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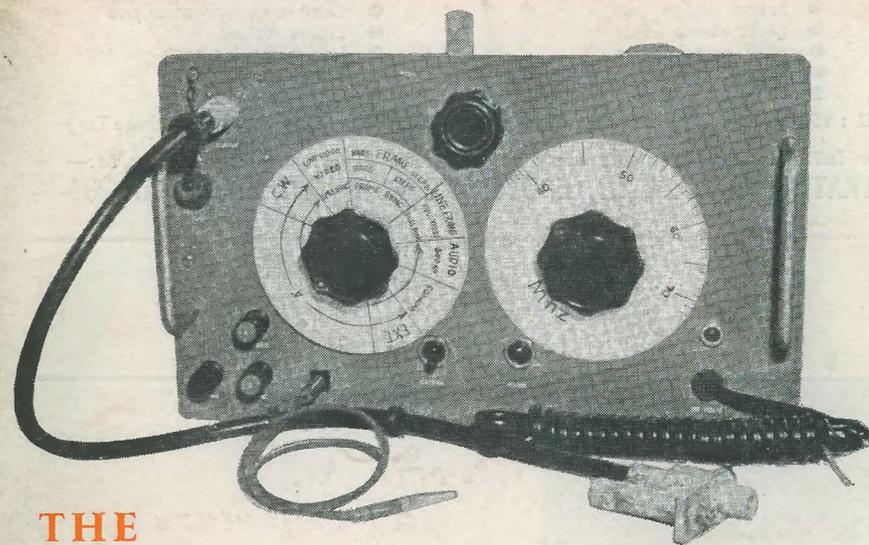


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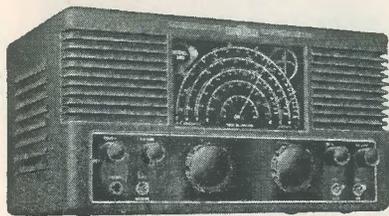
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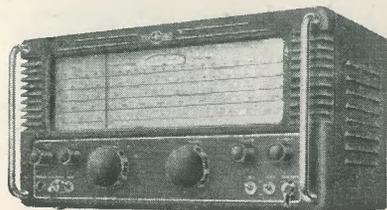
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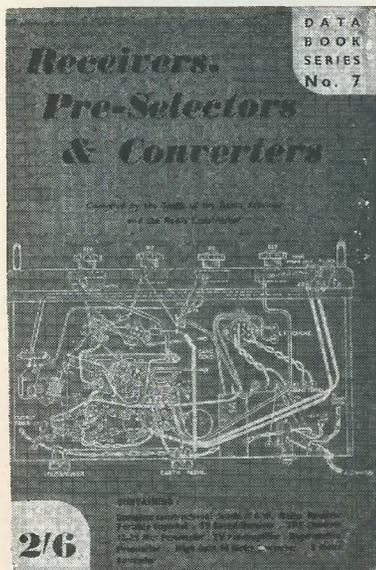


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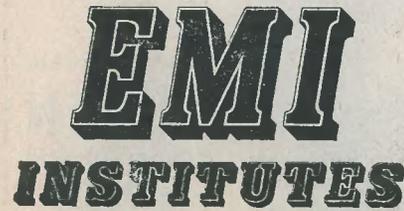
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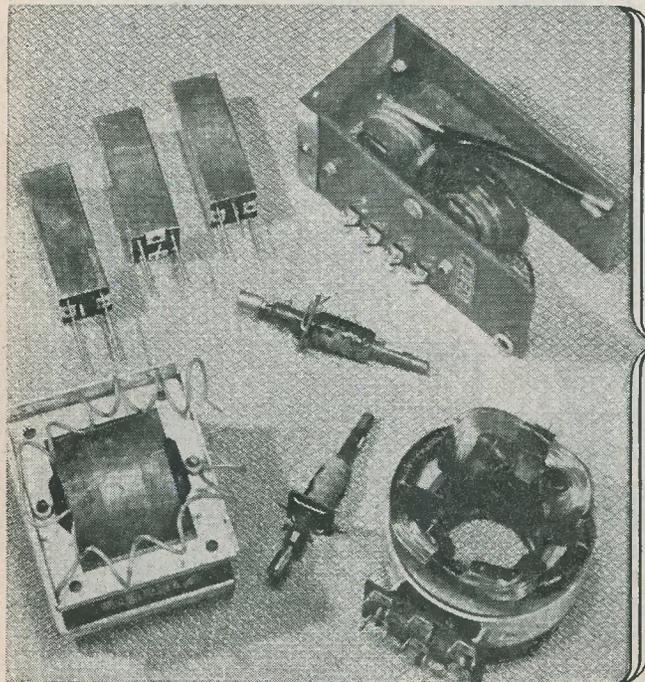
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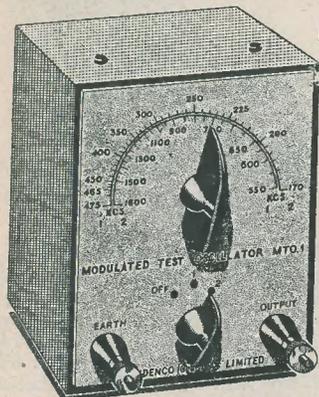


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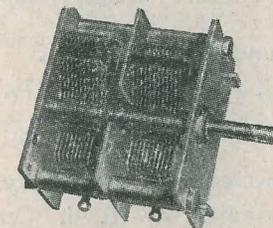
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Editorial and Advertising Offices—57 Maida Vale London W9
Telephone CUNingham 6518

Editor: C. W. C. OVERLAND, G2ATV
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No. 35. "START" MUTING CIRCUIT FOR TAPE RECORDERS

IT is conventional practice, in tape recorder design, to so arrange the switching circuits that the attendant amplifier's input and output terminals are automatically taken to the appropriate head, loudspeaker, or source of programme, whenever the tape-deck capstan motor is switched in. Unfortunately, however, this switching is nearly always instantaneous. Thus, unless care is taken to ensure that the amplifier volume level is set to zero before commencing, it is possible to feed programme to the recording head whilst the tape-deck motor is in the process of reaching its running speed. It is also possible to reproduce

second being the familiar rising pitch given by any reproducing system accelerating from rest. Both effects are extremely annoying to the serious listener and detract considerably from the aesthetic value of the subsequent recording.

This month's contribution suggests three different methods of overcoming this trouble. Each method functions by automatically muting the amplifier until the tape deck capstan motor has reached its full running speed. Fortunately, since the correct speed is usually achieved in a matter of seconds, the necessary time delays in the muting circuit can be obtained quite easily.

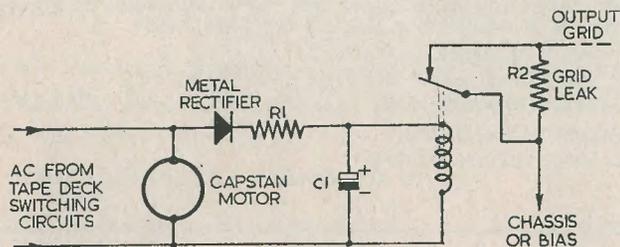


Fig. 1

programme from the tape whilst the motor is, similarly, starting from rest.

Both these processes result in heavy frequency distortion; the effect of the first, when played back, being a transient high-pitched "screeching," and that of the

A Simple Method

The simplest and most obvious circuit is shown in Fig. 1. This utilises a relay with two break contacts and, preferably, a high-resistance winding. The relay is energised, after rectification, from the AC supplied

to the capstan motor by the tape-deck switching circuits. To prevent chattering, the rectified AC is smoothed by a capacitor C1 (which may be electrolytic), connected across the relay coil. This capacitor serves also to make the relay slow-to-operate; and its value should be such that the relay operates only after the requisite number of seconds needed for the tape-deck motor to reach full running speed has elapsed. The value of C1 may best be found empirically.

R1 may be calculated. It should have a value such that the relay coil obtains its correct energising voltage after C1 has become fully charged; it being assumed that the voltage offered by the rectifier is approximately half the RMS value of the AC applied to the motor.

The contacts of the relay may be wired to any suitable part of the amplifier circuit. It is recommended here that they be connected across the output valve grid leak in the manner shown in Fig. 1. Using this arrangement (and assuming that the coupling capacitor to the output grid is not leaky), there will be no "crackles" when the relay operates and the muting is removed.

Screen-Grid Control

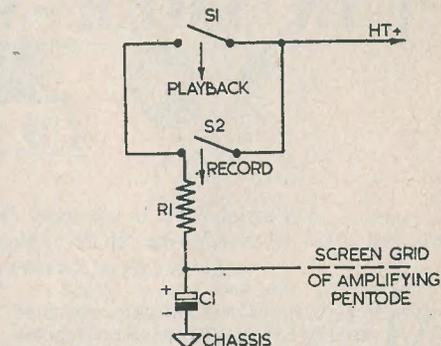
The circuit shown in Fig. 1 has the considerable advantage of not requiring any modifications to the tape-deck. It is otherwise rather cumbersome.

A neater method is shown in Fig. 2. For this circuit to operate, however, it is necessary to fit two additional sets of contacts to the tape-deck switching circuits, these closing when the tape-deck is set to "Playback" or "Record." The circuit functions by preventing the screen-grid of any pentode in the amplifier, (except, of course, the output valve), from receiving an adequate source of HT until the requisite number of seconds needed for muting has passed. The resistor R1 has the same value as would be used normally for the particular pentode chosen. The value of C1 is found experimentally.

When the contacts S1 or S2 are closed, HT is applied to R1. This causes C1 to charge, a voltage sufficient to allow the pentode to operate appearing across its plates only after the necessary time delay has elapsed. When S1 or S2 is opened again, C1 discharges through the valve.

Fig. 3 shows a circuit of similar type which may be easier to apply to existing tape-decks. In this case S1 breaks whenever "Play-back" or "Record" is selected; and it may therefore be possible to use existing unused contacts in the tape-deck switching circuits. It will be seen from the diagram that, when S1 is closed, the capacitor C1 is kept almost completely discharged by the

resistor R2. When S1 opens, C1 charges through R1. The presence of R2 is necessary in order to avoid directly short-circuiting C1 when the switch contacts close. Assuming a

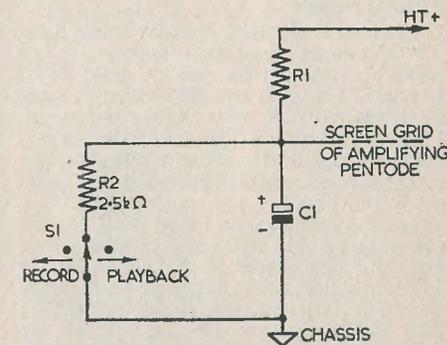


RC321

Fig. 2

screen-grid voltage of 100, the value shown for R2 will cause a momentary current of 40mA at the instant of closing the switch. Capacitor C1 should be capable of handling this current. R1 will now need a wattage rating sufficient to enable it to be connected across the full HT supply.

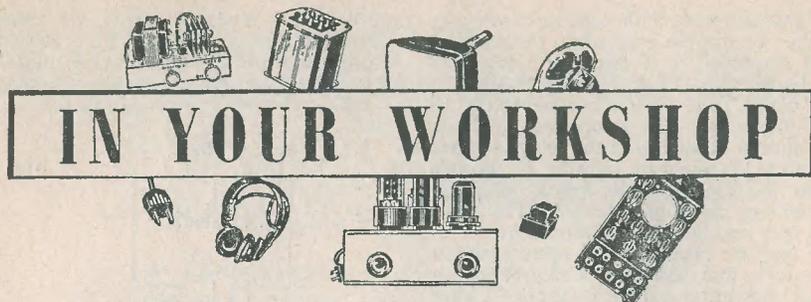
It should be noted that, since one arm of the switch of Fig. 3 is at chassis potential, it may be possible to incorporate such a



RC322

Fig. 3

switch into the mechanical design of the tape-deck. Thus, the contacts of S1 could open whenever the tape-deck brake is released; the brake mechanism itself forming one arm of the switch.



In which J. R. D. discusses Problems and Points of Interest connected with the Workshop side of our Hobby based on Letters from Readers and his own experience

MY REMARKS ON AC/DC receivers some time ago have prompted several readers to write to me. These readers agreed with me, mainly, over the fact that capacitor droppers appear to have a charmed life, despite the fact that they are often used in circuits which should cause their breakdown at an early date.

However, I thoroughly agree with reader R. H. Chesby of Hull, when he states:

"I think the day of capacitor droppers has now gone. Resistor droppers are cheap and do not leave one with the uneasy feeling that they are liable to go 'pop' at any moment! Personally, I think that the best solution of all, for a cheap and compact receiver, is to use a heater transformer. Safe, reliable, and cool!"

Altering Values

Reader Chesby then goes on to say:

"Of course, resistive droppers or line cords are essential for AC/DC sets; and I wonder if you have had the same experience as I have myself with such components. I have often found that, after the set has been switched on for a few minutes and the dropper or line cord has had a chance to get warm, its value alters appreciably."

Yes, I have definitely found this to be the case myself. My usual line of attack to a line cord or dropper is initially to cut or adjust it to the correct resistance as shown by an ohmmeter; and then check the AC (or DC) voltage across the heaters of the receiver when it is actually in use. Very often I find that this voltage is lower than it should be. What happens, of course, is that the line cord or dropper increases in value as it warms up. The value given by the dropper usually becomes stable in a matter of minutes; and no harm is consequently done by re-adjusting the dropper or pruning the line cord to give the correct voltage across the

heaters as shown by the voltmeter. Care should be taken, of course, to see that the mains voltage is not low whilst this is being done.

Incidentally, the increase of resistance as the dropper or line cord warms up is not very high (it varies roughly, for individual types, between hardly any increase at all to one of about 7.5 per cent). Those constructors, therefore, who are on AC mains and who do not have reliable AC voltmeters will probably find it advisable to leave the dropper or line cord as it is, once it has been set to the correct ohmic value.

Line cords or droppers intended for American 110 volt receivers will definitely exhibit noticeable changes in apparent resistance as the set warms up. In this case, however, the cause lies in the receiver and not in the dropper, since the HT consumption at 110 volts must be added to the heater current. A typical instance consists of a receiver employing a heater chain at 0.15A, and which has an HT current of 60mA (more than a third of the heater current). When the set has warmed up this additional current will be drawn through the dropper.

Leaving A Mark!

George B. Brown, Swansea, a regular correspondent, has also written to me (with his tongue in his cheek, I suspect) on the subject of AC/DC receivers.

"Having put my AC/DC super, complete with enclosed dropper, in a smart cabinet," he writes, "it found a home on the kitchen mantelpiece, where it stayed for several weeks. I now find that the dropper has burnt a large hole in the wallpaper! What do you suggest?"

I think I'll pass that one on to Aunt Aggie's Problem Corner, George!

Voltage Regulators

I make no apologies for referring to voltage regulators once more, because P. H. Osbourne, Newhaven, has this interesting hint to pass on.

"I don't know if you have ever tried this dodge but, if you ever have trouble in keeping hum or low-frequency AF out of the HT line, try a voltage regulator. The internal impedance of a voltage regulator valve is extremely small to the lowest of frequencies and does not increase, like a capacitor, as the frequency becomes less. Thus, if you're making an amplifier with a fairly large number of stages, try running the first two from a regulated HT supply. The rest of the amplifier can then run from the normal HT line.

"To get the best from the regulator, operate it roughly in the middle of its rating. As an example, a valve like the VR150/30 should be used for a circuit which takes between, say, 10 and 20mA."

Many thanks, P. H. Osbourne. I know from my own experience with a stabilised vibrator power pack that different types of stabiliser caused quite appreciable differences in hum; but I had never thought of using such valves for decoupling. A very useful hint.

From My Notebook

Whenever I bump into any item of interest which seems to be worth passing on to readers I always put a reminder in my notebook. Some of these points are too small to merit paragraphs of their own and so I usually wait until I have enough to make it worth while printing them all at once.

I don't know if readers have noted that miniature four-pole three-way switches are very easy to purchase these days, whilst similar four-pole two-way switches are almost unobtainable. However, it is often possible to modify the three-way switch to two-way working. If the "stop" assembly of the three-way switch is examined it will often be found that there is provision for bending up a metal tab, which will then allow the switch to work over two positions only. The fact that the third position contacts are not now used is of little importance, especially as the three-way switch is usually very cheap in the first place.

Never drive a vibrator power-pack, such as that fitted in a car-radio, from a "flat" accumulator. This is because the vibrator reed is not then given the voltage it needs to enable it to vibrate with sufficient force. The result is that the contacts arc and become pitted. In the worst case, the contacts stick. Unless there is a fuse in circuit, the latter may cause the transformer primary

to burn out. If a vibrator needs a tap on the case to get it started, it usually means that it is well on the way to being worn out. However, a symptom of worn contacts is almost always given by low HT voltage.

If you have just built a VFO, signal generator, or receiver and want to calibrate it, a wavemeter such as the BC221 is not always the best instrument to start off with. This is because such wavemeters have so many harmonics in the output that it is easy to commence with the wrong one. The best plan is to set the new equipment to a spot frequency (such as that given by a known broadcasting station), adjust the BC221 to the same frequency, and then calibrate the new equipment by keeping the equipment and BC221 "in step" over the scale.

Always connect one side of the speech coil of a speaker to chassis if the speaker is mounted in the same cabinet as the associated gear. This is because static voltages sometimes appear between the speaker transformer secondary and chassis; and can, occasionally, cause sparks between the speech coil and the magnet gap.

If you ever dabble with the sound systems on home film-projectors, you may find that most snags, apart from faults in the amplifier itself, are caused by de-focusing of the sound exciter lens system. If the light "slit" thrown on the sound track is not sharp, there will be a considerable loss of top. It is best to adjust the sound focusing with film running through the projector, adjusting for maximum top from the speaker. Loss of top can sometimes be caused if the "slit" is not exactly at right angles to the track.

Incidentally, I understand that there is a scheme run by a firm in America whereby those who take their own movies can have a magnetic track fitted to one side of the film after developing. When the film is projected, sound may then be added in synchronism with the film, and afterwards reproduced, by passing the magnetic "sound track" over a normal recording and playback head.

The gear systems used in three-speed gramophone motors are usually extremely simple. Several faults I have recently encountered consisted of a mis-alignment which necessitated merely the unfastening of a grub-screw and re-positioning of a friction drive wheel.

Best "repair" I have seen for some time consisted of a "cleaned" volume control I found in a receiver some time ago. The track had been greased! I think few will disagree with me these days when I say that there is only one cure for a worn-out volume control. Replacement!

