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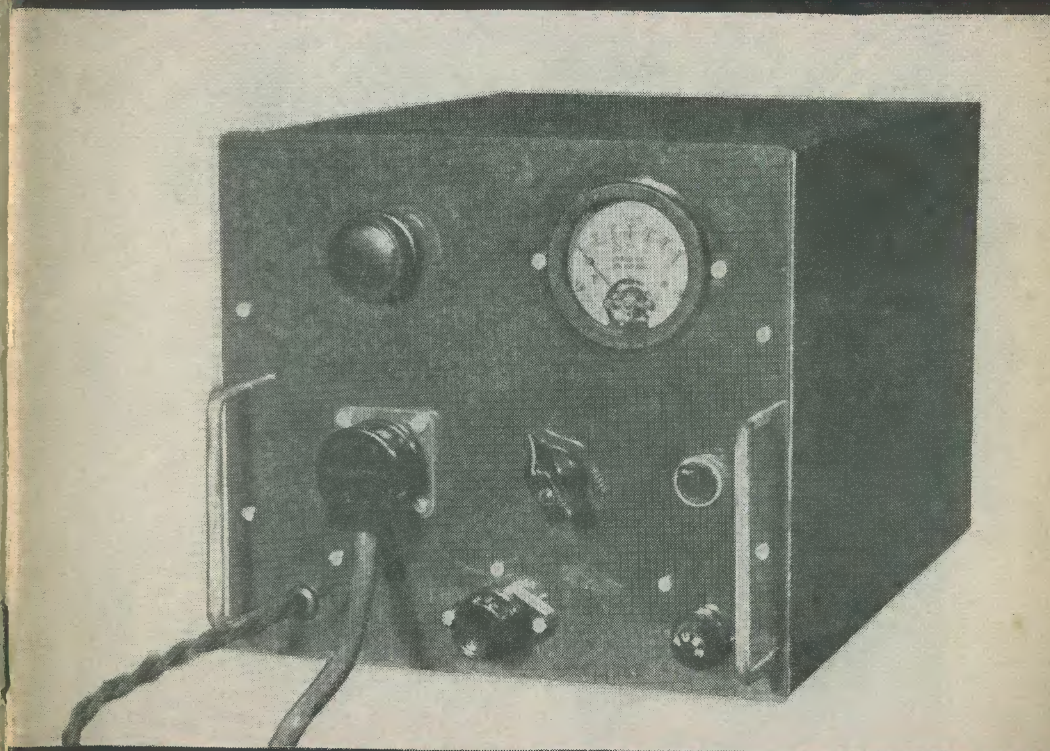
The RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



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STABILISED POWER UNIT · 5-CHANNEL SOUND/VISION STRIP · AC/DC/BATTERY "ECONOMY" PORTABLE FOUR · DISC RECORDING AMPLIFIER · Electronic Timer · Noise Limiter · In Your Workshop · Mailbag · Query Corner

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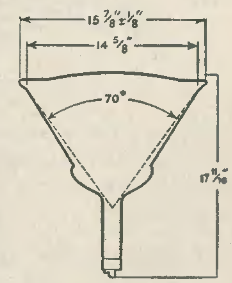

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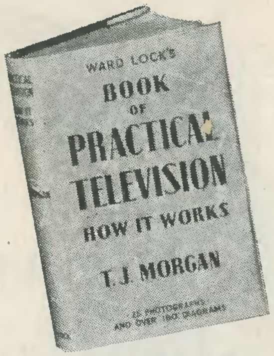

by T. J. MORGAN, A.M.I.E.E.

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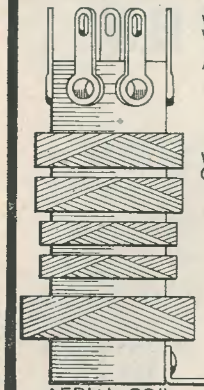

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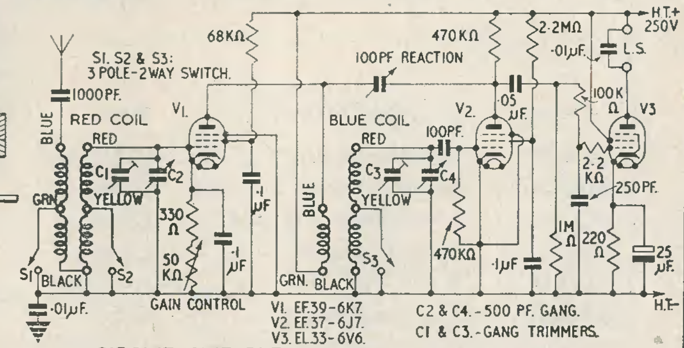

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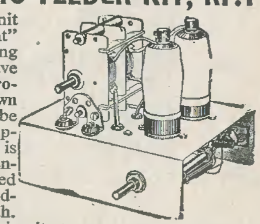

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The
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Vol. 5, No. 12. Annual Subscription 18/- August, 1952.

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Edited by C. W. C. OVERLAND, G2ATV

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NOTICES

THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but relevant information should be included. All Mss must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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

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

Suggested Circuits *for the* Experimenter

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

No. 20: AN ELECTRONIC TIMER

This month's Suggested Circuit is that of an electronic timer capable of offering a continuously variable range from 0.5 to 100 seconds. Should it be so desired, this range may be increased. It may also, on the other hand, be reduced, with consequent simplification and cheaper cost. The lower (shorter) end of the scale is limited, however, by the capabilities of the switching relay. Operation is simple, semi-automatic, and practically foolproof. In some instances, the values recommended here for several components may have to be slightly altered in practice in order to meet differing cases.

Operation

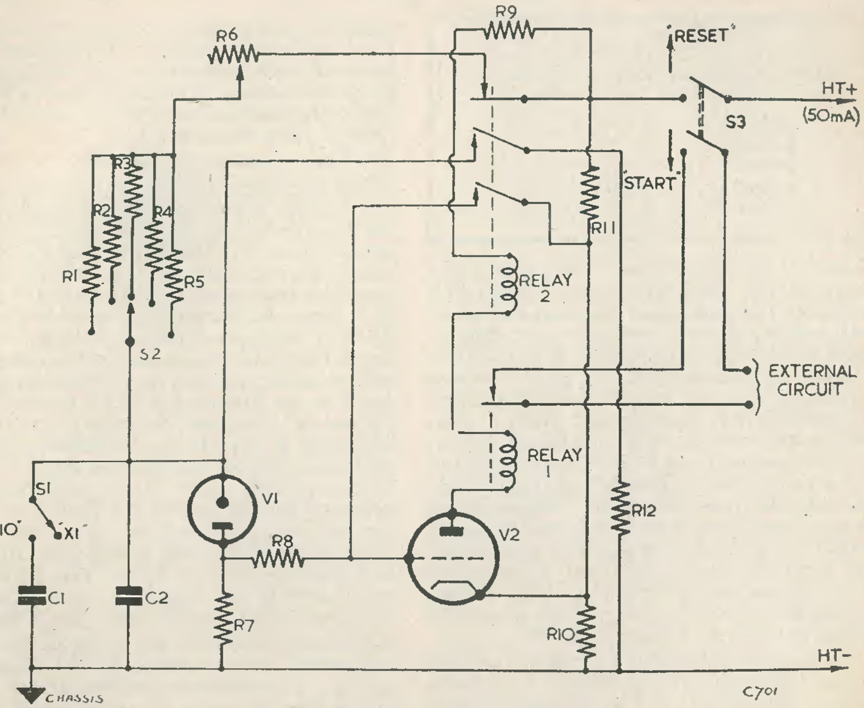
Before the timer can be brought into operation it must be set up. This necessitates, first of all, the provision of LT and HT supplies from a separate power supply circuit (not shown in the diagram), these being applied for sufficiently long to enable V2 to warm up. The "Reset-Start" switch, S3, should be put to "Reset," and the external circuit being timed connected to the appropriate terminals. Finally, the range controls, S1, S2 and R6, are set to the timing period required.

When the circuit is in this state, S3 prevents the application of HT to the timer. At the same time it also keeps the "External Circuit" terminals open.

To start the timing operation, S3 is thrown to the "Start" position, whereupon its lower contact closes the external circuit. Its upper contact simultaneously allows HT to be passed to the RC network (R1 to R6 and C1, C2), with the result that the capacitance component of this network commences to charge. HT is also applied to the anode of V2 (via R9 and the coils of Relays 1 and 2). V2, however, has its grid taken to chassis via R8 and R7 whilst its cathode is connected to a positive point in the voltage divider R11, R12. The bias resulting from this arrangement prevents the valve from drawing sufficient anode current to energise either of the relays.

As mentioned above, the capacitance component of the RC network has commenced to charge. Its rate of charge is controlled by the resistor network, R1 to R6. When the voltage across the capacitance component reaches the striking value of V1 this latter conducts and correspondingly draws current. This current passes through R7, causing a voltage to be built up across it. The upper end of R7 assumes therefore a positive potential (relative to chassis), this potential being applied to the grid of V2 via R8. The anode current of V2 immediately increases, energising Relays 1 and 2. Relay 1, being a high-speed component, operates at once, its break contact opening the "External Circuit" terminals. Relay 2 energises as quickly as its design allows; and its lower contact connects the grid of V2 to its cathode, thus ensuring that this valve still continues to keep the relays energised irrespective of whatever voltage may subsequently appear across R7. The upper contact of Relay 2 breaks the HT supply to the RC network; whilst its centre contact effectively short-circuits the capacitance component through the 1 kΩ resistor, R12, causing it to discharge.

The timing cycle is now almost complete. The circuit has reached a stable condition, the two relays remaining energised by the anode current of V2, whilst the capacitance component has become discharged. To bring the timing circuit back to its original state, S3 is thrown to the "Reset" position. This breaks the HT supply to V2 and the relays de-energise. The "External Circuit" terminals still remain open, of course, by virtue of the lower contact of S3.



AN ELECTRONIC TIMER

COMPONENT VALUES

Capacitors		R10	200Ω, ½ watt
C1	18 μF	R11	7,500Ω, 10 watts
C2	2 μF	R12	1 kΩ, 5 watts
Resistors		**Valves**	
R1	250 kΩ, ½ watt	V1	Neon bulb (see text)
R2	1 MegΩ, ½ watt	V2	Triode: 6J5, etc., etc.
R3	2 MΩ, ½ watt	**Relays**	
R4	3 MΩ, ½ watt	Relay 1	High-Speed (1 Break contact)
R5	4 MΩ, ½ watt	Relay 2	Normal (1 Break, 2 Make contacts)
R6	1 MΩ, variable	**Switches**	
R7	1 MΩ, ½ watt	S1	Scale Multiplier
R8	1 MΩ, ½ watt	S2	Range Selector
R9	25 kΩ, 2 watts	S3	"Start-Reset" Switch, Tumbler.

To commence a further timing cycle, it is necessary merely to set S3 to "Start" again.

Circuit Details

It will have been noticed that the brief details of operation given above do not account completely for the values chosen for, or even for the presence of, some of the circuit components. This point will now be dealt with.

The first item of importance lies in the fact that two relays are used where one might presumably be sufficient by itself. This

RANGE TABLE

(These ranges are selected by S2 with S1 set to the " X 1 " position)

Range 1	..	0.5 to 2.5 secs.
Range 2	..	2 to 4 secs.
Range 3	..	4 to 6 secs.
Range 4	..	6 to 8 secs.
Range 5	..	8 to 10 secs.

procedure has been adopted because, for timing short periods, a high-speed relay is essential for switching the external circuit; and high-speed relays rarely possess anything more complicated than simple changeover contacts. Relay 2 is used for a different purpose, that of ensuring automatic working, and its speed of operation is comparatively unimportant. When short periods are not required from the timer, Relay 1 could conceivably be omitted, an additional break contact being fitted to Relay 2 to control the external circuit switching. When used as shown here, Relay 1 could perhaps consist of one of the sensitive model-control relays which are now being advertised at fairly cheap prices. Relay 2 may be a normal relay (with a high-resistance coil) of the type which is capable of being actuated by anode currents.

As was mentioned above, a standing cathode bias is applied to V2 by R10 and R11. Assuming a 250-volt HT supply, this arrangement would give a bias voltage of slightly more than 6 volts. When the neon bulb strikes, the resulting voltage built up across R7 will almost certainly be in excess of 6 volts. Excessive grid current is, however, prevented by R8. The presence of this resistor also ensures correct operation of the neon bulb after striking.

It will be seen that, when the neon strikes, the bias applied to V2 changes from 6 to zero volts. The variation in anode current resulting from this change should be more than sufficient to ensure positive operation of the relays. Nevertheless, when zero bias is applied to V2, it is possible that the valve may pass excessive anode current, with harmful results. This current is kept within safe bounds, however, by reason of R9. The value recommended here for this resistor limits the possible anode current to 10 mA. If very sensitive relays are used, the value of R9 may be increased with a consequently larger valve life.

The neon bulb is an important component. Not all neons may strike reliably with a series resistor as high in value as 1 megΩ, and a little experimental selection may be needed. Neon stabiliser valves may cope, but it is suggested that best results may possibly be given by the sensitive neons used by electricians for checking for " live " mains points. (The high value of series resistor is needed to prevent the possibility of the capacitance component discharging to below the burning value of the neon before Relay 2 has energised).

The Time Constant Components

The range periods shown in the table accompanying this article have been worked out on the assumption that the neon strikes when the capacitance component has reached the voltage which corresponds to the mathematically accepted time constant of the RC circuit. In a series RC circuit this value is equal to 0.632 of the applied charging voltage. Working to this assumption makes calculations very simple, as the charging time in seconds is then equal to the capacitance in μF multiplied by the series resistance in MegΩ. A further advantage is given by the fact that a relatively reliable portion of the charging curve is used. When working under these conditions it is necessary for the applied HT to be 1.58 times the striking voltage of the neon (the latter being found empirically elsewhere). In practice, such a state of affairs can hardly be obtained with any accuracy, but it would be worth while to attempt a fair approximation.

The variable resistor, R6, is also an important component, and it should be well-made and robust. The maximum possible current which it will have to pass is an instantaneous one of approximately 1 mA, this occurring when the timer is set to 0.5 seconds. R6 is used to give a continuously variable control of timing and will need five separate scales, each calibrated in terms of the range selected by S2. Calibration may be obtained by measurements of resistance and capacitance, and calculation; or by stop-watch. The former method will, in any case, be necessary for the shorter time periods, whilst the latter may be used for checking results. R1 is included to limit the maximum current passed by R6. The resistors R1 to R5 may be high-tolerance, if desired; although low-tolerance components could be used just as well, discrepancies being taken up in the calibration of R6. If R6 has a value slightly in excess of 1 MegΩ, a small, but desirable, range overlap will be obtained.

The Capacitance Component

It is, of course, very important to ensure that both C1 and C2 have no leaks whatsoever. Paper components should be used. When long timing periods are not required the multiplying circuit may be omitted. This can be done by excluding S1 and C1 from the circuit.

A final important point lies in the discharging of the capacitance component through R12

after Relay 2 has de-energised in the timing cycle. Although this discharge will be quick it still follows an exponential law, and it would be advisable to allow several seconds to elapse after Relay 2 has de-energised before putting S3 to " Reset," since this procedure would then ensure that a really adequate discharge had taken place. A longer pause than this will occur automatically in most instances, as the timed material would usually have to be handled between timing cycles.

Power Supplies

The HT power supply circuit is not shown here as it can be fairly conventional. Its voltage stability must be high. Voltage regulation during the charging period will be assisted by the presence of R10 and R11, which take a relatively heavy current. When very accurate timing cycles are required, or when the mains supply voltage is obviously unreliable, the HT output should be stabilised.

BOOK REVIEW

PRACTICAL TELEVISION (How it Works), by T. J. Morgan, A.M.I.E.E. 288 pages, 22 photographs, over 180 diagrams. Published by Ward Lock and Co. Ltd., 6 Chancery Lane, London, W.C.2. Price 18s. 6d.

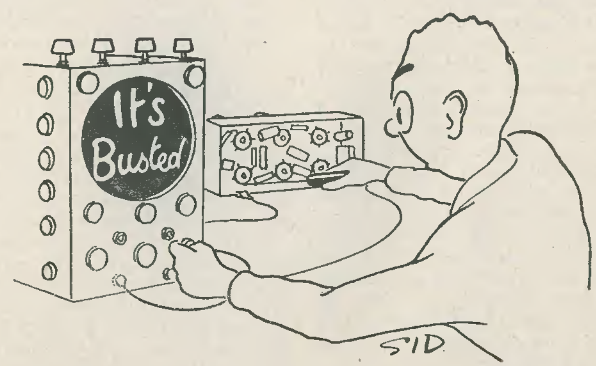
For those who are technically inclined, and even those who want to have some understanding of the things that happen to make their television set produce a picture, this book can be recommended. It is well produced; the type-face is pleasing in appearance and the diagrams are particularly clear and neat. It could form a primer for those who might wish to embark upon more serious study, and from this view-point alone is considered good value for money.

