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For Every Radio Enthusiast

Contents

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EDITORIAL

THIS is the time of year when home construction probably reaches its peak, and like many other people we have been taking stock of our components on hand. Usually the "junk box" seems to be full of good stuff which somehow never appears to be suitable for the job being built, and much of the ex-Govt. surplus gear looks as if it never will be of any use. However, in our next issue we will be printing details of an entirely new EHT system, exclusive to this magazine, which makes use of a component which can now be bought at any surplus stores for a few coppers simply because until now nobody has found any use for it.

Talking of components we cannot use brings to mind those things we could use if we could only get them! When, for instance, is someone going to supply us with transfers for marking panels? On our latest televisor we have two variable, and eight preset controls, and the appearance would be greatly improved if these could be identified by suitable transfers. So would lots of our other gear, test apparatus, transmitters, receivers, and so on.

Another piece of equipment which we could do with is the potentiometer with DPST switch. These used to be fairly easily obtainable, but seem to have now disappeared from the shops. They should, of course, be fitted to all AC/DC apparatus.

Talking of AC/DC gear, the servicing engineer would feel much happier if he could earth the chassis when testing. One large manufacturer used to supply for this purpose a 1/1 ratio mains transformer with built-in overload cut-out, but this also is no longer made. There is an alternative here, of course, in the use of an HT transformer with 250V or 250-0-250V secondary, though this has not the cut-out feature.

Meanwhile we are glad to note that more and more firms are offering kits of parts. It is not every reader who has the confidence, or the capability, to build from or convert war surplus equipment. The beginner, in particular, is likely to become "browned-off" and may even forsake his hobby, should his first effort not meet with success. He stands a much better chance of being satisfied by using a reputable kit, as he can rest assured that the components supplied will be suitable for the job and, where a coil pack is included, one of the most ticklish parts is already done. Even with such a kit, of course, success cannot be guaranteed, for a lot still depends upon the constructor.

G2ATV

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman will re-draw in most cases, but relevant information should be included. All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6518.

BUILDING YOUR OWN
SIGNAL GENERATOR

By **W. G. MORLEY**

PART TWO

The Oscillator Circuit

HERE we have the "heart" of the signal generator. The oscillator circuit used must be capable of good efficient operation, must be as free from drift as possible and should maintain its accuracy of calibration over long periods, despite mechanical knocks or rough handling. We are hardly in a position to maintain frequency stability against changes of temperature by incorporating such things as negative-co-efficient capacitors, etc., but, as stated above, we can do our best in this line by keeping the heat dissipated in the generator case as low as possible.

There is a fairly wide choice of useful oscillator circuits. Circuits such as the Hartley or Colpitts are not of much use to us here owing to the fact that they need a "floating" tuning capacitor frame. The Franklin (see Fig. 2), an oscillator that at first appears very attractive owing to the fact that it needs no feedback coil, has little use in a signal generator circuit because it will not oscillate readily above 6 Mcs or so. We are then left with circuits like the tuned anode, tuned grid (sometimes—mistakenly—called Meissner oscillators), and the ECO (see Fig. 3). All of these circuits are quite useful for signal generator use, although the author has a preference for the ECO as being the most stable. It will be noticed that a capacitor C is fitted to each oscillator circuit shown. This is the 0.01μF capacitor of Fig. 1, and this must be mounted as close to the oscillator as possible.

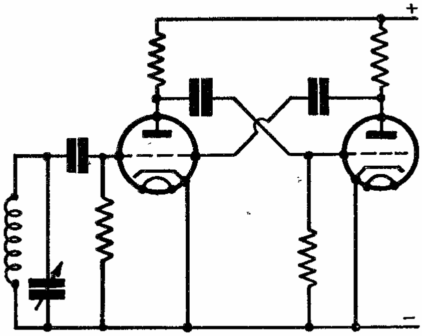


Fig. 2.
The Franklin Oscillator.

To enable RF energy to be fed to the attenuator circuit it is necessary for a coupling winding to be fitted to each oscillator coil. This may be pile-wound for the lower frequency ranges, and should have about a quarter of the number of turns used in the tuned winding. It should be mounted about ¼″ to ½″ away from the earthy end of the main tuned winding. An alternative method of supplying RF energy to the attenuator circuit does away with the necessity of using a coupling coil. This method consists of using a cathode follower directly coupled to the oscillator.

To return to the oscillator proper, let us now see what exactly is needed in the way of coils, capacitors and switching to give us a multi-range oscillator. The tuning capacitor can quite conveniently be a 500pF single gang component. It should be of good manufacture and of sturdy construction. As most of the calibration errors likely to occur in use will be caused by capacitance changes (as opposed to inductance changes), and as these will be most apparent when the tuning capacitor has its vanes almost completely unmeshed (at the high frequency end of each band), it is a good plan to keep a 50pF capacitor permanently shunted across the tuning capacitor. This 50pF capacitor should be a really good component, silver-mica if possible. The effect of this will be to somewhat restrict the range offered by the tuning capacitor, but it will help considerably in removing any sources of error.

The Oscillator Coils

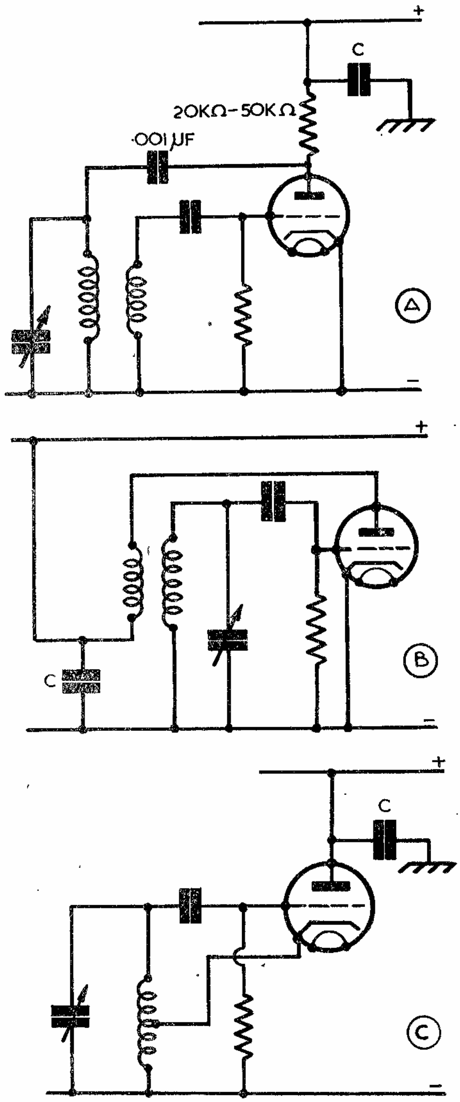
The coils required in the oscillator circuit can quite conveniently be home wound*. A certain small amount of guess-work may have to be finally employed in getting them to function on their correct frequencies, but anyone who has had experience of winding coils for their own receivers should be able to iron out the difficulties. Pile wound coils should function fairly well up to frequencies of the order of 2 or 3 Mcs. The coils can be quite small in size, the feedback windings having about a quarter or third of the number of turns used in the tuned winding itself, with the coupling getting progressively tighter as the frequency is increased. The coils should be well made and mechanically sound. The writer does not advise that they be treated with shellac varnish after completion. If the windings are not sufficiently strong to stay in position when finished they may be treated with good quality paraffin wax. In the case of the ECO (see Fig. 3(c)), the cathode tapping may be taken about a quarter of the way up the coil. If a further winding is fitted to each coil for the attenuator circuit, this should be wound as mentioned previously.

Commercial coils present a very useful alternative to the home-wound variety. If for instance we study the range of coils offered by, say, the Wearite " P " series, we find that we can get the very good coverage shown below. It will be seen that the oscillator (PO), coils have an apparent extension of range. This is, of course, due to the fact that we are not now using padding capacitors.

Coil.	*Frequency with 50pF cap. (Tuning capacitor vanes unmeshed. Zero capacitance plus 50pF shunt.)*	*Frequency with 550pF cap. (Tuning capacitor vanes fully meshed. Full capacitance plus 50pF shunt.)*
PA1	480 kcs	145 kcs
PA7	1,280 kcs	385 kcs
PA6	3,280 kcs	1,110 kcs
PO5	10.3 Mcs	3.03 Mcs
PO4	31.8 Mcs	9.60 Mcs

It will be seen from this table that, by suitable juggling with the aerial and oscillator coils, we can get a complete frequency coverage from 145 kcs to 31.8 Mcs. For the three lower frequency ranges (in which coils from the PA series are used), the aerial coupling coil can be used as a feedback coil. It is a pity that, with these coils, we cannot extend the range to 100 kcs to cover the old-fashioned 110 kcs IF transformers. However, these are rarely met nowadays.

As none of the coils in the table is supplied with auxiliary windings we would have to use a cathode follower form of output for the attenuation circuit.



RC631

Fig. 3.

Top: The Tuned Anode Oscillator (A).

Centre: The Tuned Grid Oscillator (B).

Bottom: An Electron Coupled Oscillator (C).

*A useful formula for the construction of single-layer solenoid coils is as follows:—

$$L = 4\pi N^2 A l 10^{-9}$$

Where L=inductance in henries, N=turns per cm., A=cross-sectional area of coil in sq. cms., and l=length of winding in cms.

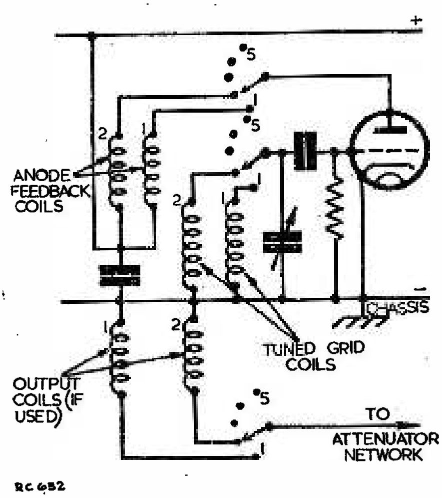


Fig. 4.

Specimen range switching circuit. For clarity, only two sets of coils are actually shown.

Switching

Switching circuits are not too difficult in theory, as all we need is a three-bank switch as shown in Fig. 4, which illustrates the switching of a tuned-grid oscillator. The third switch bank, which switches the coupling coils to the attenuator, can be dispensed with if a cathode follower is used.

In practice, however, it is advisable, though not entirely necessary, to short-circuit those coils not in use. This is best done by using a switch bank with a shorting contact which automatically shorts the coils out of circuit to earth. If this form of switch is not available an extra bank may be added to the existing switch, its purpose being to short-circuit the main winding of the coil adjacent and higher in frequency to the one in use.

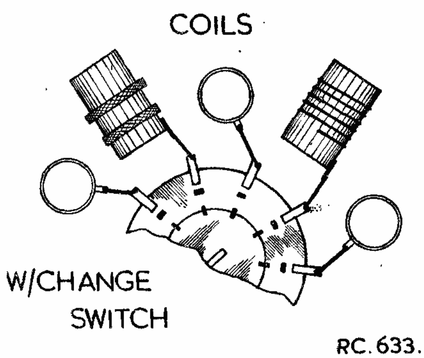


Fig. 5.

Method of mounting coils around range switch.

It is also a good plan to have the coils at right angles to each other to obviate any unwanted coupling (see Fig. 5).

The final requirement is to see that all switch wiring is short. Short wiring may be difficult to carry out in practice, and the best plan is to have the higher frequency coils as near to the switch as possible; the lower frequency coils may then be mounted somewhat further away, as on these frequencies relatively long leads are not so important.

There is no need for trimmers on the various coils if care has been taken in the original construction. If trimmers are decided upon, the best type to use are Philips concentric types, each being set to a central position before calibration is commenced.

(To be continued)

"RADIO CONSTRUCTOR"

QUIZ

Conducted by W. Groome

(1) This month we find Mr. Brain dabbling with an output triode connected as a cathode follower, in an attempt to secure the benefits of low distortion and good loudspeaker damping. The cathode load and grid bias were correct, but results were disappointing at higher volume levels within the working range of the valve. Why?

(2) In what modern form do we find the "catswhisker?"

(3) In some AF equipment of wide frequency range, the tone may seem to vary as the listener moves around the room. Why?

(4) If a continuous ring of insulated copper wire was fitted over the primary winding of a mains transformer, what would happen when the AC supply reached the primary?

(5) Why is the current rating of a dial lamp of greater significance in DC or universal than in AC equipment?

(6) As it concerns an error frequently committed even by the experienced—often through carelessness—no apology is offered with this very simple question. It is included as a warning, and if you know the answer, consider whether you trouble to apply it in practice. It is—which mains lead should the switch cut?