Safety First

Never rely upon the fact that domestic mains switches are wired in the "live" side. A friend recently had this brought home forcibly to him whilst he was checking some equipment in an acquaintance's house! It is always safest to take the mains plug out. I heard some time ago of someone who received a fatal shock when he was using a faulty electric drill whilst lying on a corrugated iron roof, and so I am not labouring the point when I say that mains voltages can be very dangerous indeed. Many years ago, another friend of mine was

unfortunate enough to catch hold of two mains wires in such a manner that he could not let go. He shorted them together and blew the fuses. A case where presence of mind probably saved a nasty accident.

One often hears tales that it is only the current and not the voltage which does the damage, and vice versa. Actually, however, the physiological aspect of shock is more complex than a mere consideration of voltage and current alone would lead one to believe. There is only one really safe course, and that is to always take care when working with high voltages.

From Our Mailbag . . .

"Inexpensive TV," Fourth Edition

Dear Sir, With patient plodding I have gone through all the work consisting of the following. . . (Here follows a comprehensive list of the units used and the work done—Ed). *Results.* Kirk O'Shotts (116 miles) received, sound and vision, on a PIECE OF WIRE capacity coupled to an ordinary "L" broadcast aerial. Test Card "C" "recognisable," the "cross" very clear, and when signal conditions are very good the "pavement" round the Houses of Parliament ("still"), at beginning of programme) is clearly seen. Fading inevitably takes place both on sound

and vision. The last remaining step, now being proceeded with, is the making of a long-range TV dipole. Local conditions are good, the site is high, the far horizon extends to 40 or 50 miles, but for all that I should not, "according to the book," receive any encouraging signals at all.

I write this letter because I always think that when a man gives out something good, as have the several authors to *Inexpensive TV*, he ought to hear about it.

Very sincerely yours,—J. Rodger (Rev.), St. Matthew's Rectory, Oldmeldrum, Aberdeenshire.

Can Anyone Help?

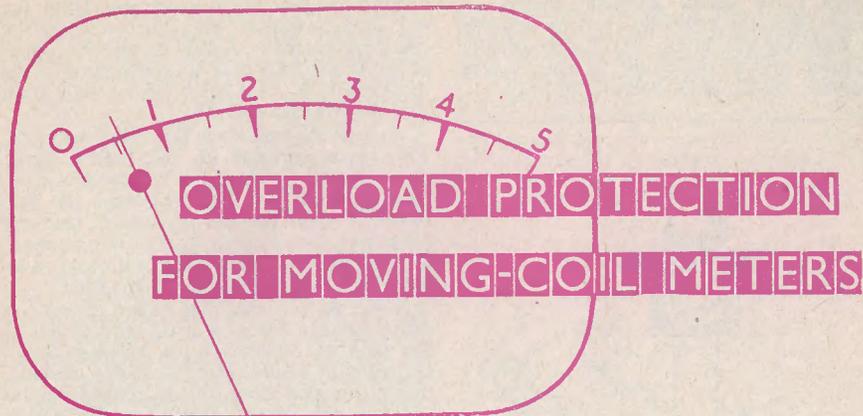
Can Anyone Help?

Dear Sir, Could any reader give me any information regarding the Test Set 666H; as I have purchased the mounted meter movement by Triplet. Any information such as FSD current, meter resistance, type of rectifier used, etc., would be gratefully received.—David Millard, 20 Jubilee Road, Powis Avenue, Est., Tipton, Staffs.

Dear Sirs, I have just obtained an R66 Monitor (for a 291 Radar) which I wish to convert into an Oscilloscope. I would be obliged if you could furnish me with some information as to where I could obtain a

circuit of the Monitor and a Conversion Circuit.—B. Epstein, 120 Newlands Avenue, Benoni, Transvaal, South Africa.

Dear Sir, Thank you for inserting in *Can Anyone Help* section my request for replacement wafer for the R1155, which am pleased to say has now been repaired. The response brought in many letters of help to which I am replying as soon as I can. It is nice to know there are so many willing to help through the medium of your excellent magazine.—E. J. Walters, East Croydon, Surrey.



By W. E. THOMPSON, A.M.I.P.R.E.

HOWEVER CAREFUL ONE MIGHT BE in making measurements with a sensitive moving-coil meter, there is always the possibility that in concentrating on the work in hand one is apt momentarily to overlook the range to which the meter is switched, and BANG! over goes the needle. This might permanently upset the calibration, or result in a bent pointer, but worse still the moving-coil could be burnt out. An expensive instrument costs a fair amount of money to repair and re-calibrate, and even if one is using only a "hack" this does not justify its being abused by severe overloading.

Perhaps a worse condition for overload is if the meter is subjected to a reverse current which is greatly in excess of its full-scale deflection. Under these conditions, one is expecting a reading somewhere in the normal direction of deflection and wonders why the needle does not travel over the scale. Too late, it is seen to be either hard over just off the left-hand end of the scale, or that it reads zero. In the first case the movement is still suffering under overload; in the second, the worst has happened and the coil has burnt out.

When a heavy overload current passes through the meter movement, there is danger of the calibration being ruined as a result of the delicate hair-springs being distorted by the heating effects of the current. These fine springs are carefully tensioned when the meter is made, and they play an important part in the maintenance of linearity and accuracy of the scale reading. Consequently,

if this tension is subsequently altered by some means—intentional or otherwise—the accuracy of the meter is bound to be adversely affected. The field of the magnet system might be slightly weakened if a very heavy overload current flows in the coil; this obviously will upset the original calibration. The least that might happen is a bent pointer, the straightening of which is a delicate operation, and one which it is not wise to undertake unless you are skilled at such fine instrument work.

Most makers of accurate and sensitive meters include some form of overload protection in the meter, especially the basic movements of multi-range instruments. This does not mean to say that an expensive, high-grade instrument can be overloaded with impunity; indeed, such instruments are generally used by those who have more than a fair idea of what they are doing, but the human male being such an unpredictable animal it is not unknown for the most careful and painstaking individual to "jump" a meter in a moment of mental absorption. It is for such rare occasions that an overload device is provided, so that the meter shall have a sporting chance of survival instead of painful death by burning.

A common form of protection is a mechanical trip which is operated by the needle. It is adjusted so as not to function on slight excesses of full-scale deflection, since it would be more of a nuisance than a virtue if it did, but a fairly heavy excess that causes the needle to travel quickly over the scale

enables it to gather sufficient inertia to operate the trip positively and so remove the overload condition. It is also usually arranged that a deflection in the reverse direction will similarly operate the trip.

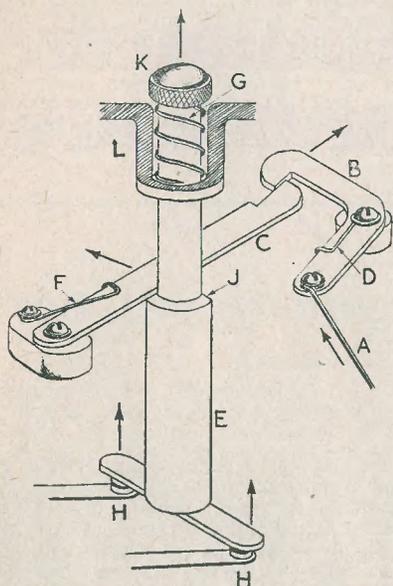


FIG. 1.

In Fig. 1 is shown a sketch of the overload trip mechanism in the author's Avometer. Only the basic details have been shown in order that its operation can be more clearly seen. The arrows indicate the direction in which the parts move when the trip operates to an overload. If the needle goes heavily off-scale in either direction, the arm A is moved as shown by the arrow. This turns the bell-crank B so that its latch disengages from the tooth on the end of the lever C. A spring D tensions the bell-crank against the end of lever C, and so provides the means of re-latching when the trip is reset. The lever C is normally held against the thinner portion of rod E against the shoulder J, which latter also keeps the rod down in the normal position. When C is unlatched, the pressure exerted by spring G forces the rod upwards, and the lever C rides up over the shoulder J. The upward movement of rod E opens contacts H which are normally held closed; the opening of the contacts

disconnects the meter movement from the test lead terminals, and thus remove the overload current. Knob K on the upper end of E now protrudes above the panel of the instrument, L, and gives visual indication that the trip has operated.

To reset the trip, knob K is fully depressed. This closes contacts H, and lever C drops down off the shoulder J under pressure from return spring F. The bell-crank B then re-latches over the end of lever C, and the movement is now ready for further operation. Of course, one removes the source of overload before re-setting the mechanism!

It will be apparent that such a device is a fairly delicate thing in itself, and is hardly the type of movement the average home-constructor would care to tackle making, unless he also does watch repairs in this spare time! Apart from the fabrication being a tricky business, its adaptation to a meter and its adjustment afterwards is no less exacting.

Another form of trip is electromechanical, and is basically a relay operated by the overload. None of the instruments in the author's possession has one, so sketches are not given. However, some experiments have been carried out on an ex-Govt. 1mA movement, many of which are still available. It was chosen as the guinea-pig because (a) the author was prepared to turn it into a sacrificial burnt offering in the cause of science (?) and (b) he felt that many readers would choose just this type of meter to build into a multi-range instrument, several designs for which have appeared in *The Radio Constructor* from time to time. Ex-Govt. 3000-type relays were also used in these investigations.

The metal scale-plate was removed and replaced by a white ivorine scale, on to which were copied the scale markings of the original. Two tiny contacts were fitted, one at each end of the normal sweep of the needle, and positioned so that the needle would touch them if it went off-scale by about 3/16ths inch. They also took the place of the usual end-stops. A thin wire was joined to both and led out of the instrument case; another wire was connected to one side of the moving-coil so that a make contact was formed by the end of the needle and either of the end-stops.

The circuit of Fig. 2 was set up and tried, the relay being made up by using contacts off other relays so that one make and one break contact could be actuated. The coils of the relays on hand were low-resistance, so several were re-wound so that operation could be secured with low current. In theory, the circuit operates as follows: when the needle goes beyond full-scale fairly heavily, or moves in the reverse direction, it touches

one of the end-stops and completes a circuit to operate relay A. Relay contact A₁ provides a separate locking circuit to hold the relay operated via the reset key; contact A₂ opens the meter circuit and removes the overload. The needle will then leave the end-stop, breaking the original operating circuit of relay A, now held operated over its own contact. Pressing the non-locking reset key will break the holding circuit of relay A, which then releases and restores the circuit to normal. All very simple, but not entirely satisfactory, unfortunately!

The weakness in this circuit is the light contact-pressure that must be used on the relay to ensure that it fully operates, and the comparatively heavy current required to do so. This operating current must be carried by the meter needle, and the actual contact which it makes with the end-stop may sometimes not be a very good one electrically. If, due to either of these deficiencies, the device should fail to operate on an actual overload, one might just as well be without it for all the protection it affords. This does not mean to say that the circuit is a complete failure, but that owing to its inherent weakness it gives room for doubt as to full reliability. It may operate properly dozens of times, but the odd occasion will come along when it won't, and that will usually be just the very time that it will be most needed.

An improvement is obtained, to some extent, by using the circuit shown in Fig. 3. Here, relay A now has only one single make contact, and so it now requires less current to operate it. Having regard for the light contact-pressure between the needle and end-stop, the smaller the current can be made the better. Relay A will operate to an overload as before, and contact A₁ closes a circuit to operate relay B, which now takes over the original functions of relay A. Contact B₁ provides a locking circuit for relay A, and B₂ breaks the meter circuit and removes the overload current. As a refinement, B₃ has been added to light a lamp which will give visual indication that the trip has operated; it also gives proof that the relays have operated and locked up. Relay B being now independent of the needle contact can be designed on more generous lines, since we are not so tied when it comes to giving it enough current to work on.

Even so, relay A can still prove temperamental. In the case of the relay used for experiment, it was found necessary to reduce the tension of the contact-springs somewhat, and to close the angle of the armature a little to reduce its travel. In so doing, the ampere-turns necessary to operate it can be reduced, and this in turn means that the

operating current can be less. The normal travel of the armature of a 3000-type relay is 31mm, and this was reduced to 27mm. It had a 4mm residual pin on it, and this was ground down to 3mm. The armature travel is measured between the faces of core and residual pin. It is not possible to reduce the armature travel further, otherwise there

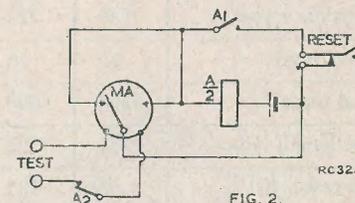


FIG. 2.

will be insufficient contact travel. Even so, the rubbing action of the contacts, caused by the "follow-through" when the contacts actually make, is lost to a large degree by this modification. It will be seen, with a relay in normal adjustment, that there is a small projection on one side of the top spring of a make contact, resting on a step of the white buffer block; when the relay is operated fully there is about 2 to 3mm clearance between this projection and the step, indicating that the top spring has been lifted by the moving spring. With the relay used by the author, if there is clearance at this point, it is only perceptible in a strong light. It does, of course, indicate that contact has been made, but it is a far lighter contact than the 3000-type relay is normally given.

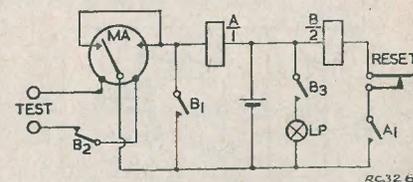


FIG. 3.

By mal-adjusting the relay in this way, and using a coil wound to suit the conditions, it is possible to secure satisfactory operation on about 6mA. As stated before, several coils were made up, and in Table 1 is shown the figures appertaining to some of those which the author wound. The design using

36 swg enamelled wire was the one used for relay A in Fig. 3. The designs were based on the assumption that a 1.5V unit cell is to be used to operate the relay, for as this is the usual source of supply for the resistance ranges in multi-meters, it was thought desirable to try to use it. Of course

they occur in. The more turns that are shorted the more sluggish will the relay be. It is not proposed to discuss further the reason for this, since this is not an article on the theory of relays, but it is a condition that might be encountered in practice, and for which the reason may not be readily

S.W.G. Enam.	32	34	35	36	37	38	40
Turns per layer	186	225	246	265	295	325	410
No. of layers	23	28	31	33	37	41	51
Total turns	4300	6300	7500	8800	11000	13400	21000
Wire length (yds.)	254	372	442	518	647	790	1240
Coil resist. (Ω)	68	135	190	275	430	670	1650
Current (mA)	22	11	7.9	5.5	3.5	2.2	0.9
Ampere-turns	95	69	59	48	39	30	19

Layer length: 2.4" Winding height: 0.3" Mean turn: 2.12"

Table 1. Coils for 3000-type relays.

by increasing the battery voltage, a higher-resistance relay coil can be used and the Ampere-turns for operating obtained more easily. The Table can serve as a guide in choosing a suitable coil, since it gives the maximum ampere-turns obtainable for each coil at the current stated. A mal-adjusted relay with a single make contact, similar to relay A in Fig. 3, requires about 50 ampere-turns, as a minimum.

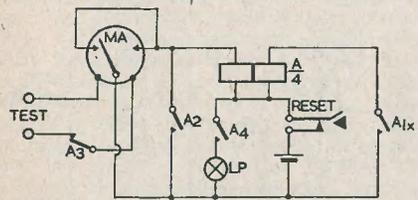


FIG. 4.

RC327

If the reader decides to make up a relay or relays as suggested here, some care is needed in actual winding to ensure that the enamel insulation of the wire is not damaged, otherwise short-circuited turns may result. Shorted turns will cause the relay to be sluggish, either in operation or in release, depending on the actual part of the winding

apparent. In this connection, it is important not to use relays that have copper "slugs" on them, since these are sometimes found on relays which are designed to have a delay period for operating or releasing. These slugs are easily recognised as large pieces of plated copper, situated at either the armature end or the rear end of the coil. They vary in length from a half-inch to one-and-a-half inches.

A variation of the circuit of Fig. 3 is given in Fig. 4, in which only one relay is used, but having two windings on the core. Among the standard 3000-type relays there are some with contacts known as X and Y contacts; X contacts are thinner springs than the normal springs, and are adjusted to operate before the rest of the contacts on the relay are moved by the armature. Y contacts operate only when all other contacts have been operated. Use can be made of an X contact to give the relay a two-step operation, thus making it virtually two relays in one. The circuit of Fig. 4 works just the same as that in Fig. 3, except that contact A_{1X} is closed when the first winding is energised by the needle of the meter; this contact then energises the second winding of the relay which provides sufficient ampere-turns to make the relay operate fully. Contacts A₂, A₃ and A₄ perform the same functions as contacts B₁, B₂ and B₃ in Fig. 3. The reset key, how-

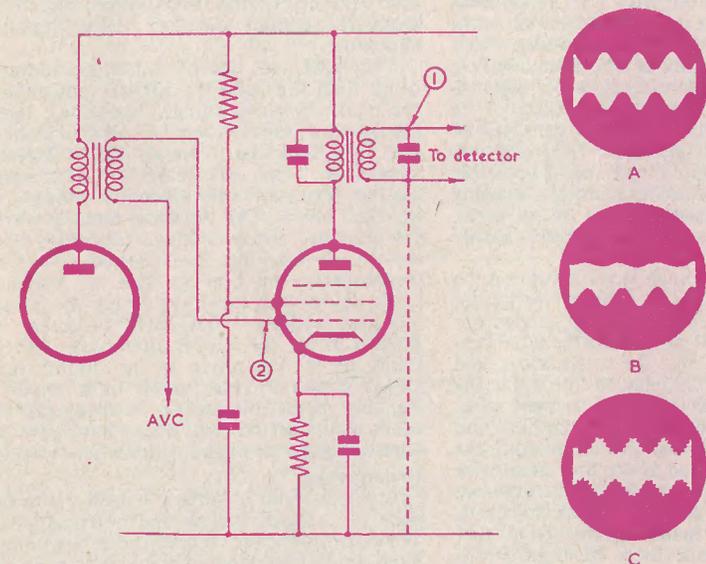
ever, is now in the battery feed, so that the holding current for both coils is broken when the key is depressed. If the key were placed between contact A_{1X} and the relay coil, there would still be a circuit via contact A₂ to energise the first winding, so the X

contact would remain closed. Under these conditions, the relay would re-operate when the reset key was released, so it would not be possible to restore the circuit to normal.

[to be continued

OSCILLOSCOPE TRACES

By A.B.



No. 5. TRACING DISTORTION IN IF STAGES

RC338

DISTORTION CAN OCCUR in intermediate frequency stages as well as in the audio frequency sections of a receiver.