The author sets out to explain in an easily readable manner many aspects of television technique, and notably achieves this object without indulging in mathematical treatments. One could well imagine that almost any reader, knowing but little about electricity, could really enjoy reading this book for the interesting way in which it presents its subjects, and emerge with quite a reasonable appreciation of many principles that have been explored and perfected in television as we know it today.

The reader is guided through the conceptions of wave motion and basic electricity and magnetism to alternating currents, signalling without wires, and thermionic valves. The chapter on the transmission of still pictures with and without the aid of wires gives a good idea of how it is possible to reproduce a picture over a distance by means of electrical impulses, and paves the way to explaining in later chapters how the principle is applied to the transmission of moving pictures. Some of the early attempts at television are recalled in a chapter which describes the mechanical systems devised by various experimenters in the past; the chapter following is devoted to the operation of the cathode-ray tube. There is an interesting discussion on the television camera and the 405-line system of transmission used in this country; a further chapter describes studio and production technique.

Various types of aerial are described, and the television receiver itself is given four chapters which embrace T.R.F. and superhet R.F. amplification, detection, video amplification, DC restoration, sync, separation, deflection generators, noise limiters, the sound receiver and power supplies. There are also short chapters dealing with choosing and installing the television receiver, and an insight into colour transmission. The book concludes with a short but adequate glossary of technical terms and an index.

RUFUS—THE RADIO CONSTRUCTOR



THE SUPER "SCINTILLASCOPE"

IN YOUR WORKSHOP

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 experiences.

On looking back over the last few weeks, the writer finds that he has had quite a few "awkward" jobs to carry out. After completing the cable-cleating mentioned last month (which was, admittedly, self-inflicted), he next started work on the conversion of a surplus chassis. This conversion necessitated the changing over of many of the connections in the chassis, these connections being made with double-cotton-covered enamelled wire.

So far as chassis wiring is concerned, DCC enamelled wire has never been looked upon by the writer with much favour at all. This type of wire is, presumably, easy enough to handle in the factory, and it has the admitted advantage of taking up little room when laced up into a harness. On the average amateur's bench, however, it is definitely awkward to work with; and the process of stripping it takes up more time than most people care to spend.

The writer has his own method of stripping DCC enamelled wire. This consists primarily of cutting the wire cleanly, allowing an inch or so for the connection. The outer cotton covering is carefully unwound to the distance required and is then cut off, close to the wire, by a razor blade or sharp knife. The inside cotton covering is next unwrapped in the opposite direction and is also cut off close to the wire. The enamelled wire which is then laid bare may be scraped clean with a razor blade, or may be cleaned with a folded piece of sandpaper; the wire being held between forefinger and thumb of the left hand as near to the end of the insulation as is possible. Whichever method of cleaning is used, pressure should only be applied as the razor blade or sandpaper moves towards the end of the wire. If pressure is applied in the opposite direction, the cotton covering is liable to become untwisted. The bared wire should be tinned before it is fixed to the tag to which it will eventually be soldered.

The main difficulty with the wire lies in preventing the cotton covering from untwisting backwards away from the bared end whilst stripping takes place. Some DCC wires appear to be impregnated with paraffin wax. This holds the cotton covering in place fairly reliably, and simplifies handling considerably. After soldering, a good plan consists of applying shellac varnish to the end of the cotton covering, this serving to keep it in position.

Heat Dissipation

One of the major problems encountered by the constructors of miniature equipment lies in the necessity of ensuring adequate heat dissipation; particularly so when the equipment is to be housed in a cabinet. Nevertheless, provided that sufficient attention is paid to this question when the basic layout of the equipment is being drawn up, heat dissipation can usually be reduced to manageable proportions quite easily.

As our Science masters at school were so fond of drumming into us when they introduced the subject of vacuum flasks, heat can be transferred in three different ways; these being conduction, convection and radiation. Conduction has its uses when we are considering how to keep a radio chassis cool, but by far the most useful method of dissipating heat in this case is given by convection. Radiation raises its own problems.

The components in a radio chassis which usually dissipate the most heat are the HT rectifier (especially when this is a valve); the output valve or valves (or any other valve handling a relatively large amount of power); and, sometimes, mains transformers, speaker field coils and similar inductors. Two types of component most likely to be seriously affected by over-high temperatures are capacitors (especially electrolytic capacitors); and such things as speaker cones. Midget transformers and resistors, etc., which work, of their own accord, at fairly high temperatures, may have these temperatures increased alarmingly if they become heated as well by other components.

The usual solution to the heat dissipation

problem consists initially of placing the components which dissipate most heat above the chassis and, if possible, at the rear. Heat-dissipating components should not be placed below the chassis, as the hot air rising from them becomes effectively trapped by the chassis itself, causing unwanted temperature rises in the other under-chassis components. Under-chassis mounting of "hot" components is sometimes permissible if large holes are drilled in the chassis immediately above, and if a free access for air is allowed to the underside of the component. Heat-dissipating components should, of course, be kept away from speaker cones and similar items.

When the heat-dissipating components are kept above the chassis, it follows that the best place for those components which are most affected by heat is below. If possible, therefore, all capacitors and similar components should be mounted below the chassis.

Heat Screens

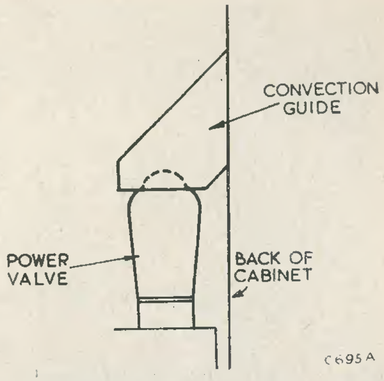
When the design or the components available for the miniature equipment do not permit of a simple above-and-below chassis layout of the type just mentioned, use can often be made of heat screens. These are usually quite effective, and are easy to fit. They work at their best above the chassis, where they may take greater advantage of convection.

A heat screen consists of a piece of sheet metal of large area, it being mounted between a heat-dissipating component and one liable to be affected by temperature rises.

The screen works in several ways. Firstly, it absorbs most of the heat radiated by the heat-dissipating component and conducts it over its own area, thus providing a greater surface for dissipation by convection. Secondly, it reflects some of the radiated heat back again. Thirdly, it prevents the hot air rising from the heat-dissipating component from reaching the protected component. When carefully positioned, heat screens can often be made to give electrostatic or inductive screening as well.

Heat screens may be used, in addition, to protect the inside walls of cabinets. Should a heat-dissipating component approach the inside of a cabinet too closely, the radiated heat can cause the material of the cabinet to warp or even to char. A flat heat screen screwed to the inside of the cabinet and slightly spaced away from it with distance washers usually gives very effective protection.

A further aid to keeping temperatures low consists of the convection guide. Convection guides are used infrequently only, and are met occasionally in commercial equipment. An example of such a guide is illustrated in



Showing how a convection guide may be fitted over a power valve to divert the hot air rising from it out through the back of the cabinet.

the accompanying diagram, it being fitted over a power-handling valve. The purpose of the guide in the diagram is to divert the hot air rising from the valve through the back of the cabinet. As the guide illustrated is fixed to the back of the cabinet, removing the back removes the guide also, thus leaving the valve free to be taken out or replaced. When convection guides are used they should be given generous cross-sectional dimensions, their slope from the vertical being kept small.

Readers interested in transmitting or SW listening will find many useful articles in our companion magazine *The Radio Amateur*.

The current issue contains such items as A VHF Grid Dip Meter, Multi-Band Aerials for Restricted Spaces, A Midget QRP Portable Transceiver, Notes on RF ZAmplifiers, and Workshop Pratice, as well as the regular Amateur, Broadcast and VHF Bands commentaries.

The seventh annual ELECTRONICS EXHIBITION will be held at the College of Technology, Sackville Street, Manchester1, from July 15th to July 18th inclusive. During the exhibition a number of lectures will be given and film shows on electronic subjects will be presented.

Admission is by ticket only. These may be obtained by forwarding a stamped addressed envelope to Mr. W. Birtwistle, 17 Blackwater Street, Rochdale, Lancs.

A STABILISED POWER UNIT

By W. E. THOMPSON

Those of us who have several items of test gear must, at some time or other, have asked ourselves the question, "Which is better; a built-in power unit in each item, or a common power unit to feed them all?" The answer is generally arrived at by weighing the advantages against the disadvantages of both systems, and deciding that as it has become common practice to give each unit its own power supply, the method must have been tried and proved years ago, so we'll take no chances and do the same! Which, after all, is logical enough, but have you given the matter more serious consideration?

Broadly, the pros and cons of each system can be summed up as follows:—

Individual power units

Advantages: Each instrument is self-contained and needs only a single mains connection. Complete portability, when required. Any combination of units can be used at one and the same time. Differing HT voltages and currents for each unit are catered for in the design of their power units. Failure of power supply in one unit leaves other units unaffected.

Disadvantages: A group of mains outlet sockets is required. Each instrument must have a mains transformer, valve or metal rectifier and smoothing circuit, which add to cost. Proximity of mains equipment to low level circuits can cause hum induction troubles. Power unit takes up space in, and adds weight to, the test instrument. Mains voltage fluctuations affect all instruments in use.

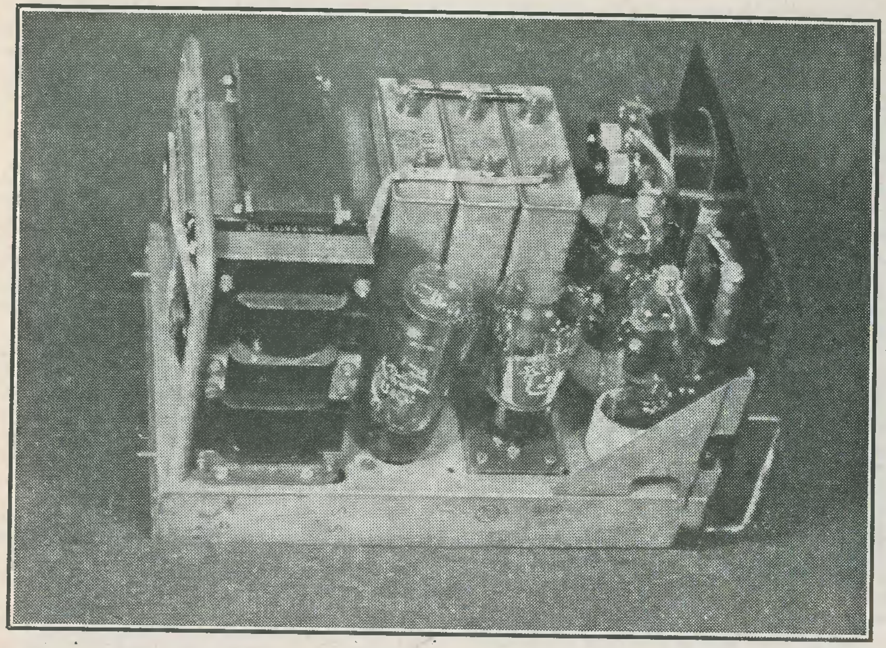
Common power unit

Advantages: One unit feeds all test instruments. Only one mains outlet socket needed. Initial cost is a single outlay only. Can be designed to cater for varying loads. Can be operated at a distance from other items of equipment if necessary.

Disadvantages: Failure of power unit renders all test units inoperative. Restricts portability of test gear. HT and heater feeds must be provided to a distributing point. Unless properly designed, HT output voltage falls when increased current drawn from power unit; conversely, HT voltage may be unduly high on light loads. When delivering power from common smoothing section, smoothing efficiency decreases with increase of load current, and unwanted hum may result.

On the face of it, the common power unit does not appear to warrant serious consideration, and in the case of the usual transformer/rectifier/smoothing-circuit this is true. Its chief disadvantage lies in its high source impedance, which results in the fall of output volts when the load current increases. Since this impedance will be common to any separate test instruments connected to the supply, any voltage variation caused by one unit is reflected into all others, and this can very well also cause the test gear to behave in a rather temperamental manner. Clearly then, a common power unit must have a very low source impedance as a main requirement, in order that its output voltage will remain constant within fine limits over the full range of current drain it can withstand. Ideally, the source impedance should be zero ohms, and though this cannot be attained in practice, it can be closely approached.

The stabilized power unit is an antidote for this particular brand of poison. With quite a simple circuit, a fairly high degree of voltage regulation can be secured, and the source impedance made very small. In the unit to be described, the circuit has been reduced by experiment to the barest necessities, yet the output voltage varies by less than one



volt when currents from nearly zero to over 150mA are drawn from it. The output voltage can also be preset to any value between 220V and 280V, the regulation being the same at all values. It is not impossible to dispense entirely with smoothing filters in such circuits, but in this case a single-section filter is employed and any AC ripple remaining is fed back into the regulator, where it undergoes treatment that is analogous to pushing a lump of pastry under a steam-roller. No originality is claimed for the circuit—the general outline has been common knowledge for years.

The complete instrument, shown in the photographs, was made up mainly from ex-Govt. gear for about £4-10-0, and is giving trouble-free service. It easily caters for all the items of test gear used, in addition to being able to provide power for the various experimental hook-ups that are produced from time to time. The constructional basis is an Amplifier Unit Type 3562; contents—the usual collection of transformers and chokes one puts aside because they won't work on 50 c/s, odds and ends in the way of resistors, capacitors, etc., which were stripped off and put into stock, and the following valves: 1–5U4, 1–EF50, 1–EA50, and 2–807's which later turned out to be a matched pair. From the circuit of the stabilizer it will be seen that with the exception of the EA50, all these valves fill the bill nicely. Even this could have been incorporated in a sort of "safety-valve" circuit to cover a fault condition, but since simplicity was the key-note the feature was omitted.

The chassis needs only minor alterations, such as a few holes in the deck to accommodate fixing screws for some components, and removal of the front panel. The small rivets securing this panel are drilled out, and the few spot-welds gently prised apart. A new front panel is fitted to the front of the deck and its brackets, drillings in the panel being as depicted in the sketch. Metal or plastic sheet can be used for the panel; I used a piece of 3/32" paxolin which was on hand. With aluminium and tin-plate being rather scarce, plastic sheet of some sort makes a good alternative material.

In the circuit one can recognize the usual mains transformer, full-wave rectifier, and single-section smoothing filter. The DC voltage delivered to the HT output terminals is regulated by a cathode-follower stage (the two 807's in parallel, triode-connected). These two valves should preferably be a matched pair, and in any case their characteristics should be closely similar to prevent one of them being overloaded while the other takes things too easy. The operating condition of this stage is controlled by the DC amplifier (EF50) stage, and since the efficiency of the unit as a whole depends on a constant "reference" voltage on this valve's grid, an S130 neon regulator is used to keep the cathode potential constant. The variable resistor R8 controls the feed-back potential on the EF50 grid; it also serves as a convenient means of adjusting the output voltage between its limits of 220V to 280V.

The 807's, in performing their function of regulating the output voltage, have some 250V or more dropped across them, and this is dissipated as heat. This is the sacrifice which must be made to achieve good regulation, but there is another aspect which is not readily apparent. The voltage at the 807 anodes is about 500V under normal conditions, but during the warm-up period of valve heaters this voltage is considerably higher. The 5U4 rectifier, being directly heated, reaches full emission before the other valves, which are indirectly heated, and it is during this time lag that the 5U4 can deliver a high peak. The rectified voltage rises to nearly 800V during the warm-up period, stays there for a few moments, and then settles down to round about 500V permanently. Consequently, if we fit electrolytics for C1 and C2 with working voltage ratings of the usual 550V, they would be subjected to severe strain, and would most likely succumb straight away to the 50 per cent. overload. Hence the paper capacitors with 1,000V DC working rating for the positions—even higher rating would certainly be no disadvantage. The practice of wiring two electrolytics in series and assuming that the voltage across the pair is shared equally by each is not good circuitry; the voltage across each might be anything BUT equal, due to each having a different leakage current. Sooner or later, one breaks down and stabs the other in the back—result, two electrolytics ruined, possibly the rectifier valve as well.

The smoothing choke used was an ex-Admiralty type rated as 9H at 100mA, and slight widening of the core-gap enables the inductance to be maintained at about 6H at 150mA. The DC resistance is 120 ohms. Several of these were bought some time ago at 3/– each, and similar chokes are obtainable now at prices varying between 5/6 and 8/6 each.

