b*). This diagram shows more clearly the impedance we obtain when we "look into" the input terminals. The 75 ohm loads are represented here as 75 ohm resistors. The impedance at the input terminals then consists of the left-hand resistor, R, in series with the parallel combination on the right of the top R, plus 75 ohms; and the bottom R, plus 75 ohms. In other words, the impedance presented at the input terminals is equal to:

$$R+\tfrac{1}{2}(R+75) \text{ ohms}$$

Now, to achieve a satisfactory match we want the impedance presented to the input to be 75 ohms also. We can, therefore, evolve the following formula:

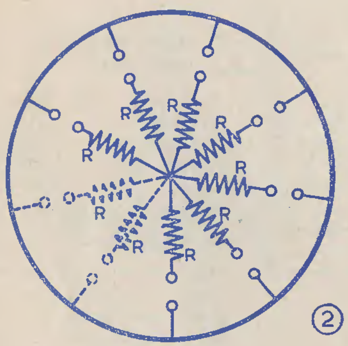
$$75=R+\tfrac{1}{2}(R+75)$$

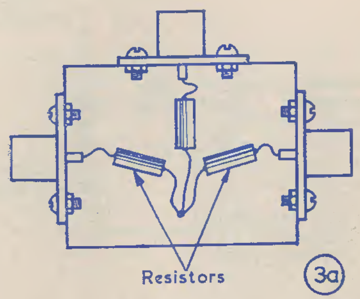
This gives:

$$75=1\tfrac{1}{2}R+37.5$$
$$\therefore\ 37.5=1\tfrac{1}{2}R$$
$$\therefore\ R=25$$

As is to be expected, each outlet in the circuit of Fig. 1 (*c*) receives half the voltage applied to the input. In Fig. 1 (*d*) only half the voltage from each aerial appears across the output terminals. Presented in dB, the insertion loss given by the splitter is 6 dB which, in areas of reasonable signal strength, is not a great deal to worry about. (It will be remembered that interference picked up by the aerial will be reduced in strength by the same amount as is the signal, so that the all-important signal interference strength ratio is still maintained.)

The circuit of Fig. 1 (*a*) is of interest because, as was mentioned above, it may be adapted for feeding any reasonable number of receivers from a single aerial (or for





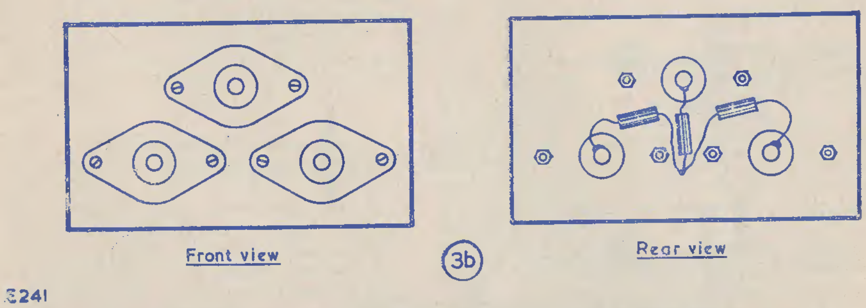


Fig. 2. The circuit of Fig. 1 (a) expanded to work with an imaginary number (n) of terminal pairs. Fig. 3 (a). A method of mounting the two-way resistive mixer in a metal box. Complete screening would be given by the provision of a metal lid. (b) A simpler method of mounting, in which the coaxial sockets are fitted to a small metal panel

If the value of each resistor in Fig. 1 (*a*) is made equal to 25 ohms the device may be used either to enable a single aerial to feed into two input sockets, or two aerials to feed into one socket. See Figs. 1 (*c*) and (*d*) which show practical examples.

feeding any number of aerials into a single receiver!). Fig. 2 shows the idea with n pairs of terminals. To find the value of R in Fig. 2 all that is necessary is to use the formula:

$$75=R+\frac{1}{n-1}(R+75)$$

Each receiver will then obtain $\frac{1}{n-1}$ of the input voltage. Two of the arms of Fig. 2 could, of course, take the inputs from separate Band I and Band III aerials.

Practical Points

The circuit of Fig. 1 (*a*) can be made up most conveniently by using the arrangement shown in Fig. 3 (*a*) or Fig. 3 (*b*). In Fig. 3 (*a*) a small metal case is employed to house the resistors, whilst in Fig. 3 (*b*) a panel is used instead. Coaxial sockets are employed, as these provide very convenient terminations, and the common earthy connections to these sockets are made through the metal of the case or panel.

Whatever method of assembly is employed, the coaxial sockets should be mounted close together. The resistors themselves should be quarter or half-watt carbon components. Wire-wound resistors would be inadvisable for this application, even if they were "non-inductively" wound. All connections should be kept short.

former with similar wire, and has 6 turns close wound. The two coils should be mounted at right angles to each other to prevent interaction. No slugs should be used. Owing to their small size the coils could in practice be made self-supporting, if desired. The two trimmers C_1 and C_2 should be ceramic types and their correct setting will lie between 10 and 20pF. These trimmers should be set up for maximum Band I and Band III signals respectively. Tuning should be fairly flat, but it is possible that the process of adjusting one trimmer will slightly upset the setting of the other. In consequence, several adjustments may be required.

The splitter shown in Fig. 4 can be used to feed a Band I and a Band III aerial into a common receiver input socket; or, connected the other way round, to feed a combined Band I-Band III aerial into the two separate sockets of a converted televisor.

In the case when separate Band 1 and Band III aerials are installed close to each other, the arrangement of Fig. 1 or Fig. 4 could be mounted at the aerials themselves,

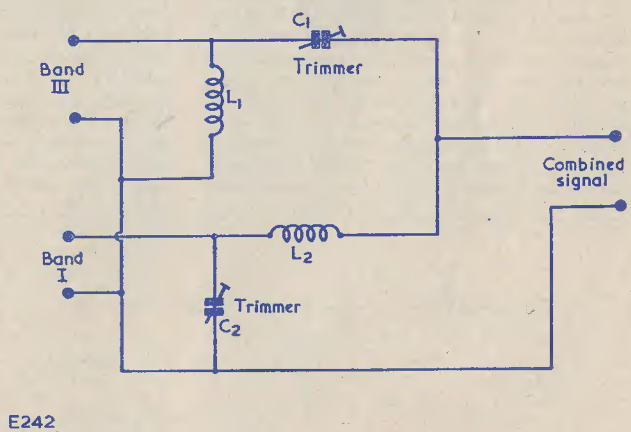


Fig. 4. The circuit of a Band I-Band III "diplexer." Component details are given in the text.

An important point to remember is that resistors having a tolerance of at least 10% should be employed if accurate matching is to be given. This applies to both the circuits of Figs. 1(*a*) and 2. 5% resistors would offer the best choice, but 10% should be adequate for most practical requirements.

The alternative type of Band I-Band III mixer is shown in Fig. 4. In this case two tuned filters are employed; and the device should cause negligible insertion loss.

The coil L_1 in Fig. 4 consists of 5 turns of 18 to 22 s.w.g. enamelled wire close wound on a ¼in former. L_2 is wound on a similar

a common coaxial down-lead then being used. This would save the cost of a second down-lead. Adequate weatherproofing would, of course, be essential if the aerials were mounted outside the house.

Band III in Flats

In many modern blocks of flats the erection of a large number of unsightly aerials has been avoided by fitting a single aerial at the most advantageous point. The signal picked up by this aerial is then amplified and piped through the building by means of coaxial cable; outlets being provided in each flat for the use of the occupant.

Several queries have been received from people living in such blocks of flats concerning the future possibility of Band III reception. The writer would like to give something of a word of warning here to others similarly placed, including especially those in the Midlands where the second I.T.A. transmitter will shortly be built.

The warning is that it would be inadvisable for any viewer in such a situation to buy a 12-channel receiver expressly for I.T.A., or even to have his existing set converted, until he has satisfied himself on the policy of his landlord or the company supplying the piped signals. This is due to the fact that, because of the higher attenuation provided by the coaxial cable to Band III signals, such frequencies may not be used at all. In London, it seems that a solution to the cable attenuation difficulty is being provided by picking up the Band III signal and *converting* it to Band I at a convenient channel before feeding it around the flats. The Band I frequencies used at present for this purpose are Channel 3 or Channel 4.

There is, therefore, no need to buy a 12-channel receiver as an existing 5-channel set may cope instead. (If the receiver is a single-channel job, converters for a different Band I channel *may* be available. It is probable that viewers who rent their receivers will score here, because the rental firms will probably supply suitable converters. Home constructors will also not be unduly worried as they will, in most cases, be able to make their own converters or modify commercial units.)

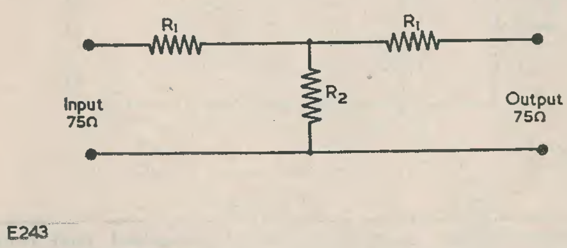


Fig. 5. A basic attenuator for coaxial inputs.

Attenuators

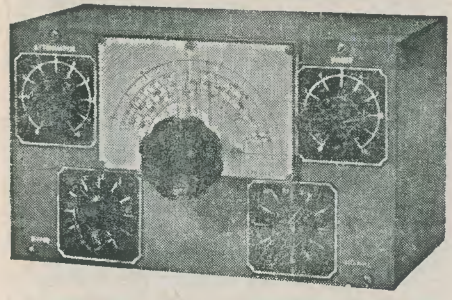
The writer mentioned recently that it is possible to overcome differing strengths between Band I and Band III signals by inserting an attenuator between the receiver and the aerial giving the greater signal strength. Receivers without a.g.c. circuits do not then require to have their gain or sensitivity controls adjusted when switching from one band to the other. Quite a number of readers have asked for details of suitable attenuators. Details on attenuator component values do not appear to be readily available, and so it has been decided to give such information in this article.

Attenuation (dB)	R_1 *(ohms)*	R_2 *(ohms)*
6	20	55
10	30	45
15	52	23
20	60	15
25	65	10

Fig. 6. A table giving details of resistor values for Fig. 5, to provide varying degrees of attenuation.

A suitable basic attenuator circuit is illustrated in Fig. 5. This arrangement consists of a symmetrical circuit whose impedance is 75 ohms at either pair of terminals. It is suitable for coaxial cable of similar impedance. (The outer conductors of the input and output coaxial cables should be connected to the bottom terminals in Fig. 5.) The two resistors R_1 have equal values. A table showing the values required for R_1 and R_2 to provide different levels of attenuation is given in Fig. 6. (The dB figures given here are accurate to the nearest whole number only). For reasonable accuracy of matching, R_1 and R_2 should preferably be 5% components; although 10% resistors should cope satisfactorily for most practical applications.

Like the resistive splitters described earlier in this article, attenuators using the circuit of Fig. 5 should employ half or quarter-watt carbon resistors with very short wiring. They may be assembled in a similar manner to the splitters illustrated in Fig. 3 (*a*) and (*b*), if desired; and they will, of course, be just as effective on Band III as on Band I.



A POWER UNIT FOR THE A.M.—F.M. SIGNAL GENERATOR

by W. PICKERING

A neat and effective power unit which may be employed with the a.m.-f.m. signal generator described in the last two issues of The Radio Constructor. *It may also be used with a Band III Converter Unit, or any similar item of equipment.*

IN THE LAST TWO ARTICLES, THE WRITER gave full constructional details of an a.m.-f.m. signal generator which could be built at home at low expense, and which was capable of providing extremely useful facilities to the amateur or professional serviceman. The signal generator described required an external power supply, and a particularly neat and serviceable unit for this purpose is now to be described.

This power unit provides outputs at h.t. and heater potentials. To provide full isolation from the mains it includes a transformer, and h.t. is obtained by means of a voltage-doubler rectifier circuit. Metal rectifiers are used, and the voltage doubling arrangement has the advantage of enabling a relatively high h.t. potential to be obtained without the use of a bulky mains transformer. The whole power unit is enclosed in a neat grey-enamelled cabinet which, as may be seen from the photograph accompanying this article, matches the cabinet employed for the signal generator both in colour and style.

The output connections of the power unit are brought out to a four-way socket on the front panel, this socket employing the standard British four-pin valveholder contact layout. The output available (for a mains input of 230 volts a.c.) is 6.3 volts at 1.5 amps and 220 volts h.t. at any current up to 25mA. As will at once be realised, the unit is capable as it stands of supplying power to items of equipment other than the a.m.-f.m. signal generator for which it was originally designed. Typical examples of such equipment are given by a.f. pre-amplifiers, Band III converters, and similar units.

It will be recalled that in Fig. 1 of the a.m.-f.m. signal generator articles an input h.t. potential of 150 volts was specified. The h.t. output available from the power unit is in excess of this figure, but this causes no difficulty in practice; the signal generator functioning perfectly at the slightly higher voltage.

The chassis, cabinet and component parts needed for the unit are available from an advertiser in this issue.

The Circuit

The circuit of the power unit is given in Fig. 1. As may be seen, it is extremely simple in design.

The mains input is applied, via the on-off switch, to the primary of the mains transformer. The h.t. secondary of the transformer then provides 125 volts a.c., which is passed to the voltage-doubling network formed by rectifiers W_1, W_2, and condensers C_1 and C_2. Due to the voltage-doubling action given by these components a rectified potential of approximately 240 volts (on load) appears between the negative plate of C_2 and the positive plate of C_1. This voltage is smoothed by the low-pass filter R_1, C_3, whereupon it becomes immediately available as an h.t. voltage for whatever equipment is to be connected to the power unit.

It should be remarked at this point that, although C_3 is shown in Fig. 1 as a single 16μF condenser, it consists in practice of two 8μF condensers in parallel. In the wiring diagrams which follow, these two separate 8μF condensers are referred to as $C_{3(a)}$ and $C_{3(b)}$.

It will be noted also from Fig. 1 that the mains transformer provides a heater potential of 6.3 volts at 1.5 amps from a separate heater winding.

In Fig. 2 (*b*) a similar arrangement is shown, this time using C_2 and W_2. Once more a rectified voltage appears across C_2. It will be noted that, on this occasion, the rectifier is connected the opposite way round to that of Fig. 2 (*a*).

The rectified voltages appearing across C_1 in Fig. 2 (*a*) and across C_2 in Fig. 2 (*b*) will be approximately equal (assuming a load of normal resistance) to the r.m.s. value of the a.c. voltage provided by the transformer winding. Thus, C_1 and C_2 both have approximately 120 volts d.c. built up across them.

In Fig. 2 (*c*) we connect C_1 and C_2 in series. In consequence of this we now obtain a rectified voltage which is equal to twice the

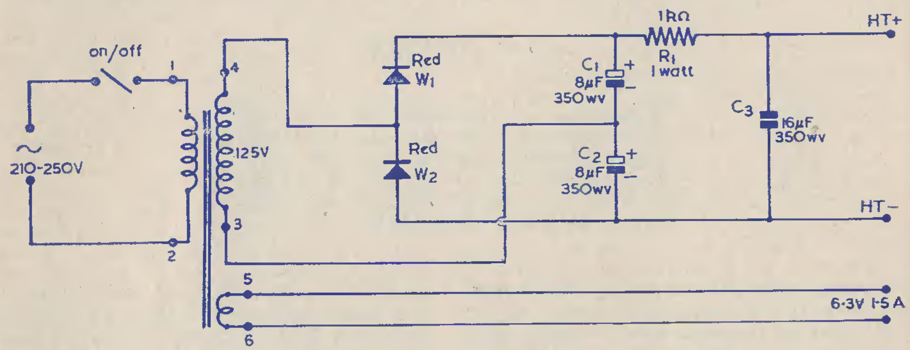


Fig. 1. The circuit of the power unit.