The small voltages encountered in IF stages make an oscilloscope amplifier a necessity. It should be capable of providing some gain at the normal IF of 500 kc/s, and the input impedance should not be too low. When connecting the amplifier to the receiver, care should be taken to keep the leads as short as possible.

The signal, derived from a modulated signal generator, should be as shown in trace A. This waveform must be checked, because if modulation distortion is present

in it, the IF amplifier cannot then be considered responsible as a possible cause.

Trace B shows the effect of overloading. A possible reason for this type of distortion is failure of the AVC system. Ragged edges on the envelope as shown in C indicate oscillation in the IF stages.

It may not be possible to obtain sufficient deflection when connection is made to point 2 in the circuit diagram, as the signal amplitude at this point is very small.

Due to the input capacity of the amplifier, the winding of the IF transformer may need retuning when the oscilloscope is connected.

Radio Miscellany

MY RECENT REFERENCES to aluminium soldering brought an interesting letter and specimen from BRS 18713 of Southgate. His youngest son is employed on work of this nature and his training course, which involved quite a study of books and leaflets on this and kindred subjects, is well demonstrated in the sample forwarded. The specimen (of Argon Arc work) consisted of two pieces butted together. The joint was so strong that it would have been impossible to separate them without seriously damaging the surrounding areas. Even so, a break along the joint would have been hardly possible.

While, of course, such work is beyond the scope of the amateur in a home workshop, details came to hand of research carried out at Messrs. Kendall and Mousley's Laboratory at Tipton, Staffs., for a method suited to amateur use. Samples of the soldering alloy were enclosed. With it, copper wires were securely soldered to aluminium and the jointing of aluminium to aluminium was successfully performed at the first effort with nothing more than a very hot soldering iron. The heat from an electric iron is insufficient.

This solder is made by dissolving (not melting) battery zinc in a 60/40 solder to saturation point. It is eminently suited to home workshop use and successful aluminium soldering can be confidently expected with a small amount of practice.

I have had no opportunity of testing it out on all aluminium alloys, but mechanically and electrically sound joints resulted with all those tried.

Jolly Roger

I was pleased to see that the Administrative Committee of I.A.R.U. recommended to the Plenary Assembly that it should declare its sympathy with the radio amateurs of Austria in that the restoration of their transmitting licences is still withheld. True, there are quite a number of OE amateurs to be heard on the air, but they are nevertheless "pirates" despite a pre-war call—which they dare not use to-day! When I was in Austria I could not quite get the system they use in sorting out their own call-signs to avoid duplication. Apparently it works

out all right, each area working as a cohesive body in such matters. Indeed, the speed and efficiency of the liaison within and between the groups once or twice literally shook me.

They QSL too, but, of course, no address other than the town or district appears on the card. What is equally important, they get the cards sent to them. In all Call Books you will find the Austrian QSL Bureau shown as "care of RSGB." Cards sent via that means, like the Canadian Mounties, get their man. The Austrian amateurs are grateful for, and will long remember, this service. I have met and chatted with OE amateurs in the beer gardens of Vienna, Graz, Linz and Innsbruck, and the toast has always been "to G2MI." Another is thrown in for the RSGB afterwards if they think of it, but there is no doubt that G2MI comes to their minds most readily. To the merry pirates of Austria, G2MI ranks as by far the most important figure in amateur radio throughout the whole world!

Underground

Amateur radio in Austria has all the romance of a secret society and a friendliness and camaraderie that is really heart-warming. You simply find one amateur and he links you up with the man from whom he gets his QSL cards, and he in turn puts you in touch with "sub-managers" of whatever districts you intend visiting. Thus you find yourself looking for George—except that George isn't his real name but simply his radio name. His real name is Anton. He in turn introduces you to Ed. Ed's proper name is Josef, and so on. A bit perplexing at first, but I found I soon got used to it. Once, however, the system slipped badly. It was when I was to meet John whose proper name was "Schoss." The buccaneering pseudonyms are fun until, as on this occasion, one cannot make sense of them in English or in German. I repeated the name two or three times to make sure I had got it right. Yes, there was no doubt about it, Schoss was the name—"the same as your King."

This was before the Coronation, but we still didn't have a King, and none likely,

at least by the name of Schoss. Even the name of the Prince Consort-to-be, Philip, couldn't by any stretch of imagination be turned into Schoss.

It took me quite a time to discover they meant Charles—referring either to a former King or mistakenly to the present "Prince Schoss."

A.S.L.

There is a surprisingly keen interest in VHF, or UKW as they call it—ultrakurz-welle. Whenever I have mentioned this it seems to come as quite a shock to British amateurs. The first G-OE contact is still awaited, and hundreds of British amateurs, including myself, are eager for the honour to be the first. One day 2 metres will open up when the OE's are on the mountain tops working portable, and some lucky amateur will bag a first. OZ, SM, PAØ plus plenty of I and DL contacts have already been made, and VHF is extensively used for cross-town ragchews, often with power of less than a watt.

Most of the time that is the only sort of contact possible even though the QTH is anything up to a couple of thousand feet

Centre Tap talks about

ALUMINIUM SOLDERING AUSTRIAN AMATEUR

above sea level. Such a height in the U.K. would be the VHF amateurs dream. Over there it is valley level, and dozens of mountain peaks between 9,000 and 11,000 feet upwards may well screen you from the next town. Austria isn't a land of hills and valleys as one is apt to imagine. It is a land of hills with mountains and more mountains piled on top of them.

F.M.

The popularity of VHF may be partly attributable to the 3 metre FM broadcasting which is becoming more and more widely used over there. I do not think it is anywhere nearly so successful as it is in Germany, where it is extensively used. The terrain of Austria does not lend itself to TV except, perhaps, on a local scale in the bigger towns. Even FM sound reception often requires elaborate beam aerials and a 10-valve set for comparatively nearby transmissions, but the variety of receivers available and the cheapness of the prices would delight every British enthusiast. A smart looking, well-made set with a slip-in VHF converter (for FM or AM) can be bought at a price comparable to a very ordinary 4-plus-1 over here.

The programmes are far more of a local character than our own, and the listener

has not only to pay for a licence, but he has to put up with a certain amount of advertising as well. This must be done to make ends meet, but apparently nobody protests. Why should they—when they get a better programme at a lesser licence fee? Either the Austrians are a more logical people than we are, or else they are not encumbered with so many "purists" and busybodies as we are.

The Cynic in Me

The radio retail trade is often reproached for its callous neglect of the home constructor and the component market. From a certain quarter comes a regular reminder that many of to-day's thriving businesses were founded on the constructor trade. The implication, of course, is that the manufacturer, and particularly the retail trader, is guilty of rank ingratitude by so base a desertion of their former friends. In theory this might sound plausible, but the vast majority of present day retailers, particularly in the cities and towns, entered in the radio trade long after the constructor market dwindled to its contemporary fraction of their turnover.

It might equally well be argued that the converse is true. The public walked out on the old-time radio dealer when the cheap factory produced set came along. Retail trade certainly passed from the man who went in the business because he enjoyed radio for its own sake rather than because he saw it in the light of big business.

A lavish display, bright lights, high pressure but non-technical salesmen and hire-purchase enticed the customer into the multiple shop and the big store. Radio, to them, is just so much merchandise. They know little of the technical side and still less of the roots of the hobby. To reproach them for forgetting their old pals strikes me as laughable. Throughout the whole of London the shops (other than those who specialise in the component business) where one might stand a chance of getting even the most ordinary components, can be counted on one hand. Even where the spirit is helpful they will tell you "We don't stock parts and our servicing workshop is at _____."

There seems little point in pleading the we - started - you - off - in - business stuff. The businesses we started off hardly exist to-day. The others owe their start to the people who financed their hire-purchase!

THE OPTICS OF PROJECTION TELEVISION

By FRANK W. COUSINS, A.M.I.E.E., A.C.I.P.A., F.R.A.S.

PROJECTION TELEVISION RECEIVERS have been on the home market for some appreciable time, and many will be interested in the novel optical system used to give the large picture on the flat screen. The cathode ray tube employed is much smaller than that of the more orthodox receivers, and this is claimed to offer several benefits economically and technically.

It may be convenient here to discuss some of the points which the manufacturers of projection television receivers claim for the small cathode ray tube as against the large one, and then show how the picture on the screen of the small tube is optically enlarged.

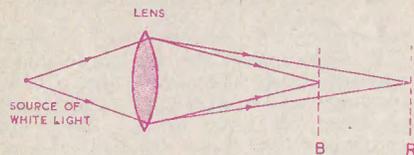


FIG. 1. RC341

The television receivers of the orthodox type are arranged for "direct view," and these have claimed the public's attention, in the main, from about 1936 to date. The image observed is the actual image formed on the luminescent screen of the cathode ray tube. Mechanical problems are involved in designing a tube of the orthodox pattern which will have a flat plane screen surface to withstand the pressure of the atmosphere and resist implosion. For example, the tubes of screen diameter over 15" have to withstand forces in excess of 2,000lb. The tubes must be of thick wall structure and curved on the screen face with attendant image distortion on the screen. Further, tube length increases with screen diameter and the cabinet volume has to be much enlarged to accommodate the extra length, often to objectionable proportions. Alternatively, the

scanning angle may be enlarged, but this introduces design problems of its own.

The projection method obviates these objections by the simple expedient of using a small cathode ray tube, and projecting the small image on to a viewing screen—much as in the well known cinema layout. This is not meant to imply that the projection method is not suitable for the home; for it is in this field that it has the maximum appeal—in that the family can sit back and regard a screen of comfortable proportions and unrestricted view. This entire article is directed toward the home receiver.

As long ago as 1937 Wolf¹ had discussed the contours of cathode ray tubes of diverse diameters, showing the curvature of screen which could be tolerated from the standpoint of glass technology and its effect upon picture area. He proposed a projection of the picture on the fluorescent screen of a small cathode ray tube on to a large ground glass screen of, say, 100×120cm, using an optical system.

The optical system suggested was a projection lens system with a relative aperture of 1/1.9, and the cathode ray tube had a concave screen surface having a curvature corresponding with the curvature of the lens image surface to facilitate the production of a plane screen image on the projection screen. This idea has, however, developed along unusual lines from Wolf's suggestions when we consider the optical system in favour at the present time.

It was fairly obvious that a lens such as Wolf proposed could be utilised, but the other classical method for image production was the well known spherical mirror. To decide which of the two—lens or mirror—was preferable necessitated an analysis of the physical properties of each.

The analysis is briefly as follows:—Lenses suffer from chromatic aberration, that is to say white light passing through a lens causes the blue rays to come to a focus at B, Fig. 1, and the red rays at R, the glass having a greater refractive index for the blue rays than for the red. The other

colours will have foci at intermediate points. Chromatic aberration may be corrected by an achromatic system for selected conditions. However—lens systems of large aperture, as needed in projection television, raise other complex problems with regard to coma, spherical aberration, astigmatism and distortion. A consideration of these complexities is outside the scope of this article, and interested readers are referred to the erudite works of Conrady² and de Groot³ on this subject.

Chromatic aberration does not exist when mirrors are used for projection, and this is one reason why a mirror system is often preferable to a lens system. Again, a spherical mirror gives less spherical aberration than a refracting surface of the same diameter and focal length. In cost of manufacture, a spherical mirror of appreciable diameter is very much more attractive than a lens system. It must be made clear, however, that a spherical mirror has the following

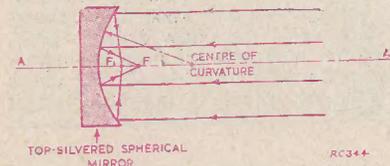


FIG. 2. RC344

third order aberrations—spherical aberration, coma, astigmatism, distortion and curvature of field. It has been found that all the above noted aberrations except one—curvature of field—can be eliminated by using a diaphragm at the centre of curvature and a Schmidt correction plate. The diaphragm removes the coma, astigmatism and distortion, and the Schmidt correction plate removes the spherical aberration.

Spherical aberration is most easily understood from Fig. 2, where it will be noted that rays far from the axis A-A₁ come to a focus at F₁, and rays near the axis at a focus F which is situated from the mirror surface at a distance of one half of the radius of curvature of the said surface. The correction of spherical aberration was solved by B. Schmidt, an instrument maker of the Hamburg Observatory at Bergedorf, who perfected his system (known as the Schmidt system) in 1931. Schmidt, however, was mainly interested in telescope optics.

To understand the way in which the Schmidt corrector plate eliminates spherical aberration, consider Fig. 3. The corrector plate is aspherical, and its contour is much exaggerated for ease of description. It will be seen that the corrector plate makes

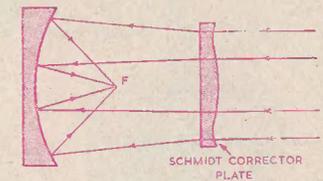


FIG. 3. RC343

marginal rays diverge, and rays near the axis converge, before they impinge upon the mirror surface. The image surface, however, is spherical, concentric with the mirror surface, and situated at a distance of about half the radius of curvature.

This is the system of optical enlargement which is now favoured in projection television. While the system was invented for astronomical research—where the light from the stars and planets comes in to the system as shown in Fig. 4—the reverse is the case in the television application, Fig. 5.

In the astronomical application, the incoming light is brought to an image on a photographic plate (Fig. 4) which is bent to a curve in conformity with the mirror surface; this, incidentally, is a minor objection of the telescopic Schmidt camera.

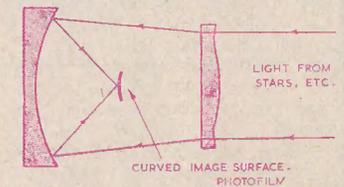


FIG. 4. RC342

In the television application this objection is not valid—for the manufacture of the cathode ray tube with a curved screen is not a difficult matter.

I am indebted to Mullard Ltd. for permission to disclose the Schmidt system which they have utilised for their fine projection television receivers, Fig. 6. This system is a folded Schmidt system, and the direction of the light path will be obvious from the

diagram. The components of Fig. 7 represent the basic three units of the Mullard system—(a) the MW6-2 2½" cathode ray tube, (b) the optical system, and (c) the EHT unit.

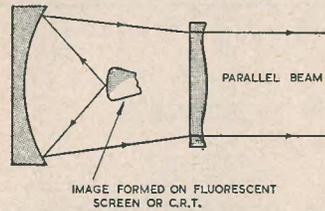


FIG. 5.

RC345

(a) The Mullard cathode ray tube is the type MW6-2, having a face diameter of 2½". The size of raster employed is about 1¼" × 1¼" so that, to obtain a picture giving good definition, the spot size must be between 1/300" and 1/400". An EHT potential of 25 kV and an average beam current of 100 to 200µA are employed. Peak beam current is of the order of 800µA. The face of the tube is spherically curved, and the screen is metal backed (aluminium), which permits easy penetration by the electron

beam and is also a good optical reflector. The screen's primary function is to reflect outwards a large proportion of the emitted light which would otherwise be directed towards the rear of the tube. The increase in forward-going light is claimed to be 75-80 per cent. The metal backing also reduces the risk of ion burn, as the negative ions are not able to pass through the aluminium film.

(b) The optical unit is available in five models, giving pictures of 15½", 17½" or 19½" diagonal for cabinet viewing, or 44" or 52" for "wall projection." The magnification of the 2½" picture requires a "throw" of 25" to 32" for the various "cabinet viewing" models. In order to accommodate such "throw" distances in a cabinet of reasonable size, the light path is folded as already shown in Fig. 6. The optical principle of the enlarger is basically as follows:—A single picture element A₁ (Fig. 6) on the curved screen of the tube C impinges on the spherical mirror M, and is reflected as a convergent beam on to the flat mirror F₁ tilted at 45° and provided with an aperture for the tube C. The light is now reflected through the Schmidt corrector plate S, where it is corrected for spherical aberration to give sharpness of focus at the throw distance XYZ. The light is now reflected from the mirror F₂ and projected toward the viewing screen V at point A₂. Similarly, magnified images

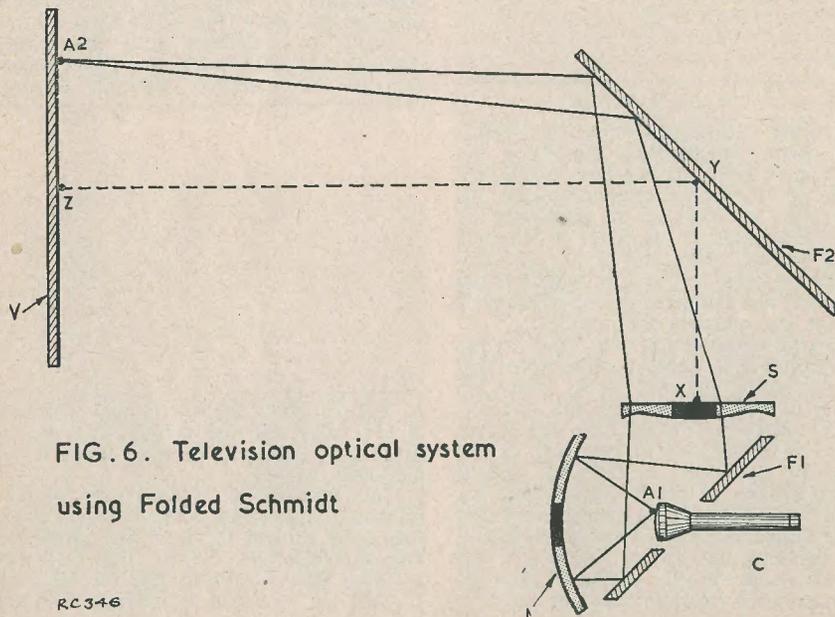


FIG. 6. Television optical system using Folded Schmidt

RC346

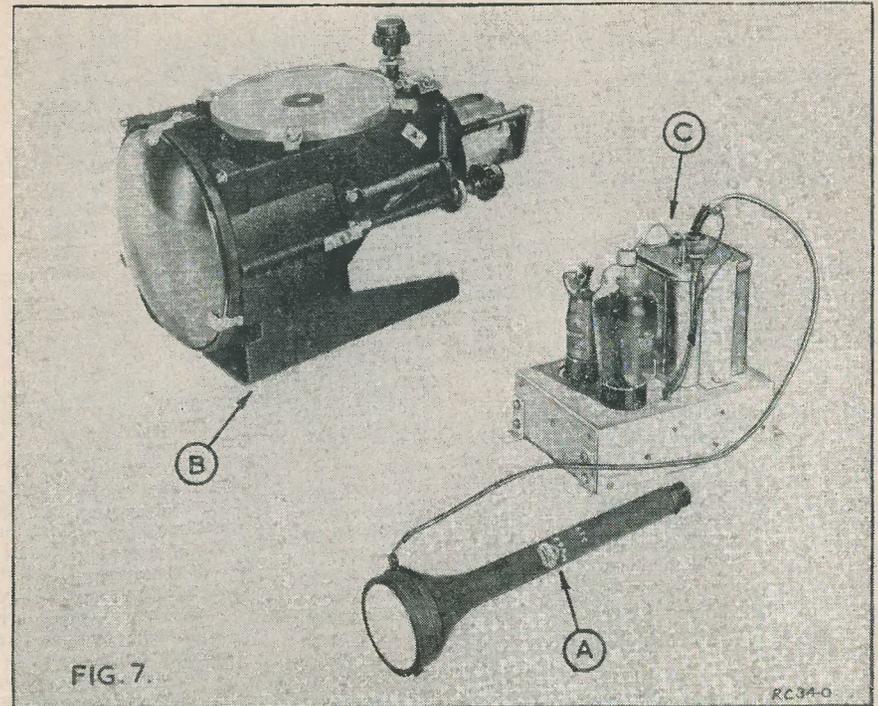


FIG. 7.