The meter, together with its associated shunts, series swamp resistor and range switch, is perhaps a refinement, but nevertheless a useful one, since it monitors output voltage and current. The basic movement is an ex-Govt. 0.5mA moving-coil meter, 2-inches diameter; it is procurable from several sources

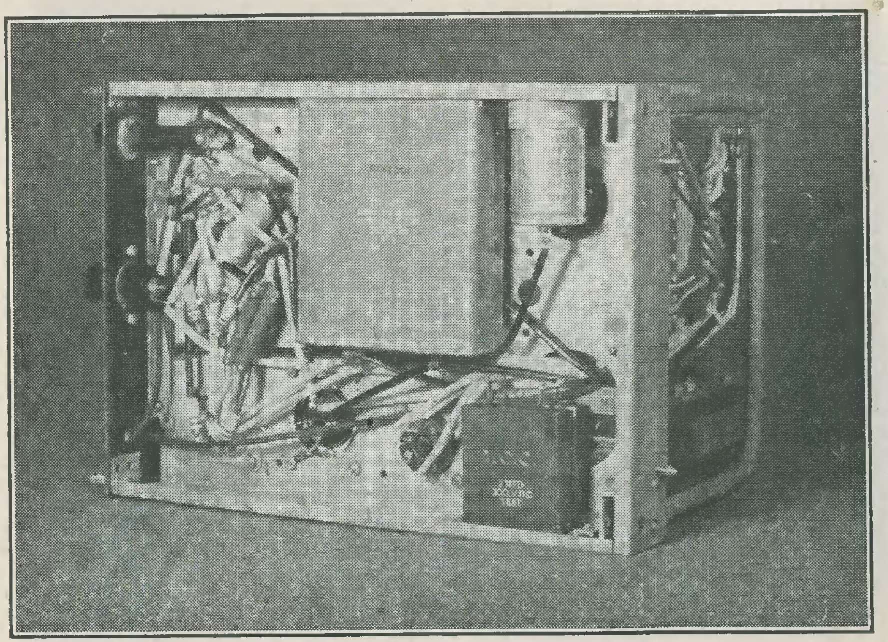
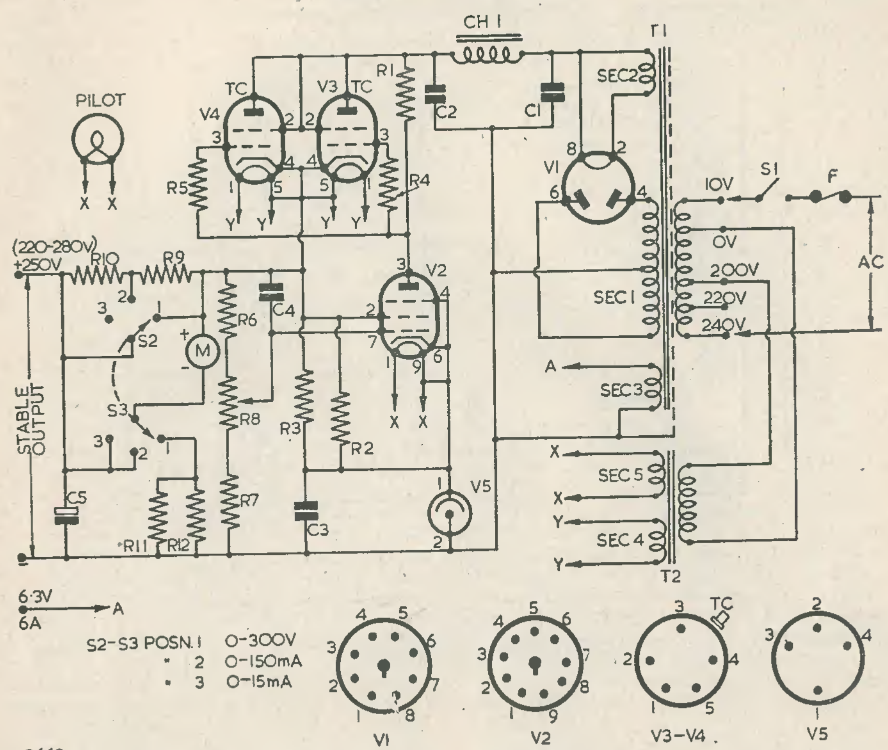


FIG. 1
STABILIZED POWER UNIT



C662

List of Components

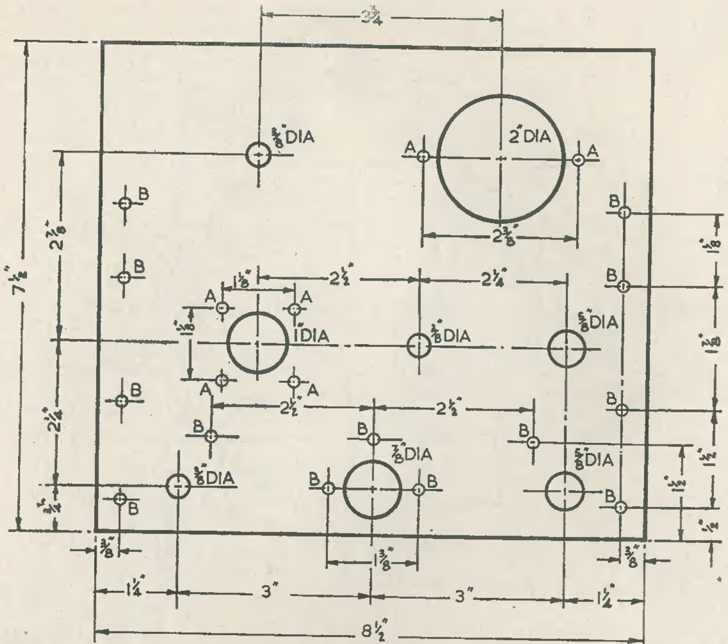
R1	250 kΩ 1W
R2	10 kΩ 5W
R3	20 kΩ 5W
R4, R5	82 Ω ½W
R6	91 kΩ 2W
R7	68 kΩ 2W
R8	25 kΩ wire wound linear potentiometer
R9	1.67 Ω (see text)
R10	15.77 Ω (see text)
R11, R12	1.2 M Ω (see text)
C1, C2	8μF 1,000V DC working paper block
C3	2μF 250V DC working paper block
C4	0.05μF 350V DC working paper tubular
C5	32μF 350V DC working electrolytic
V1	5U4
V2	EF50
V3, V4	807
V5	S130

M	0.5mA m/c meter (500 Ω)
S1	On-off toggle switch
S2, S3	2-pole 3-way Yaxley (see text)
F	1 amp fuse
CH1	6H 150mA choke (see text)
T1	Primary 10–0–200–220–240V Secondaries, 450–0–450V 200mA, 5V 3A, 6.3V 6A.
T2	Primary, 200V Secondaries, X = 6.3V 0.5A, Y = 6.3V 2A.

(see text concerning transformers).

Other items:

1 I0 valveholder
2 UX5 valveholders
1 B9G valveholder
1 B4 valveholder
1 Tubular fuse holder
1 5-pin plug and socket
1 Ruby pilot and bulb 6.3V 0.2A



A=4BA CLEAR
B=6BA CLEAR

FIG. 2
FRONT PANEL DRILLING DETAILS

C663

for a nominal sum. Its internal resistance is of the order of 500 ohms, and the resistance values shown for R9, R10, R11 and R12 apply only to a movement with these characteristics. Should an instrument be used having a different FSD current and/or internal resistance, these resistor values will have to be adjusted accordingly. The range switch was made up from a locator and wafers which were on hand, but a 2-pole 3-way Yaxley will do, provided that the S2 moving contact definitely makes the forward contact before it breaks the trailing contact, otherwise the meter could have the full load current passing through it during the transit time of the S2 moving contact. To pump anything up to a 150mA load through a 0.5mA meter does no more than convert it into a rather expensive fuse! I used a wafer with a shorting bar for S2, and this is perhaps safer for the meter than a make-before-break moving contact. By arranging the switching so that the 150mA range is passed through before reaching the 15mA range, a further source of danger to the meter is reduced. In addition, a red line indicating 15mA on the 150mA scale gives a ready means of seeing whether one can safely switch to the lower range.

The two 1.2 Megohm resistors, R11 and R12, forming the 600,000 ohm swamp for the voltage range, were selected from stock items by means of a bridge; they are very close to their marked values and reasonably well matched. This saved a few extra shillings for close-tolerance precision resistors. Those of us who may not have a bridge could perhaps get the local dealer to select a couple of 10 per cent. carbon resistors, and it is surprising how close these are at times to their nominal value. For the shunts, R9 and R10, two small bobbins were wound non-inductively with copper wire to ohmic values a little in excess of those shown in the diagram. They were then adjusted by shortening the wire a little at a time until the 0.5mA meter agreed (on the respective ranges) with the readings on a known accurate meter at three points on the scale, namely, one-third, two-thirds, and full-

scale. Greater accuracy was not considered necessary, since the meter movement itself was FG.4 accuracy. In any case, copper wire shunts can hardly be regarded as ideal, but they serve the purpose. If wire is used which has a cross-sectional area well able to carry the shunted current without tending to warm up, variation of resistance under load conditions will be negligible. Suggested wire sizes are 36 swg enamelled for the 15mA shunt, and 26 swg enamelled for the 150mA shunt, for at their nominal rating of 1,000A per sq. in. these gauges can carry 45mA and 260 mA respectively. The bobbins seen in the photograph of the top deck were wound with these size wires, and made up neatly as a result.

It was found that with the variable resistor R8 at its mid-point, R6 and R7 should have the values assigned in the diagram, but these values may not necessarily hold good in a replica instrument; some adjustment may be needed to compensate for differences in characteristics of the particular valves which happen to be used. The wattage rating is higher than calculation indicates as adequate, but this is done purposely to reduce the possibility of drift due to these resistors heating. With this more-than-adequate rating, they remain sensibly constant over long periods of working. Although shown wired on each side of R8 in the photograph they have since been placed beneath the chassis, for situated as shown they are subjected to the full fury of the heat given off by the adjacent 807's.

Grid stoppers R4 and R5 should be wired close up to the valve-base wiring tags. It may be desirable to insert similar stoppers in the screen feeds also, in which case they should likewise be right against the wiring tag. In my own unit, removal of the screen stoppers does not appear to have produced adverse effects.

Good quality systoflex sleeving is advisable, to provide adequate insulation of wiring, especially the hot HT line. Meter shunt leads should be kept short, using 16 swg tinned copper wire. This size wire should also be used where heavy currents are carried. Other wiring can be carried out in 20 or 22 swg tinned copper wire.

The five-pin plug and socket on the panel takes off the HT positive and negative, and the 6.3A heater feeds, to the loads. The cable is routed to a small panel fitted with a number of similar sockets wired in parallel, so that items of equipment can be plugged in as required.

In addition to critically regulating the DC output, this unit compensates mains-voltage fluctuations to some extent, it being an inherent feature of such circuits that they automatically set their own working conditions within certain limits of input and output voltage. In the same way that an increase of DC load will produce a drop in output volts to set the regulator functioning, a variation of input voltage to the unit will produce a consequent fall in output volts. Both conditions are accepted by the regulator as something which must be compensated for, and it does this in fact. However, the degree of regulation due to input variation is not so good as the regulation achieved over DC output variation, for in the latter case the input is at least already fairly stable. Nevertheless, small departures from the nominal mains voltage are adequately covered, but excessive drops due to load shedding, for instance, are bound to have effect.

In the photograph of the front panel (cover illustration), R8 is seen to the left of the meter. The pointer knob below the meter controls the range switch S2–S3, and is shown in position 1, i.e., 0–300V. Turning this knob to the right, the meter reads 0–150mA in position 2, and 0–15mA in position 3. The mains on-off toggle S1 is to the right of this switch, above the fuse. The ruby pilot (bottom centre) has a detachable opal which gives ready access to the 6.3V bulb for replacement, although to minimise this I fitted a tiny dropper in series with the lamp to reduce the voltage by about 1.0V. This was made with a few turns of insulated resistance wire wound on a 2-tag strip, seen in the under-chassis view, soldered to a wiring tag of V2 valve holder.

V2 can just be seen in the top deck view, below the meter. From its position, it is apparent that it is fairly close to the front panel, and there is not much space to spare for the range switch, so this has to be carefully positioned so that its wiring tags do not touch the metal case of V2.

The Cossor S130 neon stabilizer is mounted over an exisiting hole in the chassis. A small sub-panel supports the 4-pin valve holder, the hole in the chassis being too large to enable the valve holder to be mounted neatly. The under-chassis view reveals this aspect clearly.

To mount the meter, a small strip of 1/16" paxolin was fitted to its terminals, and two paxolin-tube spacers taken from a long-spindled Yaxley were made into pillars, fixed by 4-BA screws to the paxolin strip and the front panel. Two short lengths of 4-BA screwed rod were then fitted to the ends of the meter terminals by 4-BA nuts, to extend them sufficiently to accommodate the shunt bobbins.

Capacitors C1 and C2 are each made up of two 4.0 μF units wired in parallel. C1, and one half of C2, are mounted above

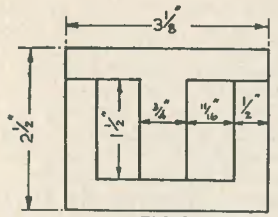
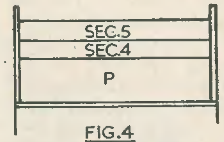


FIG.3
STAMPINGS FOR HEATER TRANSFORMER
C664



C665
FIG.4
COIL OF HEATER TRANSFORMER

chassis; absence of further space dictated that the remaining half of C2 must reside in the basement, and in the below-deck view this can be seen to be taking up a fair amount of the space there.

Choke CH1 and the small heater transformer are mounted beside the 5U4 rectifier, one above the other, the choke being fixed above the transformer. The mains transformer is necessarily fairly large, and takes up the remaining space beside these, and adjoining the 4.0 μF capacitors. The heater transformer was made from stampings and bobbin of a choke similar to CH1, the wire being stripped off and the bobbin rewound with suitable new wire. The mains transformer was also home-made, using stampings obtained from an ex-Govt. unit. The bobbin for this was made up from sheet paxolin, and having made this transformer after the heater transformer was constructed it was found that there was sufficient space to have accommodated additional heater windings! As other constructors may be interested to this extent, design details are given for a mains transformer to provide all outputs necessary for the unit, together with further details for two transformers as depicted in the circuit diagram. Whichever design is adopted, the insulation between windings of the mains transformer should be adequate, not less than three layers of 5-mil Empire tape being the minimum.

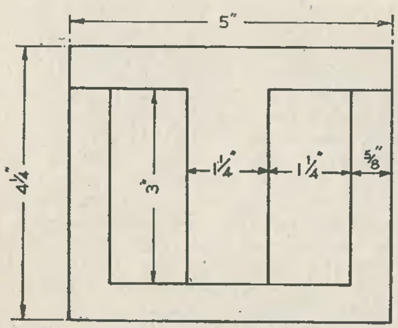


FIG.5
STAMPINGS FOR MAINS TRANSFORMER
C666

For a mains transformer designed to provide for all secondary outputs on the one core, a 1½″ stack of stampings with dimensions as shown in Fig. 5 is needed. The windings are put on a single bobbin made from 1/16″ paxolin, as shown in the cross-section, Fig. 6. Windings S2 and S5 should be kept well to the left and right respectively of the layer. Details of the windings are as follows:—

Primary: 860 turns 20 swg enamelled, wound in 13 layers, 68 turns per layer. Weight of wire, 2 lbs. 4 ozs. Tappings at 35th, 720th and 790th turns. Voltage taps will then be: Start–10V; 35th turn–0V; 720th turn–200V; 790th turn–220V; Finish–240V. Each layer to be separated with one turn 2-mil paper.

Screen: One insulated layer copper foil. Alternatively, a single layer of 36 swg enamelled, one end well insulated.

Secondary (S1), 450–0–450V 200mA. 3270 turns, centre tapped, 32 swg enamelled, wound in 15 layers, 220 turns per layer. Weight of wire, 1 lb. 1 oz. Each layer to be separated with one turn 2-mil paper.

Secondary (S3), 6.3V 6A. 23 turns 15 swg enamelled, space wound to occupy the whole layer. Weight of wire, 6 ozs.

Secondary (S2), 5V 3A. 18 turns 18 swg enamelled, close wound on left of layer. Weight of wire, 2 ozs.

Secondary (S5), 6.3V 0.5A. 23 turns 22 swg enamelled, close wound on right of layer. Weight of wire, 1 oz.

Secondary (S4), 6.3V 2A. 23 turns 18 swg enamelled, space wound over layer. Weight of wire, 3 ozs.

Insulation between windings to be three turns 5-mil Empire tape.

If a separate heater transformer is used, the windings S4 and S5 will be omitted from the mains transformer; secondary S2 can then be space wound over the layer. In all other respects the transformer windings and size of core are the same.

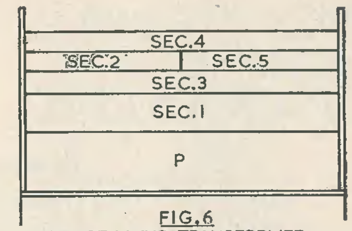
The heater transformer will have a ¾″ stack of stampings whose dimensions are as shown in Fig. 3, and the bobbin is wound as shown in the cross-section, Fig. 4. Details of the windings are as follows:—

Primary: 2120 turns 32 swg enamelled, wound in 20 layers, 110 turns per layer. Weight of wire, 5 ozs. Each layer to be separated with one turn 2-mil paper.

Secondary (S4), 6.3V 2A. 73 turns 18 swg enamelled, wound in 3 layers, 25 turns per layer. Weight of wire, 4 ozs. Each layer to be separated with one turn 3-mil paper.

Secondary (S5), 6.3V 0.5A. 73 turns 22 swg enamelled, wound in 2 layers, 40 turns on first layer, remainder of turns space wound on second layer. Weight of wire, 2 ozs.

Layers to be separated with one turn 3-mil paper.