Parts List

4	8μF 350 WV tubular electrolytic condensers (R.C.S. Products)
1	1kΩ 1 watt resistor
2	Rectifiers type RM0 or RM1 (Brimar)
1	On-off toggle switch, panel-mounting
1	Mains transformer (R.C.S. Products)
1	British 4-pin valveholder
1	Cabinet, chassis and panel (R.C.S. Products).
	Mains flex, connecting wire, sleeving, etc.

Voltage-Doubler Theory

It is possible that one or two readers may not be quite at home with the theory of voltage-doubling circuits. For this reason, a brief explanation of their operation would be of advantage at this stage, before proceeding to details of the practical layout and wiring of the power unit.

Fig. 2 (*a*) shows part of the circuit of Fig. 1. In this diagram the h.t. secondary of the mains transformer connects to condenser C_1 and rectifier W_1. The arrangement shown is a simple half-wave rectifier circuit, and a rectified d.c. voltage of the polarity shown in the diagram appears across C_1.

individual voltage across each condenser. Fig. 2 (*c*) is, of course, the combination of the two circuits of Fig. 2 (*a*) and Fig. 2 (*b*). The fact that we now obtain twice the d.c. voltage is the reason for calling the arrangement a "voltage-doubling" circuit.

An interesting point in Fig. 2 (*c*) is the fact that each condenser charges only during alternate half-cycles. Thus, whilst C_1 is being charged via W_1, C_2 receives no charging current at all. During the next half-cycle the reverse holds true: C_2 is charged, but C_1 receives no charging current. When the circuit is connected to an external load we get the case that C_1 discharges into the load

whilst C_2 charges from the transformer secondary, and vice versa. Because of this fact, it is always important to ensure that the reservoir condensers in a voltage-doubling circuit (in this case C_1 and C_2) have sufficient capacity to provide good regulation. For the purposes for which this particular power unit has been designed, more than adequate capacity is available in C_1 and C_2, and the power unit provides good h.t. regulation.

It will be obvious that all that is required to make the circuit of Fig. 2 (*c*) suitable for practical use is to provide a smoothing circuit. This will then remove the ripple from the d.c. voltage appearing between the positive plate of C_1 and the negative plate of C_2. The filter circuit is provided in Fig. 1 by the addition of the smoothing components, R_1 and C_3.

Constructional Details

We may now pass on to practical details. Owing to the fact that the chassis and cabinet are available already cut to size, the process of construction is reasonably simple.

The first thing that is required is to fit the on-off mains switch and the output socket. The position of these two components on the front panel is illustrated in Fig. 3. It will be noted that there are two 6-BA clearance holes in the lower half of the front panel. These are used later for bolting the panel to the chassis. The soldering lugs of the on-off switch behind the panel should project downwards.

The chassis itself comes next. The front apron of this requires two 6-BA clearance holes in the positions shown in Fig. 4. These two holes correspond to those drilled in the front panel in Fig. 3. A further hole, illustrated in Fig. 5, is next required in the folded apron at the rear. This hole should be sufficiently large to take the mains lead grommet, and it passes through both sections of the rear fold.

All that now remains, apart from wiring, is to fit a grommet, the mains transformer, and two three-way tag strips to the top of the chassis. The positioning of these various components is illustrated in Fig. 6, this diagram showing also the layout of the various holes required. It is important to ensure that the mains transformer is mounted the correct way round. The lead-out wires are clearly shown in Fig. 6. It will be noted also that the two three-way tag-strips mounted on the chassis are of the type in which the centre tag is used for mounting purposes, and is consequently at chassis potential.

Wiring up may now be started. It would be advisable not to fit the front panel at this stage, as this will allow easier access to the

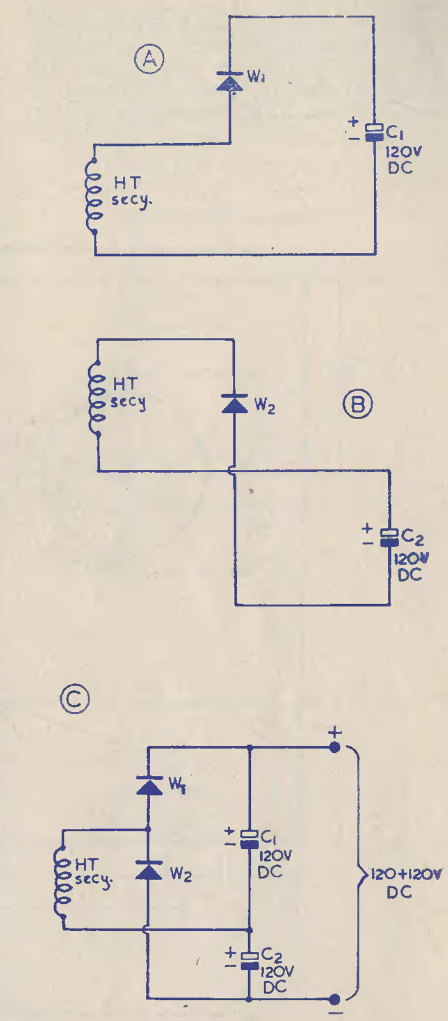
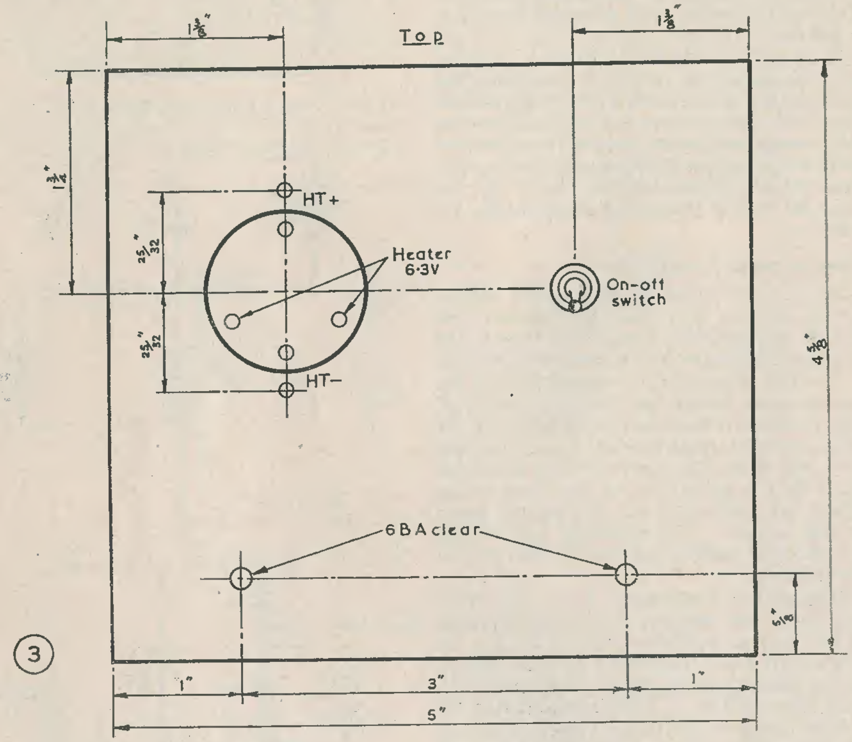


Fig. 2 (a). Part of the circuit of Fig. 1. This illustrates what is, in effect, a simple half-wave rectifier circuit. (b) The other half of the rectifier circuit of Fig. 1. Again an effective half-wave rectifier arrangement is employed. (c) By combining the two circuits of (a) and (b) it is possible to add the d.c. voltages appearing across C_1 and C_2. In consequence, a "voltage-doubling" effect is obtained.

electrolytic condensers. These condensers are relatively small components, and they are capable of being supported in the wiring from the tag-strips. If they are supplied or obtained with metal cases, it is most important to ensure that these cases are insulated. Otherwise short-circuits may occur, with consequent damage to the components of the power unit. This precaution is necessary owing to the fact that the metal cases may not be isolated from the appropriate condenser terminals. Suitable insulation would be given by fitting an insulating sleeve over each condenser or by wrapping around it a good insulating or p.v.c. tape. It will be



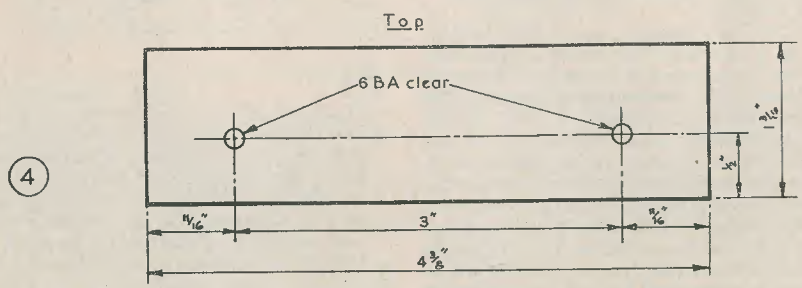


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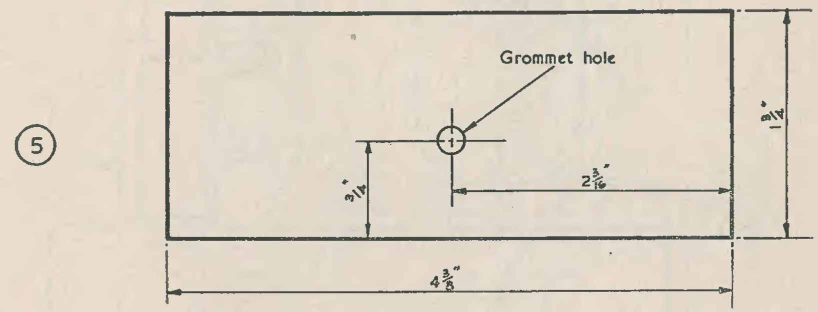
Fig. 3. The layout of the front panel. Fig. 4. The two 6-BA clearance holes in the front apron of the chassis.

remembered from what has been mentioned earlier that C_3 consists of two 8μF condensers in parallel. Thus, four 8μF electrolytic condensers are employed altogether.

The first step in the wiring consists of connecting the electrolytic condensers at the front end of the unit, and the wiring required is shown in Fig. 7. This diagram should be quite self-explanatory. The red fly-lead shown connected to the tag-strip will later connect to the output socket on the front panel, when this is fitted. The lead connecting to the negative tag of C_1 is from lug 3 of the transformer. This wire should be adequately covered with sleeving.

It is extremely important to ensure that correct polarity is observed when connecting up the electrolytic condensers. Polarity is



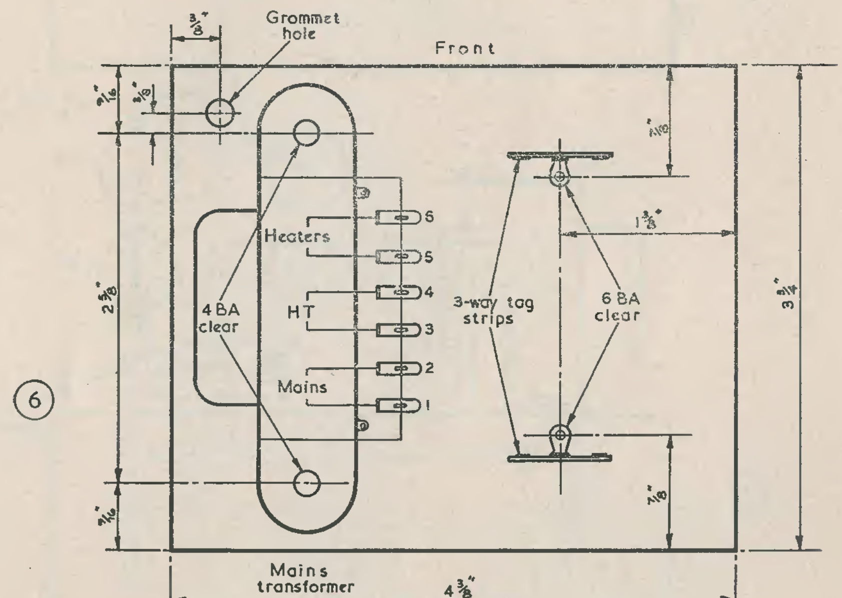


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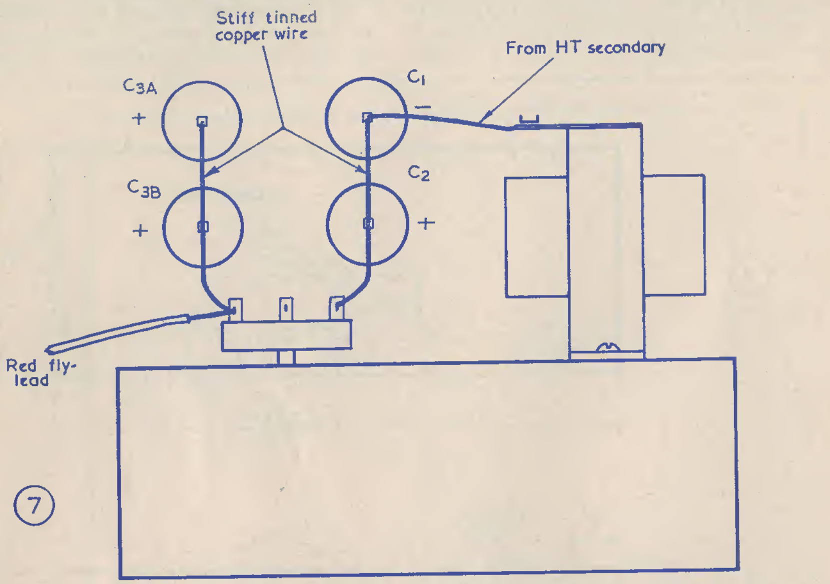
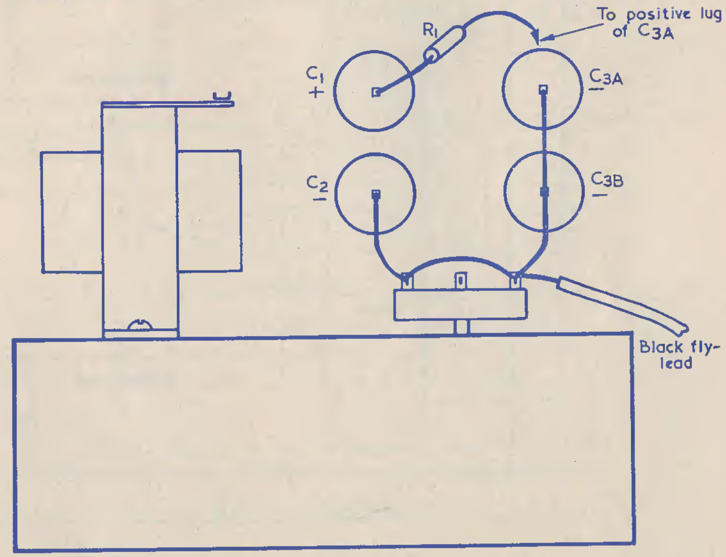
Fig. 5. The grommet hole in the rear apron. Fig. 6. Showing how the components on the top of the chassis are mounted.

indicated in the wiring diagrams by marking the appropriate tag with a positive or negative sign.