(Answers on page 157)

LOGICAL FAULT FINDING

The seventh in a series of articles to assist the home constructor in tracing and curing faults

By J. R. DAVIES

7: WEAK RECEPTION

A RECEIVER which gives weak and unsatisfactory reception is not always a simple job to put right. There is a certain amount of guesswork to be used, especially if we do not possess an attenuable signal generator; but from the nature of the set's performance we can, at any rate, obtain some idea as to whether the receiver is amplifying insufficiently before or after the detector stage.

If the loss of amplification occurs before the signal is detected (i.e. it is occuring in the RF or IF stages), it will be found possible to receive only a few stations, although the "local" may come in at good volume.

If the loss occurs after the signal is detected (i.e. in the AF stages), then a larger number of stations will be received, but none of them will be at good speaker strength.

Loss of Amplification in the RF or IF Stages

When we are reasonably certain that there is a loss in amplification in the RF or IF stages, it is well worth while ascertaining whether it occurs on only one band or on all bands. If the loss is peculiar to only one band then it follows, of course, that the trouble lies in the coils of that band or in the switching thereof.

Nearly always, however, we find that the loss of volume occurs on all bands. Before the set is taken in for repair, it may save time to find out whether or not someone has been tampering with the trimmers. Most families possess a budding Marconi, who, without the faintest clue in the world as to what he's doing, gaily proceeds to tighten up "all those loose screws." If the IF transformers have been tampered with in this way, it is advisable to use a signal generator or some sort of oscillator (see footnote on page 607, June issue), to get them on to their correct frequency again.

However, if the faulty set has not been tampered with, it by no means follows that it is out of alignment. The most probable cause is faulty valves, and these should be replaced one at a time to see if any improvement occurs. (If the receiver is a battery model, the batteries should, of course, be checked as well).

If the original valves in the set are found to be satisfactory, then we now see if the set has fallen out of alignment. In the case of a straight set the trimmers should be adjusted cautiously, using a station at the high-frequency end of the band concerned for a lining-up signal. In the case of a superhet, we should first tune in a station, then leave the tuning capacitor severely alone whilst we trim up the IF transformers. This is because the IF's are almost certain, even if "off-trim," to be on or very near their correct frequency, and trimming to this frequency will ensure that they are pretty accurately aligned. After the IF's have been done, the RF tuned circuits should then be attacked, "trimming" at the high-frequency end and "padding" at the low-frequency end of each band. It is worthy of note that, with the average commercial receiver, really bad discrepancies in trimming in the RF tuned circuits do not cause such noticeable effects in sensitivity as do comparatively smaller discrepancies in the IF trimming.

It is not intended in this article to give of a full resume of the procedure of aligning a superhet, as this is a matter that has been treated so often before. It is just worth while saying that final adjustments to the set should always be made using a weak test signal, and with the volume control set to maximum.

It may happen that adjusting one of the trimmers makes no difference to the volume of reception. If this is the case, it can be assumed that the fault lies in that particular tuned circuit. The trimmer may be short or open circuited, or its appropriate coil may be faulty.

Finally, if it is found that all the trimmers in the set are effective and are correctly adjusted, the next step is to check the voltages applied to the various valves, and to ensure that none are over-biased. This, of course, means simple voltage checks with the testmeter, remembering that screen-grid voltages may give unreliable readings on the meter owing to the large dropping resistor usually connected between screen-grid and HT positive. A reliable test and, incidentally, one that is recommended in the service sheets of a well-known communications receiver, is to switch the testmeter to a current range and measure the current passed by the particular screen-grid dropping resistor. Fig 24 shows a typical circuit

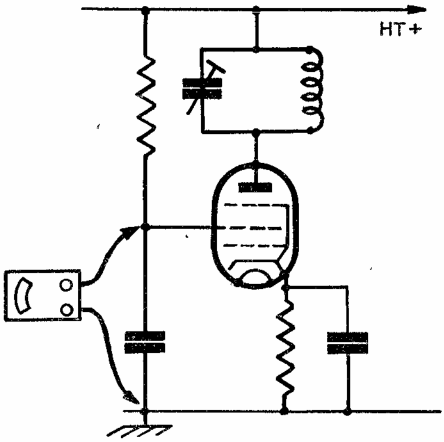


Fig. 24.

Illustrating a method of checking screen-grid supply (see text).

to explain this process. We want to measure the voltage on the screen-grid of the valve. Let us assume that the HT voltage is 200 and that the value of the dropping resistor is 100K Ω. We first connect the testmeter between screen-grid and earth, the meter being switched to a voltage range. As long as we get some sort of voltage reading we know that the decoupling capacitor between screen-grid and earth has not broken down. If the meter has a resistance of 1,000 ohms per volt and is on, say, a 200 volt range, we will probably get a voltage reading of about 60. Then, if we want to be really accurate, we can switch the meter to a current range. Remembering Ohm's Law ($I=\frac{E}{R}$), the current which should flow, given a voltage of 200 and a resistance of 100K Ω, would be 2 milliamps. This shows for certain that the resistor is maintaining its correct value and that there is no high-resistance joint in the circuit.

Loss of Amplification in the AF Stages

Usually, loss of amplification in the AF stages of a receiver is caused by such a change in the working constants of the circuit that distortion is introduced, the cure being that for distortion. Nevertheless, there are quite a few things that may happen which cause weak amplification and only slight distortion.

The most likely members of the AF circuit to cause trouble are the valves. These should be checked, the simplest means being by replacement with known serviceable types.

Should this afford no helpful result it may be worth while trying to isolate the stage in which the trouble lies. If the volume of signal is weak, then one may follow the procedure given previously for a snag of the " no signal " type, i.e. by touching the grids and so on.

However, this business of touching the grids and listening to the result is not always conclusive, particularly if the loss of amplification is not very great; and so there is nothing to it but to resort to the testmeter again.

Fig. 25 represents a conventional triode amplifier stage, and will serve as a model for the tests we require to carry out on the various valves concerned. We should first check the full HT voltage as applied to the entire set, i.e. between HT positive and chassis in the diagram. Then, we should test the anode resistor, R1, preferably by the " current " method mentioned in the previous section and illustrated by Fig. 24. It is then worth while seeing that the valve is taking its proper current by checking across the bias resistor R3, to see that the correct bias is developed across it. If the valve has a screen-grid connection the voltage on this also should be checked.

If nothing conclusive is found from these tests it might next be helpful to see that the electrolytic capacitor (C1 in Fig. 25) has not become " dry " or open-circuited. If this were the case, the bias circuit would give a form of negative feed-back, thereby reducing the gain. The capacitor may be checked quite easily by connecting a similar type across it temporarily, there being no need to disconnect the existing component. The 8μF capacitor mentioned in earlier articles and shown in Fig. 2 is a useful accessory for tests of this nature.

The coupling capacitor C2 is also of interest. If it became short-circuited or leaky it would cause heavy distortion; and so does not concern us here. If, however, it became partly or entirely open-circuited it would cause a loss in signal strength. The effect would be to give an attenuation of the bass response and would be readily noticeable. If this component is suspected it may be tested by connecting a similar value capacitor across it.

The speaker and its transformer may occasionally give trouble, although here again distortion

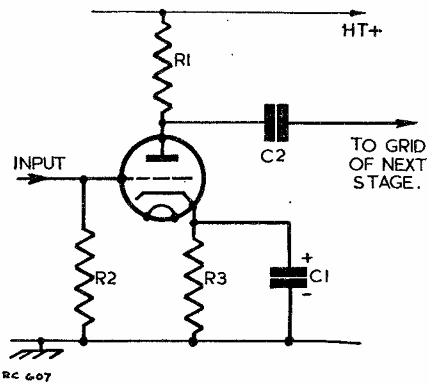


Fig. 25.

Showing tests required by AF amplifier.

is usually the result, rather than mere loss of volume. Substitution by a good speaker is the answer to this. The tone correction capacitor usually found across the speaker transformer primary (See Fig. 7), can cause a loss of signal and should be temporarily taken out of circuit for checking purposes.

There is little else in the AF circuits that can cause a drop in volume, except for those faults that will introduce distortion as well. These will be dealt with the section concerned with that fault.

SUMMARY

Weak Reception

(*a*) Ascertain whether loss is occurring before or after detection.

If before:—

(*b*) Check Valves.
(*c*) Check trimming and see that all trimmers are effective.
(*d*) Check valve voltages.

If loss occurs after detection:—

(*b*) Check valves.
(*c*) Check valve voltages and currents.
(*d*) Check cathode bypass capacitors for open-circuit.
(*e*) Check coupling capacitors for open-circuit.
(*f*) Check speaker and tone correction capacitor.

(To be continued)

(*DESIGN OF THE SUPERHET— continued from page 165*)

Choice of Oscillator Frequency

The choice of oscillator circuit need not worry the constructor overmuch. The tuned grid type of circuit shown in Fig. 2 will function excellently, as will the occasionally met tuned anode circuit of Fig. 3(a). Fig. 3(b) illustrates a shunt-fed tuned grid circuit which is often used. There is little need to experiment with oscillator circuits other than those three shown, unless one is going in for receiver construction for specialised purposes. Incidentally, the usual values of grid leak and capacitor which are used with most modern coils and frequency-changer oscillators are those of 20K Ω and ·100pF respectively. Battery operated frequency-changers which have less power in their oscillator circuits may require a larger value of grid leak. Too large a value may cause the oscillator to " block " or " squeg," this being indicated by a violent hissing in the output.

It will be seen in Figs. 2 and 3 that the grid leak is returned to the frequency-changer cathode and not to earth. This is a necessary form of connection for cathode biassed valves as, otherwise, oscillations would not be able to commence.

Next Month

Having, this month, discussed the various requirements affecting the design of the signal and oscillator frequency tuned circuits, the next step is to consider the task of ganging them together so that they may both be tuned with one dial. This process is known as " tracking " and will be dealt with in next month's article.

ANSWERS TO QUIZ

(1) Under correct conditions the cathode follower is virtually distortionless, and in Mr. Brain's case it was reproducing faithfully everything that went to the grid. But as its gain is less than unity, it requires a grid swing greater than its anode swing, i.e., over 200V, which can rarely be obtained without distortion from the penultimate stage. Mr. Brain's disappointment was due, not to the output stage, but to the limitations of the preceding stage which was being over-run.

(2) The " crystal diode," which resembles a wire-end resistor in appearance, contains a cats-whisker in contact with a crystal of more stable form than the old-fashioned type. After adjustment in the factory, the component is filled with a substance which sets hard enough to keep the wire contact in position permanently.

(3) Higher audio frequencies are projected in a narrow beam straight out from the speaker. Middle and low frequencies tend to spread in all directions. To left or right of the speaker there appears to be a loss of brilliance, compared with that heard directly in front of it. For this reason, the writer disagrees with the practice of fitting the loudspeaker at the bottom of radio-gram cabinets, thus beaming the high audio frequencies several feet below ear level.

(4) Disaster, probably. The ring would function as a single turn, and a very high current of low voltage would be induced in it. Further, it would be a shorted turn, and if of small gauge wire would burn out. If of heavy enough gauge, it would cause the primary winding to burn out, unless the latter was protected by fuses. The copper shield (static screen) often fitted over the primary winding to check the transfer of interference has its two ends insulated from each other, for this reason.

(5) In DC and universal receivers, the dial lamps are wired in series with the valve heaters, and must be capable of carrying the same current. They are often shunted by heavy wattage resistors so that the set should not cease to function in the event of a dial lamp burning out. In AC equipment the dial lamps are wired in parallel with the valve heaters, and the voltage rating becomes of more importance.

(6) Although the current can be broken by cutting either lead, it is dangerous to break only the " neutral " lead, for the apparatus, although inoperative, is at mains potential from the switch back to the " live " lead. An electric fire, for example, may be switched in the " neutral " lead, and to all appearance will be off. Anyone who innocently thought it safe to touch the element might get a shock by providing a path to earth for the current. By putting the switch in the " phase " or " live " lead, the apparatus is isolated from the supply. The " neutral " lead may be left connected as it is usually at earth potential, but it is always wise to play safe and break both leads with a double pole switch.

SIMPLE CAPACITY—RESISTANCE BRIDGE

with refinements

BY PETER F. T. REDMAN, ISWL/G.186

IN these days of shortage of money, it pays to build one's own test gear. This is the first of a series of articles in which I intend to show how test equipment can be built which, whilst not up to laboratory standards, will give results of reasonable accuracy. It will probably be found that most of the components and valves will be found in the proverbial junk box !

Circuit

From Fig. 1 it will be seen that R2, R3, C1, C2 and VR1 form the usual bridge circuit. At first the reason for R1 and R4 may not be apparent, but if you follow the grid leak of V1 you will see that the grid has no earth return, a state which cannot be permitted ! The reason for having two resistors is to maintain the balance of the bridge circuit, since if we add 1.0 megohm to one side we must add the same to the other side. The accuracy of this instrument is entirely dependent on the accuracy of the component in the bridge circuit, which is on the left of V1.