RC340

of all other picture elements are formed in succession on the screen V.

(c) The EHT supply uses the pulsed oscillator system, and while a description of this interesting unit is outside the scope of this article the reader is directed to *Mullard Outlook* Vol. 2 No. 7 of April 1952 and other sources.⁴

In conclusion, it will be appreciated that Schmidt, in applying his mind to the problem and solution of fast, wide-angle astronomical cameras has gratuitously provided television with an exceptionally fine optical system which manufacturers are now exploiting to the full. It is notoriously difficult to predict trends in electronic design, but many are of opinion that projection television with its good definition and other advantages may eventually become the orthodox television receiver.

Readers interested in the Schmidt optical system *per se* are recommended to consult the works listed under reference 5.

References

- 1 *Enlarged Projection of Television Pictures*. M. Wolf. Philips Tech. Review, Vol. 2 1937, p.249.
 - 2 *The Five Aberrations of Lens Systems*. A. E. Conrady. Monthly Not. Roy. Astron. Soc. 79. 60-66. 1918.
 - 3 *Optical Aberrations in Lens and Mirror Systems*. W. de Groot. Philips Tech. Review. Vol. 9, 1947/48, p.301.
 - 4 *Projection Television Receivers*. Parts 1, 2, 3, 4 and 5. Philips Tech. Review. Vol. 10 1948/49, pp.69, 97, 125, 307, 364, also p.286.
 - 5 *Prisms and Lens Making*. Twyman. Pub. Hilger and Watts, 1952. *Optical Instruments*. Proc. of London Conference, 1950. *Manufacture of Correction Plates for Schmidt Optical System*. Philips Tech. Review. Vol. 9, No. 12, 1947, p.349. *Testing Wide Angle Mirrors*. H. W. Cox. Journal British Astronomical Association, Vol. 56, p.111.
- * B. Schmidt. Mitt. Hamb. Sternwarte in Bergedorf. 7, No. 36, 1932.

Query Corner



A Radio Constructor Service for Readers

Feed for Pre-amplifier

I have a hi-fi gramophone equipment which is at present housed in a standard type of radiogram cabinet. The reproduction is very good and I can find but one fault, which appears as a kind of buzz noticeable only on loud passages. I believe I am right in diagnosing this trouble as being due to mechanical feedback between the speaker and the pick-up head, in spite of the fact that the motor board is spring mounted. It is intended that the fault should be overcome by mounting the record player in a semi-portable cabinet and connecting it to the main amplifier by a length of screened cable. There is, I believe, a method of feeding the HT supply to the pre-amplifier housed with the player, over the screened cable which carries the signal

voltage. If this arrangement is to be recommended would you please supply a circuit diagram of it.

D. Kinsdown, Windsor

As our correspondent very rightly points out, there are definite advantages to be gained in having the record player remote from the amplifier and speaker system. Firstly, it has a physical advantage as it allows the player to be accommodated in a semi-portable cabinet enabling the operator to lounge in a favourite armchair and put on gramophone records with the very minimum of exertion. The second advantage is the acoustical one, as the arrangement prevents any vibrations set up by the speaker from interfering with the pick-up.

In order to gain the full advantage which the system has to offer, the length of cable between the player and the main amplifier should be such that the player can be used in any part of the room, and this invariably means that the cable must be some 2 to 4 yards in length. Also, it is preferable for this cable to be thin and flexible and its terminating plug of the simple easily located type. These requirements are very largely met in the circuit shown in Fig. 1, as the only connection between the two units is a thin screened lead which carries both the signal and HT supply voltage for the pre-amplifier. As has been described in past articles, it is necessary to employ a pre-amplifier between the pick-up and main amplifier when these units are separated by a long screened lead. By so doing, the top note response of the system is preserved and the noise level kept down to a minimum. The only other lead to the player is that carrying the mains supply for the motor and the small transformer which supplies the heater of the valve.

The circuit employs a low microphony double triode, the first half-section of which functions as an R-C coupled amplifier providing a gain of about 25db. The other

triode is a cathode follower providing an output impedance in the region of 1000 ohms. This value is sufficiently low to prevent the shunt capacitance of the screened output cable from reducing the top response of the amplifier.

The heater of the double triode requires 6.3V at 0.6 Amps, and is supplied from a small mains transformer. It is important that the secondary winding has an earthed centre tap to reduce the hum level to a minimum. The HT supply for the pre-amplifier is taken from the main amplifier, and is fed over the signal-carrying screened cable. Starting at the supply end, the HT line is first decoupled by R1C1 to remove any ripple which would otherwise reach the signal circuit. It then passes through R2, which is included to prevent C1 by-passing the signal voltage to earth. The combined DC and AC potentials then travel along the screened cable. At the pre-amplifier, the DC is blocked by C2 and fed to the anode circuit of the valve, R3 being included to prevent C3 shunting the signal circuit. This arrangement is, of course, only possible where the impedance of the signal circuit is low, and for this reason its use is normally confined to circuits in which a cathode follower output stage is employed.

Battery Output Valve

I wish to build a battery powered gramophone amplifier. Can you please tell me which of the 1.4V miniature output valves give the greatest output?

P. Knowles, Uxbridge

The American 3A4 or Mullard DL93 is the miniature battery pentode which is capable of giving the largest output for a valve of its class. With a 135V HT supply, 90 volts on the screen grid and 7.5 volts bias, an output in the region of 600mW can be obtained. It is, however, necessary to pay for this output in HT and LT consumption, the latter being 1.4 volts at 0.2 Amps whilst an HT drain of about 17mA is needed.

Thermostat Interference

The thermostatically controlled switch on my refrigerator causes severe interference on the television receiver. Is there a simple cure for this rather annoying trouble?

E. Myers, Slough

Switches of this type can cause quite severe impulse interference which, apart from resulting in the familiar flash on the receiver screen, can also throw the picture temporarily out of synchronism. The interference is usually carried by the mains wiring from the offending switch to the receiver, but in some cases the wiring may radiate the noise, which is then picked up on the aerial. In either case the cure is the same, to first try the effect of cleaning the switch contacts, and if this is not successful to connect a suppressor across them. Firstly then, examine the contacts and wipe away any dirt which may have accumulated on them. If the contacts appear to be burnt, clean them with a fine carborundum stone or fine

Query Corner

RULES

- (1) A nominal fee of 2/6 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 a more general interest will be reproduced in these pages each month.

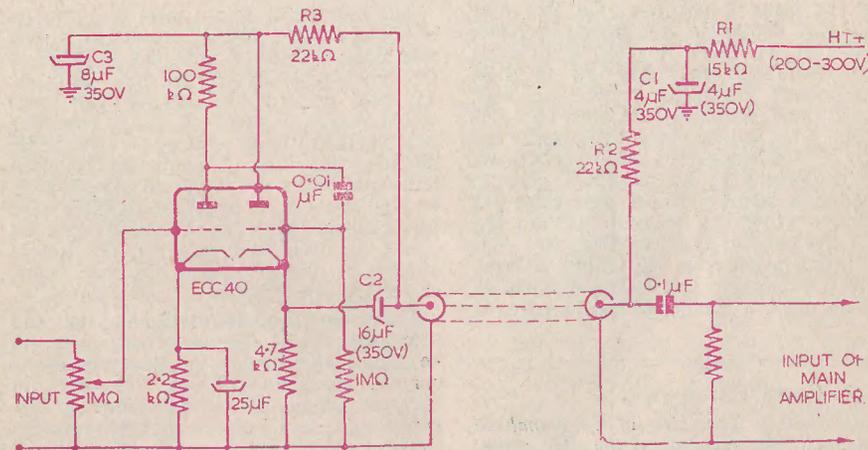


FIG. 1

RC 315

OCTOBER 1953

emery cloth, again wiping away any deposit before replacing the switch.

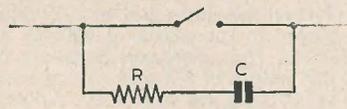


FIG. 2
SIMPLE SUPPRESSOR FOR A MAINS SWITCH

RC 316

If the trouble still persists, a suppressor consisting of a series R-C combination as shown in Fig. 2 should be connected across the switch. The capacitor must have a DC working voltage of 1kV and a value of 0.1 μ F, whilst the resistor value must be determined by trial and error methods. It will usually be found that the best suppression is obtained with a value between 50 and 200 ohms. Finally, it is important to ensure that the metal work in the refrigerator is earthed, otherwise it may form a good radiator for the interference.

The "PATTERN-MASTER"

1. A versatile TV Pattern Generator for serious work, covering 40-70 Mc/s.

By D. ALLENDEN, GRAD.I.E.E.

COMMERCIAL TV PATTERN GENERATORS fall generally into two categories: the very cheap and the very expensive. The first category usually consists of instruments which are the TV equivalent of the ordinary servicemen's oscillator, offering only the simplest facilities. On the other hand the expensive instruments produce waveforms of much greater complexity, often including sync pulses and in some cases correct interlacing circuitry as well. Ideal as these instruments are, their necessarily high price usually places them out of the reach of the amateur or small serviceman. The instrument to be described aims at providing a useful and fairly comprehensive generator which can be built without too much trouble and at reasonable cost. The instrument produces an RF output covering all five TV channels, and various modulating voltages allow a number of useful patterns

to be produced, including one with tone gradations, so that contrast and video distortion may be checked. In addition the various modulating waveforms, sync pulses, and a frame sawtooth, are available at low impedance levels.

The instrument uses a total of 10 valves to achieve this; however, the design is such that those wishing to omit one or more of the modulating waveforms may easily do so; and, in addition, the RF unit itself would make an excellent signal generator covering the TV bands, with only a very simple modulating system. A number of the circuit techniques which are employed will probably be new to most constructors, so these have been explained in detail. Although miniature valves are used and specified, no general attempt at miniaturisation has been made, as further development is contemplated.

The design will be discussed unit by unit, and a separate circuit diagram of each unit will be given; this avoids the necessity for a complex complete schematic. However, in order to obtain an overall picture of the performance and facilities offered by the design, reference may be made to the block schematic of Fig. 1.

FIG. 2—COVER ILLUSTRATION.

This shows a front view of the completed instrument. The adaptor on the RF output lead is a metering unit.

An RF oscillator covering the range 40-70 Mc/s feeds a modulator amplifier, from which the RF output is taken.

The various video voltages are:

(1) Negative sync pulses of approx. 100V amplitude and 10 μ sec duration, at a PRF of 10,125 c/s. These are the line sync pulses and are produced by an asymmetrical

bars on the CRT screen, but the brightness of the bars will be graduated from black to white in uniform steps. From this circuit is also derived . . .

(5) Negative Frame sync pulses at a P.R.F. of 50 c/s. Each of the above waveforms is available either as a video waveform or for modulation purposes. The simul-

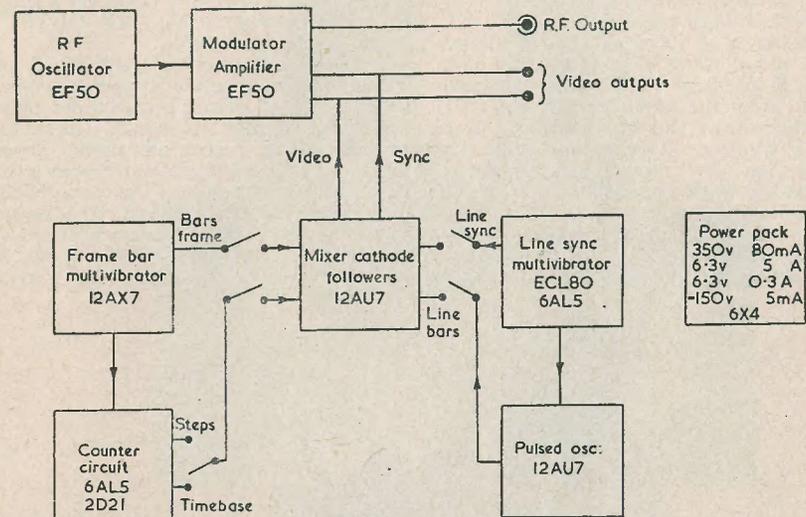


Fig. 1. Block Diagram

multivibrator. These pulses are also used to trigger an oscillator which produces . . .

(2) Trains of sine waves at approx. 250 kc/s, each train being initiated by the sync pulse.

The simultaneous modulation of the RF output by (1) and (2) will produce on the screen of a TV receiver approx. 24 vertical bars, whilst the line sweep oscillator will lock to the sync pulses.

(3) A square wave having a frequency of 500 c/s, produced by a second multivibrator. This square wave is used for either audio modulation (without frame sync pulses) or to produce 10 horizontal bars (with sync pulses). The output of the multivibrator is also fed to a "staircase" waveform generator, whose output consists of

(4) A waveform of "staircase" shape having 10 steps, so that it repeats at 50 c/s, i.e. frame frequency. This wave when applied as modulation will produce 10

taneous application of (1), (2), (4) and (5) to the modulator produces a full field pattern of black-white vertical bars, horizontal graduated bars, and line and frame sync pulses. No provision for correct interlace is made, and the line and frame frequencies are not rigidly locked together. These are the only two major features which are omitted, and this has been done on account of the extra valves which would be needed to provide them. However, since frame and line video are rigidly locked to frame and line sync, the pattern on the screen remains stationary. Attention has been paid to the stability of the line and frame circuits, so that they can be adjusted to the correct frequencies with the knowledge that there will be little deviation therefrom.

In addition to the above mentioned waveforms, a 50 c/s sawtooth is also produced and is available at a low impedance level at output terminals; it is not used for mod-

ulation purposes. Control of the depth of modulation is provided, and the same control serves to vary the amplitude of the video output waveforms.

The RF Oscillator

This is, naturally, the heart of the unit, and has been designed to have good frequency stability and screening. The circuit is shown in Fig. 3 whilst the completed unit is shown in the photographs (Fig. 4). The oscillator itself, V1, is a grounded anode Hartley covering the 40-70 Mc/s range with a single tuned circuit, L1-C1-C2. L1 consists of 6 turns of 16 swg tinned copper wound over a $\frac{1}{4}$ " dia. former to have an overall length of $\frac{7}{8}$ ". The coil is tapped $3\frac{1}{2}$ turns from the lower (earthy) end. C1 is a 50pF micro variable, whilst C2 is a 3-30 pF trimmer. It is essential that this trimmer has low minimum capacitance. Note that a single common earth point is used for all connections from this valve, and the unearthed side of the heater is bypassed by capacitor C9. It is, incidentally, worth noting that the cathode-heater capa-

stage V2, a second EF50. The grid leak R6 of this valve is returned to earth via C8-R7, and video modulating voltages are introduced across the latter resistor. Sync pulses are impressed on the output by applying them to the suppressor of V2 with sufficient amplitude to cut-off the valve.

The modulated RF output is taken from the anode (note low value of anode load) via C7 to attenuator R8-R9. The voltage across the 75 ohm R9 is taken to the co-ax plug which is visible on the top of the unit (Fig. 4). From here it is taken via a length of co-axial cable to the 'RF OUTPUT' socket on the front panel.

The RF unit is constructed of 16 swg duralumin, aluminium, or copper, assembled round $\frac{3}{8}$ " or $\frac{1}{2}$ " square brass corner pillars using 6-BA countersunk screws. The exploded view in Fig. 5 gives all relevant dimensions. An internal tinplate or copper screen passes across the inside of the case, dividing the input of V2 from its output. The diagram shows the necessary orientation of the valve-holders to achieve this, and also shows the tinplate bracket on which the variable

plug mounted in the modulator section of the case. Leads which have to pass across the modulator section and into the oscillator section are either decoupled on entry to the latter section (HT and LT) or passed through in screening (Mod feed to V1 Grid). Although

during the 'short' time interval, and so the resistance of its charging path must be reduced as much as possible. Referring to the circuit, suppose V3A to be conducting and V3B to be 'off'; these are the conditions when the pulse is actually being produced.

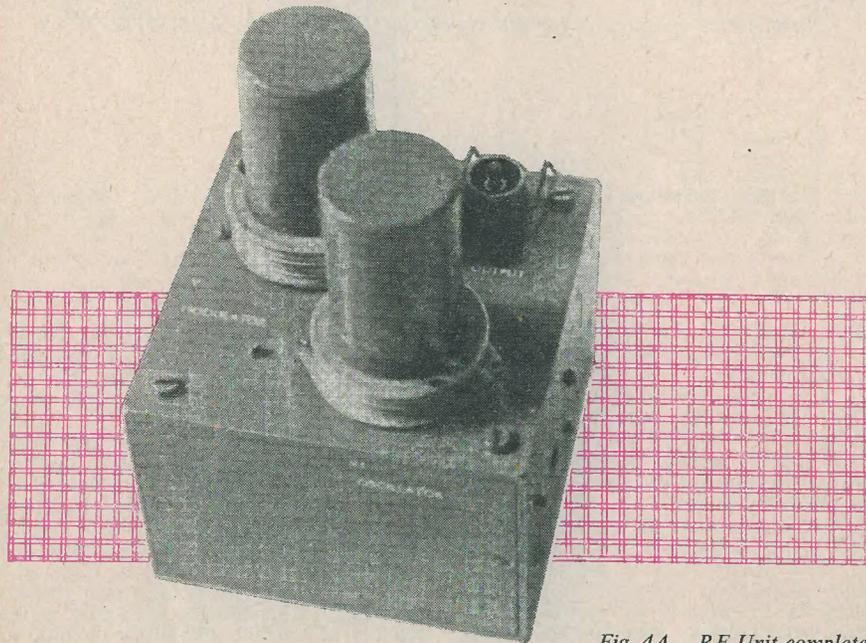


Fig. 4A. RF Unit completed.

citance of V1 forms part of the tuned circuit, and that the calibration will therefore require re-adjustment whenever V1 is changed.