The wiring at the rear end of the chassis is shown in Fig. 8. This, again, is self-explanatory. It will be seen that a black fly-lead is fitted in this diagram, this being intended for later connection to the input socket on the front panel. The resistor R_1 should be mounted such that it lies across



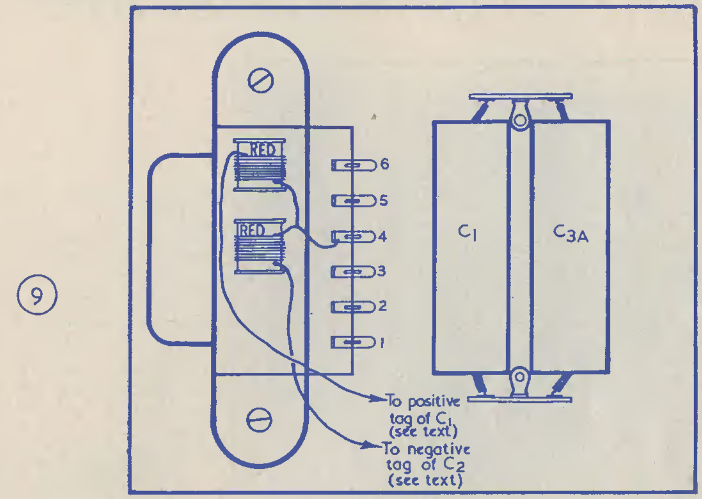


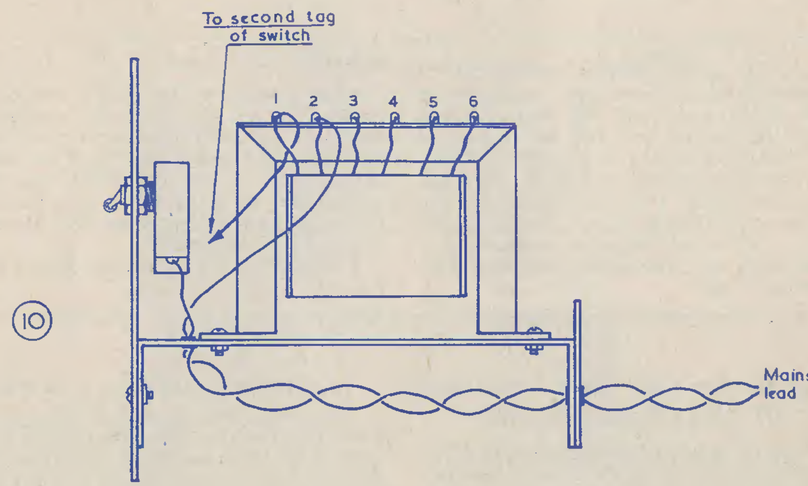
E252

Fig. 7. The first steps in wiring. Fig. 8. The wiring at the rear of the chassis.

the tops of C_1 and $C_{3(a)}$. Its leads should be covered with sleeving.

The next step in wiring is illustrated in Fig. 9. This diagram shows the top wiring layout. It should be noted that the rectifiers are mounted by soldering their "common" tags to lug 4 on the transformer tag-board. The two rectifiers are coded with red paint at their positive terminals, and this fact is indicated clearly in Fig. 9. The two wires





E253

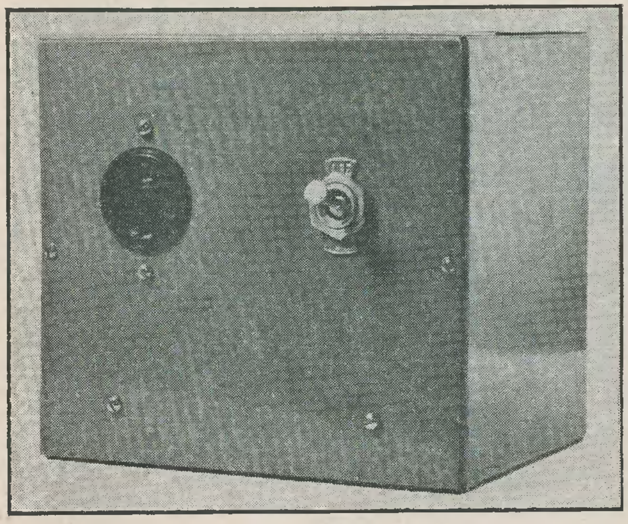
Fig. 9. Illustrating the rectifier circuit. Fig. 10. The mains input wiring.

going from the outer ends of the rectifiers to C_1+ and C_2- should be of heavy gauge wire, well insulated, to support the rectifiers clear of contact with any of the tags.

The front panel is next prepared for fitting to the chassis. This is done by connecting the various power leads to the output

It would also be worth while to solder a short lead to the contact of the on-off switch which is nearer the output socket, as this point may be difficult to reach later. The front panel can then be finally bolted to the chassis.

All that remains is to connect up the mains input wiring, this being illustrated in Fig. 10.



The cabinet of the power unit matches that of the signal generator, as shown by this and the title illustration

socket. Fig. 3 illustrated the voltages carried by each contact in the socket, looking at the front of the panel, and this contact layout should be adhered to. The red fly-lead of Fig. 7 connects to the h.t. positive contact, and the black fly-lead of Fig. 8 to the h.t. negative contact. The heater leads may also be connected to the output socket at this stage. Care should be taken to ensure that these leads are adequately insulated with sleeving.

Testing

After completion, the power unit can be tested. Before this is done, however, it would be advisable to make a final check for correct wiring and polarity of the various components. After the check has been carried out, the unit can be connected to the mains and switched on, whereupon its output voltages may be tested.

The power unit is then available and ready for use.

NEW 5/- BIB GIFT PACK RELEASED BY MULTICORE SOLDERS

Multicore Solders Ltd. announce that they have supplemented their Bib lines with a new 5s. gift pack containing a bib wire stripper, electrician's insulated screwdriver and a card of Ersin multicore match melting tape solder.

The three items are mounted attractively on a gift card and finally packed in a cellophane envelope.

AMATEUR RADIO CALL BOOK

The 1956 edition of the **R.S.G.B. Amateur Radio Call Book** has now been published, and is available from the Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1, at 2s. 6d., postage 3d.

This edition has been completely revised and brought up to date, and contains 48 pages of callsigns, names and addresses of amateur transmitting stations in the United Kingdom and Eire.

A FERRITE ROD MAINS TRANSPORTABLE

by **S. E. ADDIS**

THIS RECEIVER IS DESIGNED FOR USE WITH the new "Ferrite" Rod Aerials which are now available to the home constructor, and uses 6 miniature valves with B7G bases.

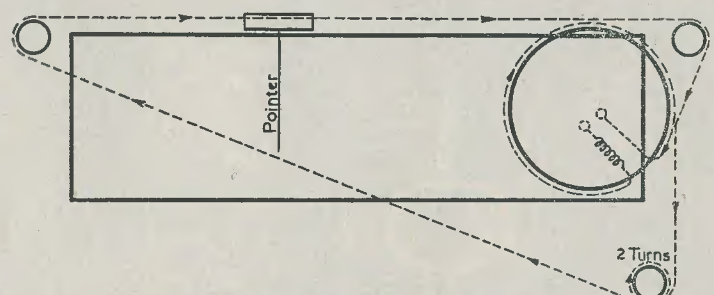
For those not familiar with this new type of aerial, it should be said that it consists of a rod of "Ferroxcube" 8 inches long by about $\frac{5}{16}$in diameter on which are wound the Medium and Long Wave aerial coils. The coils are made to slide along the rod, and so vary the inductance of the aerial circuits, which makes for better alignment and improved performance over the more usual type of frame aerial.

The receiver about to be described was designed for use in a poor signal area, and results have been very pleasing.

input to the frequency changer is a little unusual, but in practice works very well. The normal selectivity of the superhet receiver is maintained with the advantage of a much improved signal-to-noise ratio being obtained. In addition, no instability was experienced and therefore no special screening between stages is required. The output from the frequency changer is fed via the first i.f. transformer to a second Brimar 6BA6 r.f. pentode which acts as the i.f. amplifier.

V_4 is a Brimar 6AT6 which provides the signal diode detector, a.v.c. rectifier and first l.f. amplifier. The second diode in this valve is not used and is connected to chassis.

V_5 is a Brimar 6AM5 power pentode, which will deliver an output of about 1.4



This diagram shows the cord drive arrangement

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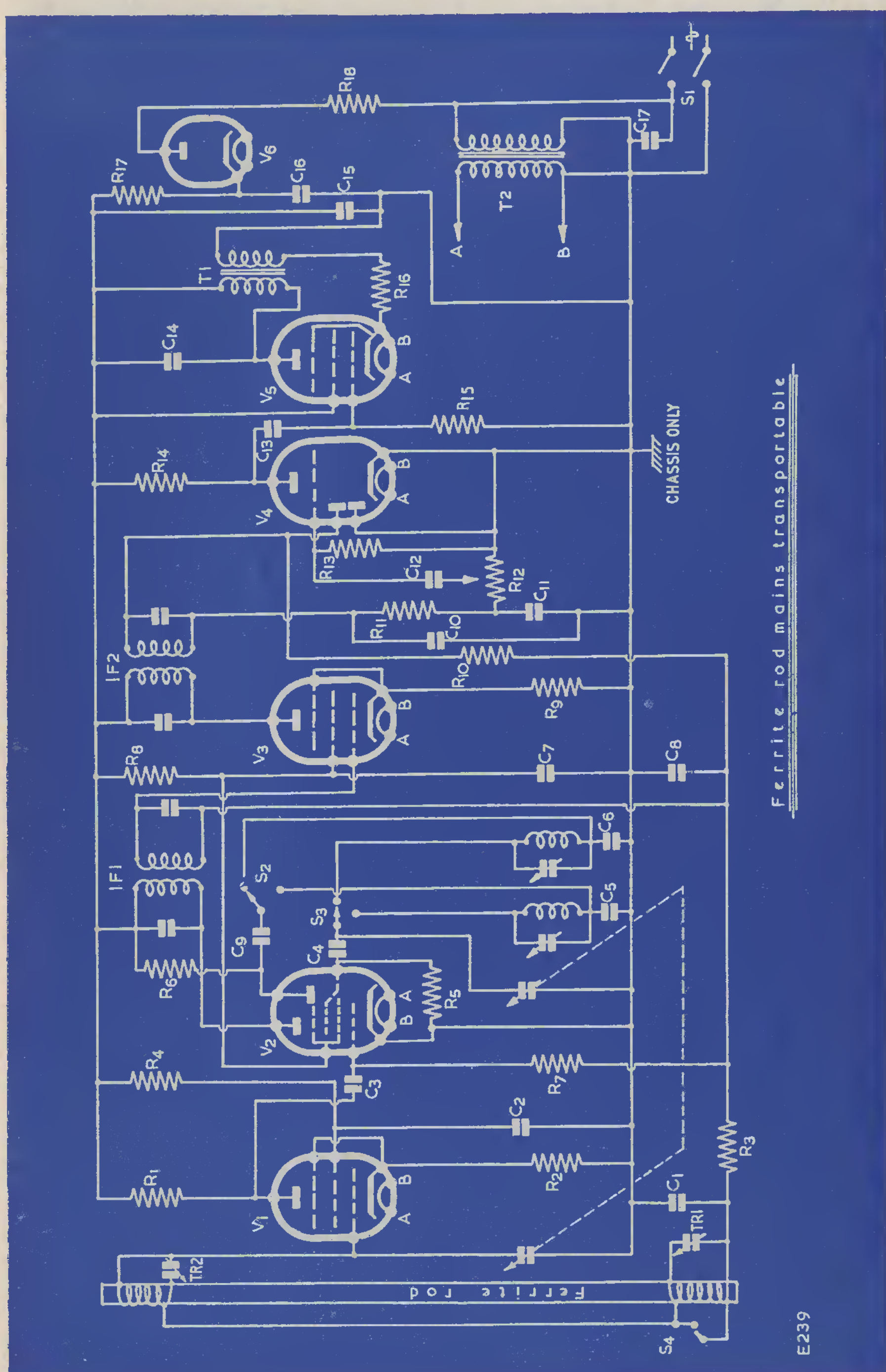
Circuit Description

As will be seen from the circuit diagram, the aerial coils on the "Ferrite" rod are tuned by one section of the twin-gang condenser, and are connected to the grid of the first valve, which is a Brimar 6BA6 r.f. pentode. This forms a complete h.f. stage which is coupled via a 20pF condenser to the input grid of an Osram X78 frequency changer. This untuned

watts when used with an output transformer with a ratio of 80 : 1. The cathode resistor is connected to chassis via the secondary of the output transformer, which gives a proportion of feedback to improve the quality of reproduction.

The h.t. rectifier valve is a Mullard EY91 used in a half-wave circuit, smoothing being carried out by R_{17}, C_{15}, and C_{16}.



Care should be taken when handling the receiver as the chassis can be "live."

Construction

The receiver was constructed on an aluminium chassis size 9in × 3½in × 1½in, and the layout can be seen in the photographs. A panel 3½in high was fixed to the front of the chassis by means of the control fixing nuts, the panel being used to carry a Perspex tuning scale. A slide rule pointer arrangement was made with the aid of a drum drive and two pulleys, and a dial lamp was secured to the pointer carriage. In this way the dial lamp will travel with the pointer and provide maximum illumination at the tuning point.

Cabinet

The cabinet shown in the photograph was made from plywood covered with a piece of rexine which was on hand, and the handle is as used for small cupboard doors and obtainable from most ironmongers. The loudspeaker aperture was made from the lid of a plastic sandwich box; the centre being sawn out, leaving a moulded frame, and then a piece of plastic grille fixed in the opening. In this receiver the loudspeaker was fixed in the bottom half of the cabinet with the chassis at the top, but the arrangement could quite well be reversed; in fact, almost any type of layout could be used, but constructors should avoid trying to mount the "Ferrite" rod too close to the chassis, as this will only lead to a poor signal-to-noise ratio. The "Ferrite" rod should be mounted behind the speaker and as far away from metal parts as possible. If fixing brackets are supplied these should be used, but if a fixing device has to be made it should be of paxolin or similar material, and on no account should metal be used as the use of this material as a fixing bracket for the rod will decrease the Q and spoil performance.

Alignment

The i.f. transformers should be aligned to 465 kc/s, care being taken to keep the "Ferrite" rod away from the underside of the chassis as this will cause instability. As the coils on the "Ferrite" rod are in series for Long Wave operation, it is essential that the Medium waveband should be aligned first.

COMPONENTS LIST—Set out for easy reference to the circuit diagram.