It will be seen that V2 is a simple audio oscillator, with an anode load consisting of centre-tapped primary to provide oscillation, and a secondary winding to provide output. This latter winding should preferably be of high impedance, and therefore a class " B " driver transformer with centre-tapped secondary will do. A push-pull output transformer will NOT work in this position. C4 is provided to adjust the frequency of oscillation and will be dependent upon the transformer used. A capacitor of 0.001 to 0.01μF may be used for trial purposes. The transformer is parallel-fed to obviate the need for three windings.

J1 is a self-shorting jack and is inserted in the cathode circuit of V1 to enable headphones to be used simultaneously with the magic eye, to check zero position. It should be noted that component values should not be checked whilst the component is in any radio gear, since capacitive losses, etc., will probably affect the reading obtained, and there may be a parallel path.

Construction

The construction and layout can be left to the individual constructor's taste, but all components should be spaced at least an inch from the chassis, including VR1, S1 and T1. VR1 and S1 should preferably be mounted on a bakelite panel well away from the metal chassis and insulated rod used to connect with the knobs on the panel. T1 may be mounted on small porcelain stand-offs to reduce capacity to ground effects. All components should be rigidly wired up, and mounted on tag boards for preference. I am not an advocate of tag boards, but this is one of the cases where they are necessary to reduce variations in capacity to ground between the various components. The whole unit should be enclosed in a metal box to keep stray capacity effects to a minimum.

Components

All components should be of the highest accuracy obtainable, especially the components in the bridge circuit. These should have a maximum tolerance of $\pm 1\%$. It is worth the extra cost to obtain the increased accuracy and stability ; ½ watt or 1 watt resistors, either wirewound or solid carbon compound types, are suitable. VR1 must be a linear wirewound potentiometer and should preferably be brand new, since old ones have a habit of getting irregular spots here and there on the track, which would upset readings.

Calibration

The easiest way to calibrate this bridge is to beg, borrow or steal as many as possible $\pm 1\%$ resistors and capacitors covering the ranges of this instrument. Next connect them in turn across X and X1, and set S1 in the appropriate position. Then turn VR1 until aural and/or visual quiet position is found. This position should be fairly sharp.

Operation

To operate, switch on and wait until the magic eye glows green. Connect unknown component across X and X1, rotate S1 to required range, turn VR1 until silent point is reached. If VR1 has to be turned fully anti-clockwise it indicates an open circuit, if fully clockwise it indicates the contrary, *i.e.*, a short circuit. In each case it is unlikely that a silent point will be obtained, but the visual and/or aural indications will be a reduced volume. It will be found that once the initial calibration has been carried out the accuracy of calibration will remain constant, but if VR1 has to be replaced re-calibration is advisable, though not absolutely essential.

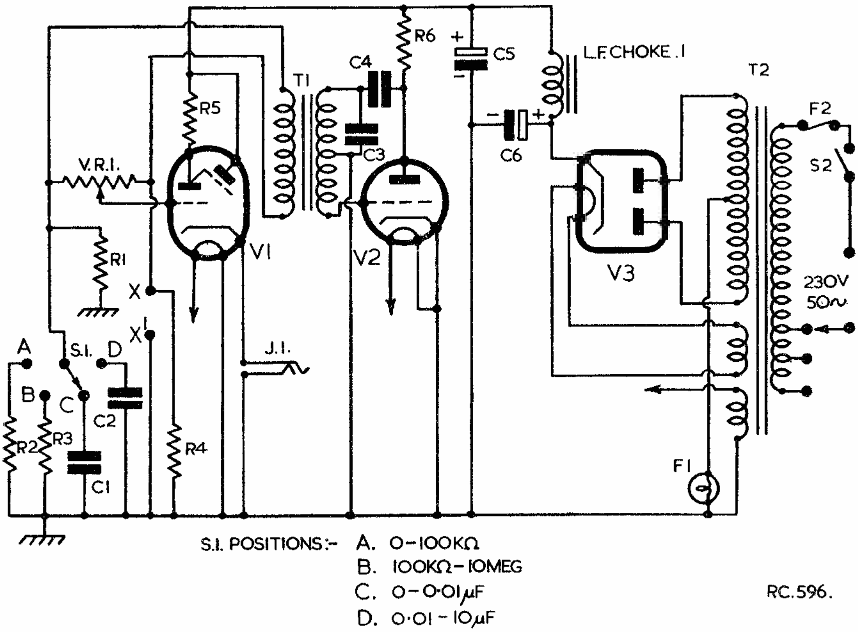


Fig. 1.

Circuit diagram of the capacity-resistance bridge.

Component Values

S1, SP 4-way rotary		*R1, 1MΩ ± 1%*	*R6, 50kΩ ± 20%*
VR1, 20kΩ wirewound		*R2, 10kΩ ± 1%*	*C1, 0.001μF ± 1%*
T1, Class B driver trans, CT secondary		*R3, 1MΩ ± 1%*	*C2, 0.1μF ± 1%*
LF Choke, 20H 60mA 500Ω		*R4, 1MΩ ± 1%*	*C3, see text*
T2, 300-0-300V at 60/100mA, 5V at 2A, 6.3V at 3/4A		*R5, 1MΩ ± 20%*	*C4, 0.1μF ± 20% 350VDC*
F1, 2.5V 0.6A Bulb	*S2, On/off toggle*		*C5, 16μF 350VDC*
F2, 1A Fuse	*J1, Self-shorting jack*		*C6, 8μF 350VDC*

Final Notes

It will be found that this C & R bridge will be a great asset to any ham shack, and well worth the time and money put into it. If you have any suggestions on the type of article you require on test gear, or have any constructive comments to make on this, previous or subsequent articles, will you please send them to me, c/o The Editor, "Radio Constructor," 57, Maida Vale, London, W.9.

THE EDITORS INVITE . .

● **Constructional articles suitable for publication in this journal. Prospective writers, particularly new writers, are invited to apply for our "Guide to the writing of Constructional Articles" which will be sent on request. This guide will prove of material assistance to those who aspire to journalism and will make article writing a real pleasure!**

Query Corner

A "Radio Constructor" service for readers

Ghost Images

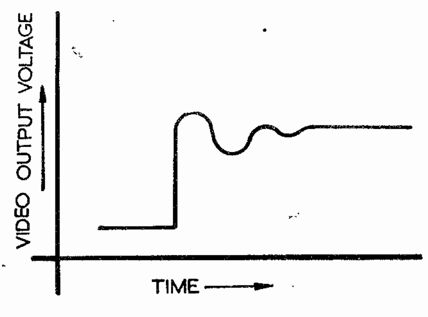
"*I have spent a considerable amount of time constructing a television receiver using a 9in. cathode ray tube of the magnetically focussed and deflected type. After ironing out the most obvious faults which were mainly connected with the time bases, I have obtained a reasonably good picture. The trouble is, however, that on some transmissions a ghost image is apparent immediately to the right of the required image. What can I do to remove this trouble?*"

D. Harlow, Windsor.

The trouble of ghost images is one which is frequently encountered in home constructed receivers and also, the writer is sorry to record, in a number of factory made receivers. The fault is easily recognisable when test card patterns or captions are being reproduced by the appearance of a second, and sometimes a third, image immediately to the right of the wanted image. The ghost images are always of lower intensity than the main image and hence do full justice to their name.

The causes of the trouble are several, and it is possible that a receiver may suffer from more than one, thus making the cure a rather more difficult task than it would otherwise have been. These causes are as follows:—

1. Signal reflections arriving at the receiving aerial after the mains signal, the latter having taken a direct path. Such reflections may come from nearby buildings, overhead lines or gasometers, and are normally avoided by slightly rotating the aerial and reflector or re-erecting it in another position.



R.C. 622

Fig. 1.

Showing the effect of "ringing" in the vision or video amplifier when the signal changes suddenly from black to white.

2. A mismatch between the aerial and the low impedance connecting cable, or between the cable and the receiver. Check dimensions of the aerial elements, and try adjusting the line coupling coil or the tapping point on the tuned coil.

3. Incorrect frequency response characteristic of either the vision RF amplifier, the video amplifier or both. The vision RF amplifier should have a flat frequency response of about 2.5 Mcs on either side of the vision carrier frequency for double side band working, and about 2.5 Mcs on one side of the carrier for single sideband working. The video amplifier on the other hand follows the detector and handles only the modulating band of frequencies over which it must have a relatively linear response. This range of frequencies is from 50 cps to 2.5 Mcs and compensating chokes are sometimes employed to boost the response at the higher frequencies. If a suitable signal generator is available the alignment of the tuned circuits in the vision channel is a relatively simple matter. However, it is possible to obtain equally good results without a generator providing the constructor has a little time and patience. The procedure is to first adjust all circuits to resonate on the vision carrier frequency by adjusting them for maximum picture brightness. When this has been done the response is widened by slightly detuning each circuit and carefully noting the results. After a little experimental work the optimum setting of the trimmers will be discovered.

If after having checked the above-mentioned points, the ghost image still persists in spoiling the picture, the vision channel including the video amplifier must be suspected of "ringing." This term is used to describe any unwanted resonance which may result in the generation of a damped wave train when shock excited by sudden changes in the vision modulation. The sudden change in modulation occurs particularly in captions where black letters are displayed upon a white screen. The sudden change from black to white may result in a damped wave train being produced which in turn will cause a number of ghost images to appear on the screen, each ghost being less apparent than its predecessor. To correct the trouble check the stability of the vision channel, it may be found that a decoupling capacitor has become open-circuited or possibly a tuned circuit damping resistor has developed a fault. An improvement may sometimes be obtainvd by the addition of further damping resistance across the tuned circuits, it should not, however, be necessary to reduce the overall resistance below 5,000 ohms.

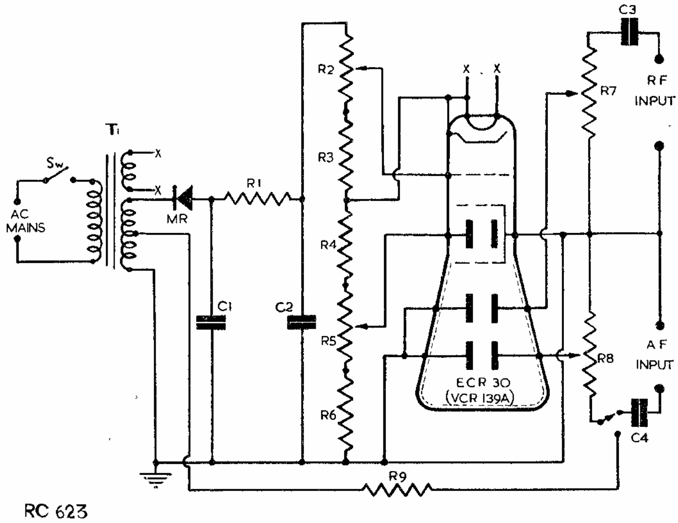


Fig. 2.

Circuit diagram of CRT modulation monitor. The metal rectifier may consist of two type J50 or one type T100.

Component Values

*R*1, 100*k* Ω
*R*2, 20*k* Ω
*R*3, 2*k* Ω
*R*4, 100*k* Ω
*R*5, 250*k* Ω
*R*6, 800*k* Ω

*R*7, 500*k* Ω
*R*8, 500*k* Ω
*R*9, 1*M* Ω
*C*1, 0.1μ*F* 1.5*V*
*C*2, 0.1μ*F* 1.5*kV*
*C*3, 0.001μ*F*
*C*4, 0.05μ*F*

Mains transformer :—
LT winding : 4V at 1.5A
HT winding: 500/700*V RMS total*

Turning to the video stage, damping resistors may, with advantage, be connected across any compensating chokes which are employed. Such chokes are a most prolific cause of ringing as together with their self capacitance they form resonant circuits. A simple and effective check upon the frequency response of the video stage may be made on the following lines : The output of a signal generator is connected into the grid circuit of the video amplifier and the generator set to about 1 Mcs (300 metres). If now the time bases are carefully adjusted a series of vertical bars will appear on the screen. At 1 Mcs the definition of these bars should be very good ; in which case increase the frequency to 2 Mcs (150 metres). The number of bars on the screen will increase, and if the frequency response of the video stage is adequate they will still be rendered with good definition. During the test the output voltage of the signal generator and the time base controls should be adjusted for optimum results.

This test provides a very good indication of the video response of the receiver and will indicate whether or not the frequency compensating chokes are of correct inductance.