The output from V1 is taken from the cathode, via C5, to the grid of the modulator

tuning capacitor is mounted. The spindle of this capacitor is extended by means of a suitable shaft coupling to extend through the instrument panel.

Power supplies and modulation voltages are fed in through a miniature 6-way Jones

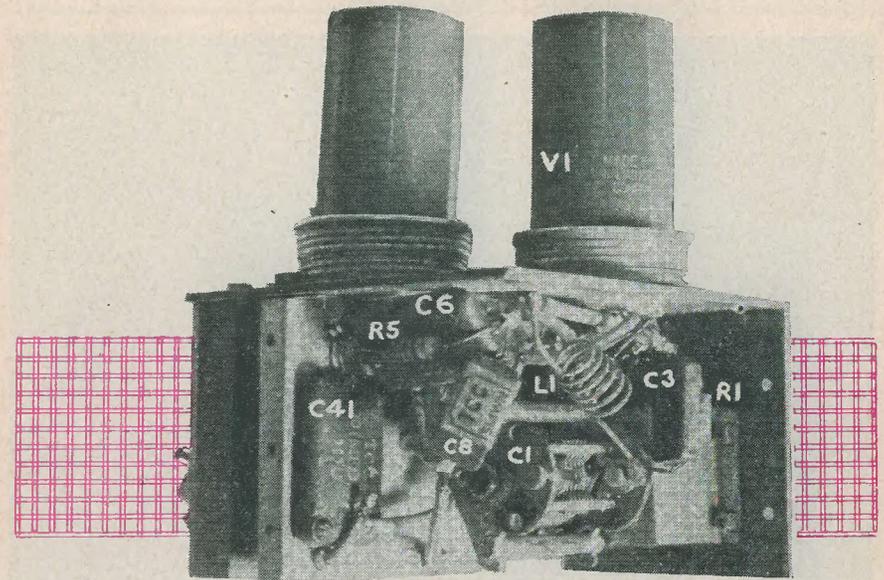


Fig. 4B. RF Unit with part of the case removed.

Photographs by H. Rumball

EF50's were used for this unit, a more compact version could be produced using Brimar 8D3's (6AM6).

The Line Sync and Video Unit

The function of this unit, whose schematic diagram is given in Fig. 6, is to produce the line sync pulses and the line video waveform. It has 3 valves and consists of two basic circuits. First consider the line sync pulse itself. The requirement is for a negative pulse of 10 μ sec duration, repetitive at 10,125 c/s. So long as the pulse has sufficient amplitude to cut off the modulator, it does not for our purposes matter if it is not flat topped. The pulses are produced by a highly unsymmetrical multivibrator using an ECL80 triode-pentode. When it is desired to produce an unsymmetrical waveform of this sort by means of a multivibrator, the main difficulty which has to be overcome is that the capacitor which sets the 'long' time interval must be recharged

The pulse length is determined by the time constant C11-R11. During this time C12 is being re-charged, the charging circuit being from HT+ via anode load and R15 and the grid-earth impedance of V3A. Since the grid of the conducting valve is being driven positive, the latter impedance is fairly low. R15 thus is the main problem. The rate of charge can, however, be increased in two ways. Firstly, C12 can be reduced as much as possible, and the time interval maintained by increasing (VRI+R13). Secondly, R15 must be kept as low as possible, but the practical limit to this is set by the permissible dissipation at V3B anode. Further improvement is possible by returning R15 to a voltage exceeding that of the HT supply, and inserting a plate catching diode to arrest the charging process when the anode of V3B reaches +250 Volts. This has been done in this particular case. The diode V4 is a Brimar 6AL5 with both halves strapped. Since the cathode of this valve is tied to the HT voltage

at +250 Volts, it is not desirable to feed its heater from the earthed heater winding. It can, however, be supplied from the 6.3 volt rectifier heater winding, since this subjects the heater cathode insulation to a PD of only about 100 volts, which is well within the rating for this valve.

The pentode section of the valve has

valve could be used for V3B—a Brimar 6C4, for instance would be ideal. A pentode of the power output type should still be used for V3A, but preferably one with one or more diodes incorporated, the diode anodes being then strapped to the control grid to reduce the grid-cathode impedance when the grid goes positive.

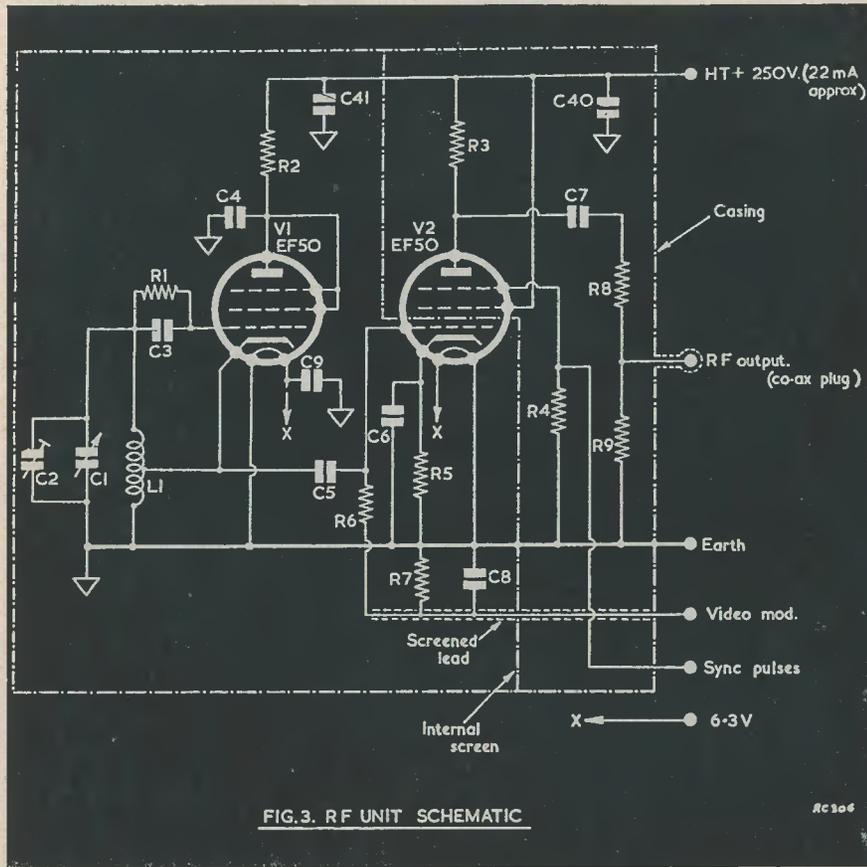


FIG. 3. RF UNIT SCHEMATIC

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negative sync pulses of about 100V amplitude appearing at its anode, and these are fed, via the switching circuits to be considered later, to the modulator. The anode plays no part in the multivibrator action, the screen of the valve being used instead.

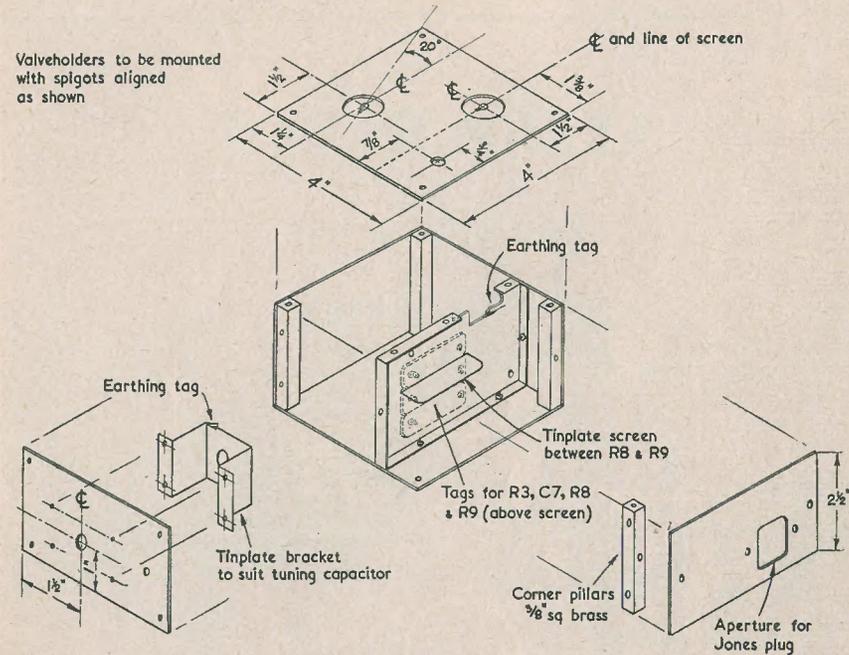
It may be pointed out for the benefit of those wishing to experiment further that this valve is by no means ideal, but it does appear to be the best miniature twin valve for the purpose. If two separate valves are contemplated, a much heavier

Positive pulses, of inferior shape to those at V3A anode, are available at V3B anode. These are fed to the line oscillator V5 via a coupling capacitor C13.

To understand the action of V5, consider V5A to be conducting. The tuned circuit L2-C14 is heavily damped, as the source impedance looking back into the cathode of V5A is very low, approximately 1/gm. A fairly large steady current flows in L2. Now let V5A be suddenly cut off. L2-C14 'rings', producing an oscillation which, in the

absence of any regenerative means, decays exponentially to zero. The oscillation is fed via C15 to the grid of cathode follower V5B, and so is reproduced at higher power level at V5B cathode. Assuming the gain of V5B to be unity (it is of course, actually somewhat less) the oscillatory voltage at

In the circuit as used, V5A is normally held cut off by its grid being returned to a suitable negative supply, derived from the power pack. The negative voltage of this bias supply must be at least equal to the grid base of the valve plus the peak oscillatory voltage, to ensure that the valve is kept



Dimensions not given are either left to the discretion of the constructor or will vary with the components used. Material:- Brass, aluminium or dural - 16 swg. Screen of 22 swg tinplate.

FIG. 5. CONSTRUCTIONAL DETAILS OF RF UNIT

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V5B cathode may be fed back to the tuned circuit to reduce the damping of this circuit. Actually the coil is centre-tapped, so if only half the output of V5B is fed into the centre-tap, the oscillation will not die out, but will continue. The regeneration is controlled by VR2, which in practice is adjusted so that the oscillation is just maintained. If, after some time, V5A is cut-on again, the tuned circuit is highly damped and the oscillations die out after one or two cycles.

in the 'cut-off' state. On the other hand, it must be less than the amplitude of the sync pulse, so that the arrival of the pulse renders the valve conducting and stops the oscillation. A pre-set control is therefore provided for this final adjustment of the bias voltage; this control is in the power pack circuit (VR7).

Since the oscillations are started and stopped by the sync pulses, it follows that if the TV set timebase locks to the sync

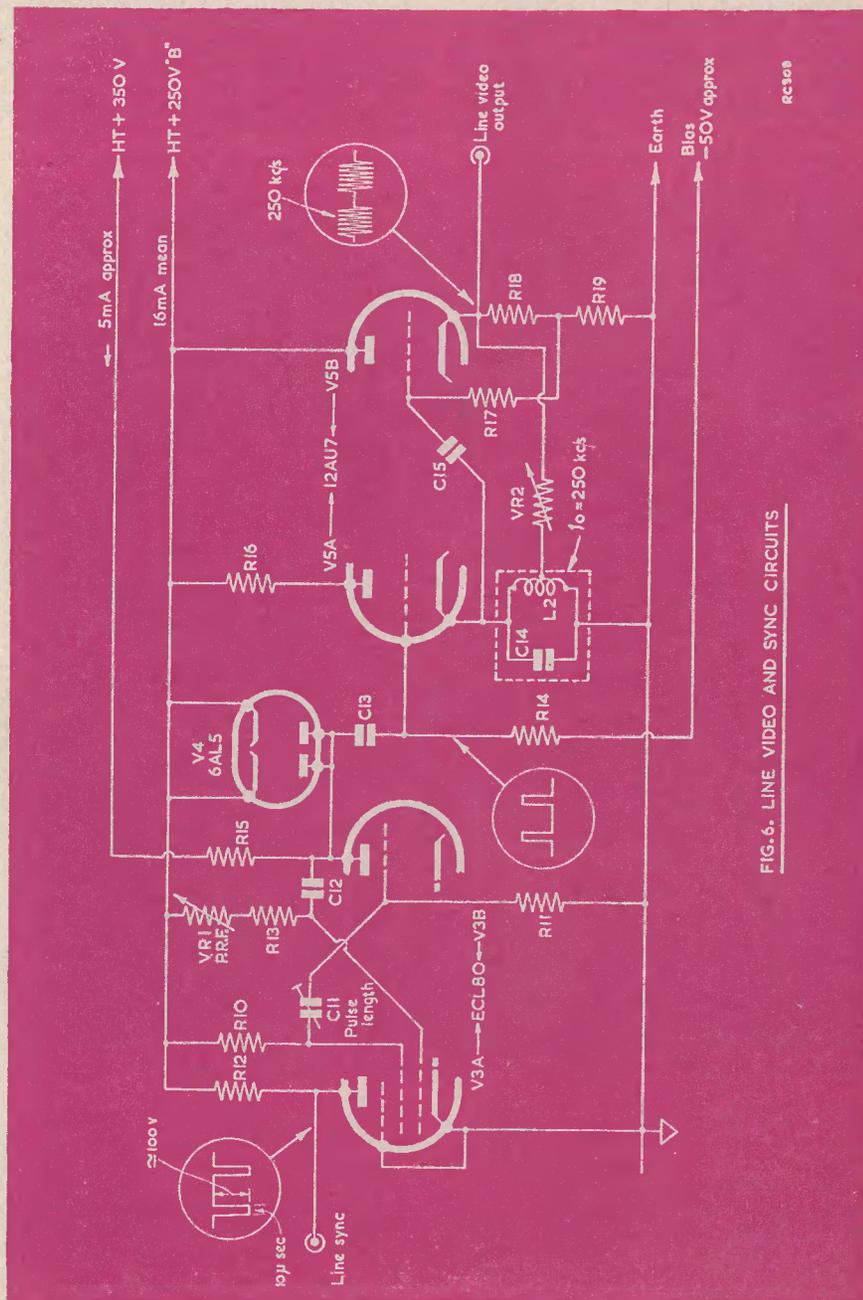


FIG. 6. LINE VIDEO AND SYNC CIRCUITS

pulse, the vertical bars on the screen will automatically be stationary. Also, the actual frequency of oscillation is completely immaterial, although coil winding details are given for a nominal frequency of 250 kc/s, giving about 24 bars.

The line video voltage is taken from V5B cathode, and fed, via the switching circuits, to the control grid of the modulator valve

V2. The valve used for V5 is a Brimar 12AU7, but a Brimar 6SN7 could equally well be employed.

Apart from VR2 there are two pre-set controls in the unit. They are VR1, the PRF control, and C11 the pulse length control. The adjustment of these will be described in the section on setting-up.

[to be continued]

L/C RATIO

By H. E. SMITH, G6UH

THE BEGINNER often sees references made to the L/C ratio of a tuned circuit, and may wonder exactly what importance and meaning this has to the operation of a receiver. There is, for any frequency, a correct operational relationship between the value of the inductance and the value of the capacitor, both in receiving and transmitting circuits. The inductance (L) and the capacitance (C) should be of the correct proportions in order to obtain a circuit free from RF loss, or free from instability. A simple equation is used to produce this L/C constant, and is as follows:—

$$LC = \frac{25330}{f^2}$$

Where L=Inductance in μ H.

C=Capacitance in pF.

f=Frequency in Mc/s.

As an example, what is the inductance value required to resonate at 7.3 Mc/s with 25, 50, and 100 pF?

$$LC = \frac{25330}{(7.3)^2}$$

$$= \frac{25330}{53.29} = 950$$

Therefore, with a 25pF capacitor the inductance required is

$$\frac{950}{25}$$

or 38 μ H. It follows then, that for 50pF, L will be 19 μ H, and for 100pF, 9.5 μ H.

Having obtained the LC constant by this means, it is a comparatively simple matter

to divide this figure by the available capacity in pF to obtain the absolute value of the inductance required. The number of turns necessary for any given inductance may be

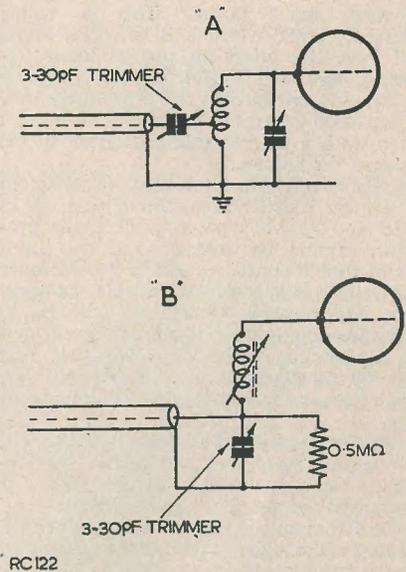
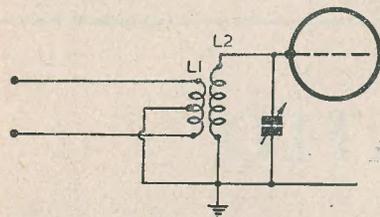


Fig. 1. "A" and "B" show two methods of correctly matching 50-75 Ω co-axial feeder to the input circuit

calculated from a reliable "ABAC" such as will be found in the *Wireless World Data Charts*.

A correct L/C ratio is usually absolutely necessary in IF circuits, and also applies in general to most RF circuits. For nearly all types of oscillator circuit, however, it is usual to use a "high C" type of circuit, where the inductance is much smaller than usual and the



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Fig. 2. Input matching for balanced feeders, 80-150 Ω . L1 is inter-wound with L2 (earth end) and should normally consist of approximately one-fifth the number of turns on L2. The earthed centre-tap should be as near as possible to the electrical centre of the winding

capacitor much larger. This is mainly because thermal effects and voltage changes will have less effect on the oscillator frequency, and thus the circuit will be more stable. In some circuits the capacitance may be increased to three or four times the normal value, with a corresponding decrease in the value of the inductance.