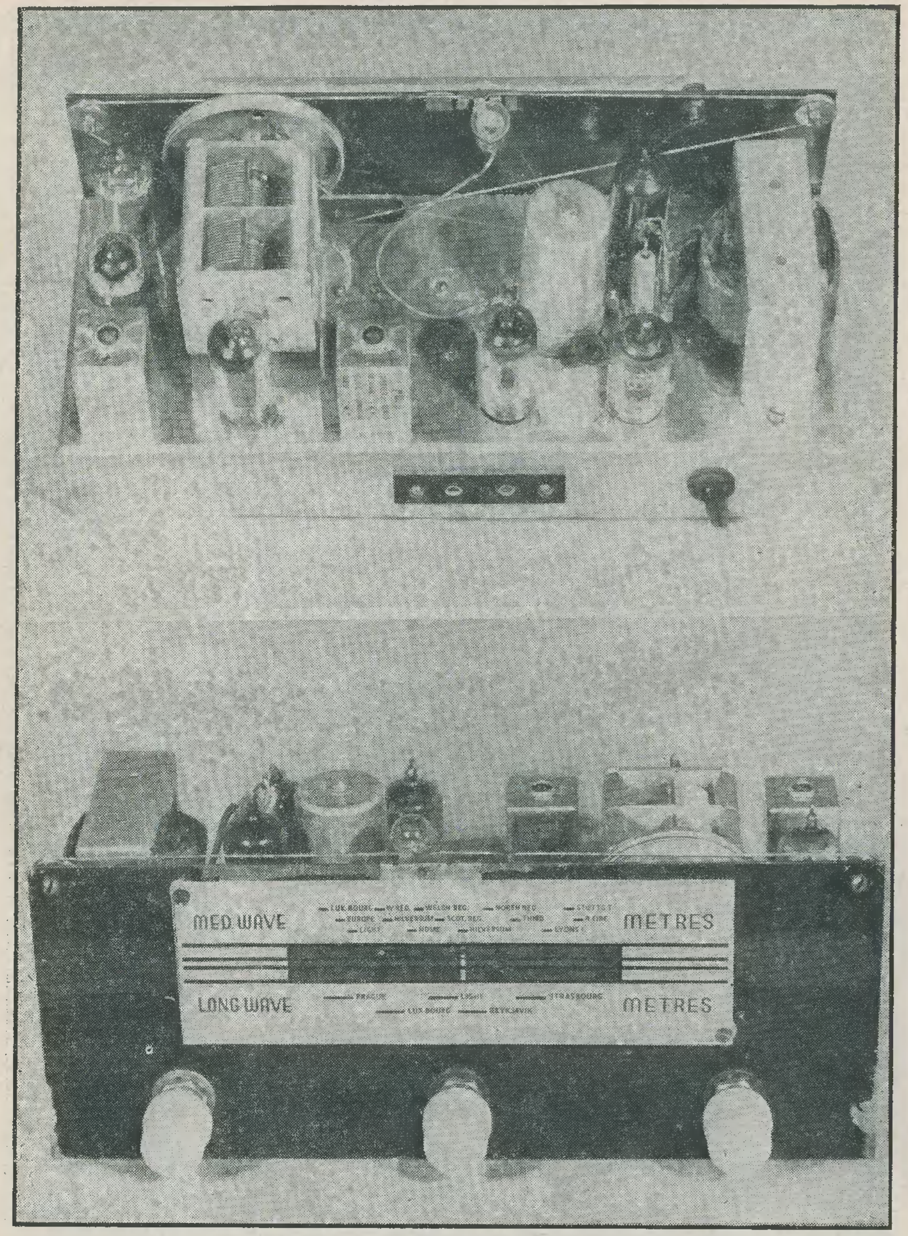
R_1	10kΩ ½W
R_2	68Ω ¼W
R_3	½MΩ ¼W
R_4	47kΩ ½W
R_5	47kΩ ¼W
R_6	47kΩ ¼W
R_7	½MΩ ¼W
R_8	27kΩ 1W
R_9	68Ω ¼W
R_{10}	1MΩ ¼W
R_{11}	47kΩ ¼W
R_{12}	½MΩ Volume control
R_{13}	5.6MΩ ¼W
R_{14}	270kΩ ¼W
R_{15}	470kΩ ¼W
R_{16}	680Ω ½W
R_{17}	2,000Ω 5W Wire-wound
R_{18}	100Ω 1W
C_1	0.1 µF 150VW
C_2	0.1µF 350VW
C_3	20pF Silver mica
C_4	100pF Silver mica
C_5	470pF Silver mica
C_6	150pF Silver mica
C_7	0.1µF 350VW
C_8	0.1µF 150VW
C_9	100pF Silver mica

C_{10}	150pF Silver mica
C_{11}	150pF Silver mica
C_{12}	0.01µF 350VW
C_{13}	0.01µF 350VW
C_{14}	0.01µF 350VW
C_{15}, C_{16}	32 + 32µF 350VW
C_{17}	0.02µF 1,000VW

Medium and Long Wave Ferrite Rod aerial
Medium and Long Wave oscillator coils
500pF twin-gang tuning condenser
T_1, 80 : 1 output transformer
T_2 heater transformer, mains input to 6.3V 2 amps output
IF_1, and IF_2, 465 kc/s I.F. transformers
S_1, Double-pole mains switch ganged with R_{12}
S_2, S_3, S_4, 3-pole 2-way wave change switch
7in × 4in elliptical speaker
Six B7G valveholders
Tuning scale, drive drum, pulleys and pointer
Three knobs. Four 50pF trimmers

Valves

V_1 and V_3	Brimar 6BA6
V_2	Osram X78
V_4	Brimar 6AT6
V_5	Brimar 6AM5
V_6	Mullard EY91



Two views of the chassis of the Ferrite Rod Mains Transportable. Note the long flexible lead to the dial lamp in the top view

The trimmers across the coils should be used at the high frequency end of the band and the oscillator cores at the low frequency end.

After this part of the alignment has been carried out, the receiver should be tuned to a station on the Medium waveband as near as possible to 490 metres, and the Medium Wave coil on the "Ferrite" rod gently moved first towards the end of the rod and then back towards the centre of the rod until the station is peaked to maximum volume. Slight readjustment of the trimmer at the high frequency end of the band can now be made. The same procedure can now be carried out on the Long waveband, but in some areas it may be found an advantage to peak the Long Wave coil on the Light programme station on 1,500 metres. Constructors will find that the receiver is sharply directional, and the best results from any given station can be obtained by slowly turning the receiver until maximum volume is obtained, The directional properties of the set need not be used on local stations, where ample volume will be obtained. A word of warning would not be out of place at this point: The "Ferrite" rod is as brittle as glass, and on no account should it be dropped, as it is certain to break.

Any good make of components may be used, and alternative valves have been tried with success in some positions in the set. As an example it is possible to use Mullard EF92 valves for the h.f. and i.f. stages in the set. The valveholder must be rewired for the new valve, and the cathode bias resistor must be changed to one of 220 ohms.

For those constructors requiring a greater output, a Brimar 6AQ5 valve may be used in the output stage. In this case the valveholder must be wired to suit the valve, and the cathode bias resistor should be changed to one of 270 ohms 1 watt, and the output transformer ratio should be 45 : 1. An output of about 2.5 watts will then be obtained.

The EY91 half-wave rectifier valve may be changed for a Brimar 6X4 if the valveholder is wired to suit the valve and the anodes are strapped together.

When substituting valves the total heater current should be noted, as with some combinations of valves the current will exceed 2 amps and a large heater transformer may be needed.

With the Osram X78 frequency changer valve the cathode is joined internally to heater at pin 3, and therefore this pin must be connected to chassis, the valve obtaining bias from the a.v.c. line.

All the valves so far mentioned are of the B7G base type, but there is no reason why the constructor should not adapt other types which he may have on hand. For instance, the Brimar 6BW6, which has a B9A base, could quite well be used in the output stage. In this receiver a 7in × 4in elliptical loudspeaker was used mainly because of the good tonal quality with minimum height, but any size of loudspeaker may be used provided allowance is made for it when making the cabinet.

Finally, it should be mentioned that if any change of valves or components is made after the receiver has been working, it should be realigned for maximum performance.

For those constructors who may be interested it has been found that the receiver works very well in conjunction with a magnetic tape recorder. A 2-way socket strip was mounted on the back of the chassis, one socket being connected to chassis via a 0.05 μF 1,000VW condenser; the other socket was connected to the signal diode through a 0.01 μF 350VW condenser. The output was taken through a screened cable to the pick-up input sockets on the recorder. Before recording, it should be ascertained that the mains connection to the receiver is connected in the right sense; otherwise modulation hum may be experienced. Should this happen the mains plug must be reversed.

RADIO—AND CONTROL

PART 3. *by* RAYMOND F. STOCK

Independent Controls

In the previous article we discussed fixed mark/space systems. Attempts have been made, however, to vary mark/space ratio and pulse repetition rate independently. This can easily be achieved by controlling the speed of the pulse-drum driving motor at the transmitter end—but separating the two effects at the receiver is a different matter! Generally, complete independence of channels is impossible, though one system was devised by the author to give proportional control over both steering and speed in a model only 9in long.

The dogged reader who is still with me may conclude that if the problem can be solved in such a small model no difficulties should arise in normal cases, and the foregoing examples have been a waste of space. Not so! This particular system is permissible in a model built for a special purpose (to exploit absolute minimum size) but seems unethical for more orthodox purposes.

The secret is in steering by engines; in this way only one function in the model need be controlled, i.e. motor speed, both collectively or differentially. In fact, if a twin screw model (beamy and therefore with widely spaced thrust lines) is steered by engines it should be more manoeuvrable than with the orthodox rudder.

Fig. 14 gives the circuit. A very simple hard valve receiver terminates in the usual sensitive relay; the latter can follow accurately pulses of any speed used. The forward contact A and back contact B energise relays P and S, and these in turn energise driving motors MP and MS connected to twin screws.

When the mark/space ratio is 50% both relays and motors are energised for equal periods and the thrusts on both sides of the model are equal. Consequently, the course is a straight line. At 0% or 100% one motor is running continuously and the model turns hard a'port or hard a'starboard (actually with a turning circle of 2ft 3in in the 9in model). At intermediate mark/space ratios a proportionate effect results and steering is remarkably accurate. The pulse rate of

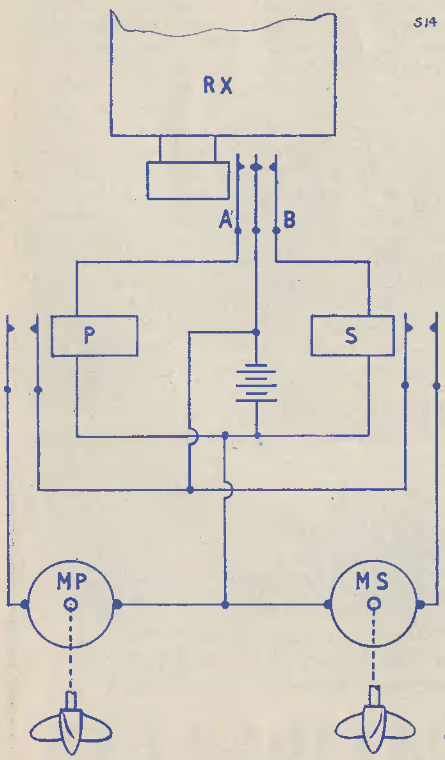
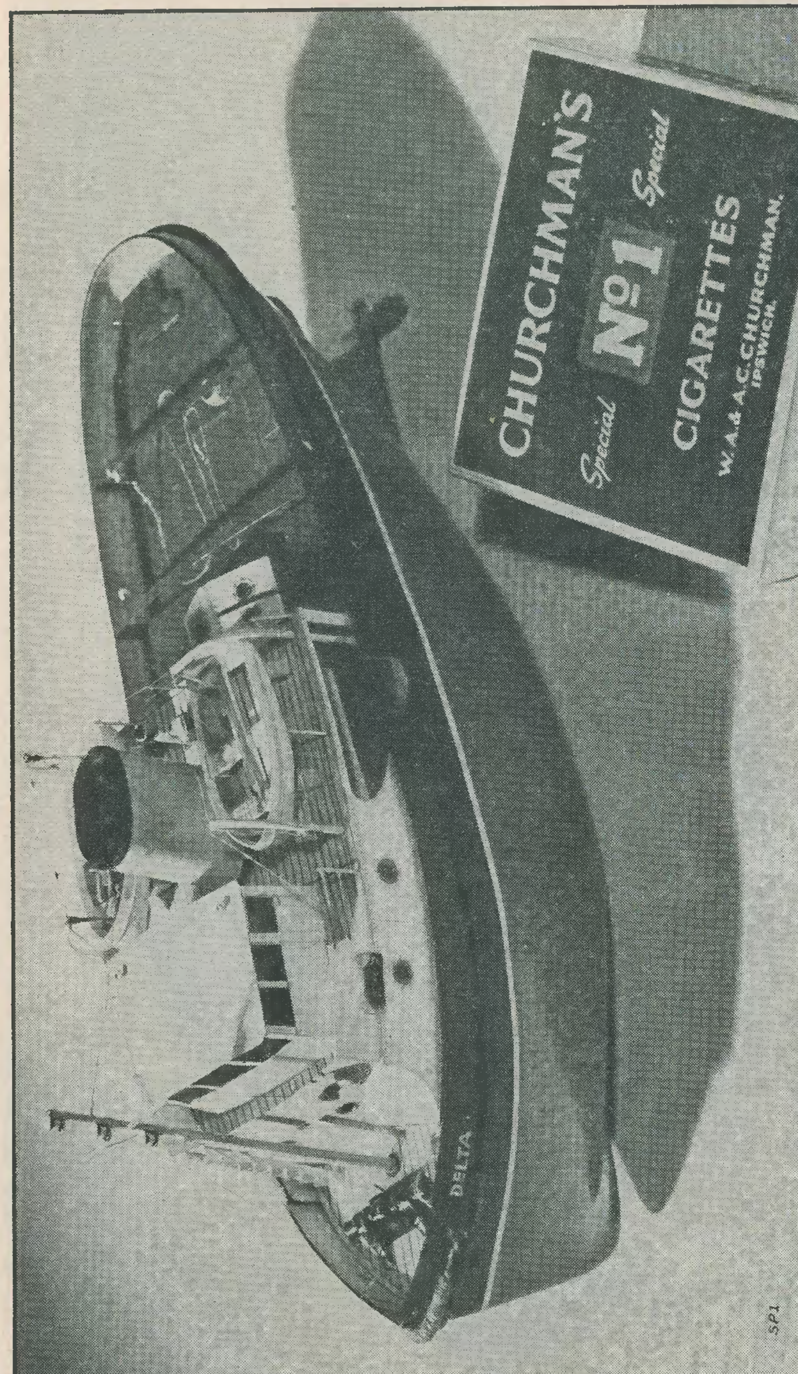


Fig. 14. Suppressor condensers are used across the motors due to their proximity to the radio receiver



A miniature radio controlled tug built by the author. Only 9in long, it is constructed from paper and balsa wood, the hull being of layers of paper built up on a wooden former

This view shows how the complete superstructure may be removed for easy access to the interior. The model is driven by two Electrotor motors, and the receiver uses a squegging hard valve circuit (3V4). Batteries used are three 22.5V deaf-aid types for h.t., a pencell for l.t., and a 4.5V lamp battery for local power (motors, relays, etc.).

about 4 per second is too fast for the motors ever to stop entirely in central steering positions, and the inertia of the model prevents it "wagging its tail."

If the pulse rate is progressively increased (irrespective of the mark/space ratio), relays P and S are unable to follow cleanly, since they are designed to be slow to-close, and the amount of power passed to the motors per cycle is reduced proportionally.

At about 25 p.p.s. these relays never actually close and the motors stop. It is thus possible to get a full proportional control of the model from Stop to Full Ahead.

As an example of the impossibility of completely separating the two effects of pulse rate and mark/space ratio, however, it will be seen that as the pulse rate is increased towards the stop position it is necessary to centralise the wheel, and complete "stop" can be obtained only with the wheel within 10 degrees of amidships.