Modulation Monitoring

" *I understand that it is possible to employ an oscilloscope for checking the depth of modulation of a telephony transmitter. If this is so would you please provide me with a circuit diagram of such an oscilloscope together with some brief notes upon its uses ?* "

G. Bowes, Nottingham.

A simple cathode ray tube unit provides an effective and accurate method of indicating the depth of modulation at any instant during a transmission. The unit may be left permanently connected to the transmitter and requires only an occasional glance to ensure that the carrier is being modulated to the correct depth. The unit consists of a power pack arranged to supply a 3in. cathode ray tube. The mains transformer should have a secondary voltage of between 500 and 700 V r.m.s. and may be of the type normally found in radio receivers having a centre tapped winding to permit its use in a full wave rectifier circuit. Half wave rectification is provided by means of a metal rectifier of a type frequently found on the Government surplus market at a very reasonable cost. The cathode ray tube mus be shielded from the stray magnetic field of the transformer, this is readily achieved by the use of a mu-metal screen surrounding the neck of the tube.

(*continued on next page*)

Amplitude controls are provided in the deflector plate circuits in the form of two 0.5 M Ω potentiometers, these permit the adjustment of the trace amplitude in order that a well proportioned image may be obtained. To increase the general usefulness of the unit provision has been made for a 50 cps horizontal sweep voltage which may be switched on to the X plates of the tube, thereby enabling frequency comparisons and other measurements to be made.

Having constructed the unit and tested it to ensure that a sharply defined spot is obtained in the centre of the tube screen connections may be made to the transmitter. This is arranged by linking the vertical shift plate to the tank circuit of the transmitter by means of a small coupling coil. The coil which may conveniently consist of a few turns of self supporting wire, should be placed axially in line with the tank coil and sufficiently close to it to provide a reasonable deflection of the CRT spot. The horizontal shift plate is connected to a high resistance potentiometer joined across one-half of the modulation transformer primary. The potentiometer may consist of two 2 megohm resistors connected in series across one-half of the transformer, the junction of the two resistors being taken to the CRT unit. The two amplitude controls are adjusted so that with the carrier and no modulation a vertical line of convenient length is obtained on the CRT screen. Similarly, with modulation and no carrier a horizontal line is obtained. Having reached these results the apparatus will be in working order and the images which will appear on the screen for various depths of modulation are shown in Fig. 3. From these diagrams it will be seen that the unit may be made to provide an effective but simple means of indicating modulation depth in a telephony transmitter.

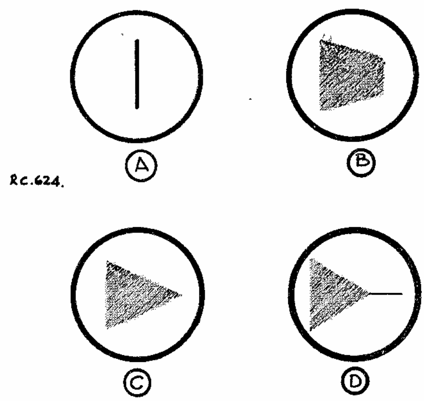


Fig. 3.

Showing the various modulation patterns obtained with the modulation monitor. (A) No Modulation. (B) Less than 100% mod. (C) 100% mod. (D) Over 100% mod.

Design of the SUPERHET

PART 3 By R. J. CABORN

READERS may remember that in last month's article we gave an explanation of the action of the frequency-changer. In this instalment we shall go one stage further and consider the design of the external circuits connected to the frequency-changer valve.

The Anode of the Frequency-Changer

Now last month we stated that, by means of the action peculiar to the frequency-changer, we obtained the difference frequency at its anode (i.e. the frequency equal to the difference between the signal and oscillator frequencies). However, it must be understood that the difference frequency is not the only signal appearing in the anode circuit, as also present will be found the two original frequencies, i.e. oscillator and signal. In addition, another frequency is found at the anode, this being equal to the *sum* of the oscillator and signal frequencies. And, in the multiplicative frequency-changer, a frequency equal to the *product* of the two frequencies is also apparent. Quite a cluster of signals!

Nevertheless, this need not worry us overmuch as the primary of our first IF transformer is intended to accept only the difference frequency, the other unwanted frequencies being, in this way, fairly easily disposed of.

So much for the anode circuit. Let us now turn to the signal and oscillator frequency circuits.

Radiation from the Aerial

In Fig. 1 is shown a simplified diagram of the multiplicative type of frequency-changer. It will help us to appreciate in full the efficient working of the additive type of frequency-changer if we quickly survey the disadvantages of the former type first.

The first great disadvantage is that since the output of the local oscillator is applied to the same grid as is the signal frequency, oscillations will then find their way to the aerial via the coils L1 and L2, and may easily interfere with neighbouring receivers.

The second great disadvantage is that, due also to the coupling at one common grid, the signal frequency is liable to " pull " the oscillator circuit towards it in frequency, thereby destroying the frequency stability of the receiver. The only way to reduce the coupling which gives rise to these two faults is to fit a buffer amplifier both between the aerial and the grid of the frequency-changer, and between the oscillator and that grid. This is a complication which is not at all desirable, since it may be the cause of instability and unwieldly chassis layout, as well as certainly increasing the cost of the receiver.

In the circuit of Fig. 2 (a typical additive frequency-changer), we see that, by reason of having the oscillator and signal voltages applied to two separate grids, shielded from each other

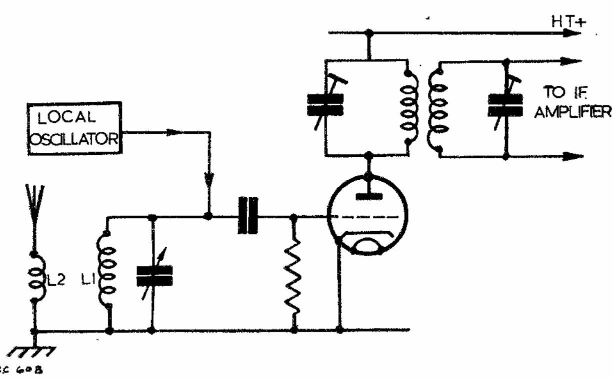


Fig. 1.
A simple multiplicative frequency changer.

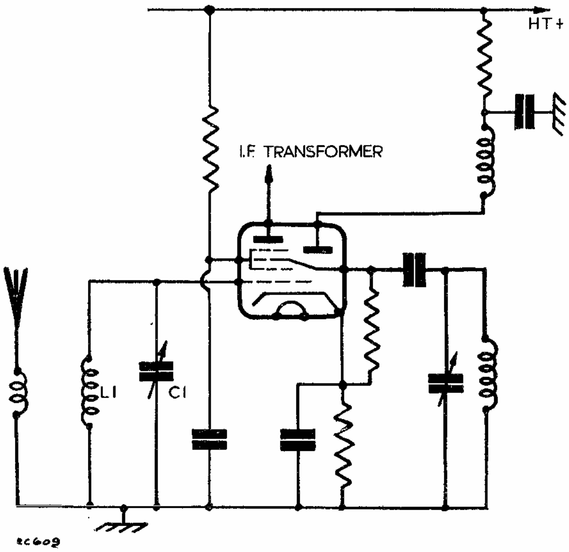


Fig. 2.
A typical frequency changer circuit using a triode-hexode.

by a screening-grid, this undue coupling is reduced to neglegible proportions, enabling us to build a superhet in which there is little danger of either radiating unwanted signals via the aerial, or of " pulling " the oscillator off its proper frequency. However, although the screen-grid reduces coupling between the two grids to a minimum, in practice there still remain small stray capacitances and undue couplings which may sometimes make a nuisance of themselves, particularly on the shorter wavebands. Undue capacitances in the valve are often reduced by bringing the signal grid out to a top cap, well away from the other electrodes. Other unwanted couplings, due to more complicated interaction (sometimes in the electron stream itself), have been mainly ironed out by the valve designers, although development work is always being carried out to improve their designs.

Second Channel Interference

If we refer to Fig. 2 again we will see that the signal picked up on the aerial is tuned by L1, C1 before being applied to the signal grid of the frequency-changer. This is necessary, of course, to ensure that the amplitude of the signal is as high as possible when applied to the valve. However, a secondary function of this tuned circuit is to prevent unwanted signals finding their way on to the signal grid.

Now let us assume that we have a superhet whose IF amplifier is designed to work at the nice round number of 100 kcs, and that we want to receive a signal of frequency 2,000 kcs. To effect its change to 100 kcs we then operate our local oscillator at 2,100 kcs to give us the necessary difference of 100 kcs.* So far so good, but let us suppose that there is also another transmitter on the air, this time broadcasting at a frequency of 2,200 kcs. Now if this second signal were to be applied to the signal grid of the frequency-changer, it also would combine with the 2,100 kcs local oscillator, again giving a difference frequency of 100 kcs. So now we find that two signals are being amplified by the IF stage, the required one at 2,000 kcs and the interfering signal at 2,200 kcs.

This form of interference is known as second-channel, or image, interference and is one of the most troublesome sources of interference to which the superhet is subject. In practice the interfering station would not necessarily have to be exactly twice the intermediate frequency away from the required signal to cause interference. In the case of the 2,200 kcs interfering signal above, any unwanted transmission within, say, 5 kcs or so of 2,200 kcs, would find its way into the IF stages, and, by beating with the required signal, would then cause a continuous (and extremely irritating) whistle in the background.

The obvious method of clearing second-channel interference is to ensure that the unwanted signal does not reach the signal grid in the first place. Efficient aerial tuned circuits will help to ensure this. Alternatively, more than one tuned circuit

* An oscillator frequency of 1,900 kcs (2,000—100) would, of course, do just as well.

may be used to make certain of second-channel rejection, either by band-pass circuits, or by using a tuned RF stage with its own additional tuned circuit before the frequency-changer.

A second method of reducing second-channel interference, incidentally, is to increase the intermediate frequency. If this were done, the necessity of the interfering signal have a frequency removed by twice the IF from the required signal would cause it to be itself further removed. The chances of its rejection by the signal tuned circuits would then become greater.

Another reason for having efficient tuned circuits for the signal frequency is to ensure that the occasionally-met trouble of cross-modulation does not occur. Cross-modulation takes place when a powerful local signal forces its way to the signal grid and modulates the required signal. The effect usually given by this fault is that of continually hearing the offending station in the background.

When a local station is so powerful that either cross-modulation or second-channel interference are fairly inevitable, it is usual practice to fit a wave-trap in the aerial circuit of the receiver, the trap being permanently tuned to reject the local signal.

The Oscillator Tuned Circuit

Now the oscillator tuned circuit plays an important part in the superhet. It must be remembered that the frequency fed into the IF stages depends entirely on the frequency of the oscillator.

To make this point a little clearer, let us suppose that a receiver with a 100 kcs IF amplifier is receiving a signal at 2,000 kcs. Now, if our oscillator is set to, say, 2,100 kcs, all is well. But it only needs a slight change in oscillator frequency to, say, 2,110 kcs for the 2,000 kcs signal to be almost completely tuned out and perhaps another at 2,010 kcs to be received. In fact, it can hardly be stretching a point to say that the oscillator *selects* whichever signal is going to be fed into the IF amplifier; whilst all that the signal grid tuned circuits do is simply maintain the strength of whichever signal is selected (incidentally, of course, reducing image interference, etc.).

It will be seen from the above then, that the frequency of the oscillator and its tuned circuits, far more so than the signal frequency tuned circuits, *must* be maintained stable and reliable. It must not " drift " (a fault caused usually by excess heat slightly altering the values of capacitors and inductors, due to expansion), or we will be " chasing " our signal across the dial all the time.

Now " drift " of the oscillator frequency is a common enough fault in a badly designed receiver; but, fortunately, its effects are only noticeable on the shorter wavebands where small changes in inductance and capacitance cause relatively large changes in frequency. The prevention of drift simply necessitates adequate ventilation of the chassis to prevent too much heat generation, and the use of good quality components in the tuned circuits. More adequate precautions are taken in communications—type receivers but we need hardly discuss these here at present. Drift will almost never occur on medium or long waves.

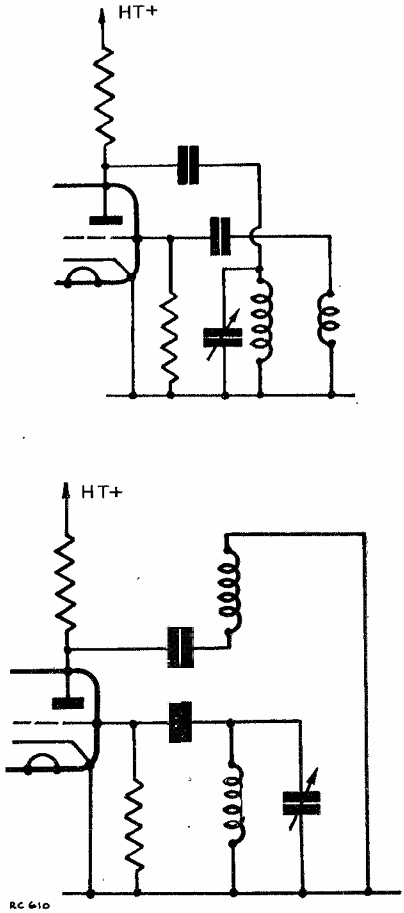


Fig. 3.
(*Top*) *A shunt-fed tuned anode oscillator.*
(*Bottom*) *A shunt-fed tuned grid oscillator.*

(*continued on page 157*)

. . . *from our mailbag* . . .