In RF circuits where the absolute maximum of voltage transfer is required, such as in VHF and 28 Mc/s pre-amplifiers, the procedure should be reversed and the tuned circuit should consist of as much inductance and as little capacitance as possible. In many cases it is possible to dispense with the C altogether (apart from the circuit strays and the capacitance of the RF valve itself) and tune the inductance with a dust iron plunger, which has the effect of varying the inductance only.

Where a capacitor is across a tuned circuit, always remember that the higher the frequency, the greater will be the RF loss. For this reason the use of a "ganged condenser" in the RF circuit is not to be recommended because of the high capacitive losses involved. On the 144 Mc/s band, as much as 3 db loss can be caused by using capacitive tuning in the RF stages, apart from the fact that tuning is sharpened up and the bandwidth is reduced. One of the most necessary requirements of the VHF RF stage is that it shall have a band-

width of 2 Mc/s. or as near to that as possible, and selectivity is not such an important factor as sensitivity.

Selectivity v Gain

On frequencies below 28 Mc/s the story is somewhat different. Here we require the utmost in the way of selectivity and sensitivity from our RF stage or pre-amplifier. If the IF stages of the receiver have no crystal filter incorporated it is essential to obtain some improvement RF-wise. It is of little use to add a pre-amplifier to provide extra gain if no additional selectivity is obtained. This will worsen the position rather than improve it. On 7 and 14 Mc/s especially, the QRM problem is very acute, so, when considering the construction of a pre-amplifier for these bands, study the following points as an aid to increased selectivity:—

- (1) Use good quality formers and wire for the coils (Litz wire has the highest Q of any).
- (2) Use a valve which has a high input and output resistance at the frequency for which it is to be used.
- (3) Never exceed the maximum anode and screen voltages as recommended by the makers.
- (4) Pay particular attention to the method of coupling the aerial to the input and never over-couple. (See below for further details).

In most receivers fitted with 465 kc/s IF stages and one RF stage, the image rejection figure is not always particularly good, and the addition of a further RF stage will improve this tremendously. From the point of view of maintaining a good signal to noise ratio, it is advisable to run the additional stage "wide open" all the time. Any type of gain control, whether AVC or manual, will lower the "gm" of the valve and thus increase the noise figure.

It may be found, however, that it will be necessary to forego some of the benefits of increased signal-to-noise ratio in favour of greater selectivity. A slight reduction in the amount of aerial coupling will do much in this direction, while the noise figure will increase slightly due to the loading being incorrect. If the aerial is *matched* as accurately as possible, however, the effect of looser coupling will not spoil the noise figure to any great extent.

Matching the Aerial to the Input

A good deal of hit or miss goes on when it comes to connecting the aerial to the input coil, and many consider this to be a relatively unimportant matter provided signals can be heard well. It is perhaps of little importance when strong signals are being dealt with, but

what about those weak signals which somehow or other you never hear? Input matching must be *right* before you will hear these weak signals.

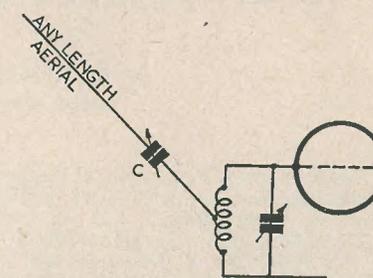
Fig. 1 shows a good method of obtaining good matching for 50-75 ohm co-axial feeders. "A" is suitable for circuits with capacitive tuning, and "B" for those where dust-iron slug tuning is used. In both cases the 3-30 pF trimmer is adjusted for maximum signal on a weak station.

For balanced twin feeders of between 80 and 150 ohms, the coupling circuit shown in Fig. 2 is recommended. The coupling coil is wound in between the turns of the grid coil, at the earth end.

The long wire aerial with its single wire "feeder" presents more of a problem than is usually realised. The best method of all is to construct an aerial tuning unit. Several types have been described in past issues of this journal. If it is not convenient to do this, the method shown in Fig. 3 will provide quite reasonable results. It will be seen that the aerial connection is made to a point about midway down the coil to avoid loading the grid circuit unduly.

No mention has been made of directional aerials as an aid to selectivity, but such aerials are, of course, of great help in this connection. It must be remembered, however, that directional aerials will only reduce QRM from

the unwanted direction, and will actually increase the strength of any interfering signals arriving from the same direction as the wanted



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Fig. 3. A "compromise" method of connecting a long wire aerial. The aerial is tapped on at about midway down the coil. "C" is a 50 pF air-spaced trimmer, adjusted for optimum results on the frequency band in use.

signal. Extreme selectivity in the receiver itself is the only really satisfactory way of sorting out the stations.

SOME USEFUL HINTS

by J.S.K.

Instability in Negative Feedback Circuits

Sometimes it is attempted to build "quality" amplifiers and receivers without going to the expense of a really good output transformer. The result can be oscillation at high frequency due to the phase change introduced by the high capacitance of the output transformer windings. Some journals have, in the past, designed circuits where this type of trouble has been deliberately introduced to give an amount of treble lift, with very good results—but trouble has come to the constructor when a transformer other than that specified has been used.

Valve Equivalents

When making a change in the type of valve used, according to the listings given by a manufacturer, do not assume that the reverse will always hold true. For instance, the Mullard list shows that a GZ32 can be used in place of a 5Y4G. This is perfectly in order. But it does not follow that a 5Y4G can be used where a GZ32 has been

specified—the maximum anode current of the latter is 300 mA, whilst that of the 5Y4G is only 125 mA.

Odd Hum Troubles

The old idea of trying a new smoothing condenser in parallel with the old ones in a set is not always effective. The best thing to do is to disconnect the old condenser, and then try the new one in its place. If this does not cure the trouble, it may be that the output valve is drawing excessive current. This can be due to several things. A soft valve may be checked by joining the control grid to chassis by a piece of wire. If the hum stops, it was due either to a soft valve, a leaky coupling condenser, or an earlier stage. If the coupling condenser is disconnected and the grid short removed, and the hum persists it is due to a faulty valve. If this procedure results in the hum being cleared, a new condenser should be tried. If the hum is still present, earlier stages should be investigated.

SOMETHING NEW

By JAMES S. KENDALL
ASSOC. BRIT. I.R.E., A.M.I.P.R.E.

IT SEEMS TO RARELY HAPPEN that one gets something new, but recently we received samples from Mullard Ltd. of their new EABC80, a 6.3V triple diode triode.

In this valve, two of the diodes and the triode have a common cathode, whilst the third diode has its own cathode and is thus completely independent. This gives the valve very wide applications. For instance, it can be used in a detector circuit in such a way that the audio voltage is doubled, providing 6db extra gain without adding to the number of valves. Again, the harmonic distortion can be turned from odd to even in the detector stage. This is an advantage as the ear does not notice even harmonic distortion to the same extent as it does the odd. In this article are given details of two circuits which we have developed around this type of valve.

The first circuit, shown in Fig. 1, is that of a TRF receiver with AVC. All three of the valves are of the glass-based type. The detector will give a voltage gain of 60 into a 680kΩ grid resistor when used with a 220kΩ anode load. An output valve with a very high slope has been chosen because it requires a far lower drive voltage—4V RMS instead of 18V as would be needed for a 6V6 for the same power output. The total current required for the receiver is of the order of 50mA at 250V. A conventional power supply can be employed.

The coils used were those made by Radio Experimental Products of Coventry. These are quite good coils, and are well within the reach of the constructor. As there is no core of magnetic material the "Q" is quite high, and as the formers are made of low-loss material the total losses are reduced to a minimum.

The main difference of the circuit to the conventional one is in the arrangement of the diodes. That used for AVC is diode No. 1, as it is of higher impedance than the others.

The layout of the components is not critical—but should RF oscillation occur, it can be reduced by increasing the value of the RF stage bias resistor.

The second circuit, shown in Fig. 2, is of use to the constructor of superhet receivers where a little extra power is needed. Should it be required to use the circuit to modify an existing receiver employing octal valves, an EL33 can be substituted for the EL41 with a 150Ω 1W bias resistor in place of that shown in the diagram.

The AVC circuit is of conventional pattern and does not require explanation, whereas the signal detector circuit is a voltage doubler of the type such as was common many years ago for the rectification of power supplies with the aid of metal rectifiers. The effect is that about double the usual signal voltage is produced, whilst the AVC action appears to be less effective by a reduction of 6db in the control ratio. For instance, in a receiver with a former control ratio of 6db for an input change of 60db, the new ratio will be 12db for a change of 60db.

The ratio of the two condensers in the bridge circuit is far more critical than their actual value. They should both be of the same capacitance, when a bridge will be formed with the capacitances, also equal, of the diodes. This will result in there being very little RF present in the output, so that the normal RF filter is not required. Diodes Nos. 2 and 3 are used for the signal detectors.

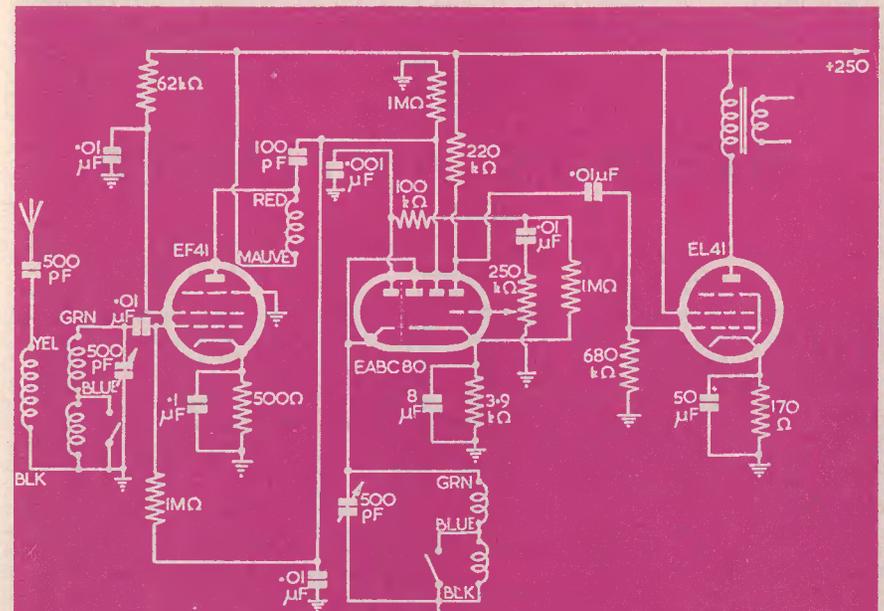


FIG. 1

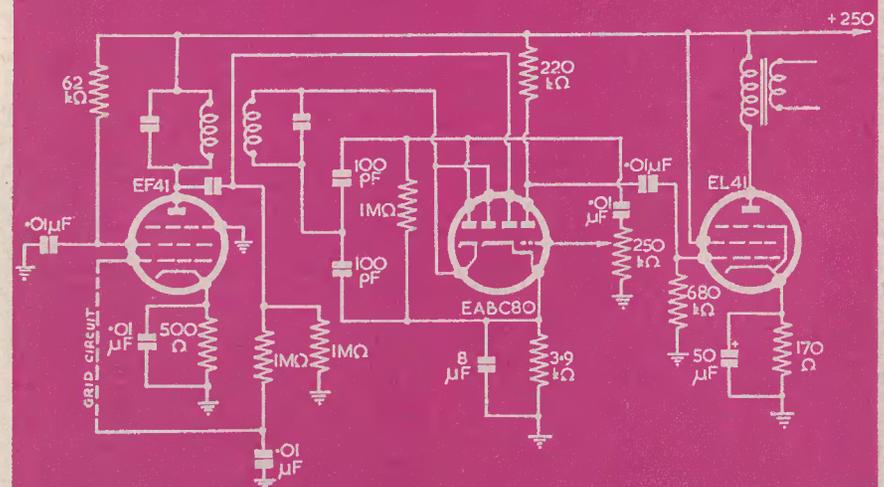


FIG. 2

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Watch for the "ORPHEUS"

The Tape Recorder which aroused so much interest
on the G.E.C. Stand at the National Radio Show

6: THE TRF RECEIVER

By A. BLACKBURN

THERE ARE TWO TYPES of radio receiver which are used—to larger or lesser extent—by radio amateurs today. Each possesses its own characteristics and advantages which, according to the performance and system of operation required, will meet the user's needs.

The conventional tuned radio frequency (TRF) receiver—which is described as being a 'straight' receiver because of the simplicity of its operation—is shown in Fig. 1. From the illustrations you will see that it comprises four basic sections, each of which has a clear cut and self-contained function.

These functions can best be described under the headings into which they fall, so that the action of the receiver can be traced from the aerial to the loudspeaker.

Into this article we have introduced a subject which so far we have not dealt with—the power supplies. Although no attempt has been made to investigate power supplies in great detail, the brief remarks made under that heading are sufficient to give you an indication of its place and operation in this particular instrument.

The RF Amplifier

The function of the RF amplifier is twofold. It increases the selectivity of the receiver by relieving the detector tuned circuit of the load imposed by the aerial, as well as increasing the signal voltage applied to the detector.

There is no difficulty attached to the operation of the stage. A straightforward system of coupling the signal in the aerial to the tuned circuit is carried out by the condenser C₁. This component couples the signal from the aerial to L₁, which inductively couples the signal to the tuned circuit, L₂C₂.

In order that the degree of coupling can be adjusted, C₁ is made variable. V₁ amplifies the signal voltage appearing across the tuned circuit. The amplified voltage is coupled inductively to the detector tuned circuit L₄C₆ by L₃ which forms the anode load.

You will notice that C₆ and C₂ are ganged, that is to say, the two condensers are on the same shaft and are, therefore, controlled by a single knob. The screen grid of V₁

is fed with the necessary DC voltage from R₃.

Some explanation of the purpose of C₄ will be found helpful at this point. In the same way that the fluctuating signal grid voltage causes amplified fluctuation of the anode voltage, so is the screen similarly affected. This undesirable effect must be eliminated, since the overall gain of the valve is reduced. A condenser is connected, therefore, between the screen grid and earth. The condenser charges up and, if the capacity is sufficiently large, will remain charged however much the screen voltage tries to vary. Another way of looking at it is that the signal appearing at the screen is by-passed to earth, so that, from the AC point of view, the screen is earthed. Under these conditions, the screen is said to be 'decoupled'.

Grid bias is derived from the voltage drop across the resistor, R₁, caused by the valve current flowing through it. The cathode end of this resistor is positive with respect to earth and as the grid is connected to earth through L₂, the grid is negative with respect to the cathode. Fig. 2 illustrates this point. It is also necessary to decouple the cathode resistor R₁ to prevent loss of gain.

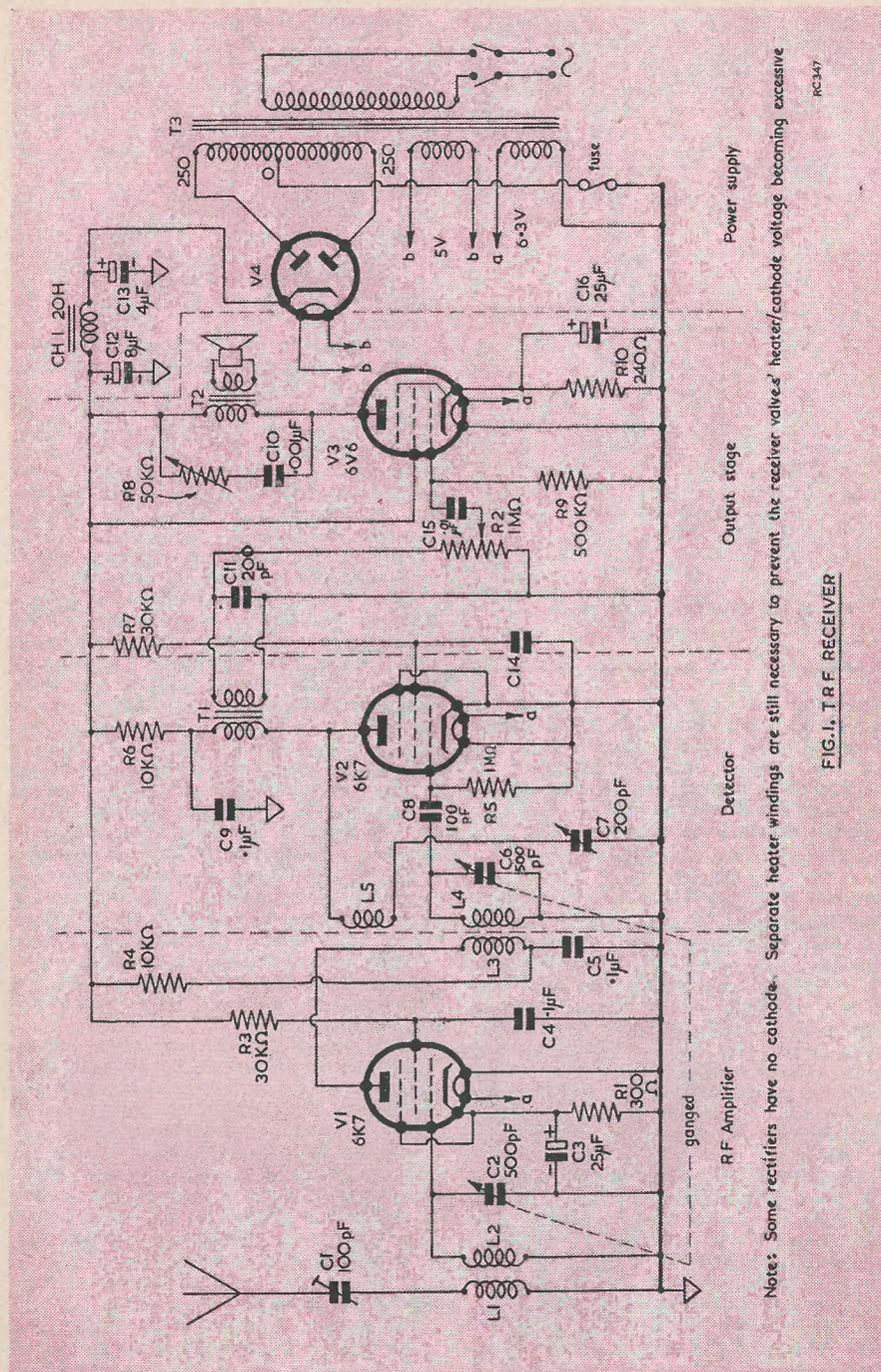
Yet another decoupling network is necessary, R₄ and C₅, to prevent small RF voltages appearing on the HT+ line. In this case the addition of these components assists in preventing unwanted interaction between stages via the HT line, which would almost certainly result in instability.