Pulse Systems

There is an entirely different method of approaching proportional control which can give as good, or even better, results. This requires the transmission of two types of information and therefore, in general, two radio channels per control. With certain reservations, noted later, it is possible to use the vibrator method on a single channel (as shown earlier in Fig. 3), but whichever radio link is employed the essential feature must be the provision of two relays in the model, either of which can be instantly operated quite independently of the other.

Fig. 15 depicts the principle. RP and RS are the two relays, and each one operates a steering unit (UP and US). These units are identical, and each rotates its output shaft through a specified angle whenever a single pulse arrives on its own channel.

The two mechanical outputs (rotating in opposite directions) are suitably combined and fed to the rudder.

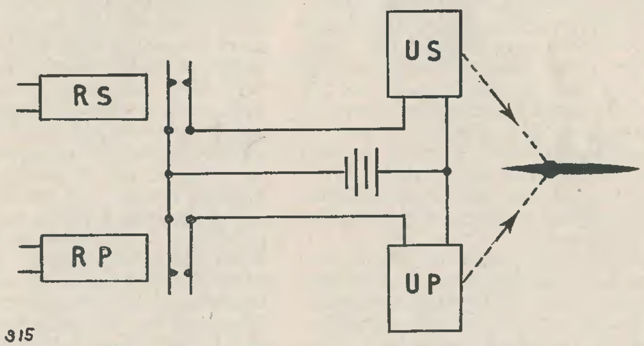


Fig. 15

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Nevertheless, this is no disadvantage in practice, and the complete system results in an interesting development of mark/space for a specific purpose. Undoubtedly the idea can be employed for much larger models if one has no scruples about ignoring the rudder completely. Given more space, one could add reversing and other facilities. In this case the steering would employ from 90% to 10% ratio and other relays could be added, which by delay circuits could respond only to a full mark or a full space. One of these might operate a two-pole reversing switch, the other being available for additional facilities.

As a matter of interest the accompanying photographs show the 9in model tug, which weighs, complete, just under 1lb.

The number of pulses transmitted obviously determines the angle through which the rudder rotates, while the channel selected determines the direction of movement.

It will be evident that the smallest movement of the rudder possible is that due to one pulse, and this represents the limit of resolution. Should the steps in which the rudder moves be large, it would be more correct to refer to the system as "Positional." In this context, however, we are assuming that the steps are small, so we are justified in calling the system proportional; it has already been stated that no system can have an infinitely close degree of resolution, and in practice a limiting factor would ultimately be backlash in gearing.

(To be continued)

Radio Miscellany

WHEREVER I HAVE BEEN IN RECENT weeks, whether at club meetings or mere gatherings of two or three enthusiasts, the subject of electric drills has come under discussion. Much gratuitous advice is given on which of the three popular makes is best suited for general use, or perhaps I should say, the more specialised uses. There is, of course, little to choose between them for the simpler uses such as drilling, sanding and grinding. It is when one requires the attachments for the more complicated uses such as bench planing, circular sawing or wood-turning, that doubts begin to arise whether one really chose the "best" make. Nor are the differences small enough to enable the average user to readily modify a piece of additional equipment of one make to be serviceable with another. Even the circular saw blades are of different diameter and have different size centre fitting holes. Thus they are not only non-interchangeable but, as far as I can discover, each make has only one tooth size.

Not only have I felt unable to join in these arguments, but I am still undecided whether I bought the "best" one myself. I bought mine when one firm was way out ahead of the others in the matter of extra tools—which largely influenced my choice—but it is not as easy as that to decide nowadays. For the new customer it has become a question of which equipment kits are most likely to meet his future needs, and although similar types of equipment may be available there may be quite a difference in the range of work to which they can be put.

The position has been made somewhat easier by the availability of a small range of "universal" tools, and now that a new (but rather expensive) multiple tool is likely to be available in quantity in the early future it should be easier for the potential purchaser to make up his mind.

Thinking of electric drills reminds me that a recent demonstration of one made in an I.T.A. advertisement was so effective that a neighbour of mine went out and bought one the next day! He is a non-radio man, and it was the circular saw that got him. Not that he had got any immediate sawing jobs to do—just the memory of the blisters he had the last time he did some sawing by hand. Maybe it is the same sort of fascination which knives with a "thing-for-pulling-stones-out-of-horses-hooves" are alleged to have for Boy Scouts. It's nice to know your drill could be used for other things, however unlikely you are to need them.

Full Steam

Those who are interested in the technical side of radio rarely do much listening of a general nature. Within my experience, the more thoughtful a person is the greater their dislike of distracting noises, and I have long since been convinced that it is only those with nothing else to think about who can stand the radio going all day—and there seems to be lots of them about. Whenever a few people get together with no special purpose someone, at the first silence, looks round for the wireless and switches it on full blast. I still have memories, from my Army days, of canteens and clubs where badly adjusted radios blared out during the whole time they were open. If, by chance, it happened to be peaceful, some half-wit would enter and straightaway turn it on and re-tune it roughly to any station with dance music. Apart from overloading the output stage, inaccurate tuning added to the discordancy by cutting the side-bands, to torture the lives of both the peaceful and the music-loving.

A sharp reminder of this came to me from a book I have just been reading. It deals with prison life, where apparently some of the star prisoners are "privileged" to occasionally listen to the B.B.C. The book is "The Verdict of You All," by R. Croft-Cooke, and the passage reads: "—one torture was inflicted here as mercilessly as at Brixton and in D Hall at the Scrubs; this was compulsory B.B.C. A specially powerful loudspeaker, supplied by a radio set in full blast, gave out the more fatuous programmes, idiotic guessing-games—" etc. Incidentally, I found the book most engrossing, very disturbing, and certainly well worth reading.

I wondered if even this could bring a blush of shame to the faces of our programme planners. It should be bitter irony to know that their efforts fail to relieve the dragging monotony of prison life!

As Others See Us

My comments in our centenary number, giving a brief history of *The Radio Constructor* and an outline of policy, brought a surprisingly heavy response from readers. Many of them wrote to me—rather too many to answer individually—but they have all been passed to the editorial staff concerned. It is very pleasant to know that so many regard *The Radio Constructor* as a circle of friends rather than just another magazine, and that they feel almost as much interest in its contents and policy as do the editorial staff. Everyone warmly endorsed the idea that *R.C.* should be a *Magazine*; something more than a text-book in monthly instalments, or a serialised collection of circuits no sooner built than forgotten about.

A very high proportion of new readers said they had built high quality amplifiers and that their interests were a.m. and f.m. tuner units—preferably an a.m. unit to which the latter could later be added.

Mr. P. W. Grundy (Sheffield, 11) not only supported this idea but asks for a spring-back binder to keep his library of circuits, etc., in order. I understand the Kingscroft Portfolio No. 4287 just fits the bill. The price is 6s. (1s. 1d. postage) and it is made by J. C. King Ltd., 42/62 Goswell Road, London, E.C.1.

The grouping of constructional features in the centre pages is not quite so easy as it sounds, but it is the normal policy to use these pages for the front cover feature—usually the main constructional item of the month.

E.F.D. of Wandsworth, S.W.18, puts forward an idea which may have a fairly wide appeal. He says: "I should like to see a couple of pages, say alternate months, on cabinet making with simple tools. Many readers must want designs for t.v., portable, corner and extension speakers, especially with methods of making dial and c.r.t. cut-outs or speaker frets. Rarely is one lucky enough to find cabinets which will fit a modern set decently, and any set worth making is worthy of a presentable case. Even if one finds a cabinet "near-enough" no little carpentry skill is required to adapt it to take the dial.

CENTRE TAP *talks about* DRILL KITS / THE MAGAZINE / CABINETS

To build up on this system is an eminently sensible idea. As far back as the days when simple made-in-an-evening sets were the vogue I advocated a similar policy. Then, it was a question of building the power stage and l.f. amplifier as a *permanent* item. Whatever the circuit favoured, these remained the same. The rest of the set could be fitted to a separate chassis member which could be changed, modified or modernised according to the constructor's experience, ambitions or pocket. Among my current gear the 2-metre converter is built on these lines, as also is the t.v. receiver. The latter, incidentally, took weeks of work when I first built it, but I can at least rebuild any section of it in a couple of evenings should I want to do so.

Suggestions

Several readers advocated planning the magazine so that the constructional articles were grouped in the centre pages. This, they urged, would enable quick detachment and permit easy filing for reference purposes without having too many loose sheets.

"Points which should also be fully covered are the various processes for amateur french polishing and the results to be expected, and even more important, cabinet acoustics. Also, why not invite readers' photographs of cabinets of their own design and making? Nor should work-benches and tool chests be neglected."

I have seen a lot of home-made cabinets at various times and while many of them were very good, the chief fault which marred the others was clumsy internal strengthening. It seems to be the basic difference between the handyman-carpenter and the man who follows professional methods. Butt joints and awkward inside reinforcement invariably spoil the general outline and make for a clumsy, patchwork appearance.

Where We Came In

I started off this month's Miscellany on electric drills and their ancillary tools. Now I find myself led around to them again. Quite a proportion of constructors have added an electric drill to their workshop

(*Continued on page 345*)

RIGHT—*From the Start*

PART 1: SYMBOLS

by **A. P. BLACKBURN**

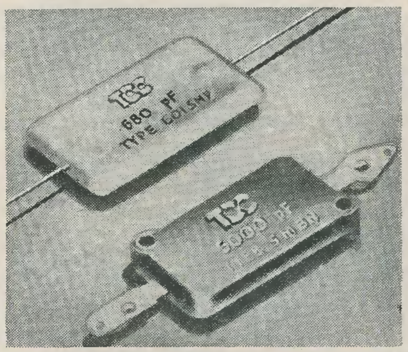
THIS IS A NEW SCIENCE. LOTS OF PEOPLE will laugh at that, but nevertheless, it *is* a comparatively new science. And if you are a beginner to radio, you are a new conquest. During the last twenty-five years, the number of radio amateurs has increased to such an extent that no other branch of art or science can boast of so many followers. Having become interested because of the educational efforts of school or service, perhaps, the average beginner starts, with the help of a kit of parts and a blueprinted layout, by making his first receiver or amplifier.

Now that, of course, is a very satisfactory achievement. Indeed, many people stop there and decide that an ability to follow a diagram is all they need to set them up in the "expert" class. However, when friends and relations have admired, and fingered, and questioned, and the finished product is no longer the sole topic of conversation, the true beginner wants to follow up his advantage and firmly establish himself as an expert. The only way to do that is to find out and learn *why* the instruments work; why did it go wrong? Could I design one?

An Electrolytic Condenser—
The T.C.C. type "Micropack"

No reason in the world why you couldn't, once you've learned the theory, and done some practical work. Those mysterious circuit diagrams will then no longer be mysterious, and the mumbling discontent of having only "put the thing together" will give way to a very satisfactory pride.

This series has been designed to help that transition.



Mica Condensers

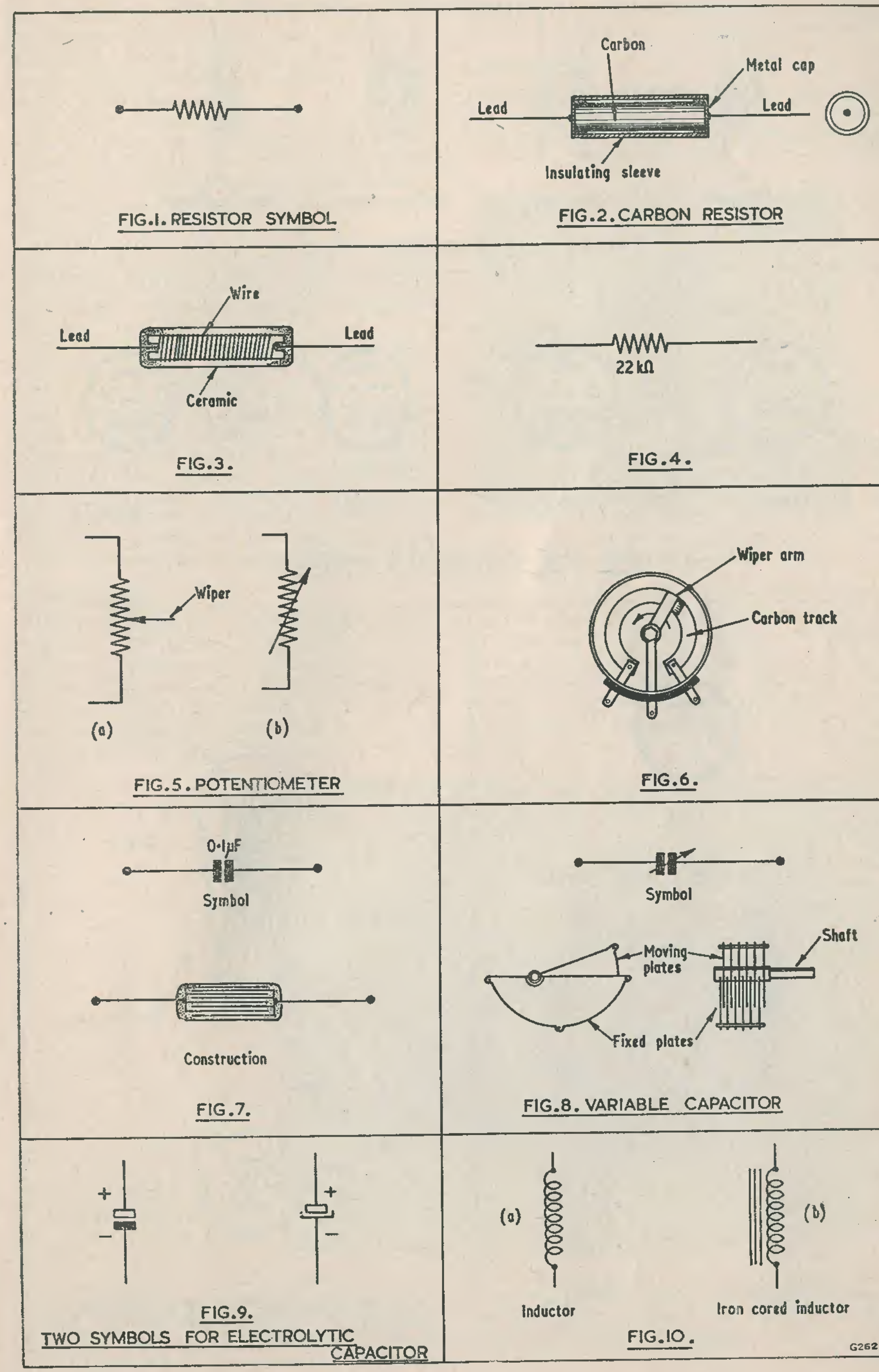
Circuit Diagrams

Many articles are published which contain no point-to-point wiring diagram, and undoubtedly reading a circuit diagram is the first difficulty to be met by the newcomer. The ability to interpret a circuit diagram is therefore essential, before one can hope to know more about the subject of radio.

Circuit diagrams are a form of symbolic representation, which saves everyone a great deal of time. They are used to reduce the tedium of ploughing through mazes of intricate wiring diagrams. So instead of drawing a component as it actually appears, a symbol is used to represent it. The first component to consider is the resistor.