ON HUMOUR

Dear Sir,

May I be permitted to congratulate you on the outstanding series of articles by H. Dudley Stilton. His brand of humour and sly digs at the " know-all " are really clever. I hope this series will be a regular feature.

J. C. Dixon
(Preston)

WANTED

Dear Sir,

You ask readers to be bold, and if they have desires to state them, and therefore I take my courage into both hands and ask for an article on the precautions to be observed in " sticking bits together."

To make myself clear, let me add that my experience to date is that parts of various designs suit me, but rarely the whole, and I would like to take part of one to add to another.

My principal interest is in Hi-Fi radio and gramophones, and my next set will probably be in unit form, say speaker/amplifier remotely controlled by various forms of radio tuner, also gramophone.

I have, however, allowed such terms as " source impedance " and " impedance looking this or that way " to scare me, and an article pointing out the pitfalls would be welcome. Possibly they are illusory and I have revealed myself for the complete tyro which I am.

I see that other desires of mine are soon to be met in that you will be publishing a series on oscilloscopes and another on signal generators, and I look forward keenly to these. No doubt you will touch on their usefulness in connection with television—also an aspiration of mine.

By this time you will probably have diagnosed the basic trouble as ambition, anyway I enclose also a stamp in case it is of use for a reply.

J. H. Leverett
(Walton-on-Thames)

We reckon that without ambition none of us would hold for long our interest in radio, for it is the urge to make something better which drives us on. The series " Building Your Own Signal Generator " commenced in our last issue, and we hope to do something about your other suggestions in future issues.—Ed.

ON TRANSMITTING

Dear Sir,

Please accept P.O. for 16/- for another 12 months supply of " Radio Constructor " which provides much interesting and well set out reading. The " Quiz " is a very good idea, because it gives one a chance to find out how much (or little) one knows.

I see in this month's issue an article on crystal oscillators which is very informative, as I for one always thought the crystal to be fool-proof, and I should like to see more articles of this kind on the transmitting side, or is this more to be found in " Short Wave News "?

R. Gill
(Widnes)

Naturally " Radio Constructor " covers a very wide field, and we do include a certain amount of transmitting articles, but interested readers are advised to take " Short Wave News " as well, for it specialises in this subject.—Ed.

TEST GEAR

Dear Sir,

I think your magazine is very good value for the money. I have no adverse criticism, but would suggest that articles on the building and use of test instruments (valve voltmeters, signal generators, etc.), perhaps not so elaborate as the commercial article, would always be attractive to readers.

S. C. Cardwell
(North Watford)

EX-GOVT. SURPLUS

Dear Sir,

Regarding the contents of the journal—I wish to say that they are first class, and you are covering most of the ex-Government gear which I have.

However, I should like to have some data on the TR1143 set (Receiver Type 71—100/120 Mcs). I believe this can be adapted to the 144 Mcs band. Can you help us with some data in a future issue?

I have also recently obtained the American VHF set SCR522 (TR5043). Will you be publishing anything on this set in the future?

R. G. Hayward
(East Croydon)

The TR1143 is the British version of the SCR522, though the latter has a wider frequency coverage—from 100 to 156 Mcs. We hope to publish something on this shortly.—Ed.

SUTTON COLDFIELD TV

Dear Sir,

I find your publication a great help to me and I wish you every success in the New Year.

For the benefit of local readers, I find that I can tune Sutton Coldfield in on my RF25 Unit. I use position 1 and 2 for the Alexandra Palace transmissions, and by changing the aerial to Sutton Coldfield's frequency and switching to positions 3 or 4 on the unit I can get the Birmingham transmissions. I have not altered the unit in any way, so it may save some of your readers a bit of money.

T. Lucas.
(Wolverhampton)

SURPLUS RADIO EQUIPMENT

described by B. Carter

In this series of articles it is intended to describe units that have (a) immediate application, after some modification perhaps, in the amateur world, and (b) to list the contents of those units that can best become sources of valuable components. This month's unit with very little modification may be of use to many amateurs as it is purchased.

SIGNAL GENERATOR TYPE 106 (10 SB/6086)

THE Signal Generator Type 106 is an instrument capable of immediate application by the amateur. It is hoped that this description will not only be of interest to those who are fortunate enough to possess a signal generator of this kind, but that it will assist those who would like to build one of their own, using this as an example.

The frequency range covered is 6.1 to 52.0 Mcs in four bands, as follows :— (A). 6.0 to 10.5 Mcs. (B). 10.4 to 18.3 Mcs. (C). 18.3 to 32.0 Mcs. (D). 29.5 to 52.0 Mcs. The amount of output voltage is variable between 1 micro-volt and 100 milli-volts. Calibration charts are provided in the rear of the case, showing the range and dial setting used, and these charts have an accuracy of ±1% except on the highest output voltage step, when it is in the order of ± 2%. The waveform output from this unit can be of various characters. Continuous wave operation is available (S1

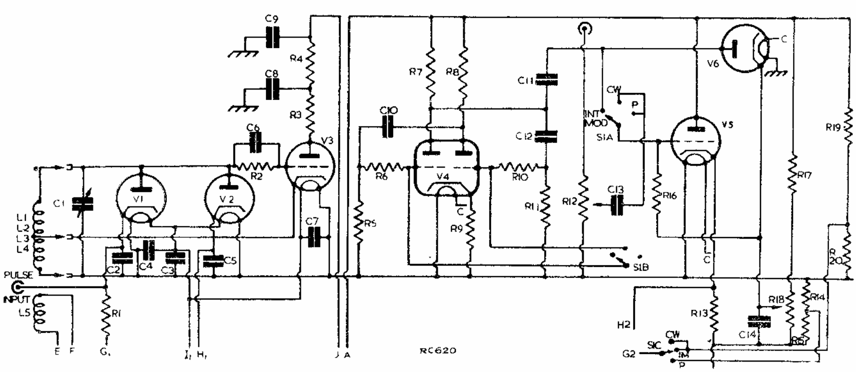


Fig. 1. *RF and Modulator stages*

Letters A-D refer to Power Supply, E-F to Monitor and G-J to RF Filter.

Component Values

L1, 2, 3, 4, Coil Turret	*C6, 250pF*	*C14, 4.0μF*	*R8, 4.7k Ω*	*R16, 100k Ω*
L5, Output Coil	*C7, 300pF*	*R1, 1k Ω*	*R9, 220k Ω*	*R17, 100k Ω*
S1 (ABC), Mode Switch	*C8, 300pF*	*R2, 4.7k Ω*	*R10, 4.7k Ω*	*R18, 25k Ω pot*
C1, 50pF	*C9, 300pF*	*R3, 30 Ω*	*R11, 330k Ω*	*R19, 27k Ω*
C2, 300pF	*C10, 0.001μF*	*R4, 1k Ω*	*R12, 10k Ω pot*	*R20, 15k Ω*
C3, 0.01μF	*C11, 0.1μF*	*R5, 330k Ω*	*R13, 3.3k Ω*	*V1, 2, 6, VR92 (EA50)*
C4, 300pF	*C12, 0.001μF*	*R6, 4.7k Ω*	*R14, 200 Ω*	*V3, VR137 (EC52)*
C5, 0.005μF	*C13, 0.5μF*	*R7, 4.7k Ω*	*R15, 330 Ω*	*V4, VT61 (RK34)*
				V5, VR67 (6J5)

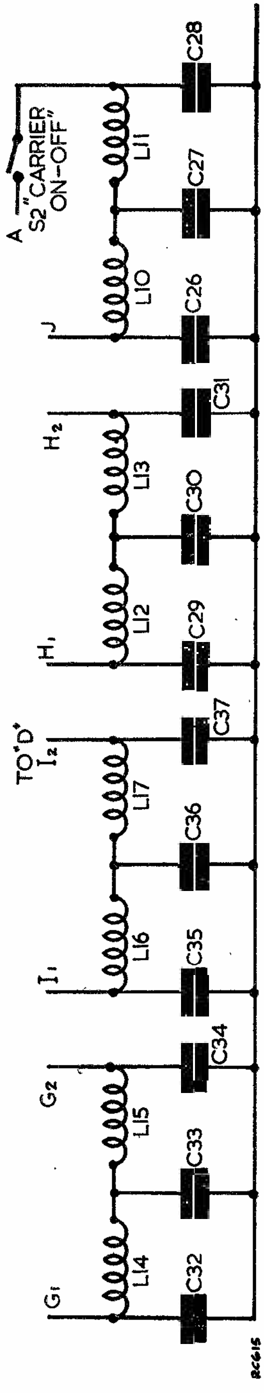


Fig. 2. *RF Stage Filter*

Component Values

C32, 33, 34, 0.001μ*F* C35, 36, 37, 0.01μ*F*
C29, 30, 31, 0.001μ*F* C26, 27, 28, 0.01μ*F*

position 2), and if required this may be amplitude modulated by an external waveform introduced by way of the socket marked " EXT MOD." However, if it is desired to have a 1,000 cps modulated continuous wave, this is provided for internally (S1 position 1) by a multivibrator (V4). Third mode of operation concerns pulsed IF output (S1 position 3). By applying a pulse to the socket marked " PULSED INPUT," the output will be similarly pulsed, and can also be amplitude modulated by an external source under similar circumstances as can the continuous wave. The pulse used should be positive in nature, one microsecond long, and of at least forty volts in amplitude. It must also be isolated from any DC, and the modulation voltage, if used, should be the same as is used with continuous wave, i.e., at least 15 volts.

Turning to the circuit diagram, it will be seen that the valve V3 is used as an oscillator, with the coils L1—L4 and the capacitor C1 as the tuned circuit. The coils L1—L4 are arranged turret fashion, and form the Band-switch (S3) markep " A.B.C.D." The variable capacitor C1 tunes each band by the vernier handle marked " Frèquency." The output of the RF Section is fed from L5 into an attenuator formed by the inductive potentiometer L9 and a step attenuator S4, each step representing 20 decibels, and the output is taken via either a 70 ohms or a 100 ohms socket. The valve V1 acts as a switch. When the switch S1 is turned to either continuous wave or modulated continuous wave positions the valve does not conduct and the oscillator V3 operates, but, when pulse conditions prevail, the valve V1 is allowed to conduct during " no pulse " periods so that the valve V3 can only oscillate during the time of the pulse. The valve V2 is a limiting diode controlling the output amplitude of the Valve V3 in conjunction with the control R18 called " Set RF." The self-running multivibrator V4 working at 1,000 cps and producing a square waveform is allowed to operate when required under continuous wave condition, and also when pulse is used, as in the latter case its influence is negligible, but the grids are " tied " together when operated under plain or external modulation condition. The 1,000 cps output is fed to the cathode follower V5 direct. When the output of V4 is not required, valve V5 handles any incoming amplitude modulation via the " Ext. Mod." socket and the " Mod. Depth." control R12. The output of the cathode follower is fed to the controlling diode V2 using R18 for amplitude control. The diode V6 keeps the waveform output of multivibrator V4 square, and eliminates any tendency to peak. The diode V7 and the meter M1 form a monitor circuit, where part of the output current is recti-

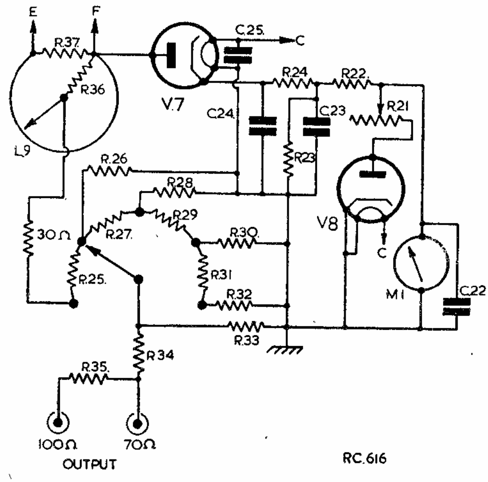


Fig. 3. *Output and Monitor circuit*

Component Values

L9, Inductive Potentiometer		*S4, Step Attenuator Switch*
C22, 0.01*μF*	*R25*, 270 Ω	*R33*, 68 Ω
C23, 0.01*μF*	*R26*, 33 Ω	*R34*, 47 Ω
C24, 300*pF*	*R27*, 270 Ω	*R35*, 30 Ω
C25, 300*pF*	*R28*, 33 Ω	*R36*, 220 Ω
R21, 25*k* Ω *pot*	*R29*, 270 Ω	*R37*, 100 Ω
R22, 2.7*k* Ω	*R30*, 33 Ω	*M1*, 50*μA*
R23, 33*k* Ω	*R31*, 270 Ω	*V7*, *VR92* (*EA50*)
R24, 470 Ω	*R32*, 30 Ω	*V8*, *VR92* (*EA50*)

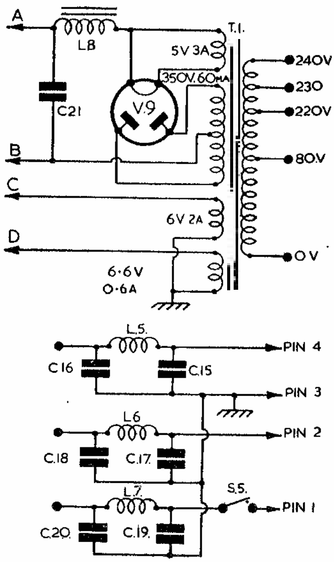


Fig. 4. *Power Supply*

Component Values

T1, Mains trans.	*C18*, 0.005*μF*
L8, Choke	*C19*, 0.005*μF*
L5, 7, Mains filters	*C20*, 0.005*μF*
C15, 0.005*μF*	*C21*, 8.0*μF*
C16, 0.005*μF*	*V9*, *VU71* (5*U4G*)
C17, 0.005*μF*	

fied to indicate the amplitude of the output. When the oscillator (V3) is not working there is still a small amount of current flowing but its effect on the meter is balanced by the current flowing through the diode V8. To set the meter to zero, switch off the HT to V3 by means of S2 ("Carrier on/off"), and adjust potentiometer R21 ("Set Zero"). The value of the output of the unit is set by moving L6 and S4 to the maximum indicated position of 100mV, then moving the "Set RF" control until meter scale reads "×1." The indicated values on the dials of L6 and S4 are now accurate to the degree of ± 2db ±1μV, if these adjustments are made at each change of frequency and as the unit heats up. The valve V9 completes the valve complement, working as a full wave rectifier in the power supply circuit, with the negative high tension line negative with respect to the chassis.