C667
FIG.6
COIL OF MAINS TRANSFORMER

No screen need be provided on this transformer. Insulation between Primary and Secondary S4 should be 3 turns 5-mil Empire tape, and between Secondaries S4, S5, 2 turns Empire tape are sufficient. The primary of this transformer is wired permanently to the 200V section of the mains transformer primary, as shown in the circuit diagram.

Stampings for all the above transformers should be interleaved, and close jointed. The built-up cores should be tight in the bobbins, and clamps should be well tightened to prevent stampings buzzing when the transformers are "on load." The wire sizes quoted are generous for the currents to be carried, and they will be found to run just warm.

KIT REVIEW

RF1 Feeder Unit

(MAIL ORDER SUPPLY CO., *The Radio Centre*
33 TOTTENHAM COURT ROAD, LONDON, W.1)

The M.O.S. Feeder Unit RF1, covering the medium waveband, can be used satisfactorily with any audio amplifier, although primarily designed as an adjunct to the M.O.S. A1 amplifier. It is not suitable for use on DC mains, and will have to be provided with its own power pack if the amplifier is of the AC/DC type.

A straight circuit is employed, using two high gain SP61 pentodes. The first of these acts as an RF amplifier with tuned input circuit. Gain is controlled by a single potentiometer so wired that a shunt resistance across the aerial winding becomes progressively lower as the cathode resistance, and hence the bias, becomes higher.

The second stage is also straightforward, consisting of an anode bend detector transformer coupled to the RF stage. Reaction is omitted, as the unit is designed from a quality rather than a sensitivity viewpoint.

The kit is supplied, as usual, down to the last nut and bolt, except for one item. It is a chassis job meant to fit into the constructor's own cabinet, and so no tuning drive is included, in order that the builder may fit one of his own choosing to suit the particular cabinet he proposes to use.

The price of the complete kit is £2. 12. 6d., which includes a step-by-step construction manual. The latter may be purchased separately at 2s. 0d.

Mainly for the Beginner . . .

PARASITIC OSCILLATIONS

By H. E. SMITH, G6UH

Parasitic oscillations occur in both RF and AF circuits, and are quite often very difficult to trace and cure. As, perhaps, the majority of readers will be more interested in the audio side, we will deal with some of the more obscure causes, and offer a few suggestions on designing Audio Amplifiers which will operate in a stable and parasitic-free manner.

In an extreme case, the amplifier will operate with a high pitched whistle which may at first be diagnosed as poor decoupling on one of the stages. This high pitched whistle, being within the audio range, is described as a *Low Frequency Parasitic*, and may be due to quite a number of causes. The layout of the chassis may be such that inductive coupling is taking place from the output valve to one of the early stages. If no transformers are being used in the early stages, it is still possible for back coupling to take place by capacitance. The only cure is to ensure that the components associated with the output stage are mounted on the chassis as far from the input as possible. Quite often, bad parasitics can take place without the constructor being aware of their presence. In most cases, however, if the parasitics are present they are accompanied by some form of distortion, especially if they are in the output stage itself. Push-Pull Amplifiers are very prone to this trouble, especially if the stage consists of a pair of valves of the Beam Tetrode type. When using a pair of valves of the 807 type in a push-pull audio amplifier it is as well to fit 100 ohm stoppers in both grids and anodes, and to screen both valves halfway up the glass as one would if they were being used in a transmitter PA stage. Use carbon type resistors for the stoppers, and make sure that they are of the correct wattage rating when used as anode stoppers. It has been found in one or two cases that it was necessary to *neutralise* the push-pull stage in order to finally dispose of the parasitics.

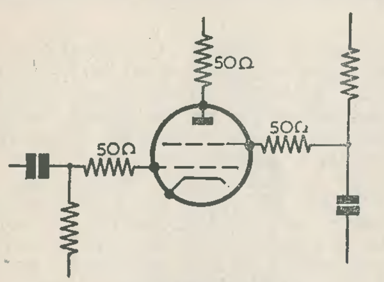


FIG.1
AUDIO AMPLIFIER WITH STOPPERS IN GRID, ANODE & SCREEN

C710

High Frequency Parasitics are the most difficult to locate of all. An ordinary gramophone amplifier using two beam tetrodes in a push-pull output stage may, if no precautions have been taken against parasitics, cause terrific interference to Television Receivers over a very wide area. In order to detect the presence of these VHF parasitics, it is necessary to check with either a sensitive absorption wavemeter of the meter indicating type, or with an all-wave receiver covering all bands up to 70 Mc/s or so. It may well be that neither of these items are available, in which case it will be as well to tackle the problem without their aid, and if the following precautions are taken, there will be little likelihood of any parasitics occurring in your audio amplifier.

To avoid feedback troubles from the mains supply, always use a mains filter of some kind. Even fitting two 0.01 μF capacitors across the mains input, with the centre connection earthed, will assist in this direction. *All* grid leads should be run in screened lead, even if for only a short distance, and a carbon resistor of at least 50 ohms fitted in series with the grid (the connection being made directly to the valve holder). When a driver transformer is used to feed the push-pull pair, never attempt to obtain top cut by fitting a capacitor across the secondary.

This increases the grid to anode capacitance of the following stage and renders it more prone to start spurious oscillations. 50 to 100 ohm carbon resistors should be fitted in all anode and screen connections, making the actual connection right at the valve holder. Good decoupling of all anodes and screens is an absolute necessity, and in general it is a good plan to make the decoupling resistor approximately one quarter the value of the anode load resistor. Audio decoupling capacitors should never (unless particularly specified), be of a lower value than 2 μF, and in general values of betwwen 8 and 16 μF are more satisfactory. Do not use a common decoupling capacitor for two separate anode feeds, as this is as bad as not decoupling the stages at all. In a high gain amplifier used for microphone or gramophone work, it often happens that the microphone or pickup transformer is mounted on the same chassis as the mains transformer and output transformer. When the gain control is advanced towards maximum, a high pitched whistle occurs, even when the microphone is switched off. This form of oscillation, although not strictly speaking a parasitic, can be described as one, and is due to induced feed back from the output transformer to the input circuit. The higher the gain, the more difficult is the cure for this trouble. One good method is to enclose the microphone transformer in a second screened can and isolate this second can from earth, bringing the earth lead from the original screening out and taking this to chassis.

Parasitics in local oscillators

The oscillator stage in a superhet receiver is seldom suspected of producing parasitic oscillations. This trouble is seldom encountered in commercially built receivers, but the home constructor should take care that the oscillator is going to operate in a stable condition, otherwise some trouble will be experienced in locating the fault later on. The parasitics will most likely occur on the short wave bands, and will take the form of rough unmusical carriers separated by only a few degrees on the scale, making satisfactory reception impossible. An important point to remember is that the makers value of HT voltage should never be exceeded, and the correct bias resistor for the HT used should always be fitted. When separate coils are used in the anode and grid of the oscillator (as distinct from the cathode tap circuit of the electron-coupled oscillator), make certain that the coupling between the coils is not too tight, as this will produce "squegging" with its attendant train of nasty little oscillations all over the bands.

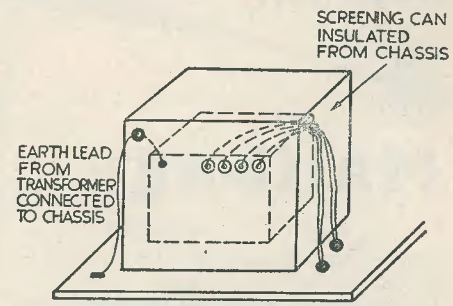


FIG.2
DOUBLE SCREENING A TRANSFORMER

C711

When this condition exists, screening the oscillator will make no difference, as the random oscillations will follow heater wiring, anode and grid wiring, and will often make use of the earthed chassis itself to transfer to other parts of the circuit. With the "Cathode Tap" ECO, connect the tap to a point on the grid coil which will sustain oscillations over the wave bands to be covered, and do not be tempted to increase the coupling "to be on the safe side." The shunt-fed Colpitts oscillator, often used in SW and VHF receivers, is another circuit requiring care in its construction. For VHF receivers, the coupling capacitors in the anode and grid circuit should not exceed 20 pF, and for the average communication receiver they need be no larger than 50 pF for good oscillator action. The oscillator should be as carefully

(*Continued on page* 483)

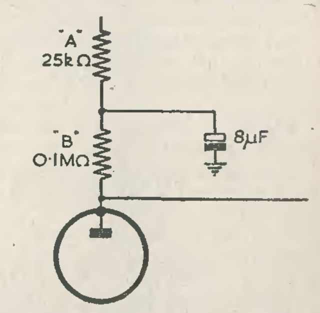


FIG.3
TYPICAL ANODE DECOUPLING.
DECOUPLING RESISTOR "A" APPROX. ¼ THE VALUE OF LOAD RESISTOR "B"

C712

from our Mailbag

CRT's as X-ray Generators

Dear Sir,

I am a regular reader of the *Radio Constructor* and, as a matter of interest, I would like to raise the following:—

There has been a small slip in the circuit diagram, Fig. 1, in Mr. French's article in the June issue of page 378. V2 has no anode load, and as it is referred to in the text, this may cause some ' bother ' to your less experienced readers. This has unfortunately been amplified later in the article as only the Input side of the circuit has been shown.

(*We must apologise for the omission of the anode load resistor for V2, which should be inserted between the anode and the HT+ line (Fig. 1). A suitable value would be 27 kΩ.—Ed.*)

Another point I would like to raise is with the author of the excellent series of articles of 16″ Television receiver. I would be obliged if you would pass this to him for his comments.

Under the sub-heading of " Power Supply Considerations " it has been stated that, quote:— Gamma and X Rays are present at voltages exceeding 15 KV !—unquote.

I am interested to know if the author has any evidence that this is a fact ? Frankly, I am rather sceptical of the presence of Gamma Radiation, but X Rays of the lower order I know are produced by a metal backed screened C.R.T. where the electrons have been under the influence of the accelerating potential for (compared with 16″ C.R.T.) only a short period.

The 16″ is not a metal backed screen type, as it is provided with an Iron trap.

The screen material, I think would be hard put to it to produce X Rays by virtue of density and depth.

Collision at the neck weld with the metal cone (the only place where the angle of " attack " is not too acute, with reference to the Cathode ray), is unlikely to produce radiation, as the type of tube used employs mainly post deflection acceleration, and the electron velocity would not be high enough at this point.

In my experience, the production of Gamma Rays require much higher voltages and electron velocities than are under consideration here.

I would be very pleased to have the author's observations on this.—

B. H. SHARDLOW (Nottingham)

(*It is not denied that some exaggeration was introduced. This was essential to emphasise the situation which would arise under the circumstances explained on P. 406, June issue. Many constructors will be entering the field of high kV for the first time, and it is the responsibility of a technical writer to safeguard those without experience in these matters. Agreed ?*

" *X-ray Radiation Precautions. All types of picture tubes may be operated at voltages (if ratings permit) up to 16 kV without producing harmful X-ray radiation, and without danger of personal injury on prolonged exposure at close range. Above 16 kV, special X-ray shielding precautions may be necessary."—Reprinted by courtesy of " RCA Laboratory Procedure."—A.T.*)

Television Interference

Dear Sir,

Having just read your Editorial referring to interference to television programmes by electrical apparatus, I feel that I must take up the question of interference by television sets on ordinary radio. At the present moment, on my radio there is an appreciable whistle, plus interference from a thermostat of some sort. The whistle has been identified and located by the GPO, but the owners of the TV set say it is too expensive to have it corrected. Nearer to the set, which is at least 200 yards away, I believe it is impossible to listen to sound radio when this TV set is switched on. Incidentally, the GPO engineer informed me that 50–60 complaints of this kind are received every week in the Merseyside area.

In view of the much larger ratio of sound to vision users, don't you think the time has arrived when ALL TV sets and electrical apparatus is rendered immune from any form of interference by the manufacturers of any apparatus liable to develop interfering whistles and sparks.—

F. J. ANNAL (Birkenhead, Ches.)

Help Wanted

Dear Sir,

I am wondering if you or any of your readers would be so good as to let me have information concerning the following:—

Converting the 1155 Receiver for AC/DC.

Building an efficient short wave receiver (about 6–8 valves) for AC/DC, for reception on 10–500 metres complete coverage.

I am naturally prepared to meet any reasonable expense involved.—C. W. SUTCLIFFE, Handicrafts Master, Greenford County Grammar School, Ruislip Road, Greenford, Middx.

New Field

Dear Sir,

As a very amateur radio enthusiast, I am at a loss to understand why some of your keen constructors do not divert their energies into the field of Medicine. I fully appreciate that electricity has been and is being utilised in this field, especially as a therapeutic agent, i.e., X-ray, Ultra Violet ray, Infra Red, Radium, etc., and yet nobody seems to have toyed with the idea of making an instrument capable of recording temperature, pulse rate, respiratory rate, etc., which would not only be a boon to Doctor and patient alike, but a means of assessing extremely accurately the biological state of the body.

It requires but very little imagination to visualise the time when one will visit the Doctor, and instead of having a thermometer stuck in one's mouth and pulse rate and blood pressure taken by the crude existing methods, one will merely be told to perhaps hold a metal and bakelite disc, or something of a similar nature, from which, by meters, etc., the Doctor will be able to ascertain one's condition immediately and accurately.

A point worth remembering here is that as far as the pulse rate is concerned, a Doctor requires to know not only the frequency or regularity (or otherwise) of the beat, but also the strength and number of beats per minute.

In conclusion, may I add that I first thought of this idea a year or so ago, when I paid a visit to the local Pier. On the Pier was a machine which registered one's pulse rate *and* vitality, although I was more than sceptical about the latter arrangement! The set-up was very simple, as I remember it. All one had to do was to hold or squeeze a little bulb affair, whereupon a cut-out " heart " on the front of the machine was illuminated intermittently, the timing obviously coinciding with the pulse rate. Well, there's the germ of an idea, and from some of the articles I have read in the " Radio Constructor " it is very apparent that some of your readers, at least, are more than capable of "translating" this into a practical and efficient instrument for really serious work.

Mihi cura futuri (Clacton-on-Sea, Essex).

TEST CARD " C "

Dear Sir,

With reference to your telephone call on 29th May, I am asked to let you know that the new equipment referred to in Mr. Brian Begg's letter to you of 20th November 1951 has not yet been delivered and we are unable at present to increase the times of our demonstrations either by test card or film.

Yours faithfully,

Mineva Cortien

Secretary to Director of Television Broadcasting.

MAINLY FOR THE BEGINNER.

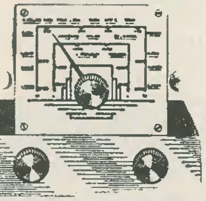
Continued from page 481

decoupled as the IF stages, and it is a good plan to fit a capacitor of 0.005 μF from the unearthed heater to earth. The whole question of parasitics in local oscillators can be summed up as follows:—

When constructing a superhet receiver, always follow a good circuit diagram, and never copy one part from this circuit and one part from that. Use only the components specified, and do not make do with substitutes, especially if of inferior quality to those specified. Study the circuit well before attempting the construction, and do the layout on paper first. Finally, use a clean, well tinned soldering iron and let every joint be a good one.

'MOVING' SALE STOCK OFFERED AT SENSATIONAL REDUCTION THIS MONTH!

ALL-MAINS CHASSIS

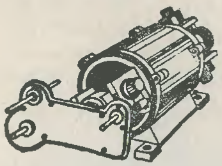


This is the equivalent of a 4-valve receiver for it uses three valves and a metal rectifier. It is all wired up ready to work off A.C. mains, complete with modern valves, ganged tuning, high precision dust cored coil, first grade condensers and resistors, all on metal chassis. Tunes long and medium wave-bands. Large clear dial. Receives Home Service, Light programme, Luxemburg, etc. Chassis size approximately 9in. x 4in. x 5in. Complete with valves but less speaker. Post and insurance 2/6.

SALE PRICE 49/6

Suitable speaker with matching transformer, 16/6—nothing else needed.

MULTI-SPEED MOTORS



You can adjust this motor to almost any speed you want, it will work directly off A.C. mains, or if you require greater power or greater speed work it through a metal rectifier. This motor is fitted with a gear box enabling speeds down as low as 1 r.p.m. to be obtained.

SALE PRICE 9/6 plus 1/- post.

THERMOSTATIC SOLDERING IRON

The Famous Biobar

A cancelled export shipment permits us to offer these at half the normal price. These irons have a built-in thermostat which permits quicker warming-up, greater available heat for soldering on metal chassis, etc. No burning when idling and finally a saving of current as the thermostat reduces the wattage when the iron reaches a critical termperature. 500 only available (standard pencil bit type). Please state voltage.

SALE PRICE 12/6 plus 1/- post.

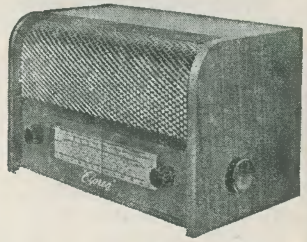
TWO-VOLT ACCUMULATORS

Made for the Forces by one of the most famous firms in the world. 15 amp.-hour size approx. 6in. x 1¾in., square in ebonite case, pre-charged, only need filling with acid.