Resistors

The symbol for the resistor is shown in Fig. 1. It is a component which can take many forms; probably the most common is



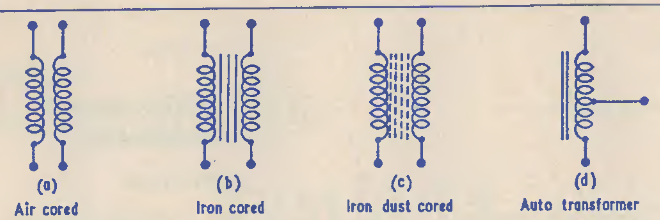


FIG. 11. TRANSFORMERS

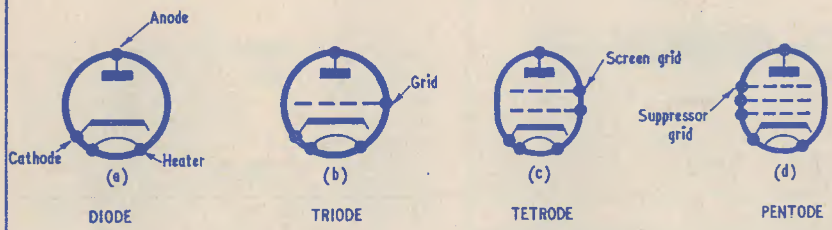


FIG. 12. SOME COMMON VALVE SYMBOLS

FIG. 13. DIRECTLY HEATED TRIODE

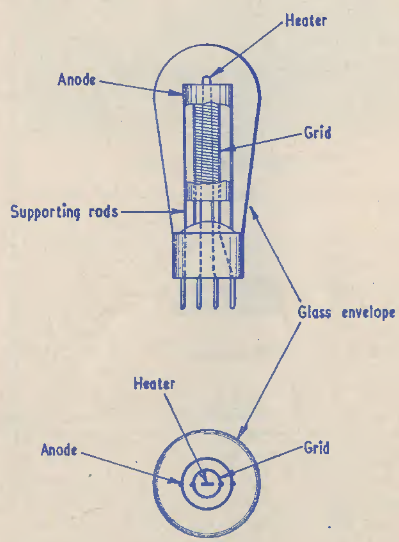


FIG. 14. CONSTRUCTION OF A TRIODE

G263

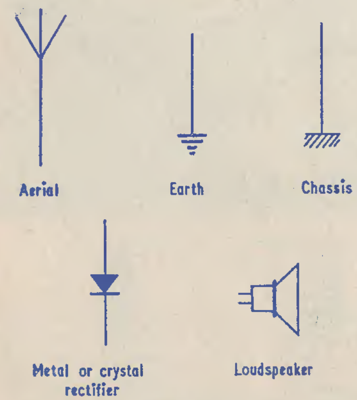


FIG. 15.

the carbon type. It consists of a carbon compound cylinder with a lead attached to both ends. Some types have a ceramic insulating tube surrounding the carbon rod, as shown in Fig. 2.

Another common type is the wire-wound resistor. Here the resistance material is wire instead of carbon. The wire is normally wound on a former, and in some types a layer of glazed ceramic is coated on the outside, as shown in Fig. 3.

Carbon resistors are normally used when the power to be dissipated in them is low—of the order of one or two watts—whereas wire-wound types may be used up to hundreds of watts.

The same symbol (Fig. 1) is used whatever type of resistor is specified.

The unit of resistance is the ohm. Once again the symbol is used to avoid writing the whole word; the symbol is Ω (capital omega). Often many thousands of ohms are required, sometimes many millions. A thousand ohms is designated by kΩ, meaning kilohms, and a million ohms by MΩ, meaning megohms. The resistor shown in Fig. 4 therefore has a value of twenty-two thousand ohms.

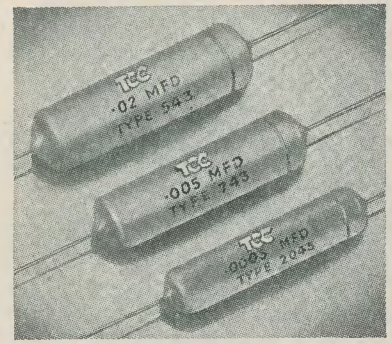
Potentiometers

Potentiometers are really variable-tapped resistors. The symbol is shown in Fig. 5a. The same component connected differently, as a variable resistor, is shown in Fig. 5b. (This is achieved by connecting the wiper and one outer contact together.)

A potentiometer may be carbon or wire-wound, in the same way as an ordinary resistor. It consists of a carbon or wire track with a slider as shown in Fig. 6. Like resistors, their values are measured in ohms.

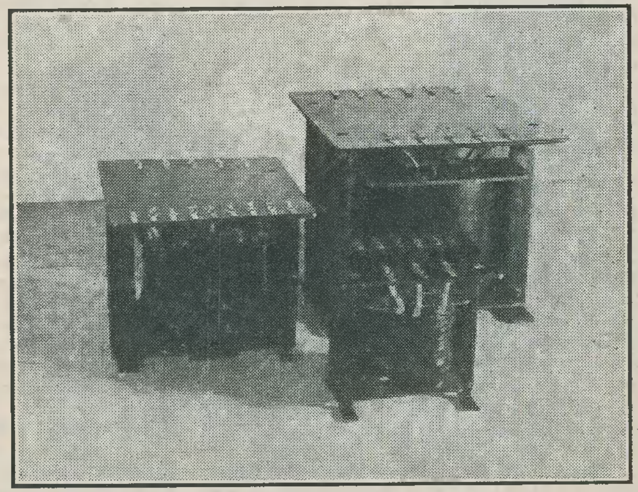
Capacitors

Capacitors (otherwise known as condensers), have a circuit symbol which represents perfectly their actual construction.



Tubular Paper Condensers of various values

Fig. 7 shows a capacitor and the way in which a simple one may be constructed. It consists of a set of plates connected together, and insulated from another set similarly connected. The physical shape and construction of capacitors varies considerably from type to type, and make to make. The material used for insulation between sets of plates also varies considerably.



A group of Iron Cored (Mains) Transformers. See Fig. 11

The unit of capacity is the farad. Normally capacitors have values far smaller than this, and the microfarad (one-millionth of a farad) and the micro microfarad (one million-millionth of a farad) are used. The microfarad is designated by μF and the micro-microfarad by $\mu\mu$F or pF. If pF is used, it is often called the picofarad (or just "puff"). The capacitor in Fig. 7 has, therefore, a value of 0.1 microfarads.

Some capacitors are variable, that is, their value may be changed by turning a shaft. These are familiar to anyone who has looked at the inside of a radio set.

The symbol and construction of a variable capacitor are shown in Fig. 8. The capacity between sets of plates is varied by moving one set away from the other.

Another important type of capacitor is the "electrolytic." This is used when high values of capacity are required in a small space. The symbols are shown in Fig. 9. Electrolytic capacitors have a definite polarity (normally marked + on one terminal and — on the other). Should one be connected wrongly, damage to it will almost certainly result.

All capacitors have a "voltage rating." This is the maximum voltage which may be connected across the component. If it is exceeded a voltage breakdown between the plates is probable.

A miniature variable condenser

Coils

The symbol for a coil is shown in Fig. 10. This is pretty well self-explanatory, merely representing a coil of wire. If the wire is wound on an iron core, parallel lines are added as shown in Fig. 10b.

In the same way that a resistor has resistance, a coil is said to have inductance. Inductance is measured in henrys; or millihenrys (mH) for one thousandth of a henry or microhenrys (μH) for a millionth of a henry.

Inductors (coils) vary considerably in their physical shape. Those of low inductance value may consist of one or two turns of heavy gauge wire, self supporting, whilst iron cored types may have thousands of turns would on an insulating former, and have a value of tens of henrys.

Transformers

These, like inductors, fall into many classes and have many uses. The symbols used for transformers are shown in Fig. 11. As may be seen from this figure, a transformer consists of two coils, with the exception of (d).

(a) is an air cored transformer, merely consisting of two windings wound close together; (b) is similar to (a) but an iron core has been introduced. (c) has a "dust iron" core. This is a material made up of minute iron fragments moulded into the required shape. (d) is the exception in transformers. It has only one coil, which is "tapped," that is, a connection is made at a point between the ends of the winding. This type is called an auto-transformer and may be air cored, iron cored or dust iron cored.

Valves

There are many types of valves, and there are a corresponding number of symbols. We will not involve ourselves with the operation of valves at the moment, but merely draw up a table (Fig. 12) of the commoner types and their symbols.

All the valves in Fig. 12 are "indirectly heated." However, every one of them may be "directly heated," an example of which is shown in Fig. 13. The only difference is that the electrode called the cathode is "missing" in directly heated types; that is, the heater (or filament as it is more commonly called in battery types) is coated to act as a cathode.

You will probably have noticed that the valve names indicate numbers; for example, triode (three) and diode (two). These names indicate the number of electrodes in the valve, not counting the heater. As an example, an extra grid added to a triode makes it a tetrode, but if the valve was indirectly heated and a cathode were added, the valve is still a tetrode and does not become a pentode.

Once again, the valve symbol is a very logical one. It represents the construction of a valve in a remarkably accurate and simple manner. Fig. 14 shows a simple, directly heated triode. At the centre is the filament or heater. Wound around it, but not in contact with it, is the grid, consisting of a helix of fine wire. Surrounding the whole is the anode—a metal tube rigidly supported. The electrodes are connected to the base by the supporting rods.

Miscellaneous Symbols

A few symbols which are frequently found in every day circuits are shown in Fig. 15. With the exception of the rectifier, they are self-explanatory.

Next month we shall examine a simple circuit and consider how it may be translated into a piece of working apparatus.

Constructional Exhibits

at the Ninth Annual R.S.G.B. Amateur Radio Exhibition

PROMPTLY AT NOON, ON WEDNESDAY 23RD November, the Ninth Annual R.S.G.B. Amateur Radio Exhibition was opened at the Royal Hotel by Vice-Admiral J. W. S. Dorling, C.B., M.I.E.E., M.BRIT.I.R.E., in the presence of the President, Council and many new and old-timers anxious to have a preview of the stands and exhibits before the crowds appeared later in the day.

Full marks again to Mr. Phil Thorogood for the organisation of yet another excellent show, and for his most generous gesture in the presentation of a beautiful silver trophy to be awarded to the R.S.G.B. member exhibiting the most meritorious item of equipment. The judges had a most arduous task in endeavouring to choose the winner, as the work exhibited was of an exceptionally high standard, but it was eventually awarded to Lt. D. Beacon, G3BCM, for his complete miniature home-built Transceiver for operation on all bands from 1.8 to 28 Mc/s; a very handsome and well-designed unit.

Much thought and hard work had also been put in by members of the Exhibition (Home Constructors) Committee, whose duty it is to make the exhibition more attractive and interesting.

Amateur television was again to the fore and this year's television demonstration was very ably conducted by G3DUS, J. B. Howard, using all of his own home-built equipment. This consisted of a Storticon camera, quite a small unit, only 12in. × 4in. × 10in. in size, with a turret carrying three lenses for short, medium and long focus, a 16mm Telecine Unit and Test Card "C" Monoscope, as well as the main television waveform generator and power supplies. Mr. Howard had gone to great lengths to simplify as much as possible the station layout, and is of the opinion that the whole equipment could be built for around £250. By using surplus material, where possible, this figure could be still further reduced. Excellent pictures of various members and of the exhibition itself were to be seen daily on the screens and Mr. Howard is to be congratulated on a fine show. Also on the stand was a Flywheel Spot Scanner by M. H. Cox, suitable for the t.v. beginner, which was built chiefly of surplus material. It uses the standard 200 line scan, i.e., 10kc/s line frequency, 50 cycle frame, with a 931 photo cell. Mr. Cox stated that this unit cost only about £15 to produce.

The sound side was well taken care of by GB3RS. This station operated throughout the day on the 1.8 and 3.5 Mc/s bands, using D. C. Jardin, G5DJ's very attractive rack built and t.v.i. proof transmitter, modulator and power supplies. Over 300 contacts in all were made, and cards were written out at the conclusion of every QSO. For the first year since the exhibition opened, a live station was run on 2 metres using a J-Beam aerial, 50 feet above the hotel roof. The equipment used was the mobile station of C. J. McClelland, G6AG, a very compact and businesslike effort, and over 50 contacts were made in and around London.

VHF/UHF Stand

The practical method of aerial matching within the means of the average ham was demonstrated, showing how an aerial could be matched using an open-wire two-stud tuner and small pea lamps, comparing this method with the very expensive equipment of high accuracy standard. Another interesting exhibit on this stand was the ZC39A crystal controlled high power tripler for 24cm, with an input of 25 watts, together with its rotatable beam, displayed by S. C. Tucker, G5DT. Other exhibits were a 24cm crystal controlled converter by D. W. Furby, G3EOH; an all-6J6 two metre transmitter, 3 watts input, by R. B. Forge, G3FRG, which has worked up to 300 miles; a 3 watt power tripler for 24cm by A. L. Mynett, G3HBW; a two-metre mobile equipment by T. O. G. Talboys, G2ATK; and others too numerous to mention.

Single Side Band Stand

The S.S.B. stand again stressed the no t.v.i. theme and some very excellent items of equipment were on show. A 2-band mixer and amplifier exhibit by G. H. F. Knott, G3CU; a filter modulator unit by G. N. Myatt, G3FRN; a single side band receiver with three-section crystal filter by G. C. Bagley, G3FHL; a pulsed two-tone oscillator by B. J. Rogers, G3ILI, and a phase shift exciter by J. Mortimer, G2MF. Much interest was again shown on this specialised subject, and the stand personnel were kept busy demonstrating and answering questions.

H.F. and Test Equipment Stand

This was, as usual, well patronised, as it carries all miscellaneous equipment from 1.7 Mc/s down to 28 Mc/s, as well as the ancillary equipment. Obviously the apparatus which drew most attention was the miniature Transceiver by Lt. Deacon which had won the silver trophy. A useful instrument was the GDO 6-range switched turret made by Mr. J. Davie, G2XG. A phone and signal monitor by C. H. Edwards, G8TL, was a necessary and easily constructed unit. Mr. E. Yeomanson, G3IIR, who is well known for his neat workmanship, displayed his latest harmonic checking unit for 45cm, and also an excellently built 150 watt 5-band transmitter to G3BTM's design. Also on this stand was a linear PA by S. H. Feldman, G3GBN; a very neat countryman's mobile transmitter/receiver for the 1.8–3.5 Mc/s bands made by F. W. Crabtree, G3BK; a signal amplifier by E. G. Styles, G3JSE, and a well-constructed 150 watt band-switched transmitter by G. G. Gibbs, G3AAZ. All of these items were taken at random from a stand full of first-class gear, there being little to choose in workmanship and ingenuity.

Headquarters Stand

Always the centre of activity, Headquarters Stand again lived up to its reputation this year. The usual R.S.G.B. publications were on sale, and a new 1956 Winter Call Book was published and available. Pieces of equipment on show by the Technical Committee were: the antenna match by F. Hicks-Arnold, G6MB; the new Britannia Communications Receiver by A. D. Odell, BRS20655; a simple bridge for measuring the separate resistive and reactive components of aerial impedances, frequency ranges up to 30 Mc/s, by R. H. Hammans, G2IG, and a 2-valve F. M.Tuner with crystal or vacuum diodes by A. H. Koster, G3ECA. Mr. J. Rouse, G2AHL, the Assistant Editor, who was available most of the time, was kept busy answering many questions. Particularly on the Saturday, the staff and voluntary members had a hectic time.