"Query Corner" Rules

(1) A nominal fee of 1/- will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with the more general interest will be reproduced in these pages each month.

Radio Miscellany

ONE of the chief anxieties of a radio columnist is the fear that he will unthinkingly run the beginners out of their depth. I often have an uneasy feeling in this respect, partly, perhaps, because it was so long ago that I was a beginner myself and partly because things were so different in those days. It was then easy to quickly find oneself beyond the beginner stage, when one only had triode valves to bother about and a 3-valver was regarded as being in the super-de-luxe class.

Correspondence with, and more important, actually meeting beginners does help a lot in keeping the right prespective. I have, by the way, always replied to correspondents even if the replies have not been as detailed or as prompt as I might wish. It's nice to have the letters, of course, but replying—well, I have long since decided never to become an M.P., at least, not without having a half-dozen secretaries thrown in!

Beginners to-day find themselves in a much more complicated world of radio than we old timers dreamed possible. Whoever would have thought we should have drifted into a state where we have many hundreds of different types of valves with a multiplicity of bases? Still stranger for those who remember the Hivac-Harries All-Purpose valve. One spare receiving valve and a rectifier was a sufficient safeguard against valve failure in any set. They were good, too! I built a superhet using them which gave a first-rate performance, and was only finally broken up for parts in late '39 after I couldn't get a spare! Thinking back, it must be over fifteen years ago when they were first introduced, so if you have any bright ideas like that don't make the mistake of thinking they are original.

CENTRE TAP
TALKS ABOUT
Old Ideas — Trouble Shooting — The Modern Beginner

Old Ideas Revived

It would be very difficult to think of something really new.

The idea of slow running gramophone records recently so extensively (and vigorously) marketed in the States, is far from new. In the early twenties we had the Pemberton-Billing attachment—a set of governor springs slowing down the turntable and giving three or four times the playing period. This was years before the introduction of "electrical" recordings, but the idea did not catch on. Quite why I never could be sure, although it was generally supposed to be due to the limited number of suitable records.

I remember, too, the idea of inductive tuning, using a copper plate to vary the coil inductance, in use in 1922, fall into disuse and more recently re-appear in an improved form. Electrolytic condensers were manufactured commercially over 40 years ago, and baseless valves were highly popular 30 years back. Both went completely out of production to make sensational come-backs.

Many, too, are the ideas born before their time that quietly disappear to lie dormant until they get a new lease of life as they become required to meet some new demand in a modernised form.

Any Offers?

We seem to have digressed some way from the subject—the modern beginner. It had occurred to me that despite the enormous range of text books now available, the proportion of really modern, practical and readable books for the newcomer is very small. A quick check-up on this point at the largest radio book stockists in the country emphatically confirmed this.

What do the beginners themselves think?

For those with definite views I hasten to add, write to the Editor, not me. That is, unless you do not expect a reply for weeks.

It would be interesting to know, too, where present day beginners pick up their radio knowledge the quickest, or shall we say the pleasantest, way.

Is it from text books, magazines, Radio Clubs, at School, in the Services or simply by getting together with the chap a few doors down the road?

Whatever your answer, I'll wager one thing. That is, you started young. It's years since I met a middle-aged beginner, although it is pretty certain that at least one hoary veteran will prove me wrong by writing in to say that when he first drew his Old Age Pension he didn't know the difference between a valve and a "toob," but now he helps the local repair man out whenever the latter runs into a really sticky one!

Remote Trouble-Shooting

I suppose every constructor gradually acquires a reputation among his friends as being something of an "expert" whose advice is sought whenever they run into trouble. Giving advice on ill-described effects, and sometimes even simple faults, can be a treacherous business.

I remember once being asked by a listener friend for my "expert" opinion about the cause of an intermittent crackle. To save time I gave him the usual formula—try disconnecting the aerial, if it stops it is outside the set, if not, it is inside. He agreed it was logical and said he ought to have thought that much out for himself.

A few days later he reported that the noise was coming from outside alright. It stopped completely when the aerial lead was removed. Could I please pop in to see if I could detect what was the source of this interference, so he could do something about having it suppressed?

Well, well! I might have used my loaf and saved myself a journey. There was, of course, no local electrical interference. It was simply a break in the aerial lead-in wire, with the two ends just touching together!

It just goes to show how easily one can be led astray by taking it for granted that someone else would have enough knowledge to look for the simple things first.

Actually most of the faults one is asked to diagnose turn out to be almost equally simple, but the trouble is one is disposed to take it for granted that the seeker after advice has already tried the obvious. One doesn't like to insult his intelligence by suggesting that it is only a very elementary trouble that is baffling him.

Microphony

Another difficulty is the way symptoms are described. For instance, microphony does not always produce the well-known howl or singing sound.

It may sometimes appear as distortion, perhaps accentuating only certain notes.

Beginners look upon microphony and distortion as quite separate and distinct troubles. Nor is it necessarily attributable only to a microphonic valve. (A microphonic valve is one in which electrode movement takes place due to lack of rigidity in assembly. A ringing sound is set up by any slight mechanical shock or even sound waves from the speaker, and in bad cases builds up in intensity once it has started.)

Experienced constructors sometimes wrongly associate microphony with valves only, forgetting that in modern receivers it is often not due to valve trouble at all. The effect is quite commonly caused by sound waves from the loudspeaker setting up vibration in the tuning capacitor vanes, especially if these are thin or springy, or not supported by a stiffening bar. It will disappear if the speaker is removed from the cabinet housing the chassis, and can normally be cleared by mounting the tuning capacitor, or even the whole chassis, on a rubber pad.

TRADE NOTES

BRITAIN MAKES HISTORY IN VALVES FOR HEARING AIDS

Valves so small that three of them will go into a thimble. This is the latest achievement of Mullard Electronic Products Ltd., and represents the greatest advance yet made in valves specifically developed for use in Hearing Aids.

Space Reduced by Quarter

The extremely small size of these valves may be gauged from the fact that they are one-fortieth the size of an average radio receiving valve, and less than one-twelfth the size of the first Hearing Aid valves which Mullard brought out in 1936. Their dimensions are as follows:—8.5mm (0.33″) wide, 6.1mm (0.24″) thick by 28mm (1.1″) or 35mm (1.38″) long, according to the type. This results in almost a two-thirds saving in space.

Longer Battery-Life for Hearing Aids

Another outstanding advantage of these new valves is that they operate efficiently with an extremely small filament current, requiring no more than 15 milliamperes. This advance will be apparent when it is considered that a Hearing Aid, using these valves, would consume a total filament current of only 30 milliamperes as compared with 50 milliamperes required by Hearing Aids at present in use, and an average of 160 milliamperes required by instruments in common use before the war. The importance of this may be further judged from the fact that 1,000 Hearing Aids with the new valves would consume less electrical energy than a single 60-watt electric lamp. This marked reduction in filament current has been obtained through the use of filament wire having a diameter of less than 8 microns (3/10,000th″). This is less than 1/10th the diameter of a human hair.

Characteristics

Despite the reduction in size and the saving in filament current, the performance of these new sub-miniatures is actually better than that of the larger 10mm valves. For example, loss in gain resulting from the reduced filament current, has been more than offset by improvements in the design of the filament and grid systems. In this way, it has been possible to increase the gain by one to two dB.

Both the voltage-amplifier pentode, DF66, and the output pentode, DL66, at present available, are designed for use with a 22.5-volt HT Battery supply, thus meeting the needs of most Monopacks. The filament rating of the output valve is 1.25V whilst that for the amplifier is 0.625V, it being customary in Hearing Aids to run two of the latter valves in series. Using a 22.5-volt battery, the DF66 will give a voltage gain of about 30dB per stage. This is adequate for the majority of Hearing Aid circuits. The DL66 will give an output power of approximately 2.5mW at no more than 10 per cent distortion. This is sufficient to meet the demands of seventy per cent of the Hearing Aids at present being manufactured, but where larger outputs are required,

(*continued on page 177*)

A DUAL-WAVE BEDSIDE SET

BY P. MANSFIELD

THE circuit comprises a simple 3-valve straight set, HT supply being obtained by a metal rectifier (MR). The valve line-up is EF39 HF stage, EF36 operating as leaky grid detector, and a 12A6 output. Any 0.2 amp output should prove satisfactory, the only possible alteration being in the bias resistor. A valve which operates with a bias of at least 10 volts should be used, as this bias voltage is put to another use.

Components throughout have been cut to what I fondly believe to be a minimum. I have no doubt that I shall shortly be informed that half the remaining components are superfluous —so much for rash statements. By dispensing with screen dropping resistors, screen decoupling capacitors are also rendered needless. If a 12A6 is used, with heater current of 0.15 amp, a shunt must be placed across its heaters, as the current flowing in the circuit is 0.2 amps.

Well, to follow Mrs. Beeton—first obtain your components. A word of warning here. When purchasing your chassis, make sure that you can get a cabinet and dial which will match up properly, also a matching gang, so that the tuning spindle will come on the centre of the dial.

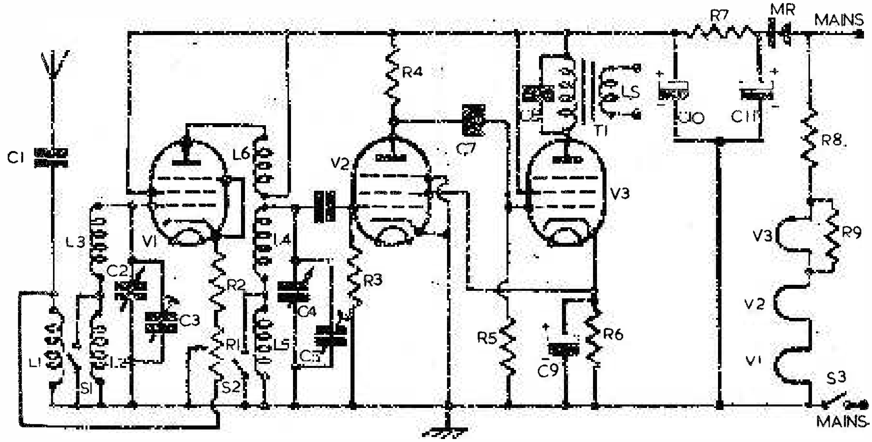


Fig. 1.

Circuit of the receiver. Note the shunt resistor across V3 heater (see text). Also note that a direct earth connection must NOT be made to the chassis. The sign shown in diagram indicates that the HT— line is connected to chassis. The suppressor grid in V3, if existent in the valve used, will be connected internally to the cathode.

Component Values

C1, 300pF	C7, 0.10μF	R2, 330 Ω	R8, see text
C2, 500pF	C8, 0.005μF	R3, 1M Ω	R9, see text
C3, 30pF	C9, 50μF 25V	R4, 500k Ω	V1, EF39
C4, 500pF	C10, 16μF 350V	R5, 500k Ω	V2, EF36
C5, 30pF	C11, 16μF 350V	R6, 600 Ω	V3, 12A6
C6, 100pF	R1, 10k Ω	R7, 1k Ω 10W	

Overlooking such details can cause you a lot of grief later.