Plus 9d. post and insurance.

SALE PRICE 3/9

"ELPREQ" WOLSEY 5 VALVE A.C./D.C. SUPERHET

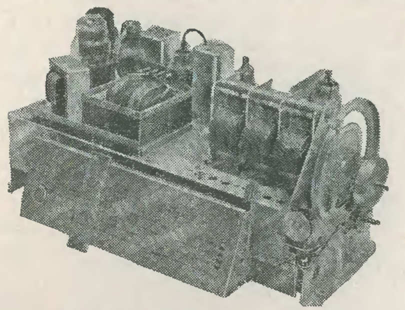


Long, medium and short wave in handsome wooden cabinet, illuminated glass dial with station names, A.V.C. and usual refinements: Size 11in. x 5½in. x 7in. with B.V.A. valves and built-in aerial. 12 months' guarantee. Limited quantity only.

SALE PRICE 179/6

Carriage and insurance 5/-.

7 VALVE, 5 WAVE-BAND RADIO CHASSIS



GIVE AWAY PRICE

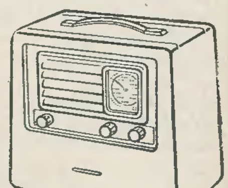
only £6. 19. 6.

A famous set by a famous manufacturer. Undoubtedly a serious listener's receiver. Among many special features are a H.F. stage and tuning indicator. Tunes up to 11-metre band.

We have a few left, less valves and power packs, otherwise in good condition, they definitely have never been used.

SALE PRICE 139/6 plus 15/- carriage.

BATTERY PORTABLE CONSTRUCTORS' PARCEL

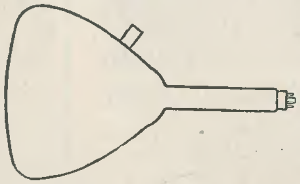


Cabinet with plastic ivory fret, metal chassis (already punched), frame aerial, scale and back.

Free circuit diagram and constructional details to all purchasers.

SALE PRICE 29/6 plus 2/6 post.

MAGNETIC T.V. TUBES



9in. G.E.C. Flat Ended, Heater 6.3 v.

These tubes have had very little use and will probably give years of service.

Type 2. Have small ion burns otherwise in good condition.

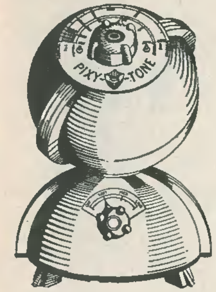
SALE PRICE 65/-

Type 3. Have large ion burns but are useful as spare or when first testing out a circuit, or doing repairs, etc.

SALE PRICE 45/-

Note:—We guarantee a 'working' tube. If not calling please add 7/6 each tube for packing and postage.

NOVELTY BATTERY SET

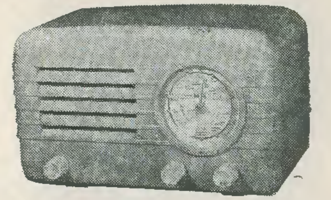


Novelty radio in coloured plastic cabinet only 6in. high, ideal for a nursery or bedroom, complete with 2-gang tuning condenser, volume control and ON/OFF switch, all wired up ready to operate as soon as valves and speaker are fitted. Works off dry batteries. Valves required are three of type 1T4 and one of 3S4. Because of a frustrated export order, we are able to offer these sets brand new and perfect, complete except for valves and speaker.

SALE PRICE 29/6

Postage and insurance 2/6 extra.

CONSTRUCTORS' PARCEL

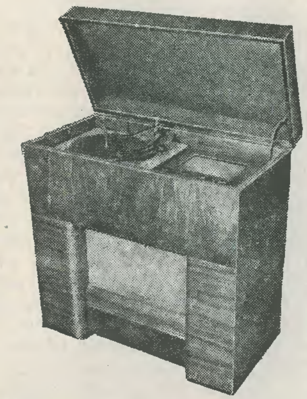


Modern design, bakelite cabinet in ivory, blue or brown, complete with metal chassis punched out for speaker and 5 valves, etc. Parcel also includes moulded perspex window, matched set of knobs, scale and hardboard back.

SALE PRICE 22/6

Carr. and pkg. 2/6.

RADIO GRAM CABINET



Console type cabinet, with full grained walnut finish, will take standard type auto change gram unit. Sale Price **£10/10/-** plus 15/- carr.

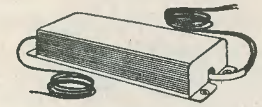
Radio chassis to suit. Sale price **£8/19/6** plus 7/6 carriage and insurance.

Auto Change units, three speed with pick-up. Sale price **£11/11/-**, plus 7/6 carriage.

Special Offer. Cabinet, Radio Chassis and Collaro 3-speed Auto Changer with Dual Purpose Pick-Up.

SALE PRICE £31

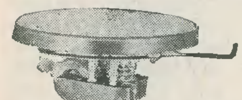
FLUORESCENT LIGHTING UNITS



40-watt Type. This is a combined condenser and choke unit for controlling fluorescent tubes. The only other item needed is a starter switch which can be an automatic type or an ordinary on/off manually operated type. We offer these well made units at less than half price.

SALE PRICE 14/6

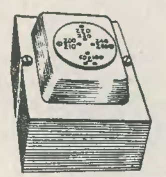
SPECIAL THREE-SPEED GRAMOPHONE UNIT



Complete with turntable for use with standard or long-playing records and which also caters for the new American (45 r.p.m.) records. Only a limited quantity.

SALE PRICE 59/6 plus 2/6 post.

TRANSFORMER SNIP

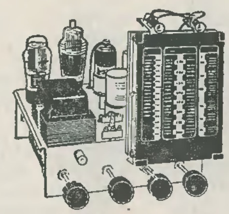


A Universal replacement by a very famous maker. Standard mains input secondaries: 350-0-350 at 80 mA 6.3 tapped at 4 v. 4 amp. and 4 v. at 3 amps. Note this is a half shrouded drop through type.

Plus 1/- post.

SALE PRICE 12/6

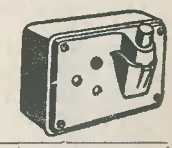
A.C. MAINS OPERATED 5-VALVE SUPERHET CHASSIS



Completely wired, aligned and ready for immediate operation, covering three wavebands, 13-37 metres, 37-100 metres and 200-500 metres. A really excellent receiver ideal for new installations or as a replacement chassis in existing radiograms, etc. The set employs a 5-valve line up either international octal valves 6K8, 6K7, 6Q7, 6V6 and 5Y3 or "E" types ECH35, EF36, EBC33, EL33 and 5Y3 or 5Z4. The overall size is 8½in. deep x 11½in. wide x 11½in. high, the dial size is 6in. x 8in.

SALE PRICE 130/- plus 7/6 carriage.

CLIX 15-AMP SWITCH PLUG



Made to B.S.S. specification, shuttered in moulded bakelite case.

Plus 9d. post.

SALE PRICE 6/6

Orders by post are dealt with by our RUISLIP depot. To avoid delay address to: E.P.E. Ltd., Dept. 3, Windmill Hill, Ruislip, Middlesex.

Except for heavy and delicate items where carriage charge is specified, orders over £2 are post free, under £2 add reasonable amount bearing in mind a 15lb. parcel costs 2/-. Postable items can be sent C.O.D. additional charge approx. 2/6. List 6d.

Early closing, Wednesday—Ruislip, Saturday—City.

ELECTRONIC PRECISION EQUIPMENT

WINDMILL HILL, RUISLIP MANOR MIDDLESEX AND AT 152-153 FLEET STREET, LONDON E.C.4

LARGE SCREEN TV.

THE RADIO CONSTRUCTOR'S 16 inch TELEVISOR

PART SIX

In earlier chapters of this series it was shown how an existing receiver could be modified from the last tuned circuit, and be connected to a modern detector, noise limiter and a very efficient video stage.

Unlike many vision strips which employ a cathode follower, it will be seen on p. 403, June issue, that both the CRT and the sync separator are fed with signals from the anode of the video amplifier (N78).

It was for this reason that the circuit shown was given from this point, so that the correct polarity required by the tube and sync separator could be obtained without any confusion. Reversal of the sync pulse is clearly illustrated by the fact that the output from the video stage remains positive for tube modulation but becomes reversed when connected to the cathode of the sync valve. Thus, the sync pulses are correctly polarised.

It has become very obvious, after reference to frequency considerations, that the great majority of TRF designs in general use will not be satisfactory in all areas.

A brief consideration from a geographical point of view will indicate other hazards in addition to the inherent limitations of TRF receivers.

This type of TV strip can be made to function with average resolution from Alexandra Palace (45 Mc/s), but what of Wenvoe? At 66.75 Mc/s such a set would almost certainly have had to be constructed for the lower sideband. Under these conditions, the coils in such a circuit designed for Alexandra Palace would have somewhere around seven turns. This probably allows something to take off in reaching up for the higher frequencies, but it would be a very " chancy " affair in any case, and without a complicated trap the sound channel would overlap the vision.

But what of those situated halfway between transmitters? Interference and radiation effects would be a serious problem, and the chances of resolving a picture to be proud of would become very slender.

Bearing these things in mind, it was decided to produce a first-class superhet of modern design capable of easy adaptation to any of the five channels, both sound and vision.

There is, of course, more than one way of doing this, but some obstacles were expected in achieving this *and* ensuring that one set of coils would cover all the transmitters concerned.

First and foremost, one cannot expect the home constructor to possess pattern, signal and sweep generators. In consequence, a design was required which would render station selection and alignment a simple process devoid of " hit-or-miss " procedure. The receiver seen here accomplishes this with genuine simplicity.

However, the first obstacle expected duly revealed itself in the fact that the coils required are quite impossible to make without the test equipment mentioned above. Several gauges of wire are required, with several types of coil formers and of screening cans. The only sensible technical and economical answer was to see that these coils were readily available professionally made.

Alignment and accurate resonance points depend entirely upon L12A and L12B. (Note: The coils marked A and B are on one former). This coil is transformer coupled and is tuned under severe laboratory conditions, to the sound IF of 23.25 Mc/s. (The vision IF is 19.75 Mc/s).

The purpose of this is obvious. The chances of tuning such a transformer to this frequency of 23.25 Mc/s by hit-or-miss methods is about equal to winning a football pool.

These coils, then, L12A/L12B will be obtainable pre-set as stated, and MUST NOT BE INTERFERED WITH.

As far as coils L1, L2A and L2B are concerned, the local sound transmitter may be tuned in simply by using Brass Slugs or Iron Dust Cores. (Brass slugs for the higher frequencies, iron dust cores for the lower).

An outline of the signal path will explain the ease with which correct resonance may be established from L12A and L12B.

The signal is fed to V1 (RF stage), V2 (Mixer and oscillator), and V3-V4-V5 (IF stages). The sound signal is taken from the tapped coil L5 and established accurately to the sound IF of 23.25 Mc/s at V6 by means of the much mentioned transformer L12A/L12B. From there, of course, it goes to the diode, noise limiter V8 and ultimately to the speaker after standard practice in audio amplification.

It at once becomes clear that with the sound IF pre-set, a definite reference point is established from which the entire strip, vision and sound, may be aligned.

As stated earlier, a rough setting of the cores in L1, L2A and L2B should at once render the sound channel audible, but if by any chance no audio is present, re-set the cores of L4 and L5. (Readers must, of course, establish that their circuitry is accurately constructed and that all valves are drawing both heater and HT current).

Alignment procedure is then as follows:—

Set the Sensitivity and Contrast controls to maximum.

Adjust L1, L2A and L2B until sound is heard.

Adjust L4 and L5 until sound is at maximum (Sound should now be at good volume, but will still be incorrectly adjusted).

Now adjust L1, L2A, L3, L4, L6 and L8, varying the Sensitivity control, until the brightest picture at this stage is obtained.

Re-adjust L5 until all traces of sound on picture disappear.

Now short out temporarily to chassis with a small screwdriver the control grid (g1) of V6.

Next, adjust L7 until sound on picture is again at minimum.

Remove the short from g1 of V6.

The receiver is now correctly aligned as far as sound on picture is concerned.

Now re-adjust L1, L2A, L3, L4, L6 and L8 until the test picture is obtained at Lowest Sensitivity. (Note: This is not necessarily at the brightest observable condition on the tube).

The Contrast control is placed at the centre of its range and the Sensitivity control is placed at an average setting for local conditions.

At the conclusion of the above procedure, and **ONLY THEN**, readers should carefully note the position of the screw slots in the slugs of L12A/L12B. Now, with great care, slightly adjust these two to secure maximum audio output.

Precautions

The aerial input arrangement to L1 was designed to safeguard all types of power pack supplies.

Where auto-transformer or mains metal rectifiers are to be used, the chassis is at mains potential.

To isolate the aerial from this condition the 1,000 pF condenser is included. This component should be the best obtainable and rated at an adequate working voltage. A good working formula for condensers for mains use is 3×DCW, thus on 230 AC mains this particular component should be rated for at least 750V wkg.

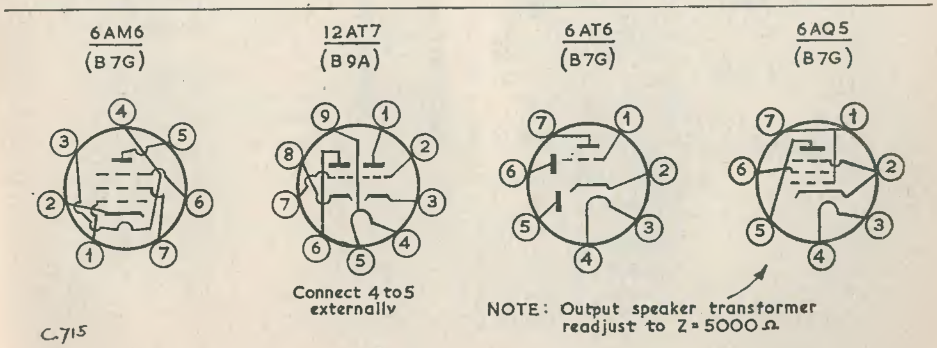
In any case, some precautions are advisable and a golden rule would be—Never adjust the aerial with the set working. Remove the aerial plug or completely disconnect the mains plug.

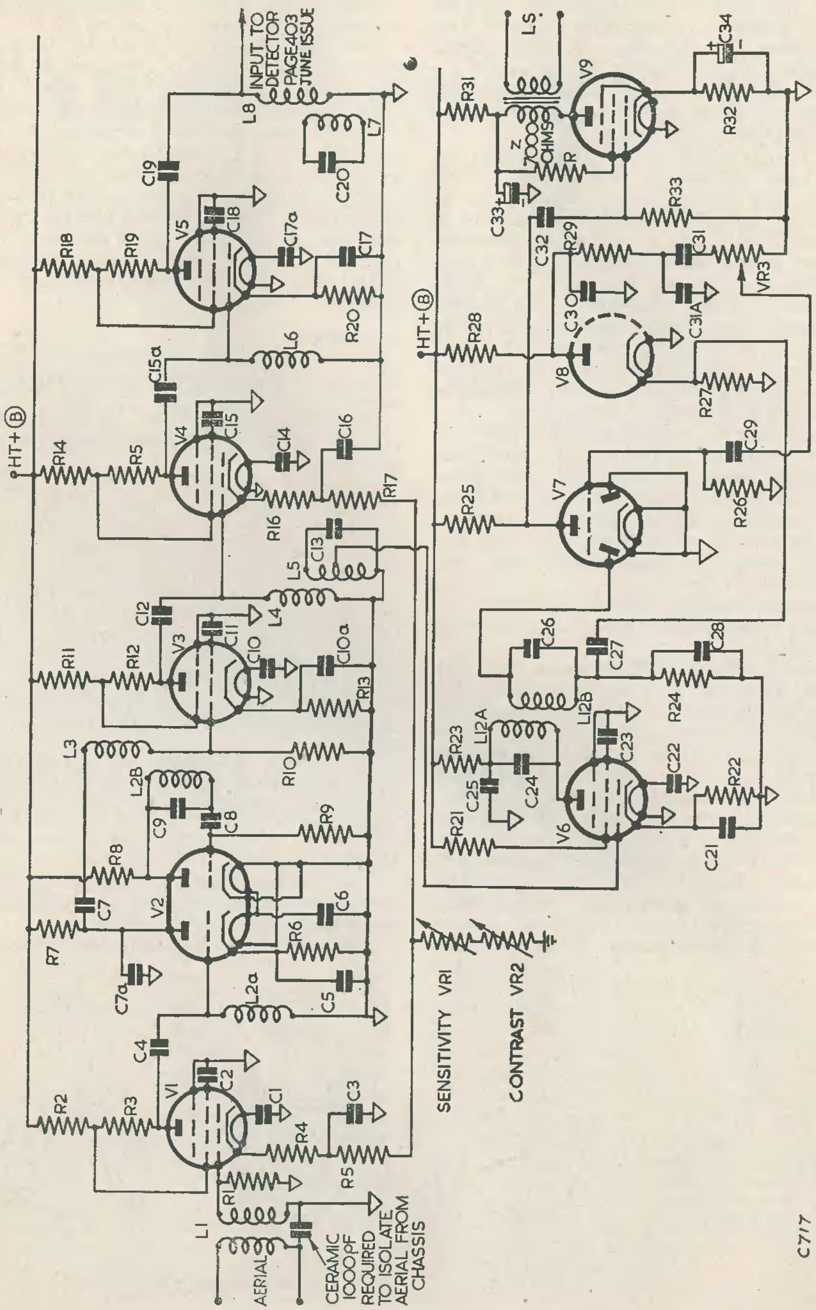
No aerial attenuator is provided. An average sensitivity level may be found for local area requirements from the alignment procedure.