The Detector

This detector is of the leaky grid type. The easiest way to understand the functioning of this detector is to consider the grid and cathode of V₂ as the anode and cathode of a diode.

As explained in an earlier article, a diode can only pass current in one direction. No attempt was made at that stage to explain the real process of demodulation, and this is an excellent opportunity to deal with it rather more thoroughly.

In a diode detector circuit, shown in Fig. 3, the condenser and resistor C₈ R₅ are connected in parallel, instead of in series



Note: Some rectifiers have no cathode. Separate heater windings are still necessary to prevent the receiver valves' heater/cathode voltage becoming excessive

FIG. 1. TRF RECEIVER

as in Fig. 1. There is really no difference between these connections, as will be shown.

On the first positive peak of RF the diode will conduct and partly charge C_8 . However, as the voltage reverses and moves toward the negative peak the diode will cease

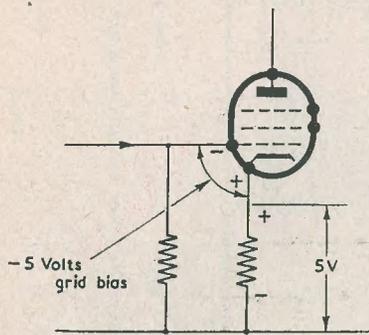


FIG. 2. ILLUSTRATING AUTO-BIAS

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conducting and C_8 will begin to discharge through R_5 . Now a condenser with a resistor in parallel takes a definite time to discharge. The time depends upon the values of the components; the larger the capacity and/or resistance, the longer the time.

This is expressed as time $T=C \times R$

T in seconds

C in μF

R in MO

If the time constant is long compared with the time between positive peaks of RF, the condenser will never fully discharge, and if each RF peak charges it a little more than the last, eventually it will become charged to the peak voltage of the RF.

The peak voltage of a modulated RF signal varies, however, according to the amplitude of the modulation. The charge on C_8 will vary accordingly, therefore, unless the time constant is too long to allow it to do so.

Clearly, then, the choice of time constant must be such that this factor is long compared with time between peaks of the RF, and short compared to the highest audio frequency in the modulation. The modulation voltage is developed across the condenser (and the resistor, as they are in parallel) with some residual RF superimposed.

By returning the grid leak to earth, Fig. 3 becomes similar in appearance to the

detector portion of Fig. 1. The condenser, C_8 , can still discharge through the resistor but it has the tuning coil in series with it. When it is remembered that the resistance of R_5 is at least one megohm, compared with the coil resistance of a few ohms, it can be seen that the difference in connection is negligible.

The modulation voltage can now be considered as being developed across the resistor, which we see in Fig. 1 is connected between the grid and earth. An amplified version of the grid voltage, ready for AF amplification, will therefore appear at the anode of V_2 .

However, the detector circuit has another job to do. As there is no perfect system of detection, a small amount of RF appears at the anode of the valve. Use is made of this by feeding it back to the grid circuit via L_5 , which is closely coupled to L_4 . The circuit will therefore tend to oscillate, the oscillation being controlled by C_7 , which impedes more or less, according to its setting, the RF flowing into L_5 .

For telephony, i.e. modulated carriers, C_7 is adjusted so that the circuit is just below oscillation, in which condition selectivity and sensitivity are greatly improved. What is happening in effect is that the losses in the tuned circuit are largely being overcome by the "fed back" energy and the circuit is operating more efficiently. This system is variously referred to as regeneration or reaction.

Reacting detectors also find application in the reception of unmodulated morse signals or CW signals, as they are called. Such a signal is produced by starting and stopping the carrier in the form of the morse code. As there is no modulation, the detector will produce no audio output. An audio signal can be produced by adjusting C_7 until the circuit oscillates, providing the receiver is tuned just off the frequency of the transmitter. The audio is produced by the "beating" of oscillator and transmitter frequencies.

There are, of course, many other circuits for detection and reaction, but basically their principles are the same as described above.

The coupling transformer, T_1 , passes the audio signal on to the output stage, and decoupling R_6C_9 is incorporated, the purpose once again being to prevent undesirable interaction with other parts of the circuit. A small condenser is also connected across the transformer secondary to ensure that no RF reaches the output stage.

The Output Stage

The output stage in this particular case is perfectly conventional and little has to be added to my remarks in an earlier issue.

As in the RF stage, V_3 also has "autobias." There are other ways of biasing valves in mains receivers, but this is by far the commonest. Tone control is effected by C_{10} and R_8 connected across the primary of the output transformer. Quality enthusiasts will not agree with this as a tone control, as all it really does is to cut the upper frequencies. However, it is usually desirable when using the tetrode or pentode output stages, as they normally produce a rather harsh reproduction. Control of volume is, of course, effected by the potentiometer R_2 .

Power Supplies

The transformer T_3 supplies the necessary heater voltages and HT voltages from the mains. The rectifier valve V_4 rectifies the AC in the HT secondary winding in exactly the same way as the diode rectifies the carrier. In this case, however, there are two diodes with a common cathode. Now the transformer is centre tapped and on one particular cycle one end of the transformer will be positive with respect to the centre tap, and the diode anode connected to that end will conduct. During the next half-cycle the voltage across the transformer will reverse and the other end will become positive when the other anode will conduct. The DC at the cathode of this double diode will have a considerable ripple voltage superimposed upon it, at twice the mains frequency, i.e. 100 c/s for 50 c/s mains. If this ripple were applied with the HT to the valves, the effect would be an objectionable hum in the loudspeaker. The choke CH_1 and the condenser C_{12} are used in order to smooth out this ripple. The function of the condenser C_{13} is to charge up to the peak voltage of the transformer secondary and to remain charged between cycles. For this reason it is known as the reservoir condenser.

The use of a double diode rectifier in this way is called full-wave rectification; if only one diode is used it is called half-wave rectification. The advantage of full wave rectification is that as the ripple voltage is twice the mains frequency, the choke does not have to have such a high inductance nor the smoothing condensers such a high capacity as would be necessary with mains frequency. Heater voltages are provided by two separate windings on the transformer, one supplying the receiver valves, AA, one side of which is earthed, and the other supplying the rectifier valve. The reason for a separate winding for the rectifier is that its "cathode" is 250V or more positive with respect to earth, and the cathodes of the receiver valves are earthy. Therefore, if we were to feed all the valves from one winding, there would exist between the

cathodes and the heaters of the valves a potential of some 250V. With only a few exceptions, the heater to cathode insulation will not stand more than 100V.

Conclusions

The reader may be tempted to ask why the TRF is not in more general use today. There is no single reason, but a combination of factors.

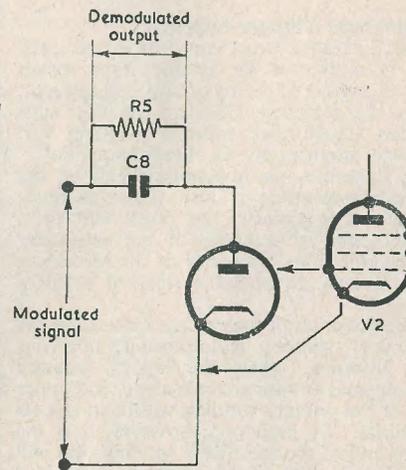


FIG. 3. THE DETECTOR

RC349

The difficulty of obtaining a high sensitivity is an important one. It might seem that the solution would be to add stages of AF amplification between the detector stage and the output stage. This fails inasmuch as the detector operates more efficiently and produces less distortion if it is fed with a reasonably large signal amplitude. The obvious answer to this would appear to be to add more RF stages. Once again, however, a difficulty arises, which is the keeping of two or more RF stages stable and accurately in line over the whole tuning range. In addition, variable tuned circuits suffer from variation in selectivity over the band.

Admittedly, the greater the number of RF stages, the more selective does the receiver become, but this apparent advantage is offset by the fact that the better the selectivity and alignment of each stage, the greater the difficulty of retaining stability becomes. By stability, we mean freedom from

[continued on page 161]

Valves and their Power Supplies

PART 12

By F. L. BAYLISS A.M.I.E.T.

Synchronous Vibrator Supplies

THE SYNCHRONOUS VIBRATOR power pack is similar to the rectifier type except in respect of the rectifying arrangement.

As the armature vibrates, the two ends of the transformer primary winding will become alternatively at chassis potential.

If, therefore, the appropriate end of the secondary winding is also instantaneously connected to chassis, the result will be a steady positive potential at the secondary centre-tap, whilst each end of the secondary will, in turn, become the relevant negative end.

The direction of the voltage induced in the secondary winding is important, however. For instance, when the upper primary contact makes with the armature, the upper end of the primary winding will be at chassis potential. By induction, however, it is the lower end of the secondary winding that will exhibit the same chassis potential, and it is the lower end of the secondary which must therefore make contact with the armature at the same time.

This is perhaps made clear by reference to Fig. 37, where the secondary end connections have been shown crossing over to their relevant vibrator contacts.

The voltage step-up across the transformer is similar to that for the rectifier type power pack described in this series, however, and the smoothing and filter circuits remain the same.

The transformer primary arc-quench components are also of similar value to those shown in Fig. 36, i.e. R_1 , R_2 and C_3 , but the secondary peak absorption capacitor C_4 is replaced by two capacitors, C_8 and C_9 , one across each secondary vibrator contact.

C_8 and C_9 should have a value of from $0.005\mu\text{F}$ to $0.01\mu\text{F}$, and must have a working voltage rating of 2,000 volts minimum.

A 2.0 Volt Half-Wave Circuit

The idea of supplying the HT power of a two-volt battery receiver from the receiver accumulator is not new or novel, but, possibly because large capacity accumulators are expensive, is seldom put into practice.

By using a vibrator power pack it is possible to dispense with the HT battery,

however, and, providing the accumulator is well cared for, to effect a considerable saving in so doing.

Neither of the two circuits so far discussed is entirely suitable, however, the rectifier type mainly because of difficulty in obtaining a suitable transformer, and the synchronous type because it is impossible to arrange the circuit satisfactorily to give automatic bias.

In any case, 2.0 volt vibrator transformers are not normally available: a 6.0 volt component may be used, however, but the secondary voltage available to supply the two rectifier anodes would be only one third of the usual 250-250 volts. The rectified and smoothed HT+ supply would be 80 volts or less and reproduction would suffer accordingly.

All in all, a half-wave circuit of the type shown in Fig. 39 is much more suitable. A 6.0 volt transformer is used, and the primary connections and arc-quench arrangements are as normal practice.

The secondary centre-tap is ignored, however, and the two halves of the secondary winding are used in series as a half-wave winding, to give approximately one third of the normal 500V, i.e. 160 volts.

An absorption capacitor C_3 , and protective resistor R_3 are connected across the secondary, whilst one end of this winding is connected to a half-wave metal rectifier. The HT voltage is finally smoothed by a 20 Henrys choke, C_4 and C_5 .

With large value smoothing capacitors, very nearly the peak ripple voltage of 160×1.4 , some 220 volts, will be available at the HT+ terminal, and it will be necessary to insert a 2 Watt voltage dropping resistor of between $3.3\text{k}\Omega$ and $5.6\text{k}\Omega$ at point "X," Fig. 39, to drop the excess 70 or 80 volts.

At the other end of the transformer secondary, the insertion of resistor R_4 between the secondary and chassis provides the necessary bias voltage for the receiver, smoothed by C_2 , and, if the receiver normally functioned with a grid bias battery, the battery may be dispensed with by plugging in the HT- plug at the point shown.

If automatic bias is already arranged for in the receiver itself, however, R_4 should be omitted from the vibrator pack; it, or a

resistor like it, will already be wired inside the receiver.

LT Filtering

With so low an operating LT voltage, it is not advisable to insert an LT filter choke in the LT lead to the vibrator coil, and transformer primary centre tap.

The vibrator current will be some 1.5A; the total receiver filament current possibly not greater than 0.5A.

The first requirement, however, is a two volt accumulator with a capacity of not less than 60 AH.

If this previously lasted one month, supplying LT current to the valves only, it will now, with the vibrator pack, require charging every week.

At 1/- per charge, the cost for three months will be 13/- compared to the previous 3/-.

An HT battery costs 19/-, however, and

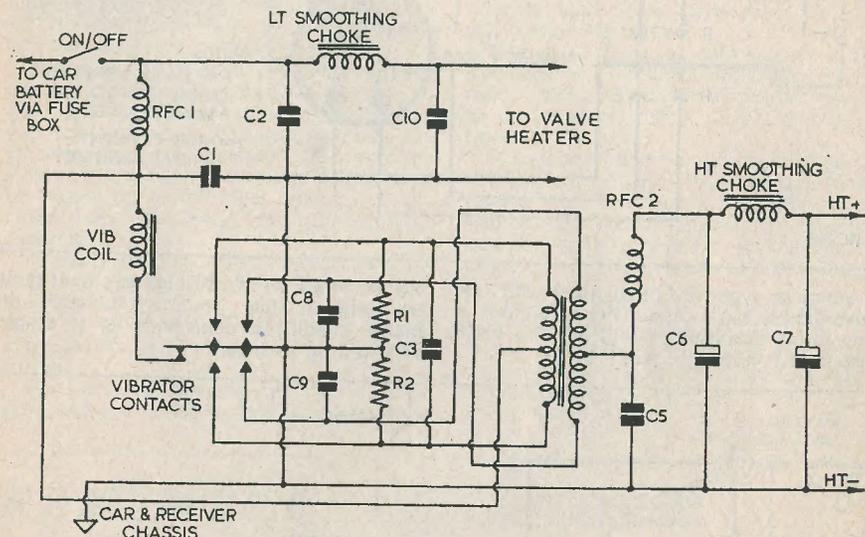


FIG. 37
SYNCHRONOUS TYPE VIBRATOR POWER
PACK

RC 317

Any iron cored LT choke used, therefore, would seem better inserted in the LT + lead to the valve filaments, and, for convenience, mounted in the receiver itself.

Even so, not more than 0.3 volts should fall across such a choke, so that the winding, in 20 swg enamelled wire, should have a resistance of not more than 0.6Ω .

As with the LT choke previously described, this winding—27 yards of 20 swg—may also be wound upon the core of a standard type output transformer. Two $0.1\mu\text{F}$ capacitors may be connected, one from either end of the choke, to the receiver chassis.

The Economics

The isolated country battery set user may well ask, "Is such a conversion an economic proposition?"

The answer is, that it can be.

used at the same rate will not last longer than three months—as a rule.

There would thus be a clear saving of 9/- per quarter, which would allow the purchase of a new accumulator every two years—and still show a pound or so to spare.

It is an economic proposition, but—an accumulator, and a thin plate (multi-plate) type, remember, of not less than 60 AH rating.

Consider, too, that the HT voltage of a vibrator pack doesn't dwindle away to nothing, and a miserable squeak from the loudspeaker.

Types of Vibrator

There are many British makes of vibrator, Messrs. Mallyory, Oak Bulgin and Wearite all marketing very efficient and reasonably priced models.

British rectifier types are usually fitted with standard British 4-pin or 5-pin type bases, and plug into a valveholder. British synchronous types are usually fitted with B7 valve type bases.

Normally, it is unwise to attempt to remove the can. The vibrator is delicately adjusted, and mounted upon very soft sponge rubber; it should not, therefore, be disturbed. If in doubt about the connections of

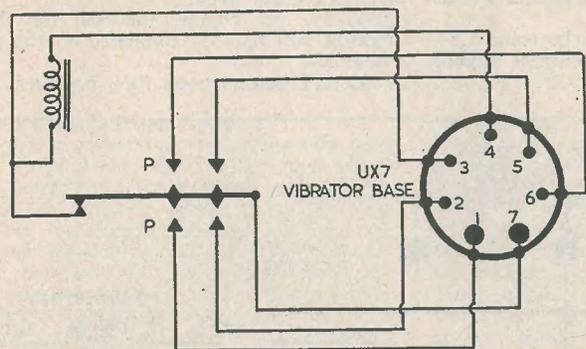


FIG. 38
AMERICAN SYNCHRONOUS
VIBRATOR CONNECTIONS

NOTES
PIN No. 3 IS SOMETIMES
CONNECTED TO THE
VIBRATOR CASE
P=HIGH CURRENT
PRIMARY CONTACT

RC 318

American types are often fitted with UX valve bases, but occasionally one finds a plug fitting arrangement that is not a valve base, and is non-standard.

British types, or if, through a circuit-fault, the vibrator has become damaged, the maker should be consulted; he is always very willing to help.

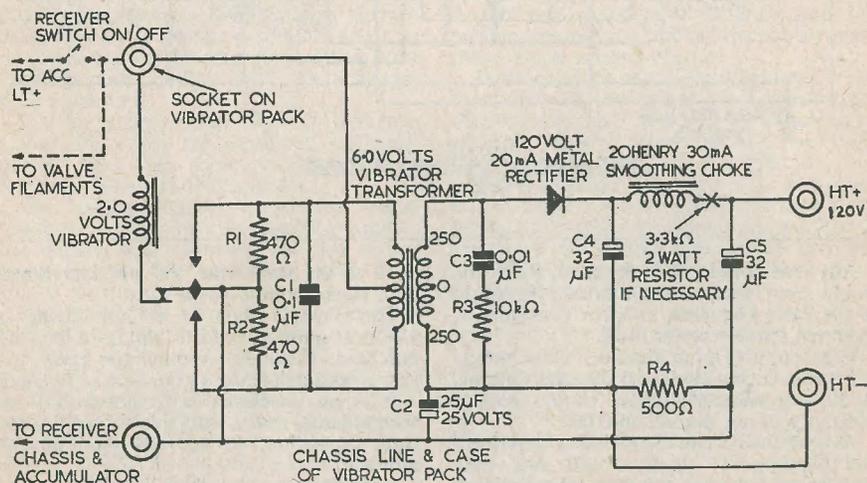


FIG. 39

All vibrators are usually encased in a screening can or box, and, except when one or more of the vibrator contacts or connections are connected to the case, this screen should be connected to chassis.

If, however, an American type has been purchased as WD surplus, a certain amount of experiment will have to be carried out; American manufacturers are most inaccessible, unfortunately.

The writer recently bought a 2.0 volt type, by Electronic Laboratories of Indianapolis, U.S.A.

Indiana is a long way away; the screw-driver, however, only a yard. The vibrator was opened.

Slowly, but surely, the upper screening can was prised away from the base, and eventually removed—to reveal one of the neatest and finely finished pieces of mechanism that one could wish to see.