The exhibition was visited on the opening day by the I.T.A. newsreel staff, and part of the film taken was reproduced in the late night news. The B.B.C., not to be outdone, attended on the Saturday morning and a sound broadcast on discs was recorded. Included in this was a QSO between the 2 metre station at the exhibition, GB2RS, and a mobile station with which Mr. Rouse, the Assistant Editor, and the B.B.C. commentator, circled around town.

Altogether a good time was had by all, and well over 2,000 members visited the show.

Can Anyone Help?

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

H. Hinde, 97 Burton Road, Withington, Manchester 20, is anxious to obtain data on the transmitter T1403, and also the circuit of the Identification Unit R.D.F. No. 1.

* * *

E. G. Woods, 28 Pall Mall, Leigh-on-Sea, Essex, wishes to buy or borrow the circuit and data of the Philips a.c./d.c. receiver model 753.U.15.

* * *

G. P. Langton, 55 Engadine Street, Southfields, London, S.W.18, wonders if any reader can sell or lend to him the circuit of the Regentone eliminator, model W.5 200/250V a.c.

* * *

E. Eaton, GW3KLU, Kelsterton Hall, Flint, Flintshire, N. Wales, will willingly purchase, or reimburse anyone able to supply on loan, the circuit and/or conversion data for the Bendix T.A. 12B transmitter.

* * *

G. Frost, of Meadow View, The Grove, Broadway, Weymouth, wishes to buy or borrow the circuit and valve line-up of the ex-Navy Receiver M361.

* * *

H. Dawson, "Rocklea," 402 Uttoxeter Road, Blythe Bridge, Stoke-on-Trent, Staffs, wishes to purchase information about bandspreading, and fitting an "S" meter to the R1155.

* * *

F. Hewitt, 188 Hamilton Road, Glasgow, E.2, wishes to buy, preferably, or borrow, handbooks for the Hallicrafters SX28 and the R1155A receivers.

R. T. McIntyre, Calderstones Hospital, Whalley, Blackburn, Lancs, would appreciate any information on valve types and line-up, type of h.t. battery, etc., for the ex-Admiralty 4-valve battery receiver Marconi 361.

* * *

J. Grasby, "Ivy Gables," Longhurst Lane, Marple Bridge, Cheshire, would be very glad to learn the valve line-up, and any other information such as working frequencies, etc., of the type CRP 46 ACA Radar Receiver, a unit of the Model SD13 Radar Equipment manufactured by the Raytheon Mfg. Co.

* * *

Garth Ollerton, 190 Town Lane, Denton, Manchester, requires the circuit of the RDF No. 1 either on loan or purchase.

* * *

M. J. Montgomery, Lea House (F), Ardingly College, near Haywards Heath, Sussex, wishes to obtain the circuit of the American BC929A Indicator Unit.

* * *

R. S. Haslam, 3 Wasdale Grove, Terenure, Dublin, Eire, would be grateful for any information regarding the Bendix TA.12G or TA.12A to C transmitters. He is willing to purchase or borrow the circuit diagram/manual and any conversion data.

* * *

G. C. Deal, 8 Tutor Road, Leuchars, Fife, Scotland, wonders if any reader can assist him by supplying the circuit of the MCR1 Miniature Receiver and the a.c./d.c. Mains Power Unit for same.

MORE TRANSISTORY

by **B. H. JAY**

The small transistor receiver described in our February, 1955, issue served as a simple example of the possibilities of "transistorised" reception. However, the point type of transistor used as a detector does not represent the optimum use of a single transistor. There are of course several possibilities, including such things as the reflexing type of circuit (described in a *Teletron* leaflet supplied with their transistor coils). But for simplicity, and for volume of output, it is difficult to beat a "crystal detector/junction transistor" combination.

Readers may be interested, therefore, in experiments made using the little chassis previously described as a basis for a "Detector l.f." combination—transistorwise. While present types of junction transistor on sale in this country have a very limited h.f. performance—a matter being speedily remedied —they make excellent l.f. amplifiers. In fact, the output from a crystal set followed by a junction transistor will provide loud headphone, and even loudspeaker, results from a strong signal.

soldering are thus easily obeyed, providing one does not solder on the leads closer than an inch to the body of the transistor. Moreover, if the wires are gripped by a pair of pliers when soldering, effective "thermal shunting" is achieved, and no fear of damage to the transistor need be felt. Warnings are in order not so much because of the fragility of transistors, which are physically very robust little creatures, but because familiarity breeding contempt may cause a valuable transistor to be damaged!

There are many ways of using a junction transistor as an l.f amplifier The most useful method for our purpose is the "earthed emitter" connection, which is the "dual" of the usual earthed cathode valve amplifier (Fig. 1). To connect a crystal detector audio output to the transistor input the obvious method is to use conventional audio r.c. coupling circuits (Fig. 2). However, there is a snag in this. Due to the low input impedance of the transistor, a sizeable coupling capacity is needed if excessive bass loss is to be avoided. The usual types of 0.5μF

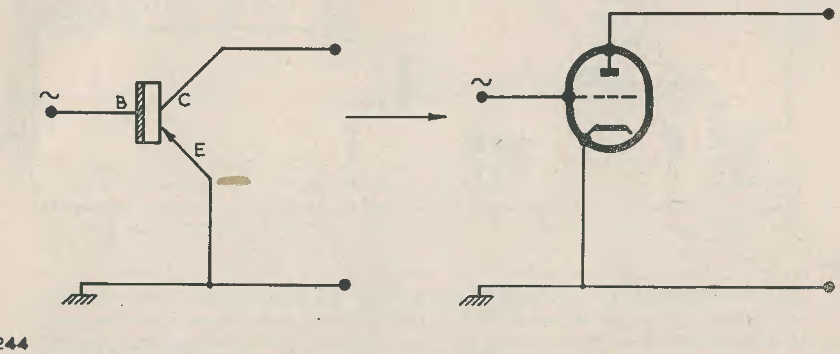
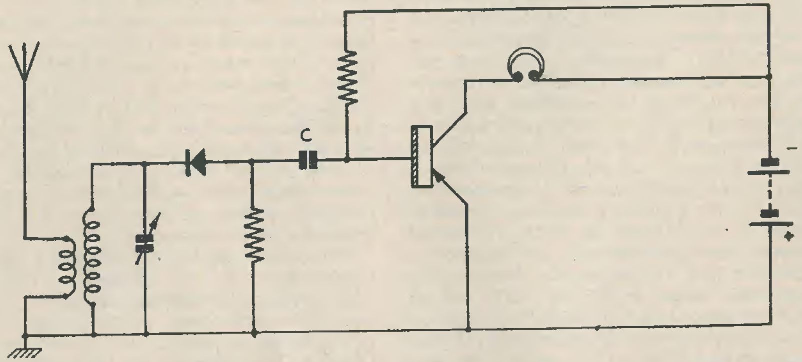


Fig. 1. The earthed emitter junction transistor connection (a) is the analogue, or "dual," of the conventional triode amplifier (b). B=Base; E=Emitter; C=Collector.

The transistor used was the *Mullard* OC71, which does not need a holder, as it is provided with long wire leads enabling it to be wired directly into a circuit. The usual precautions against overheating the transistor when

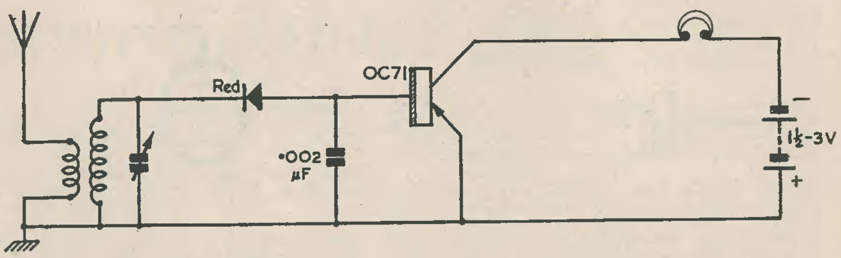
coupling condenser are large, and defeat the purpose of making a compact transistor receiver. The super-miniature tantalum electrolytics developed for transistor circuit use are expensive. However, tests showed that even a 0.01µF coupling capacitor was too small, although a 0.5µF condenser was adequate for good headphone quality. It should be noted, by the way, that transistors of the junction type have exceptionally linear characteristics, and give very pleasant crisp clean audio that sounds remarkably "hi-fi" even on a pair of phones. Distortion is noticed with valves. Hence, unless overloaded, the transistor gives remarkably pure reproduction.

For a slight compromise we can eliminate the large coupling capacity and two resistors in the transistor circuit, by employing direct d.c. coupling to the base of the transistor. It is essential to connect the crystal detector



E245

Fig. 2. A crystal detector may be followed by a junction transistor R/C coupled to the crystal audio output to make a practical "Det-L.F." receiver. However, to obtain a good bass response the coupling condenser C must be of fair size, around 1µF, which is difficult to accommodate in a limited space unless expensive special condensers are used.



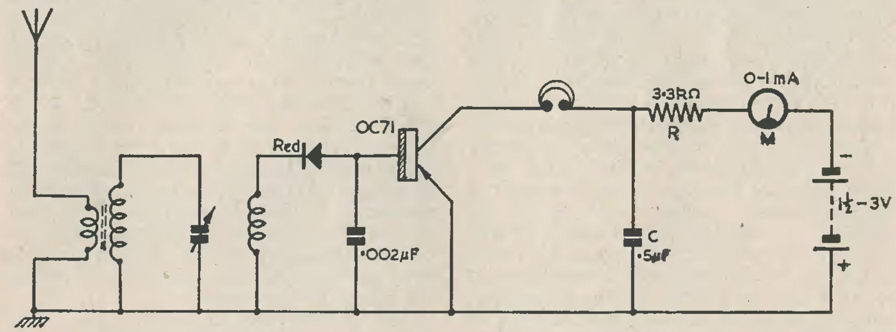
E246

Fig. 3. Provided the crystal diode detector is connected in the correct polarity as shown, a practical direct-coupled transistor circuit is achieved. Two resistors are eliminated as compared with the Fig. 2 circuit, and the large size coupling condenser disappears, to be replaced by a low capacity r.f. bypass-cum-tank condenser. With standard components a midget receiver is now possible.

noticeable only on a very loud signal that overloads the transistor, a condition noted because quality abruptly changes from clean to distorted at a sharply defined signal level. There is in other words a sudden onset of distortion due to limiting with a transistor, rather than the gradual increase of distortion the right way round. The correct way (Fig. 3) is the one giving a negative output. If a small capacity is shunted across the detector as shown, this builds up a suitable negative d.c. bias due to the r.f. carrier level so that the transistor is correctly biased, and can carry the audio signals without cutting or

clipping them. Actually this arrangement falls down at 100% modulation of the received carrier. However, broadcast signals are lightly modulated on the average, and seldom if ever reach the 100% modulation level. In any case conventional broadcast receiver detector stages usually introduce distortion at modulation levels well below 100%.

The correct polarity of the detector is obtained by wiring the end which is colour coded red away from the transistor. A surplus germanium glass-bodied crystal was used and behaved perfectly. Besides saving the cost and bulk of three components, the direct coupling method has a further advantage in that the current taken by the transistor depends on the strength of the received carrier. Thus when the station goes off the air, the battery drain virtually ceases—a useful feature! Moreover, this could be used to operate a sensitive relay for top band addicts to call up one another, or (happy thought) to switch on a mains broadcast receiver! It does mean that a battery could be connected permanently without much loss of life, as a good phone signal is obtained at (a gas main as aerial can be dangerous—*Ed.*) plus body capacity as "earth." For initial setting up it is advised that a limiting resistor of 3.3kΩ bypassed to audio and a milliammeter be used in series with the h.t. negative line (don't forget the transistor h.t. potentials are the reverse of a valve's!) and a low range milliammeter to show that the maker's rating is not being exceeded. A single miniature cell giving 1½ volts is adequate, but h.t. can be increased to three volts if desired. There is only a slight volume increase on going to three volts on a given signal, but on loud signals overload will occur unless there is ample h.t. The milliammeter gives a graphic indication of signal strength and of correct tuning, the audio output on fractions of a milliampere at 1½ volts being surprisingly "beefy." A series aerial condenser to reduce input is a useful measure to prevent overload on strong signals when setting up. It is possible to overload and harm the transistor by excess current, so some may prefer to include a series resistor of from 1kΩ to 3.3kΩ permanently. Otherwise, when once set up, the resistor



E247

Fig. 4. When initially setting up the Fig. 3 circuit, a safety resistor limiting transistor current (R), a bypass condenser (C), and a low range milliammeter (M) are added. The bypass condenser may be omitted, and the meter, although useful for tuning, is also not essential, though it does indicate whether or not transistor current is in a safe region. The resistor R may be reduced to 1kΩ finally, if it is desired to retain it as a limiting device. Variable aerial coupling when setting up is also helpful in preventing excessive transistor current; a series aerial variable condenser is suitable.

a fraction of a milliampere. Anything in the milliampere region is a very loud signal, and will give moderate loudspeaker volume.

Accordingly the direct coupled circuit was used, by wiring a crystal detector into the transistor chassis previously described, and coupling this directly into a *Mullard* OC71. The original *Teletron* Hi-Q transistor coil was used, and this incidentally gave excellent results also with crystal detectors. The "standard" aerial used was the gas main and meter may be removed when satisfied that no overload can occur.

The simplicity and "punch" of this simple arrangement, plus its microscopic demands upon battery power, make it a useful "personal" and emergency receiver. Provided that caution is exercised in first "firing up," it should be trouble free and capable of almost indefinite life. Battery life should be virtually shelf life—if not tuned to a QRO local!

Technical Forum

Dry Accumulators

A CONSIDERABLE AMOUNT OF INTEREST has been shown in our recent description of a battery charger, and one reader has asked if the charging procedure is the same for the jelly acid type of accumulator. The dry and jelly acid cells operate on the same principle as standard free acid types, but instead of the electrolyte being in liquid form it is contained in the pores of the separators, the plates, and the jelly if this is employed. It is normally never necessary to add acid to these cells, but distilled water should be added before the charging is started. Enough water is used in the jelly type to keep the jelly moist, and in the case of the dry accumulator enough is used to ensure that there is always moisture present in the vent during the charging period.

The time and rate at which to charge dry cells is specified on the maker's label. If a lower charging rate has to be employed, a correspondingly longer time should be allowed. A charging rate in excess of that specified should never be used. It is not, of course, possible with dry accumulators to test the specific gravity of the electrolyte, and the state of the charge must be determined by reading the terminal voltage with a good quality moving coil meter. On a cell which is in good condition the following readings should be obtained:

Discharged	1.9 volts off load
Fully charged	2.15 volts off load
Fully charged	2.5V—2.6V on charger.

The final voltage should remain substantially steady during the last three hours of the charging time.

On the completion of the charge the accumulator should be allowed to stand for an hour to enable as much moisture as possible to percolate back into the cell; the surplus should then be drained off.

Idle accumulators should never be allowed to stand in an uncharged condition, but must be given an occasional charge to keep the plates in good condition. As with the free acid type, it is advisable to keep the terminals of the dry cells covered with vaseline to avoid corrosion.

Vision A.G.C. Fault

Until recently, the use of automatic gain control on the vision channel of a television receiver was regarded solely as a method of preventing picture fading and reducing the effects of certain types of aircraft flutter. As such, few designers considered the added complication and cost of the circuit worth while. However, with the introduction of a second television programme and the possibility of a third in the not too distant future, vision A.G.C. has come into its own. It is very unlikely that a T.V. set will receive both signals at the same strength, so that the viewer will have to reset the contrast control, and probably also the brightness control, when turning from one channel to another —if his set is not fitted with A.G.C. When one considers the difficulty which many viewers encounter in resetting these controls, to say nothing of the annoyance, the necessity of using a gain compensating circuit will be apparent. In this short article we propose to examine some of the defects which can occur in the gain control circuits, showing how they can be diagnosed by observing the results on the screen.