General

It will be found that even with the Sensitivity control at minimum and the tube almost blacked-out, no loss of sync occurs.

This receiver is approximately sensitive to





Circuit of 5-Channel Sound/Vision Strip

20 μV. A general interpretation of this means that for a fully modulated picture its range is some 80 miles or more.

Without any idle claims, the " end product " is something to please the most fastidious of constructors. This will be demonstrated at the National Radio Show, where we understand that models will be on show on the stands of three well-known CRT and valve manufacturers.

Some trouble has been experienced with valveholders in the past. No such risk was taken with this receiver, McMurdo valveholders being used throughout.

When purchasing coil sets, readers should establish their requirements for L1, L2A, L2B by quoting whether brass slugs or iron dust cores should be supplied. The three wave wound correction chokes for the video stage are also available from the same source.

LIST OF COMPONENTS USED IN THE PROTOTYPE

R1	4.7 kΩ, ½W, Erie type 9
R2	1.5 kΩ, ,, ,, ,, ,,
R3	4.7 kΩ, ,, ,, ,, ,,
R4	32 Ω, ,, ,, ,, ,,
R5	100Ω, ,, ,, ,, ,,
R6	680 Ω, ,, ,, ,, ,,
R7	2.7 kΩ, ,, ,, ,, ,,
R8	22 kΩ, ,, ,, ,, ,,
R9	10 kΩ, ,, ,, ,, ,,
R10	2.7 kΩ, ,, ,, ,, ,,
R11	1.5 kΩ, ,, ,, ,, ,,
R12	6.8 kΩ, ,, ,, ,, ,,
R13	150 Ω, ,, ,, ,, ,,
R14	1.5 kΩ, ,, ,, ,, ,,
R15	2.7 kΩ, ,, ,, ,, ,,
R16	32 Ω, ,, ,, ,, ,,
R17	100 Ω, ,, ,, ,, ,,
R18	1.5 kΩ, ,, ,, ,, ,,
R19	3.9 kΩ, ,, ,, ,, ,,
R20	150 Ω, ,, ,, ,, ,,
R21	22 kΩ, ,, ,, ,, ,,
R22	150 Ω, ,, ,, ,, ,,
R23	1.5 kΩ, ,, ,, ,, ,,
R24	100 kΩ, ,, ,, ,, ,,
R25	220 kΩ, ,, ,, ,, ,,
R26	6.8 MegΩ, ,, ,, ,,
R27	1 MegΩ, ,, ,, ,, ,,
R28	220 kΩ, ,, ,, ,, ,,
R29	33 kΩ, ,, ,, ,, ,,
R30	100 Ω, ,, ,, ,, ,,
R31	1.5 kΩ, 1W, ,, ,, ,,
R32	270 Ω, ½W, ,, ,, ,,
R33	270 kΩ, ,, ,, ,, ,,
VR1	25 kΩ, Colvern
VR2	25 kΩ, ,,
VR3	500 kΩ, Morganite
C1	1000 pF, T.C.C., type SCT5 except in larger values.
C2	1000 pF, ,,
C3	1000 pF, ,,
C4	47 pF, ,,
C5	1000 pF, ,,
C6	1000 pF, ,,
C7	47 pF, ,,
C7A	10 pF, ,,
C8	47 pF, ,,
C9	22 pF, ,,
C10	1000 pF, T.C.C., type SCT5 except in larger values.
C10A	1000 pF, ,,
C11	1000 pF, ,,
C12	47 pF, ,,
C13	100 pF, ,,
C14	1000 pF, ,,
C15	1000 pF, ,,
C15A	47 pF, ,,
C16	10,000 pF, ,,
C17	1000 pF, ,,
C17A	1000 pF, ,,
C18	1000 pF, ,,
C19	47 pF, ,,
C20	320 pF, ,,
C21	10,000 pF, ,,
C22	1000 pF, ,,
C23	1000 pF, ,,
C24	10 pF, ,,
C25	1000 pF, ,,
C26	10 pF, ,,
C27	0.05 μF, ,,
C28	47 pF, ,,
C29	0.05 μF, ,,
C30	220 pF, ,,
C31	0.05 μF, ,,
C31A	200 pF, ,,
C32	0.05 μF, ,,
C33	32 μF, 500V wkg.
C34	50 μF, 12V wkg.

Aerial condenser 1000 pF ceramic
Valve Bases 6 — B7G, McMurdo
1 — B9A ,,

Speaker Transformer Electrovoice type 117
Coils, Video Correction Chokes,
"Denco (Clacton) Ltd."

V1	Brimar 6AM6,	Osram Z77
V2	,, 12AT7,	,, B309
V3	,, 6AM6,	,, Z77
V4	,, 6AM6,	,, Z77
V5	,, 6AM6,	,, Z77
V6	,, 6AM6,	,, Z77
V7	,, 6AT6,	,, DH77
V8	,, 6AL5 (½),	,, D77
V9	Osram N78,	Brimar 6AQ5

RADIO MISCELLANY

CENTRE TAP talks about

COIL BOXES—TVI and BCI

My remarks regarding the need for coil-boxes, to enable constructors to build receivers with a first-class communications type performance, have not passed unheeded. Denco, Ltd., manufacturers of a wide range of high-class amateur gear, are willing to co-operate in the production of suitable units if it promises to be an economic proposition.

From correspondence received from readers, there is obviously an increasing interest in the home-construction of a really flexible receiver which such coil-boxes would make possible. Commercial communications receivers are expensive, and the better of the ex-WD types are becoming scarcer. There is no reason why a home-built receiver with a range of suitable coil-boxes should not hold its own with both classes, and be more flexible than most of them.

To the present generation of hobbyists the workings of the superhet circuit is no longer a mystery, and at no time in the history of our hobby have there been so many amateurs capable of building the more elaborate receivers demanded by present-day conditions. For them, a range of coil-boxes would complete their last need in making a really superlative receiver possible.

For the beginner, construction would be simplified, and he would have a receiver of expandable tuning range which would form the heart of whatever receiver he might subsequently need to meet his most exacting requirements. Nor must it be overlooked that such a range of coil-units could well cover the broadcast and long-wave bands and, incorporated in the de-luxe radiogram for instance, would provide a flexibility unequalled by the most luxurious commercial model.

Simplicity

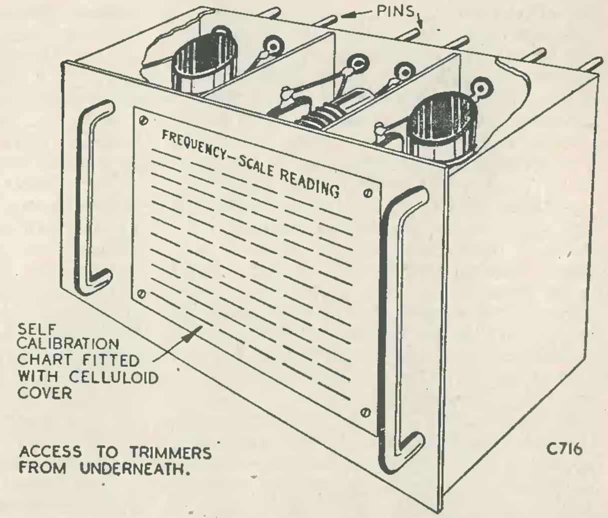
This column is read by, as it is indeed intended for, beginners as much as the expert, so perhaps for the sake of the novice a few words on the design and purpose of coil-boxes would not be out of place.

They consist of all the tuning coils for any single wave-range, built into a single unit complete with padders, trimmers, screening, etc., which can instantly be changed without disturbing the set in any way. Coil switching, with its attendant noisy and uncertain contacts, and wiring losses and complication, are thereby eliminated. Space is also saved by not having the idle coil ranges left inside the cabinet.

By using bandspread models, we can spread narrow sections of the short-wave spectrum over the whole dial, and thus we make considerable gains in the efficiency, compactness and flexibility of a receiver.

There is, however, one minor drawback. It is no longer possible to use direct calibration. That can be quickly overcome by fitting a self-calibrated chart on the visible side of the unit to show the frequency in relation to a numbered scale on the tuning dial.

£1-1-0 will be paid by this magazine to the sender of the most interesting and constructive letter on the subject of coil boxes. Envelopes should be marked "Coil Box" in the top left hand corner, and should reach us not later than July 30th.



Suggested design for a plug-in coil box.

Practical Design

A suggested design is shown in the illustration, and it is hoped this will provide a basis for all readers, beginner and expert alike, to let us have their ideas on just what points they would wish to see incorporated in their ideal coil-box. We are, of course, concerned only with the mechanical features. The style of winding, etc., is a job for specialists. If the design proves both economic and popular, coils from the Denco range or ones specially designed by them will be integrated.

The following points are suggested, and it is up to each interested reader to comment on, or add to them.

1. The unit should be interchangeable from the front panel, so that lid-opening or groping at the back is not necessary.
2. They should be primarily designed for mounting sub-chassis to enable short and direct wiring.
3. In the interests of neatness they should fit flush to the front panel.
4. The front, which will be visible externally, should have a chart for individual calibration, so that any given frequency can be found instantly.
5. Trimmers, padders, etc., should have their pre-set adjustments accessible from the underside for initial ease of setting, and they should be readily locked or sealed to obviate risk of disturbance upon removal and re-fitting.

Other Features

Now for the points on which readers' opinions are sought. For how many RF stages should they be designed, and what capacity tuning condensers would meet with most general approval? Can a simple design for semi-automatic ejection to facilitate interchangeability be suggested? Would there be a demand for a model with plain formers so that the experimentally minded can wind the coils to suit any particular requirement? Would an "across-the-chassis" assembly (to follow the line of the conventional ganged-tuning capacitor) be possible, instead of the "along-the-chassis" arrangement in the illustration?

The dimensions of the unit shown, exclusive of pins and handles, is 5″ × 2″ × 2″.

No doubt other points will occur to readers. If so, we want to hear about them. Even if you feel you are unable to add anything to what I have already outlined, your views will be welcomed so that the final design may be best suited to meet the needs of the progressive constructor. Please mark your envelope "Coil-box" and get down to writing to-night. Don't leave it to the other chap, and hope he has got the same ideas about it as you have.

TV Troubles

Those readers interested in TV will find a lot of valuable hints and tips on trouble-shooting in the recently published book *TV Fault Finding* (Amalgamated Short Wave Press, Ltd.). This useful handbook delves into the reason as well as the result of faults, and deals with the subject in plain everyday terms. Constructors who have the good fortune not to have recourse to diagnosing troubles with its help, will still find much useful information presented in a readable manner.

However, there is one trouble, apparently by no means rare, that is not covered in this comprehensive addition to TV literature. It concerns the deterioration of signals due to "poaching" by one's neighbour who erects his aerial nearby the site where you have yours, perhaps the opposite face of the same chimney stack. The cases of this which one hears about chiefly occur in or near the fringe areas, when the deterioration may be particularly noticeable as the receiver was already working all out before the second set was installed.

Nothing more can be done to coax more gain out of it, and the only course open to the victim is to add another RF stage or push the dipole a bit further heavenwards.

Such a happening is galling for the original viewer, who usually feels he has some cause for indignation by virtue of his "seniority"—doubly so if his aerial happens to be serving as a reflector for his neighbour and actually reinforcing his poached signal.

The same thing, of course, might easily happen with any metal object (water-pipes, conduits, etc.) installed nearby. These objects may absorb part of the signal, or their presence may cause reflections or spurious signals which appear on the screen as "ghost" images. As I see it, unless your neighbour is co-operative, you have to put up with what he leaves you. You can hardly order him to move his dipole from a position where he has every right to put it. If one could, one might find some self-important viewer telling the Gas Board to shift their gasometer 50 yards over to the right so that it no longer affects his TV reception!

B.C.I.

Complaints of interference from TV receivers in local broadcast sets are becoming more common. Receivers using electromagnetic deflection, as the overwhelming majority of them do, produce a strong field at the line and frame scanning frequencies. Without elaborate precautions it is not possible to confine them (and their harmonics) within the TV receiver cabinet.

Some manufacturers minimize this interference by screening the line scanning circuits in a metal box and/or by coating the inside of the cabinet with colloidal graphite. These measures certainly reduce the area of radiation, but not sufficiently to avoid location by Post Office Pirate Detection vans. The TV receiver in operation betrays itself over quite an area, perhaps up to a hundred feet, and the detection equipment tuned to the second harmonic (20.25 kc/s) can locate a pirate set with certainty by measurement of comparative signal intensity and bisection from the lines of two bearings. Even the twentieth harmonic of the line scanning frequency is strong enough to cause serious interference in a broadcast receiver next door.

The threat of the van and the viewers' guilty consciences brings hundreds of times more licence dodgers to heel than the actual detection. No doubt for this reason shots showing their "scenting out" powers were included in TV News Reels, and their purpose is boldly described in large lettering on both sides of the vans themselves.

The next, please!

A reader refers to my recent account of the invisible mending of a bakelite cabinet. He tells me he repaired a black bakelite case in a similar manner using a mixture of broken pieces of gramophone records dissolved in alcohol. Cap that, if you can!

Progress

A correspondent writes, "For years, whenever I have listened on the short waves I've heard nothing but static. Now I've got TV, I can watch it as well."

He doesn't make it clear whether he considers it worth the extra pound.

QUERY CORNER

A "Radio Constructor" Service for Readers

Phase Splitter

I am contemplating the construction of a push pull amplifier but I am at a loss to decide which is the best type of phase splitter to employ. Can you recommend a circuit which you consider the most suitable for use in a 10 watt amplifier?

A. Watkins, Leeds.

Of the many types of audio phase splitters at present in use, perhaps the simplest, if we neglect the centre tapped transformer, is the split load arrangement. This circuit will be familiar to most constructors as the type in which the valve load is equally divided between the anode and cathode circuits. This circuit suffers the disadvantages that the heater to cathode potential of the valve is rather high, and in order to avoid exceeding the maximum safe limit it is necessary to work with a fairly low value of HT voltage. This in turn limits the maximum output voltage which is obtainable from the phase splitter. Because of these disadvantages of the simpler circuit, we feel justified in recommending the arrangement shown in Fig. 1, which is usually termed the 'see-saw' phase inverter. It consists basically of two valves, one acting as a straightforward R-C coupled audio amplifier, whilst the second is fed from the output and has a considerable degree of negative feedback.

With the type of feedback employed, the input impedance of the valve is dependent upon the amplification of the stage. Now the output from the second valve is dependent upon its input voltage, which in turn depends upon the value of the potential divider feeding its grid. This divider is formed mainly by R1 and the input impedance of the second valve. Thus the value of the divider is dependent upon the amplification. The effect is very largely self compensating and the balance of the circuit is therefore not upset by changes in the valve characteristics. This is the main feature of the arrangement, but other advantages include a low heater to cathode potential of the valves and a very good signal handling capacity. If so desired, this type of phase splitter may be used to feed directly into a pair of output triodes without any intermediate amplification.

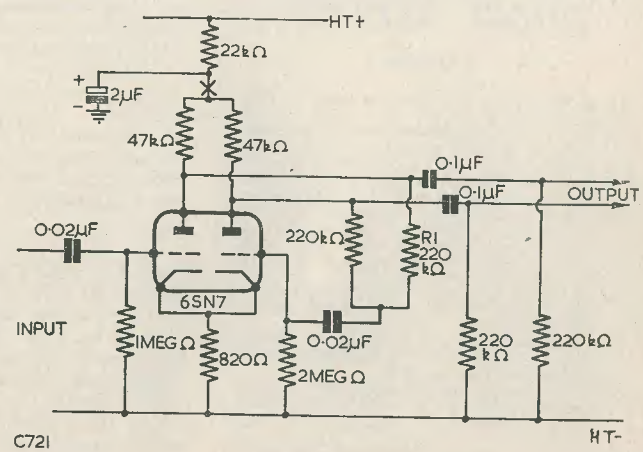


Fig. 1. The recommended phase splitter arrangement

So much for the more technical aspects of this method of phase splitting; now a few words about the practical problems involved in its construction. The two valves are best incorporated in one envelope, the double triode type 6SN7 being very suitable for the job. The circuit values quoted on the diagram will be found to give the best results, but it is as well to check the initial balance of the circuit. The balance is adjusted by means of the resistor R1. When carrying out this procedure a pair of low impedance headphones should be connected in the common anode lead at the point marked X on the diagram. Resistor R1 is then adjusted with the circuit in operation until the point of minimum signal is found in the phones, thus indicating the correct value for the resistor. Once balance has been obtained in this manner, it will be retained indefinitely, and the valve may be changed without the need for further adjustment.