So now you have your components, you know what it's all about, and you'd like to hear the music. But No-o-o-o. You now bolt all these bits and pieces on to your chassis in the positions indicated on the diagram, or as nearly as they will fit on your particular chassis. Now you may plug in your soldering iron, search for a little piece of solder, some odd scraps of wire, your cutters (scissors ?), and commence internal decoration. Firstly, and please do this, even though it seems time wasted, go right round the set and properly tin every tag. It is the very devil when you have got most of the wiring in to find a tag which is hard to reach, and on which the solder just will not run.

I recommend that the first wire in the set should be a piece of bare tinned copper, passing round the chassis, and soldered to all earthy points en route, then earthed properly on a solder tag bolted to the chassis. It will help to solder pin 1 on all valve bases to earth, this is the metallising on the EF36, and the can on the 12A6. Next comes heater wiring. From the mains dropper, wire output stage, HF and detector, in that order, the last pin on the detector being directly earthed. For the next step I recommend wiring from the HT supply. That is to say, from the red tag (make no error) on the rectifier to the reservoir capacitor through the 600 ohm 1 watt resistor to the smoothing capacitor, thence to pin 6, a spare pin, on all valves. You will thus have HT to hand on all valve bases.

R8 is the mains dropper resistor, and is rated at 0.2 amps. This resistor is usually 1,200 Ω total value, and it may be necessary to tap or adjust it to give the required voltages for the valve heaters. The total heater voltage adds up to 25 volts (to nearest volt) and therefore 225 volts will have to be dropped across R8. By Ohms Law, 225 divided by 0.2 equals 1,125 ohms, and as this is very nearly close to the total value of R8 the whole length of the dropper resistor may be included. The discrepancy is small, and the extra resistance will make very little difference to the circuit operation. The shunt resistor for V3 heater (12A6 or similar with 0.15 amp heater) must by-pass 0.05 amp at 12.6 volt, and using Ohms Law again, we arrive at 25 ohms, the value of R9.

Now wire in all small components, and do not crowd the first ones in, you will have ample space. The wiring completed, insert plug into the mains, attach an aerial, switch on, retire immediately. No, better, stand to your post, and at the first sign of smoke switch off and check. This is unlikely, however, and it is far more likely that you will hear signals straight away.

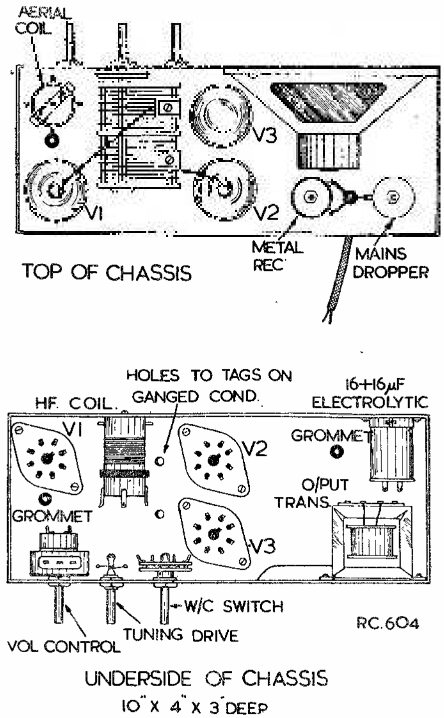


Fig. 2.

Sketches showing suggested layout above and below chassis (not to scale).

Adjust gang for best signal, turn the volume control down until it is almost inaudible, and then adjust trimming capacitors for maximum volume. I have had good results from this circuit, and listening is by no means confined to Home and Light programmes.

I have been in touch with a company advertising in this magazine, and they have agreed to provide all the components in a kit form, which is extremely handy, as all the components fit together in a decent fashion, and the receiver can look really professional.

A TVI-FREE RF POWER AMPLIFIER

BY JAMES BRAMHILL, G2BMI

THE piece of equipment about to be described, when originally built about eighteen months ago, was designed to be a medium power, all band final, running at about 60 watts input. As such it worked very efficiently, that is, until a very near neighbour some 50ft. away decided that a television set would be an added asset to his homestead.

Apparently, the next time that the transmitter was operated in the 14 Mcs band his picture was completely wiped off the screen, and the sound channel was fully modulated with G2BMI calling CQ. This was TVI in its worst possible form. So to keep the peace, and to enable both of us to enjoy our own particular form of radio entertainment, it was decided to " clean up " my side of the fence.

The following is a detailed account of how the transmitter was modified, outlined in three separate steps.

The Driver Stage

This for 14 Mcs is a very simple 6L6 tritet, or a straight CO and/or buffer stage for 7 Mcs. The modifications to this section were very simple, the normal link between the anode and the PA grid being replaced with 80 ohm co-axial cable and pye connectors. No other modification was done, or tried, although it was realised that should TVI persist, the whole unit would have to be completely screened.

The RF Power Amplifier

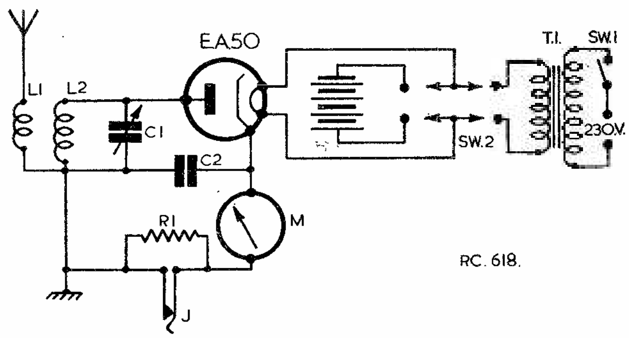
This, when first constructed, consisted of the conventional pair of push-pull 807's running at about 60 watts input. The following description gives details of the initial design together with the TVI modifications.

The PA is built on an 18 swg mild steel chassis, measuring $16\frac{1}{2}''$ x $8\frac{1}{2}''$ x $3''$, which is mounted on a standard 19" x 12" rack panel. The two 807's are placed above deck, not sunk in as is usual with these valves.

The plug-in grid coil is located to the left of the 807's and is surrounded on three sides by a mild steel shield measuring $2\frac{3}{4}''$ x $2\frac{3}{4}''$ x $3\frac{3}{4}''$ high. The height is such as to completely screen the grid coil from any RF from the anodes of the 807's.

In the centre is the anode tuning capacitor. In its original form this was an 0.001μF Cyldon. This was completely dismantled and the fixed stator supports cut. On re-assembling, both sets of stators were double spaced, so that a quite reasonable split-stator capacitor was obtained. The two insulated end pieces, i.e., those remote from the 807's were removed and replaced by a perspex platform, which was cut and bent so as to form end pieces, and to give support for the anode tank coil. This platform also ensures very short wiring to the split-stators.

Also mounted on this platform is the swinging link assembly, which is connected via a flexible



DIODE HARMONIC INDICATOR

Diode Harmonic Indicator

Component Values

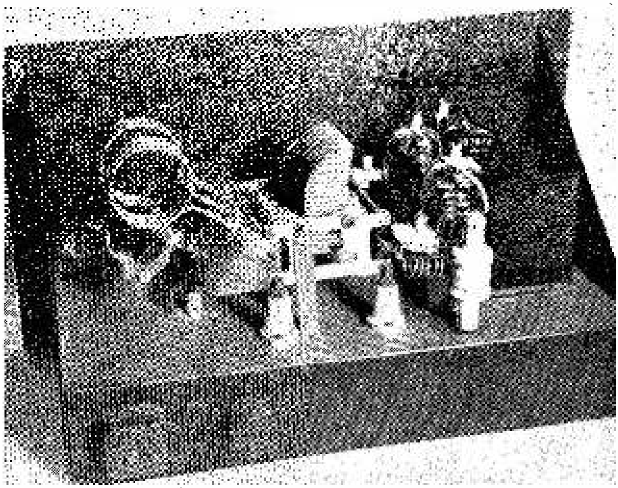
L1, 2 turns 16 swg ½in. diam. spaced over ½in.

L2, 4 turns 16 swg ½in. diam. spaced over ½in.

C1, 300pF C2, 0.001μF

R1, 2k Ω M, 1mA fsd.

T1, Bell transformer, secondary 5V.



REAR VIEW OF THE POWER AMPLIFIER

coupler to the dial on the right of the anode tuning capacitor.

TVI Suppressors

Between the 807's and the stators are fixed the vacuum-mounted 50pF bypass capacitors (Western Electric 5kV 5A type). The connection of the anode to each capacitor is carried out by means of ¼″ wide copper strip. Between each capacitor and its stator is mounted a harmonic trap, one side of which is bolted directly to the stator. This trap consists of a 15pF midget preset ceramic capacitor connected in parallel with an inductor. The latter is air cored, and has 5 turns 16 swg spaced to occupy 1″, with an internal diameter of ½″ (see illustration).

Below chassis, and placed directly under the grid coil, is the grid split-stator capacitor. This is of the butterfly type and was extracted from one of the well-known ex-govt. IFF sets. Copper strip was again used to earth the rotor.

All leads to the 807 and grid coil holders are symetrical, wherever possible, e.g., the screens are connected by a reasonably thick wire and the centre point of this is taken to the appropriate point in the circuit.

Parasitic stoppers are fitted in both the grid and screen of each 807, in the shape of a 12 turn coil, close-wound with 20 swg, with an internal diameter of ¼″, for the grids, and 1,000 ohm ½W resistors for the screens.

The screen potential is taken from a bleeder network, the values of which are calculated to give a screen potential of 260V with an anode supply of 500V.

Closed-circuit jacks are provided to enable grid, screen and anode current readings to be taken. Two such plugs are supplied for the anode, one for meter readings and the other for anode modulation if this is required.

Typical performance figures are given below:

CW

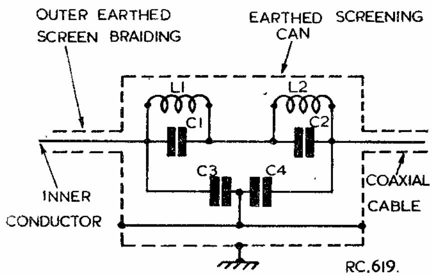
Anode Volts=450	Anode Current=120mA
Screen Volts=250	Screen Current= 12mA

Grid Modulation

Anode Volts=500	Anode Current = 70mA
Screen Volts=350	Screen Current = 6mA

Harmonic Suppression Filter

As this station might sometime in the future wish to experiment with various types of aerials and their associated coupling units, it was decided to link couple the PA tank coil to the aerial coupling unit via a short length of 80 ohm concentric line. Now this form lends itself admirably to the inclusion of a harmonic suppression filter.

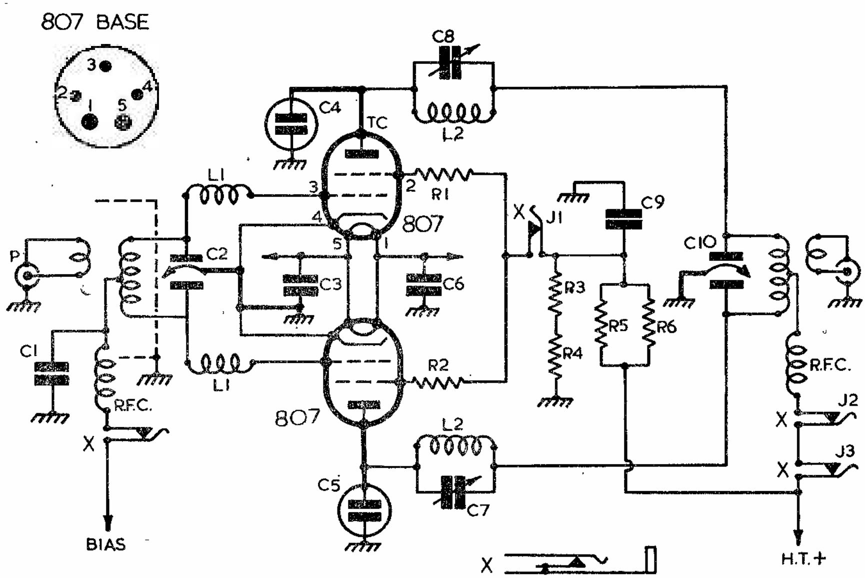


HARMONIC SUPPRESSION FILTER, FOR 80 Ω CONCENTRIC LINE

Component Values

L1, 2, 10 turns 16 swg ½in. internal diam., air-spaced over 1in.

C1, 2, 20pF C3, 4 100pF.



RC.617.

CIRCUIT OF THE POWER AMPLIFIER

Thick lines are copper strip.

Component Values

L1, 2, *see text*	*C4*, 5, *see text*	*R1*, 1*k* Ω	*R5*, 25*k* Ω
C2, 10, *see text*	*C6*, 0.001μF	*R2*, 1*k* Ω	*R6*, 25*k* Ω
C1, 0.01μF	*C7*, 8, 15pF, *see text*	*R3*, 50*k* Ω	
C3, 0.001μF	*C9*, 0.01μF	*R4*, 50*k* Ω	

The filter and its constants are shown in the accompanying circuit diagram.