It was a synchronous type, fitted with a UX7 base; it was but the work of a few minutes, then, to trace the contacts and coil connections to their relevant base pins. The connections are shown in Fig. 38.

It is not necessary to remove the can if one can discover the two coil pins (3 and 4, Fig. 38). By sticking the leads from a two volt accumulator on to these two pins, the vibrator may be operated momentarily. A battery in series with a voltmeter may then be tapped on to the other contacts to discover pairs that make, with the vibrator operated.

Vibrator contacts which should be connected to the transformer primary are distinguishable by being silvery. They are made of a hard nickel-chrome or similar alloy and are suited to carry the high primary current.

The secondary contacts are a much duller grey, and are usually a tungsten-steel alloy.

The primary contacts are marked "P" in Fig. 38.

Finally, perhaps it is worth noting that a synchronous type vibrator may be used in a rectifier circuit, but a rectifier type, owing to insufficient contacts, may not be used in a synchronous one.

Unit Screening

The vibrator pack, complete with its transformer, chokes, filters etc., should always form a completely screened unit, whether used for a car receiver or as an HT battery eliminator.

The usual form of enclosure is a steel screening box, although aluminium may be used. The box should be efficiently connected to the receiver chassis, and if possible to earth.

A final and important point; in order that the receiver switch of the converted battery receiver may switch on the vibrator pack as well as the valve filaments, it is perhaps best to connect the LT+ socket, Fig. 39, direct to the filament side of the switch, as shown.

Similarly, the LT- socket should be connected to the receiver chassis.

This arrangement will leave the original accumulator leads unaltered, and no further connections need then be made to the accumulator.

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THE FIFTH OF NOVEMBER!

Thoughts about the Radio Show 1953

By A. S. TORRENCE, A.M.I.P.R.E., A.M.T.S.

REGULAR READERS OF *The Radio Constructor* must surely be familiar with the annual grouse made by your writer that the Radio Show has forgotten the amateur.

At long last there comes an exhibition with a definite trend towards that end, or—hopefully—beginning. It is true, of course, that the component section is still absent and still diverted to the private exhibition held annually at a London hotel. Why this is not extended and opened to the public is a mystery.

Exactly what size or sort of business does a manufacturer require before he will display his wares?

A recent trip around the retailers has shown that the amateur is, in general, a regular customer, and usually follows his hobby through-

out the years. This clearly destroys the manufacturers' policy that all must bow to the set-maker. The average citizen may purchase a new domestic receiver once every ten years, but the home constructor goes on week after week.

Nevertheless, a distinct awareness of this situation is showing itself, and was evident at the Radio Show, both in the exhibits intended for the amateur, and the willingness shown by manufacturers to co-operate in design. *The Radio Constructor* is itself indebted to many firms for their co-operation and assistance towards the creation of a great many designs which have appeared, and for those intended for future publication.

The reader may not fully realise the enormous technical preparation required to produce such



Mr. Taylorson of G.E.C. explains the Orpheus to, visiting at Earls Court, Miss Claire Romaine and Miss Bella Burge, of stage renown, and Felix King the famous pianist and band leader.
(G.E.C. Stand D9)

receivers as the *Magna-View*, the *Universal*, the *Coronet*, the *Orpheus* Tape-Recorder and so on. This technical co-operation has truly made it possible for us to say our designs may be built with confidence.

Let us recap on Earls Court and recall the items of interest to our hobby.

Here was to be seen on the wall, in huge photographic form, the *Universal* televisor, and on the counter the actual receiver itself. Several thousands of the free booklet describing this set were handed out, the interest being quite amazing.

Further proof of this firm's intentions towards



A technical character (no prize for correct guesses!) discusses the Universal televisor with Felix King, Miss Bella Burge, Miss Marie Rose, Miss Claire Romaine and, on the right, Mr. M. Bourne of Mullard Publicity. (Note.—Miss Romaine is comparing details with the Mullard Universal booklet. Another constructor joins the ranks?)

(Mullard Main Stand)

Mullard, Ltd.

This firm has definitely re-discovered the home constructor, and it is with the greatest of pleasure that this is noted. Many among you will recall those early receivers that were built with so much pride and joy. Do you remember the bright emitters? How they burned the "midnight oil" in more senses than one!

Take a glance at the photograph of the Mullard stand, and take heart that this was a section of this manufacturer's main stand. At all hours a technician was present to dispense literature on the many designs utilising their valves, and to give advice on various subjects.

the amateur was the display of equipment, amplifiers, tuners, etc., from contemporary publishers.

The General Electric Co. Ltd.

As announced last month, on stand D9 was to be seen the *Orpheus* Tape-Recorder. A crowd was always present, recording their voices, and thoroughly enjoying the fun of hearing themselves, many for the first time. The constructors of the future caused the most amusement, and one little fellow, by name Charles Norman Jnr., entertained us with two delightful nursery rhymes.

Quite obviously, the tape-recorder will be almost as common a thing in the home, ere long, as the teapot!



Mrs. Allday, the popular assistant Secretary of The Television Society, discusses Mr. Corfield's converter with a group of keen types. (Television Society, Stand 220).

The acoustics student was invited throughout many demonstrations to hear a most advanced sound presentation. Three metal-coned speakers fed from a high-class amplifier and a mixer pre-amplifier arrangement clearly showed what can be done to recordings with the right basic equipment. Readers interested in this field of electronics should find the book—*Art and Science in Sound Reproduction*, by F. H. Brittain, D.F.H., a delightful treatment of this subject. It was on this stand (G.E.C.) that your representative had the great pleasure of meeting Mr. Newell and his party. These were the boys who make the glass part of our cathode ray tubes. Perhaps Mr. Newell will tell us something of this intriguing process one day.

Goodmans Industries Ltd.

A most impressive array of beautifully housed speakers was to be seen here, and heard, but the outstanding thing was the new microphone. A moving coil type, but as sensitive as a crystal, yet quite devoid of that annoying ringing so often inherent in the latter species. Quite an achievement.

The English Electric Co.

A thoughtful innovation by the makers of the T901 will surely please those who installed this CRT into their *Magna-View* TV receivers, or indeed the owners of the commercial types made by the English Electric Co. By sending any electronically faulty tube made by this

company with appropriate requisition form to the nearest English Electric Television Service Depot, the authorised dealer can exchange the faulty CRT for a reconditioned tube at a cost of £12.

Brimar Valves (Standard Telephones and Cables)

Here were seen copies of the revised Brimar version of that deservedly popular televisor, the *Magna-View*, containing many modifications and new valve types not previously seen in this circuit, which have been incorporated to give still further improved performance.

Newcomers embarking on the construction of this receiver should find the task much simplified by the many new illustrations to be found in this, the third, edition of the Brimar booklet.

The Television Society

Here was revealed a few items of their forthcoming TV transmitter and also the converter (427 Mc/s to 45 Mc/s). This was designed by Mr. Corfield and we are grateful to the Society and the designer for permission to fully describe this instrument in future issues of *The Radio Constructor*. It is hoped that many amateurs will build this converter. Reports on reception are sure to be most welcome by the Television Society and, as a rough guide, good reception is expected within a radius of seventy miles.

Of the Main Stands.

There can be no doubt that at these exhibitions the public are looking for the wonders of science. Wherever there was a gadget or working model, a crowd was sure to collect.

One would imagine from this that the exhibitor would see a moral. Apparently not! To those stands devoted to "tinsel" and "mirrors" most people merely gave a casual look, and passed on their way. Any demonstration with action created a crowd. The Pye closed-circuit TV on which the public could get a glimpse of themselves always looked vaguely like a Cup-Tie. One manufacturer asked your writer's opinion on flywheel sync, black clamp level, automatic picture control etc. (These selling angles are featured by many as the reasons why this or that TV was the best at Earls Court). The answer to this was very simple—"Ten years too late." The country is almost covered now with TV transmissions and the public should be seeing receivers, both simple and complicated, for those areas still called fringe. As each area is suitably served by transmissions, so accordingly, those with the smaller pay packets may enjoy TV.

The responsibility in the technical sense is clearly on the B.B.C. the government and the B.E.A. if that manufacturer is to be answered properly. The B.B.C., must discard their "noisy" old cameras and equipment which often produce more "snow" than sync pulse. The powers-that-be must press on with nationwide coverage.

Finally, if the B.E.A. produce a national standard of 230 volts AC, stabilised at 50 c/s, almost any sync circuit will provide a high degree of interlace. TV, then, and the many Tape-Recorders were the main theme at the National Radio Show.

One last reflection—The Bars at Earls Court are open all day. "Light" relief from tedium?



A group of technicians, mainly from G.E.C. headquarters, amuse Mr. A. Allwright of Denco (Clacton) Ltd. (G.E.C. Stand D9)

ERRATA

"An Inexpensive Three Valve Receiver," page 82, Show Number. Component List—R6 should read 470kΩ ½ watt, R7 500kΩ pot. with switch, R8 270 ohm 1 watt.

Denco (Clacton) Ltd., advertisement on page 64 of Show Number should read—Ready drilled chassis complete with all mechanical parts suitable for the "Universal" Televisor.....Price 53/6.

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350-0-350 120 mA., 6.3 v. 3 a. tap 4 v., 5 v. 2 a. tap 4 v. 25/-.
350-0-350 70 mA. 4 v. 5 a. 4 v. 2.5 a., C.T., 18/6. P. & P. on the above transformers 2/-.
500-0-500 125 mA., 6.3 v. C.T. 2 a. 6.3 v. C.T. 2 a. 5 v. C.T. 2 a., 27/6.
500-0-500 120 mA., 4 v. C.T. 4 a. 4 v. C.T. 4 a. 4 v. C.T. 2.5 a., 27/6.
500-0-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., 39/6.
500-0-500 250 mA. 6.3 v. C.T. 4 a. 6.3 v. C.T. 3 a. 5 v. C.T. 3 a., 39/6. P. & P. on the above transformers 3/-.
32 mfd., 350 wkg. ... 2/-
16x24 350 wkg. ... 4/-
4 mfd., 200 wkg. ... 1/3
40 mfd., 450 wkg. ... 3/6
16x8 mfd., 500 wkg. ... 4/6
16x16 mfd., 500 wkg. ... 5/9
8x16 mfd., 450 wkg. ... 3/9
32x32 mfd., 350 wkg. ... 4/-
32x32 mfd., 350 wkg. and 25 mfd., 25 wkg. ... 6/6
25 mfd., 25 wkg. ... 11d.

250 mfd., 12 v. wkg. ... 1/-
16 mfd., 500 wkg., wire ends 3/3
8 mfd., 500 v. wkg. wire ends 2/6
8 mfd., 350 v. wkg., tag ends 1/6
50 mfd., 25 v. wkg. wire ends 1/9
100 mfd. 350 wkg. ... 4/-
100+200 mfd., 350 wkg. ... 9/6
16+16 mfd. 350 wkg. ... 3/3
Ex-Govt. 8 mfd. 500 v. wkg., size 3½x1½, 2 for ... 2/6
60+100 mfd., 280 v. wkg. 7/-
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65 mfd., 220 wkg. ... 1/6
8 mfd., 150 wkg. ... 1/6
60+100 mfd., 280 wkg. ... 8/6
50 mfd., 12 wkg. ... 11d.
32+32 mfd., min., 275 wkg. 4/-
50 mfd., 50 wkg. 8 mfd. wkg., wire ends ... 1/9
Miniature wire ends moulded 100 pf., 500 pf., and .001 ea. 7d.
CONSTRUCTOR'S PARCEL comprising chassis 12½x8x2in., cad. plated 18 gauge, v/h., IF and trans. cut-outs, back-plate, 2 supporting brackets, 3 waveband scale, new wavelength station names. Size of scale 11½x4½in., drive spindle, drum, 2 pulleys, pointer, 2 bulb holders, 5 paxolin international octal valve holders, 4 knobs and pair of 465 IF's, 16/6. P. & P. 1/9.
AS ABOVE, but complete with 16+16 mfd. 350 wkg. and semi-shrouded drop thro' 250-0-250 60 m/a. 6 v. 3 amp. Pri. 200-250, 60 m/a. 6 v. 3 amp. P. & P. 3/-, and twin-gang, 31/6. P. & P. 3/-.
EX-GOVT. RECEIVER TYPE B28. Complete coil unit, 6 bands, 60 kc/s., 420 kc/s. 500 kc/s-30 Mc/s., 21/-, Plus 2/- P. & P. Circuit for above, 4/-.
Variable Selectivity IF Switch to suit above, 7/6. 465 Kc. I.F.'s to suit above, type 3, 4 and 5, 5/- ea. IFT2 incorporating 465 Kc/s Xtal, 19/6. BFO, 7/6 Special 4-gang, to suit, 15/- R. & A. 8in. M.E. Speaker field coil, 1,600 ohms O.P. trans. 5,000 ohms, imp. 18/6. P. & P. 2/-.
5in. M.E. field coil 750 ohms with O.P. trans., 17/6. P. & P. 1/-.
Constructor's Parcel, comprising chassis 8"x4"x1½" with speaker and valveholder cut-outs, 5in. P.M. speaker with transformer, twin gang with trimmers, pair T.R.F. coils long and medium, iron cored, four valveholders, 20 K. volume control and wave-change switch, 23/-, P. & P. 1/6.
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16 mfd. 500 v.w.	3/3	60+100 mfd. 350 v.w.	7/6
32 mfd. 500 v.w.	5/11		
50 mfd. 350 v.w.	4/6		BIAS
60 mfd. 350 v.w.	3/6	25 mfd. 25 v.w.	1/6
250 mfd. 350 v.w.	4/11	50 mfd. 12 v.w.	1/3
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Manufacturer
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FOR SALE. The Practical Wireless Car Radio, 12v., with power pack, and The Practical Wireless TV complete, the two sets need lining up. £12 the lot. J. Collins, 87 Keetonwood Road, Downham, Bromley, Kent.

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INEXPENSIVE TELEVISION. Holme Moss on indoor dipole. Selling for price of components. Send for details. Harris, 95 Borough Road, Wallasey.

EDDYSTONE 640. Built in speaker and "S" meter, 6AK5 RF stage, Voltage Stab, £18. R1155, built in power pack and output stage, £6. I. Black, 148 Craven Road, Newbury, Berks.

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[Continued on page 179]

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INDICATOR UNIT TYPE I82A. This unit contains VCR517 Cathode Ray 6" Tube, complete with Mu-Metal Screen, 3 EF50, 4 SP61 and 1 5U4G valves, 9 wire-wound volume controls and quantity of Resistors and Condensers. Suitable either for basis of Television (full picture guaranteed) or Oscilloscope. Offered BRAND NEW (less relay) in original packing case at 79/6. Plus 7/6 carriage.

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This Tube replaces the VCR97 and VCR517 without alteration and gives a full Blue and White picture. BRAND NEW in original crates, 35/- .

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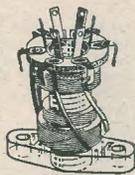
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IS4	7/9	6J5g	4/6	6SN7	8/6	12AT7	7/6
3S4	7/9	6K7g	4/6	6SQ7	7/6	12AX7	5/9
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R. COOPER

32 SOUTH END CROYDON SURREY
Telephone CROYdon 9186

SMALL ADVERTISEMENTS

continued from page 177

TESTED VALVES. EF92, 185BT, 7BA6, 807, ECC91, X78, 6/- each. SAE for list. Blackwell, 25 Barons Way, Thorpe Lea, Egham, Surrey.

740 SERVICE SHEETS, mostly "Trader", Nos.: 49-1074 at 8/- per dozen or would consider offer for lot. Taylor Signal Generator 65A at £8/10/-, Moulard, "Harnham," Lower Buckland, Lymington, Hants.

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WANTED. The Radio Constructor, Volumes 1 and 2, or Vol.1, Nos. 4, 5, 7, 8, 11. Vol. 2, Nos. 1 and 8. Good prices paid. S/Ldr. J. Pinder, RAF Station, El Hamra, M.E.A.F.15.

WANTED. Teletype machine preferably in working order for experiments.—Seymour, Hackmans Gate, Worcester. Tel.: Blakedown 101.

WANTED. Ham requires Wilkins and Wright M/C Pick-up with transformer in good order at reasonable price. D. Carter, 14 Fletton Grove, Kingsheath, Birmingham, 14.

FOR SALE. BC348R receiver, Xtal model, AC mains power pack, Eddystone speaker, £22. Forty copies *Electronic Engineering* 1949/1952, what offers? Pinnegar, GPO, Towcester, Northants.

FOR SALE. 0-500 mA round meters 2" diam, 10/6. 0-1 mA round 2 1/4", Weston m/c. 12/6. 25-0-25 mA lab. type meter with X4 and X10 shunts, 10/6. Morse keys—straight 7/6, miniature 3/-, Mains dropping resistors 30 w 2/6. Denco 1.6 BFO coil 7/6. Class B Varley input transf. 10/6. 1166 unit transformers Type T-2446-31 2/6. Small interstage transformers 2/6. Ferranti output transf. 3/6. Ditto A.F. 3 3/6. Headset adapters MC-385A high to low impedance 5/-. Transformers Type g55-008 3/-, 12 volt metal rectifier 5/-. Txing variable capacitors, 100 pF 30/-; 30 pF 7/6. Smoothing power pack capacitors, 4 μF 1000V DC 5/-; 2 μF 1000V DC 3/-; 2 μF 600V DC 2/6; 1 μF 250V DC 2/6. 0.1 μF 250V DC 2/-; .001 μF 5000V DC 2/6. Vitreous tubular w.w. resistors, contact ends, 14,000 ohms 30W. 3/6; 75,000Ω 30W. 3/6. 4 and 6 pin 1 1/2" diam. coil formers, ribbed, used, 9d. Miniature split stator variables, porcelain ends, 0-100 pF 3/6. Miniature variables porcelain ends 0-30 pF 2/6. Base for 813 7/6. Porcelain formers suitable p.a. tank coils, ribbed, 2" diam. x 6" long, 8 position push button switches 5/-. Txing chokes, suitable 3.5-1.8 Mcs. 2/6. Selector drive unit 3/6. "East Keal," Romany Road, Oulton Broad, Suffolk.

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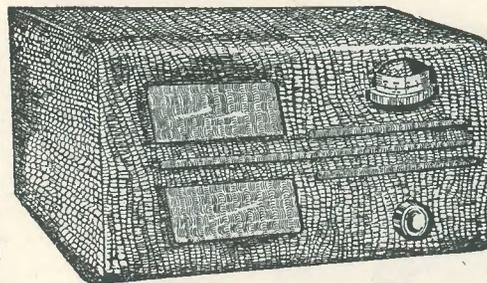
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