Test Records

Whilst I can test the frequency response of my amplifier and speaker by means of a variable audio oscillator, this gives no indication of the response of the pick-up. Are test records available for this purpose?

R. Anderson, Norwich.

The Decca Record Co., 1-3, Brixton Road, London, S.W.9, manufacture a series of fixed and gliding tone records which are designed specifically for checking the response of gramophone equipment.

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.

Simple Noise Limiter

As I am forced to do much of my radio listening with head-phones, I am particularly troubled by short bursts of interference which are frequently quite deafening. Can you recommend a simple self-adjusting noise limiter which I can incorporate in my five valve superhet?

E. Unwin, Cardiff.

Noise limiters of the type which adjust themselves automatically to the signal level are very suitable for use in receivers which are subject to short bursts of interference of a transient nature. Car ignition interference comes within this category, as does the click which occurs when a light switch is operated. This latter form of single pulse interference can be particularly annoying when headphones are in use with the receiver.

A circuit diagram of a simple self-setting noise limiter is shown in Fig. 2. The limiter is included in a typical diode detector arrangement of a superhet but, as will be explained later, it s equally suitable for use with anode bend or infinite impedance detectors.

The mode of operation is simple, and is as follows. The detector load is divided into two equal parts R1 and R2, the anode of the noise diode being taken to the centre point. The cathode of the diode is returned via R3 and R4 to the upper side of the load resistors, so that under normal working conditions the cathode is maintained at a negative potential with respect to the anode. The noise diode is normally held in the conductive condition, and thus the signal is passed on through the diode and C2 to the first audio amplifier. Upon the reception of an interference pulse the upper end of the diode load resistor is driven further negative, but because of the time constant R3/C1 the voltage at the noise diode cathode remains substantially unchanged and the diode becomes non-conductive for the duration of the pulse. Under steady working conditions the cathode of the diode takes up a steady negative potential which is proportional to the mean signal level, and the valve is therefore held in conduction until the arrival of a noise pulse.

The circuit arrangement when an anode bend detector is used is exactly the same, it being the anode load resistor which is centre tapped for the diode anode. In the case of the infinite impedance detector, the signal at the cathode of the valve is positive going hence the noise diode must be reversed, the cathode being taken to the centre tap of the load resistor. Apart from these modifications the circuit arrangement remains unchanged.

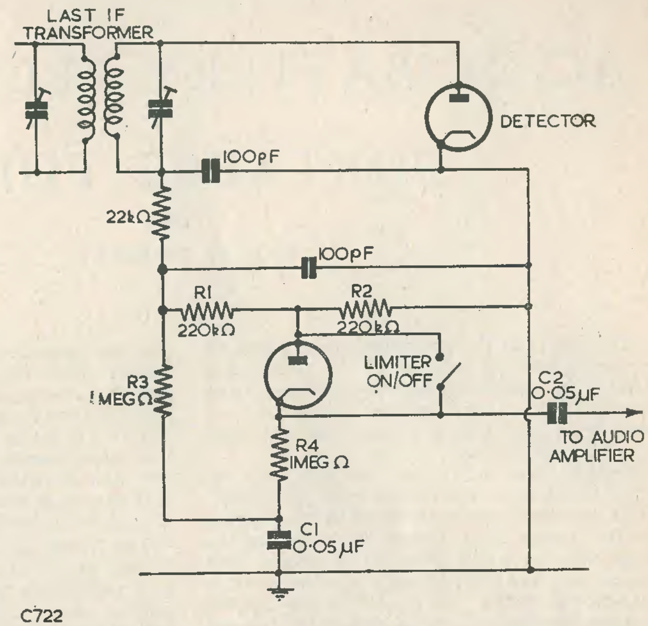


Fig. 2. Noise limiter. Suitable diode: EA50, EB91, 6AL5, 6H6

There is only one disadvantage of this type of self-setting series limiter, namely that because of the necessity of tapping the detector load there is a loss of signal voltage of 50 per cent. When a new receiver is being designed this can easily be overcome by adding further AF amplification. With a receiver which is being modified, the additional gain which is required can sometimes be obtained by increasing the audio load resistor or by reducing the negative feedback. This matter can, however, only be decided with the knowledge of the particular set.

Electronic Timer. (June issue)

Many readers have written in enquiring if a substitute can be used for the 40 kΩ relay, as there is some difficulty in obtaining these.

20 kΩ relays having a pull-in current of about 2 mA are more readily available, and these may be used providing the values of two resistors are changed. The required alterations are: R4—22 kΩ and R5—22 kΩ.

WIN A 16in. LARGE SCREEN CRT!

An English Electric T901 16" cathode ray tube, as used in the Large Screen TV receiver now being described in these pages, will be presented to the sender of what is adjudged to be the most suitable title for this receiver.

Entries should be made on a postcard, marked "TV" in top lefthand corner of message side. Wording should be limited to the suggested title, and the sender's name and address. Entries to arrive at A.S.W.P. Ltd., 57 Maida Vale, London, W.9., not later than first post, 21st July.

In the event of the winning title being submitted by more than one entrant, that first scrutinised shall be the winner. The Editor's decision will be final.

Note: The winning entrant must be prepared to arrange for the collection of the CRT from our offices.

AC/DC/BATTERY "ECONOMY" PORTABLE FOUR

by D. W. DRAKELY

The design of the portable receiver about to be described was evolved as the result of a need for a receiver for holiday use, away from home, and combining the advantages of sensitivity, low initial outlay and moderate cost of maintenance.

Despite their advantage on the score of weight and size, receivers of the "personal" class were excluded from consideration owing to the limited capacity and high cost of the tiny batteries which have to be used. This factor may lead to a running cost of as much as sixpence an hour. The use of a larger receiver enables batteries of greater capacity to be used without, necessarily, any increase in battery drain, resulting in a considerable saving in running cost. The "all-up" weight may be kept to a minimum by the use of "layer" type batteries for HT such as the "Battrymax" or "Drymax" series, which combine a long life with moderate dimensions.

To avoid the use, whenever possible, of inconvenient and unsightly "throw-out" aerials, it was intended to use a frame aerial and, since the efficiency of such an aerial is directly proportional to the area enclosed by the loop, it is obvious that the tiny frame which is all that can be accommodated by the "personal" receiver places it at a serious disadvantage on the score of sensitivity in comparison with a receiver of more generous proportions. Sensitivity is a major factor in a receiver for holiday use, when local station reception is often impossible.

In the event, it was found possible to combine all these various requirements in a chassis which fitted into a case approximately 10″×8″×6½″, which compares favourably with the dimensions and performance of many commercial products.

Circuit

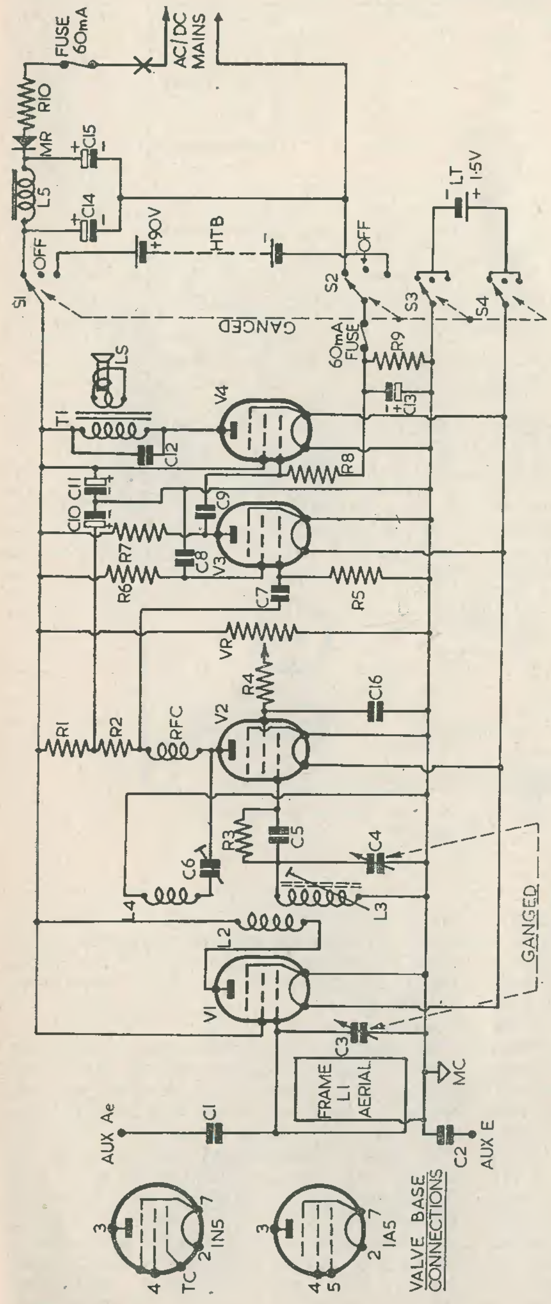
In the interests of low initial cost, a four valve TRF circuit, covering the medium waveband only, was selected, as shown in Fig. 1, using a 1N5 pentode RF amplifier, coupled to a 1N5 reacting pentode grid detector, followed by a further 1N5 operating as an AF voltage amplifier feeding a 1A5 pentode output valve. All these valves are part of the octal based small "GT" range, and are available cheaply in the surplus market. Greater output can be obtained if desired by the substitution of a 1Q5 as output valve, but this change naturally results in increased HT consumption.

The frame aerial, consisting of 18 turns of 26 swg silk or cotton covered wire, is wound with the turns lying neatly side by side on the outside of the case, close to the front edge, and protected with a wide band of cellulose adhesive tape. It forms the tuning inductance of the RF stage, which is coupled inductively to the detector by a Denco Range 2 (green) coil, having a reaction winding and an adjustable dust-iron core which will be found invaluable for adjusting the inductance to match that of the frame aerial. The inductance of the coil is 270 µH, adjustable within limits of ± 15 per cent. by means of the iron core.

The two inductances are each tuned by one section of a small 350 pF two-gang capacitor.

The arrangement of the detector stage follows normal practice, except that the reaction control is preset by means of a 100 pF trimmer capacitor (C6) and the efficiency of the detector stage as a whole is controlled by variation of the screen voltage of the valve by means of VR. Both AF couplings are of the resistance-capacitance type and bias for the output valve is obtained from R9 which is inserted in the HT negative lead, and by-passed by C13.

The only remaining point of interest in the design is the inclusion of the components R10, MR, L5, and C14, C15, to form a built-in unit for deriving HT current from the mains, where available, as an additional means of battery economy. In view of the comparative cheapness of battery LT supplies and the difficulty of obtaining adequate smoothing for filament current for battery valves, it was

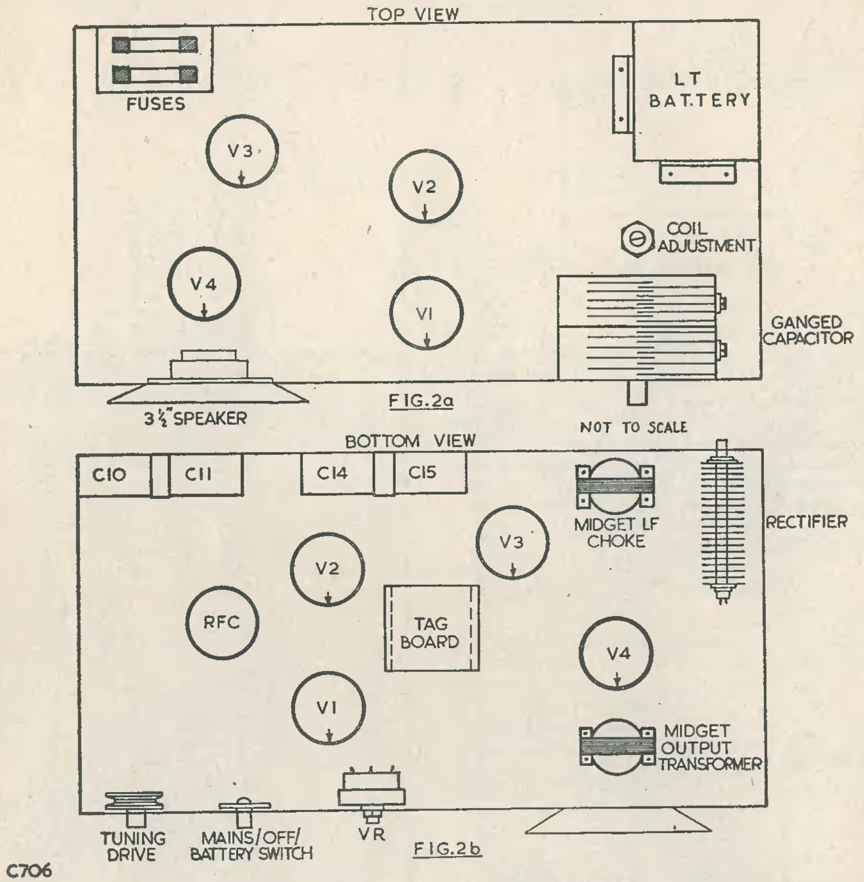


C705

Component List

VR,	500 kΩ pot.	L1,	Frame aerial, 18 turns 26 swg DSC
R1,	27 kΩ	L2, 3, 4,	Denco Range 2 Green Coil
R2,	270 kΩ	L5,	AF Choke, 10 H, 60 mA
R3,	2 MegΩ	MR,	Selenium Rectifier, 150V, 30 mA
R4,	1.2 MegΩ	C1,	100 pF 350V wkg.
R5,	1.2 MegΩ	C2,	0.01 µF 350V wkg.
R6,	1.2 MegΩ	C3,	350 pF variable } ganged
R7,	270 kΩ	C4,	350 pF variable
R8,	470 kΩ	C5,	200 pF
R9,	470 kΩ	C6,	100 pF preset
R10,	10 kΩ 2W	C7,	0.01 µF
HT Battery,	"Battrymax" B107 90V	C8,	0.1 µF
LT Battery,	"Alldry 4" 1.5V	C9,	0.01 µF

C10,	8 µF 250V electrolytic
C11,	8 µF 250V electrolytic
C12,	0.001 µF
C13,	25 µF 25V wkg. elect.
C14,	8 µF 350V electrolytic
C15,	8 µF 350V electrolytic
C16,	0.1 µF
V1,	1N5GT
V2,	1N5GT
V3,	1N5GT
V4,	1A5GT



decided to retain LT supplied from a battery, even when the HT is being derived from a mains source. The batteries are switched by a four-pole, three-way wafer type switch, such as the Oak or Yaxley pattern, which is fitted with a pointer knob and arranged so that in the centre (Off) position, both poles of both batteries are disconnected, and the remaining positions connect LT battery and HT battery, or LT battery and mains HT, as required. Using the specified valves, the HT consumption is under 10 mA and the LT consumption 200mA and this is well within the capacity of the batteries, so that long life is assured. Naturally, to conserve the HT battery, all tests and adjustments are carried out using HT supplied from the mains. *It should be noted that the HT supply is AC/DC when connected to the mains, and the usual precautions should be taken, in particular the isolation by capacitors of the frame aerial, and any external aerial or earth, from direct connection with the supply mains, the chassis being "live" under such conditions.*

Construction

To simplify construction, and to avoid the intricate shapes often assumed by the chassis of portable receivers, the whole of the receiver, except for the frame aerial, was assembled on a standard aluminium chassis 10″×6″×2½″. The layout employed is shown in Figs. 2a and 2b, but this was found to be in no way critical and minor variations to meet individual requirements may be introduced. Fig. 3 shows the disposition of chassis and batteries in the case, which was constructed of hardboard. This may, if preferred, be covered with rexine or leathercloth. The front panel

is also of hardboard, but reversed to show the textured surface, which contrasts pleasantly with the remainder of the cabinet. A drum drive is used, together with a dial mounted by brackets on the chassis and viewed through a perspex or celluloid window in the panel. The use of a 2″ drum gives a reduction ratio of about 8–1, which is adequate for most purposes.

Performance

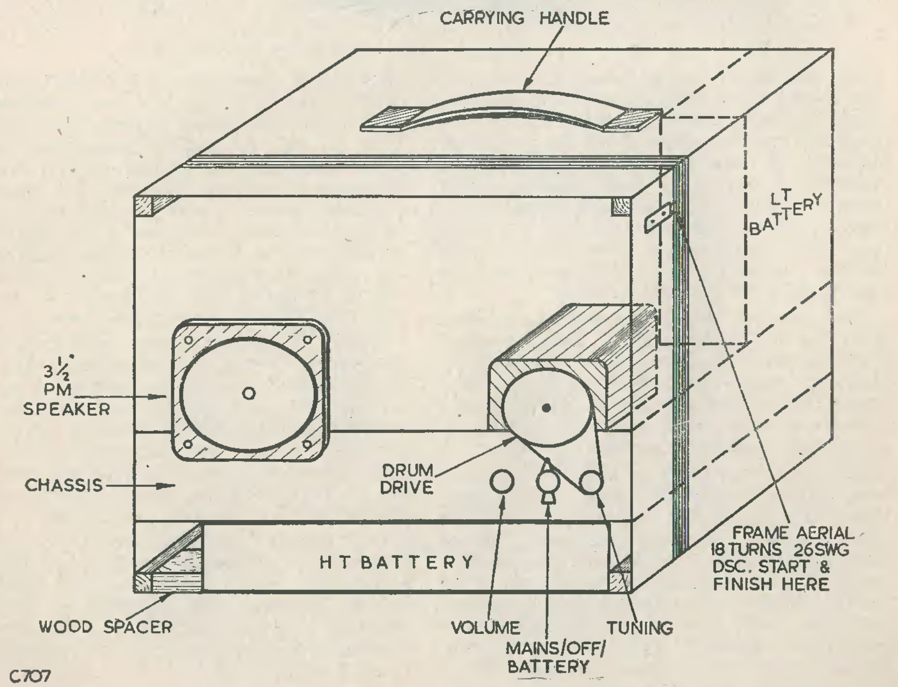
In London and the Home Counties, reception of all three BBC transmissions was good, and some continental stations were also received at useful strength. Provision is made for connecting an auxiliary external aerial and earth for use when required in poor reception areas, by means of the usual socket strip mounted on the side of the case.