For convenience the filter was totally enclosed in one of the long types of tin which usually contains a cycle puncture repair outfit. This is ideal because the length is just right to take the two coils end-on, leaving just enough room alongside to house the four mica capacitors. The outer casing of the co-axial is soldered directly to each end of the container. This makes a very neat unit which can, if need arises, be used for testing in other parts of the equipment.

Lining Up Filters, Etc.

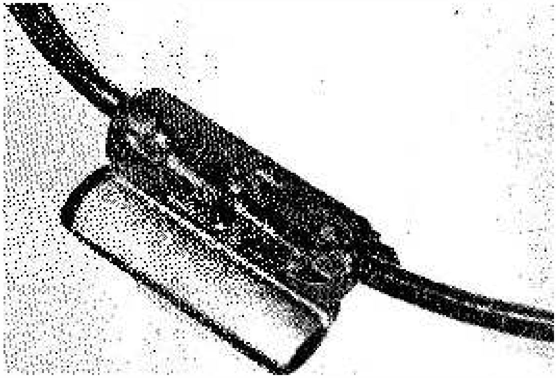
For the adjustment of the filters some form of Harmonic Indicator is essential, and this must tune to the harmonic which it is desired to eliminate, in this instance 41.5 or 45 Mcs. Fortunately this station possesses a diode field strength indicator, built during the war, which is capable of being tuned throughout the range from 28 to 60 Mcs. For the convenience of readers a circuit diagram is given.

For initial tests, the filter in the co-axial line is not used.

The method of using the instrument as a harmonic indicator is as follows. First tune the transmitter in the normal manner, in this case to 14 Mcs, with the harmonic filters shorted out. Then couple the field strength meter to the transmitter just tightly enough to give full scale deflection on the 0-1mA meter at that harmonic which falls in the television band. Direct coupling is not necessary, just bring the aerial of the indicator near to the transmitting aerial.

Now remove the shorting clips from the harmonic filters, and with an insulated trimming tool tune each of the filter capacitors for minimum current reading on the meter. This is the

SHOWING CONSTRUCTION OF THE HARMONIC SUPPRESSION FILTER



position of least radiation of TV harmonics. Warning—remember these capacitors are " hot " to both RF and HT.

The inclusion of the harmonic suppression filter finally removes the last trace of TVI.

The transmitter was now tuned and operated in the 14 Mcs band using both CW and phone, and tests with our neighbour showed no signs of TVI, either on his sound or on his vision channels.

Acknowledgements

The writer records his thanks to the RSGB for their publication on " Transmitter Interference " and to Mr. L. Varney G5RV for his article " Further Advances on TVI Suppression " in the RSGB " Bulletin " May, 1949, for without their help this station would be QRT during television hours.

(*TRADE NOTES—continued from page 171*)

use may be made of the Mullard 10mm sub-miniature DL72.

Construction and Performance

These new valves are of robust construction and can be relied upon to give excellent performance over long periods of service. They embody the advantages of the all-glass technique, which the Mullard Company has perfected in this country, and are characterised by short internal connections, and rigid electrode supports. These features result in a marked absence of microphony, and in carefully designed instruments using these valves, it is possible to obtain a high order of reproduction.

The lead-out wires may be soldered directly to circuit components without the use of sockets. The base connections however, are standard, and where necessary the lead-out wires may be cut back to about 0.25″, thus permitting the valve to be used with standard sub-miniature sockets.

(*BOOK REVIEW—continued from page 179*)

The 16 pages of Chapter 8 deal with instrumentation and measurement—B/H curves, noise, distortion, wow, flutter, bias adjustment, head tests, coercive force estimations, etc.

The final chapter assesses the challenge of magnetic recording to the gramophone companies. At present there is no simple way of mass-producing tape recordings, and many more people must have playback equipment before the sale of such recordings becomes an economic project.

Each chapter has its own references to books and articles; there is a seven-page glossary of technical terms and an index. Altogether some 230 pages of interesting matter, lucidly set out, and recommended as a good, general outline of the field—in fact, the first we've had. Magnetic recording is becoming increasingly important, and go-ahead amateurs (that means most of them) will find in it plenty of scope and interest.

K. KEMSEY-BOURNE

Jones builds a Televisor

A TALL TV STORY

BY CYRIL NOALL

JONES is one of those perverse fellows who always know better than the experts. So, having decided to build himself a televisor, he contemptuously tossed aside his copy of *Inexpensive Television* and proceeded to construct a model entirely to his own design.

Of course, he went wrong from the start. Instead of using the R1355 or something equally appropriate, he unearthed a weird piece of centimetric apparatus from some junk shop and pressed this into service as the basis for his vision unit. Jones laboured for six months at the conversion, until at last the Great Day arrived when he considered it safe to switch the thing on.

All his relatives and friends were invited to this ceremony, but, alas ! all they saw was sweet nothing on the screen, accompanied on sound by poor Jones' imperfectly suppressed bad language.

" I know what it is," he said savagely, grasping the controls fiercely in each hand. " I haven't got it tuned-in properly." Which was hardly surprising, seeing that the receiver's RF stage had not been altered from its original radar-coverage setting.

Strangely enough, though, he *did* get a signal of sorts after a while. Queer streaks and spangles flashed across the screen. It looked like some crazy Guy Fawkes display.

" Marvellous ! Wonderful ! " exclaimed Jones' short-sighted old grandmother delightedly. "What wonders science has given us, to be sure !"

Jones dismissed his tittering audience, and then grimly got to work on the time-base with screw-driver and soldering iron. The trouble, he thought, clearly lay in this section ; yet, in actual fact, this was about the only part of his set-up which *had* been aligned properly.

After two more months' Herculean labours Jones eventually began to get the pictures to scan after a fashion. " Mind you," he confided to me the other day, " the adjustment was altogether fantastic by AP standards. Heaven knows what kind of scanning it was, but *it worked*. At least, I was getting pictures on the tube ; but what pictures they were ! Everything looked all queer and distorted. The human beings didn't seem human at all ; and as for the buildings, scenery and animals I got sometimes——! Altogether, it was a very perplexing business. I didn't invite anyone in to see the set again, as I couldn't have stood the disgrace of another fiasco."

There were, indeed, many remarkable things about Jones' home-made televisor. Not only were the pictures grotesque and unrecognisable, but the times of their transmission failed to correspond with those put out by the BBC.

" I could get something at almost any hour of the day or night," declared Jones earnestly. " My first guess was that, by some means or other, I had succeeded in logging America. Yet, on reflection, I knew it couldn't be America, because there just wasn't any advertising. I felt just plain flummoxed. I was in the position of a man who had gone out shrimping and caught a whale. I tell you, the thing was most upsetting ! "

It was more than upsetting ; it began to prey on Jones' mind. He got fascinated by those weird, surrealistic pictures; he just couldn't leave his televisor for an instant. He forsook his work, he forsook his bed. Hour after hour, day after day he would sit there, his raw and sleepless eyes glued to the CR tube. People began to whisper that he was going nuts. Week-old newspapers and letters piled up in the hallway, and the unopened milk bottles stretched, like a file of soldiers, from his doorstep to the front garden gate. But still he sat on, forgetting everything, his whole existence wrapped up in the flickering greenish shadows that danced mysteriously across the fluorescent screen.

" Everything which appeared there," he confessed to me later, " seemed to belong to some ghastly nightmare world. I just didn't understand the fantasies I saw. It was as meaningless as a piece of Oriental music or a book printed in some outlandish tongue. I couldn't make any sense of the programmes at all. Yet there was a peculiar, compelling beauty about them—the hypnotic symbolism one experiences sometimes in the wilder kind of dream. They were visionary terrifying, sublime. I'm not an imaginative type at all, but I'm telling you, those pictures just " got " me. I *couldn't* leave them, no matter what the consequences."

This went on for about a fortnight ; and Heaven knows what would have become of Jones in the end if something unusual didn't happen. Late one afternoon as he sat at the receiver, his eyes almost closing for lack of sleep, a new type of picture suddenly flashed upon the screen.

" The camera," said Jones, " seemed to have been set up in some kind of Heath Robinson workshop. There were queer instruments scattered around, and in one corner stood what looked like the great-grandfather of all telescopes. I guessed that I was gazing upon the interior of an astronomical observatory. . . . The camera "panned" this scene for a bit; then the picture was faded and on the screen appeared—you'll hardly credit it—a picture of the Milky Way!"

Jones was vastly excited. This was absolutely the first time he had ever received anything upon his screen that he could definitely recognise. The whole heavens were swept by the telescope; then it came to rest upon a little planet attended by a miniature moon. Jones realised then that he was seeing the Earth as it appeared from another point in the Solar System. There could be no doubt of it at all. The ice-caps, oceans and continents were all clearly visible. What he had been half-suspecting all along was here unmistakably proven. He was getting these pictures direct from Mars!

"As I watched," said Jones, "the Earth grew larger and larger until it filled the whole screen. I could now make out details in the landscape, such as lakes and mountain ranges. They must have simply marvellous telescopes on Mars; nothing we have here could give such magnification.

"Still the picture kept on growing; and now the telescope seemed to be pointed at England. It appeared sideways on the screen, and so looked a little odd, but there was no mistaking the old place. Then they concentrated on London. I could see the S-bend in the river and the great dome of St. Paul's Cathedral. It was incredible, I tell you, incredible!"

Jones grew so excited about this aerial close-up of his native city that he rose and leaned across the work bench to get a better view. Ever since his late experiments on the time-base all his apparatus had lain strewn about there in glorious confusion, with the transformers at the front and the CR unit rigged up behind on top of a biscuit tin. It was just too bad that Jones' handsome gold watch-chain, with Kruger sovereign attached, got mixed up with the 2,000 volt terminals of his power pack. The resulting explosion did neither Jones nor his receiver any good. I'm afraid. He was blown through the conservatory window into the top branches of his neighbour's Cox's orange pippin espalier, and it took fourteen fire-brigades to get him down and quench the smouldering ruins of his house.

Ever since then, I must sadly record, the poor fellow has been confined to an asylum. He still has his lucid moments, however, and it was during one of these that I managed to get this story from him. You may give it what credence you please, but this I can tell you; I have myself taken up haunting the junk shops in the hope of picking up another of those remarkable centimetric units such as Jones used in his experiments. If only I knew its serial number! That Martian TV must still be there, simply waiting to be tuned-in. You won't think *I'm* going nuts, too, will you? And if anyone *could* help me in my search——

BOOK REVIEW

"MAGNETIC RECORDING"

(Book Review notice)

IT has been estimated that about 200,000 magnetic wire and tape recorders have been built, but it is not known what proportion of those now working are used for office work, for music reproduction, or for speech analysis, radio monitoring, etc. When the Danish telephone-engineer Poulsen produced the first wire recorder, the Telegraphone, in 1898, his instrument was intended as a dictation machine. It was not until 25 years later that the development of electronic amplifiers made the early wire recorder ripe for re-discovery and development, for the playback level of the Telegraphone was very low.

In 1930 Blattner made films with a synchronised sound-track, using the steel-tape Blattnerphone; his system was used by the BBC. Tape recorders as we know them really began with the development of paper or plastic tapes coated with powdered magnetic material. At present magnetic recorders with a full frequency range are widely used by broadcasting stations, film studios and theatres, and are now commercially available for the amateur who wishes to record broadcast music or to add a sound-track to his cine films.

"Magnetic Recording," by S. J. Begun, is published by Murray Hill Books Inc. Mr. Begun belongs to the Brush Development Co., who produce a range of recorders and other equipment.

Naturally enough, this book covers primarily American developments. After a brief historical chapter come 15 pages on the acoustics of hearing and recording—a good, if rather condensed, summary. A chapter on Fundamentals of Magnetism covers only what is needed for an understanding of the theory of magnetic recording, which has a chapter to itself. The treatment is not involved; mathematics is kept to a minimum, but plenty of graphs and diagrams are given. Chapter 5 outlines the components of a magnetic recording system- recording, reproducing, and erasing heads, drive mechanism, amplifiers and the recording medium itself. Enough design detail is given to provide working ideas for well-equipped constructors. Then comes a survey of various commercial designs for recorders, from the original Telegraphone to the Ampex system now used to re-transmit programmes across the States on a staggered time schedule. Details of the Brush Soundmirror, marketed over here by Thermionic Products Ltd., are included, with several full circuit diagrams. The German Magnetophone is mentioned, but not the new British equipment made by Scophony-Baird, Wright and Weaire, and Boosey and Hawkes. Chapter 7 deals with some applications of magnetic recording—time delay, artificial echo production, transient recording, telegraphy and transcription recording, sound films, and dictating equipment.

(*continued on page 177*)

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