The various types of vision A.G.C. have already been described in a previous issue, so it is sufficient here merely to list them.

(*a*) Mean level system, in which the A.G.C. control voltage is normally obtained from the grid circuit of the sync separator valves and is dependent upon the mean amplitude of the video signal.

(*b*) Frame pulse gated system, in which the A.G.C. voltage is dependent upon the black level radiated during the frame blanking period.

(*c*) Line pulse gated system; functions as (*b*) but the black level taken is that which exists during part of the line blanking period.

From the functional point of view the latter two systems have much to recommend them, but the first arrangement has the big advantage of simplicity. When checking an automatic gain control system, the first thing is obviously to find if it is functioning as such. This is usually quite easily done by advancing the preset R.F. control and noting the change in picture contrast. If all is well the gain control (not contrast control) should have very little effect upon the picture level for quite large changes in setting. If this is found to be so, it means that as the signal level is raised by advancing the gain control, the A.G.C. voltage also increases, and this in turn reduces the gain of the vision channel, so that a more or less steady condition is maintained.

If a fault in the A.G.C. circuit causes a defect to appear on the picture even when all controls are adjusted for optimum, it invariably indicates the presence of an a.c. component on the gain control line. Where the control circuit falls within the first two categories (*a* or *b*) listed above, this a.c. component is most likely to consist largely of a 50c/s wave. The effect of this on the picture is to produce a tendency towards a shading bar to appear across the top of the image. In the more severe cases the line timebase may fall out of synchronism only at the top of the picture. The fault is usually traced to an open circuit filter capacitor across the A.G.C. line. Referring to the circuit diagram Fig. 1, the capacitors to be suspected are either C_2 or C_3; should the effect be particularly severe, the component having the greater capacitance is the most likely culprit.

the less severe case the trouble may simply appear as slight shading on the extreme left of the image. The filtering capacitors C_2 or C_3 must again be suspected if this type of fault appears.

Referring back to the circuit diagram, it will be seen that there is a further R-C combination associated with the A.G.C. line, namely C_1R_1. The purpose of this combination is two-fold. Primarily the capacitor is there to provide a short earth return path for the r.f. current in the tuned grid circuit of the valve. Should this capacitor become defective it may either reduce the gain of the associated stage or cause instability. The secondary use of C_1 and R_1 is to remove any line pulses which may be radiated by the line timebase and picked up on the A.G.C. line. Unwanted pick-up of this nature will cause a shading bar, similar to that already described, to appear down the extreme left of the picture. In this case, however, the bar may be either darker or lighter than the remainder of the picture, depending upon the polarity of the pulses on the control line.

In general, if one of the faults described is encountered it at once suggests an open-circuit capacitor, and it is a relatively simple matter to shunt the suspected components in turn with a known good capacitor to

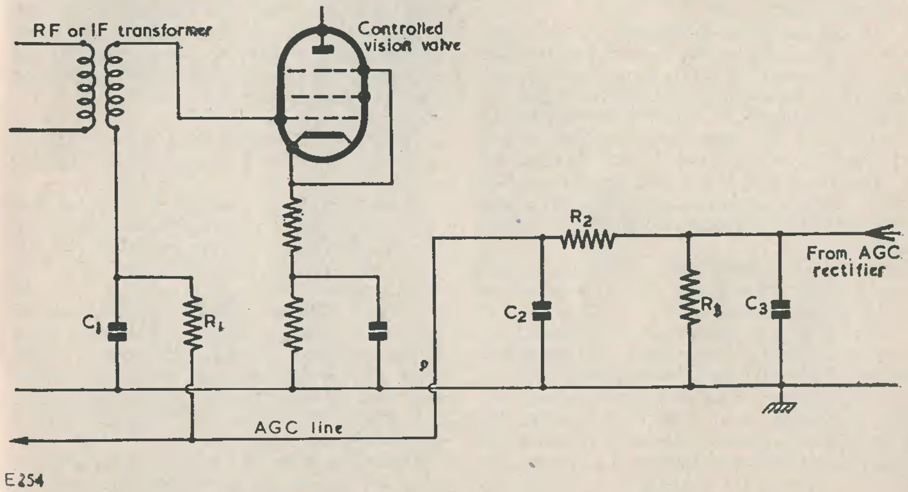


Fig. 1

A filtering defect in the line gated circuits (*c*) in our list will permit line pulses to reach the vision channel. This will generally result in a dark band appearing down the extreme left hand side of the picture. In

determine at which point the trouble is located. This is a standard quick method of locating a defective capacitor which can well be applied to trouble-shooting in this particular part of a television receiver circuit.

DESIGN CHARTS FOR CONSTRUCTORS

No. 2. PARALLEL RESISTANCE COMBINATIONS

by HUGH GUY

THE NECESSITY FOR CALCULATING THE combined resistance of two resistors in parallel frequently occurs during the course of circuit design and construction, and the formulae involved are rather unwieldy, involving as they do "reciprocals of the sum of reciprocal resistances."

Speaking in general terms, if we have two resistors R_1 and R_2 in parallel, as shown in the inset on the accompanying chart, their combined resistance R_p is given by:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

which simplifies to

$$R_p = \frac{R_1 R_2}{R_1 + R_2}$$

Thus if the resistors are, say, 100kΩ and 68kΩ respectively, their parallel combination will be

$$R_p = \frac{100 \times 68\,\text{k}\Omega}{100 + 68} = 40.48\text{k}\Omega$$

This is not easy to calculate without the aid of logarithms or a slide rule, but fortunately it lends itself to easy calculation in the form of a design chart.

To use the chart for finding R_p as shown above, the value of R_1 is read horizontally, and the value of R_2 read slant-wise. Now a rule or straight-edge is placed with one end passing through "0" (in the bottom left-hand corner) of the chart and the other end through the point where R_1 and R_2 intersect.

The required parallel value or R_p is now given by the level, read on the R_1 scale, where the straight-edge cuts the "R_p" vertical line.

For the example given above, the chart gives a parallel value of 40kΩ, which is an error of less than 2%.

A case which occurs far more frequently is that of finding the value of resistance required to make up a known parallel value.

Once again, the basic formula for calculating the value of an unknown resistor, R_2, which with a known resistor, R_1, will give a desired parallel combination R_p, is given by

$$\frac{1}{R_2} = \frac{1}{R_p} - \frac{1}{R_1}$$

and this simplifies to

$$R_2 = \frac{R_1 \times R_p}{R_1 - R_p}$$

This is also shown in the inset on the chart.

To use this chart for this purpose, the straight-edge or rule is lined up with the "0" or the chart origin at one end as before and with the required parallel value on the vertical R_p scale at the other.

Scanning along the straight-edge to the right, a value of R_2 is sought which coincides with the chosen value of R_1 at the straight-edge.

The general case, of course, is that no exact value of R_2 is obtained on the graph so the nearest value is selected, and using the procedure outlined earlier, the parallel combination that this compromise value of R_2 gives with R_1 is found.

If no specific value for R_1 is considered at the outset, and it is merely a question of determining two resistors that will give a required parallel combination, then the task is simplified. In this case it merely remains to seek any intersection of R_1 and R_2 values at the straight-edge.

Example 1

The required screen resistor in a pentode circuit is 68kΩ. What resistor will give this value when wired in parallel with 100kΩ?

The straight-edge is laid through "0" and through "68" on the R_p scale and is seen to pass through $R_1 = 100$ when $R_2 = 220$. Thus a 220kΩ resistor would be used. Notice how common sense prevails in allocating the correct number of noughts to the value that is solved.

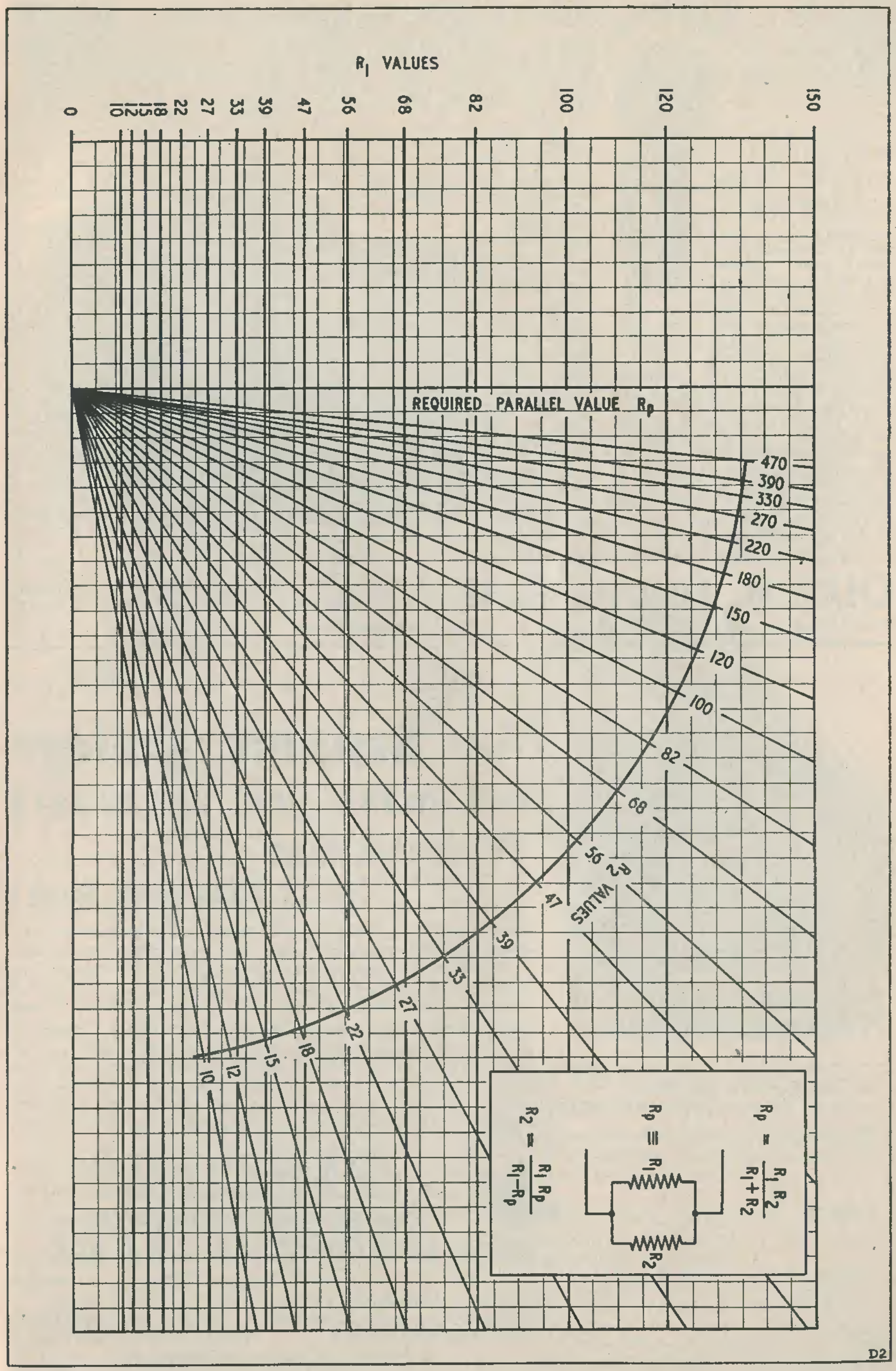
Example 2

A 330kΩ resistor is required for a tone control. What two resistors will give this value?

Proceeding as in example 1, we find that "56" and "82" for R_1 and R_2 respectively, lie on the straight edge. Hence, a 560kΩ and 820kΩ resistance combination would be used. In lieu of these, the chart shows that $R_1 = 39$ and $R_1 = 220$ also satisfy the combination, in which case a 390kΩ and 2.2MΩ combination would be used, with better results; although the tolerance, in either case, is far less than that which the 10% components, for which the chart was designed, would themselves introduce.

One final note; the values of R_1 and R_2 are, of course, interchangeable, and for practical purposes, the smaller value of resistor should preferably be referred to as R_1 since this scale on the chart is more restricted than that of R_2.

The range of values provided is, however, adequate for most purposes; and to have included more would have detracted from the chart's accuracy.



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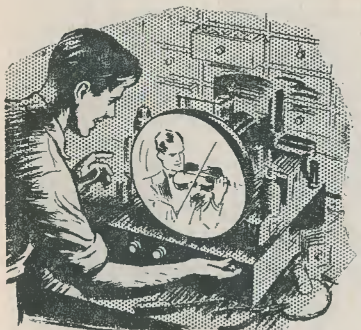

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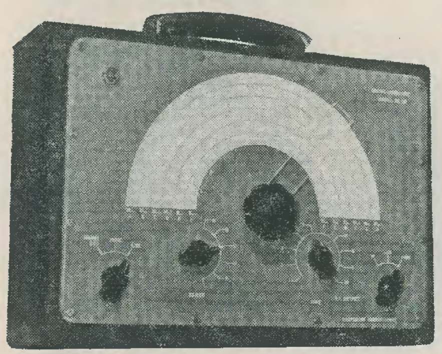

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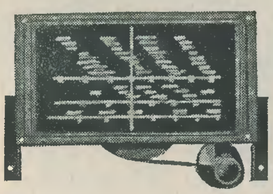

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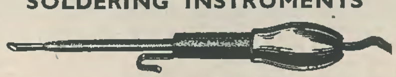

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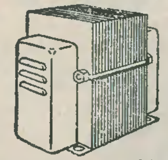

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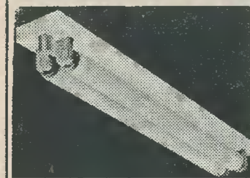

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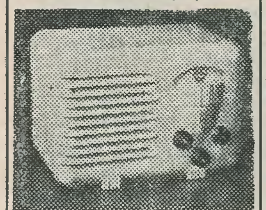

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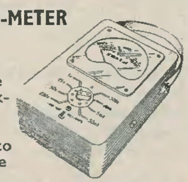

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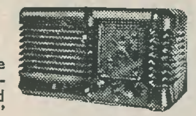
1956 T.R.F.

32/6



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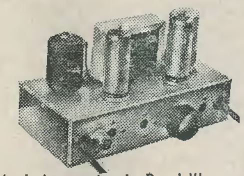

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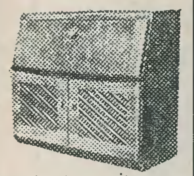

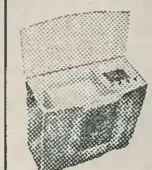

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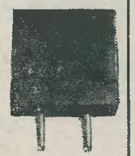

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(continued from page 389)

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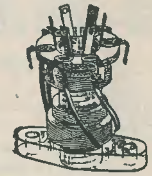

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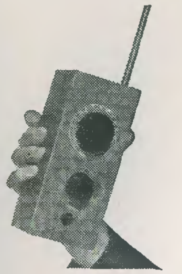

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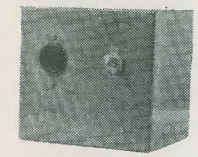

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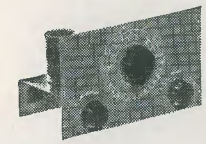

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