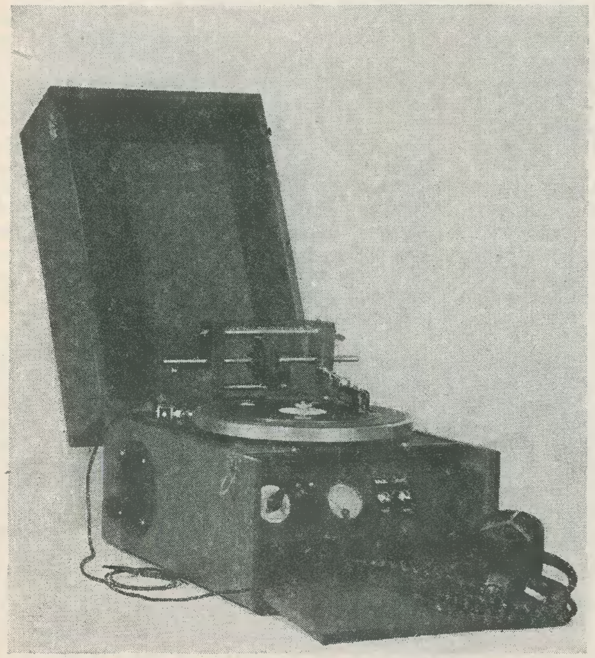
Selectivity is good, but if some deterioration in this direction can be tolerated, increased sensitivity can be obtained by substituting choke-capacitance coupling between V1 and V2. This is done by disconnecting L2 and replacing it by a medium wave RF choke, and connecting a 100 pF mica capacitor from the anode of V1 to the grid end of L3. Some sacrifice of selectivity can be accepted in view of the directional properties of the frame aerial, which can often be utilised to eliminate any unwanted signal.

Adjustment and Operation

When the wiring of the receiver has been completed, the chassis should be fitted into the case, upon which the frame aerial has been wound, as previously described. A reasonably efficient auxiliary aerial should then be connected, through a 100 pF capacitor, to the grid end of L3, any trimmers fitted to the gang capacitor fully unscrewed, and the iron core of the coil set to a mid position. Efforts should then be made to tune in the BBC Home Service transmission on 330m, the preset reaction capacitor, C6, being fully screwed home for maximum capacity and the volume control VR being adjusted to the fullest extent possible, without oscillation.

On tuning in the 330m BBC transmission, the external aerial may be removed and the set positioned so that the plane of the frame aerial is in line with the Brookmans Park transmitter. Under these conditions, a signal of moderate strength should still be received, and the adjustment of the iron core of the coil may then be varied to obtain maximum volume. Although this rather unorthodox method of trimming ignores, and makes no adjustment for, stray capacitances, it will nevertheless be found that the ganging holds satisfactorily over the whole waveband.





TRADE REVIEW

TAPE OR DISC?

The fascinating art—or should it be science?—of Sound Recording has made rapid strides during the last few years, and the revival of magnetic tape has done much to popularise the field of this intriguing subject. As a medium for recording, tape has lain more or less dormant since the early years of the century. It has now emerged with its oxide coat and, with a good clean input plus a suitable sprinkling of "ultra-sonics," is capable of quite excellent quality.

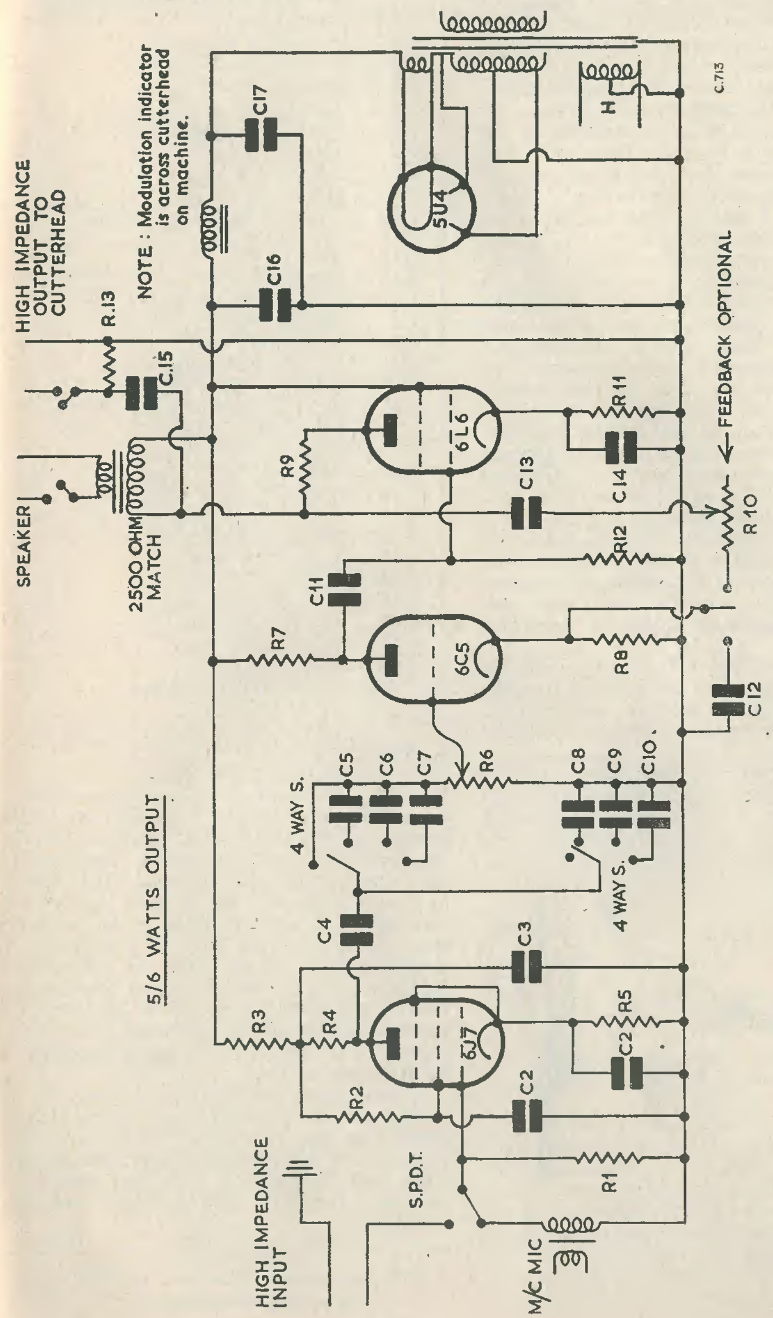
The embryo recording enthusiast often faces the initial problem of Tape or Disc. With modern equipment, there is little to choose in results from the "quality" aspect nor, indeed, is there any appreciable difference in running costs unless, of course, recordings are not permanently required.

Disc recordings made on lacquer "blanks" with modern equipment bear little resemblance to the earlier uncoated aluminium disc in general use some years ago. These were "cut" with a steel cutter and had to be generously greased over before use. The "end product"—very limited in its frequency response, and with copious background noise—was accepted more for its novelty appeal than for its aspersions to high fidelity.

The modern direct recording is exactly similar in appearance to the ordinary commercial record, and can cover a range from 50 to 9,000 c/s with no audible background noise. It is, indeed, much quieter in this respect than most commercial records. On playback it will have quite a long life, provided that a lightweight pick-up is used. Pressings can be made from these recordings, producing any required number of copies and these are, of course, exactly identical in every way with the ordinary commercial discs.

Disc and tape equipment each have their relative merits and, used separately, each has its limitations. As a team they form a perfect combination, and nothing but harmony can emerge from a wedding between Mr. Disc and Miss Tape. We award the Mr. to the disc, because he is the heavier of the two and has to perform rather more forcefully than his partner (any comments, Ladies?).

In "cutting" a blank we are, in effect, engraving a groove in the lacquer, and an appreciable amount of power is absorbed by this process. The turntable must have adequate "drive" and momentum, necessitating a comparatively powerful motor and heavy turntable.



Circuit for a suitable disc recording amplifier, recommended by Kine-Technic Services Ltd. For component values see table on next page

An attachment to fit to an ordinary electric gram is a possibility but, if you want first class results, make sure that your existing gram motor and turntable is above the average, otherwise you will run into serious trouble.

It is this weight and power requirement—essential to a disc machine—that adds to its production cost. The tape machine is far less greedy in this respect. Both units are, of course, precision built, although neither need have complicated "mechanics." Basically, of course, a disc machine comprises the turntable, a suitably mounted motor, cutting head and stylus, and some means of traverse mechanism whereby the cutting head is made to progress smoothly and evenly across the recording area. Most of the professional disc machines have several refinements—often quite unnecessary to the amateur—and it is these refinements that add considerably to the cost of the equipment and often puts it outside the reach of the average amateur.

With these points in mind, we have recently carried out some tests on two machines manufactured by Kine-Technic Services, Ltd., of 60 Aylward Road, London, S.W.20.

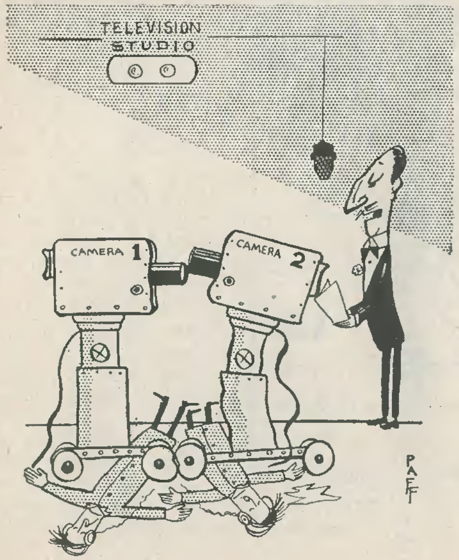
This company produces two basic machines; each is available as a recorder only, for use with existing amplifier equipment, or complete with microphone, amplifier and associated apparatus to form a complete recording channel.

The Cine-Vox Type C7 (listed at £50 for Recorder only) is a fully professional machine and has a most impressive performance. For amateur requirements, however, we were more interested in the Type C7J—a junior version of the C7. This machine has an excellent frequency response, but retains only a minimum of refinements. It is similar in design to the C7, but is more lightly built and uses a direct belt drive to the turntable rim. As a Recorder only, it is available in chassis form, without case, at £30, which brings it into line with a good quality tape desk. A modified Type C7 in kit form will shortly be available to the home constructor. The price is not yet fixed, but is expected to approximate to £26.

If you have any particular problems in mind, or want any information on any matters relative to disc recording, K.T.S. Ltd., will, we know, be very pleased to have your queries. They will supply you with full details of coupling networks and suitable amplifier circuits.

COMPONENT VALUES

R1	500 kΩ, ½W
R2	1 MegΩ, 1W
R3	30 kΩ, 1W
R4	250 kΩ, 1W
R5	1.5 kΩ, 1W
R6	500 kΩ, volume control
R7	100 kΩ, 1W
R8	1.5 kΩ, ½W
R9	100 Ω, 1W
R10	1 MegΩ, feedback control
R11	170 Ω, 1W
R12	250 kΩ, ½W
R13	100 kΩ, ½W
C1	0.25 μF, 350V wkg.
C2	50 μF, 25V wkg.
C3	8 μF, 500V wkg.
C4	0.1 μF, 500V wkg.
C5	0.005 μF, 500V wkg.
C6	500 pF, 500V wkg.
C7	50 pF, 500V wkg.
C8	0.01 μF, 500V wkg.
C9	0.005 μF, 500V wkg.
C10	0.001 μF, 500V wkg.
C11	0.1 μF, 500V wkg.
C12	50 μF, 25V wkg.
C13	1 μF, 500V wkg.
C14	50 μF, 25V wkg.
C15	0.25 μF, 500V wkg.
C16	16 μF, 500V wkg.
C17	16 μF, 500V wkg.
Mains Transformer,	350-0-350V at 120 mA, 5V at 3A, 6.3V at 4A.
Smoothing Choke,	20 Henry, 100 mA.



"*Will anyone who saw the accident please telephone Whitehall* 1212."

Abbreviations, Symbols and Simple Formulae

USED IN RADIO AND ELECTRICAL CIRCUITS PART 2

Compiled by H. E. Smith, G6UH

(The following data has been compiled at the request of a number of readers, and will, it is hoped, be of assistance to the beginner and to the more advanced reader who has no ready access to all of the information given. The symbols have been grouped in order to provide a quicker reference).

Commonly used Abbreviations

As applied to Valve Circuits *—continued*

Z,	Impedance (Ohms).
M,	Mutual Inductance.
Xl,	Inductive Reactance, (Ohms).
Xc,	Capacitive Reactance (Ohms).

As applied to Valve data (British)

m or mu,	Amplification Factor.
Ef,	Filament or Heater Voltage.
Eg,	D.C. Grid voltage.
Ea,	Anode voltage.
Es,	Screen voltage.
Ek or Ec,	Cathode voltage.
Ia,	Anode current.
If,	Filament or Heater current.
Ig,	Grid current.
Is,	Screen current.
Ik or Ic,	Cathode current.
Ra,	Anode resistance.
RL,	Load Impedance in anode circuit.
mA/V or g,	Mutual conductance (Slope).

As applied to Valve data (American)

Eg,	Grid Voltage.
Gg,	Grid conductance.
rg,	Grid resistance.
Ec,	Grid bias voltage.
Gp,	Anode conductance.
rp,	Anode resistance.
Gm,	Mutual conductance.
μ,	Amplification Factor.
Ef,	Filament voltage.
Cgp,	Grid/Anode capacitance.
Cgk,	Grid/Cathode capacitance.
Cpk,	Anode/Cathode capacitance.
Cg,	Input capacitance.
Cp,	Output capacitance.

Quantitive Symbols

Y or y,	Admittance.
K,	Dielectric constant.
W,	Energy.
B,	Magnetic flux density.
N or n,	Number of turns.
μ,	Permeability.
P,	Power.
Q or q,	Quantity of electricity.
v,	Reluctivity.
n,	Speed of rotation.
H,	Magnetic intensity.

Abbreviations for instrument wires

DCC,	Double cotton covered.
SCC,	Single cotton covered.
TCC	Treble cotton covered.
SSC,	Single silk covered.
DSC,	Double silk covered.
Enam.,	Enamelled.
SPC,	Single paper covered.
DPC,	Double paper covered.
Brd.,	Braided.
HD.	Hard drawn.
SD,	Soft drawn.
Pl. cu.,	Plain copper.
TC.	Tinned copper.
swg,	Standard wire gauge.
BWG,	Birmingham wire gauge.
B & S,	Brown and Sharps gauge.
VC,	Varnished Cambric (Empire Tape.)

Output Transformer Ratios for given anode load impedance and speech coil impedance

A quick reference to some of the more usual matching ratios required in small amplifiers.

Anode Loading (in Ohms).	*Speech Coil Impedance (Ohms).* 3	5	10	
4000	36:1	28:1	20:1	Ratios
5000	41:1	31:1	22:1	
6000	45:1	34:1	24:1	
8000	50:1	40:1	28:1	
10000	58:1	45:1	31:1	

For two valves operating in push-pull, the total load impedance may be reckoned as being twice that of a single valve. The simple equation for calculating the required output transformer ratio is:—

$$(\text{Ratio}) = \sqrt{\frac{\text{Load impedance (in ohms)}}{\text{Speech Coil impedance (in ohms)}}}$$

Power in Watts

Power in AC and DC circuits is calculated in the following simple manner. For DC circuits:—

$$P = E \times I \text{ or } I^2 R.$$

For AC circuits (single phase):—

$$P = E \times I \times \cos \varnothing$$

(equivalent $\cos \varnothing$ = Power Factor = cosine of the angle of lag between voltage and current in a sine wave).

The foregoing list is not intended to be a complete guide to all the abbreviations and formulae met with in modern radio practice, but has been compiled as an aid to the beginner in interpreting diagrams, and sorting out some of the simpler problems.

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(*ii*) Damage to your property or that of your landlord arising out of the breakage or collapse of the Aerial Fittings or Mast, but not exceeding £500.

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IF TRANSFORMERS
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