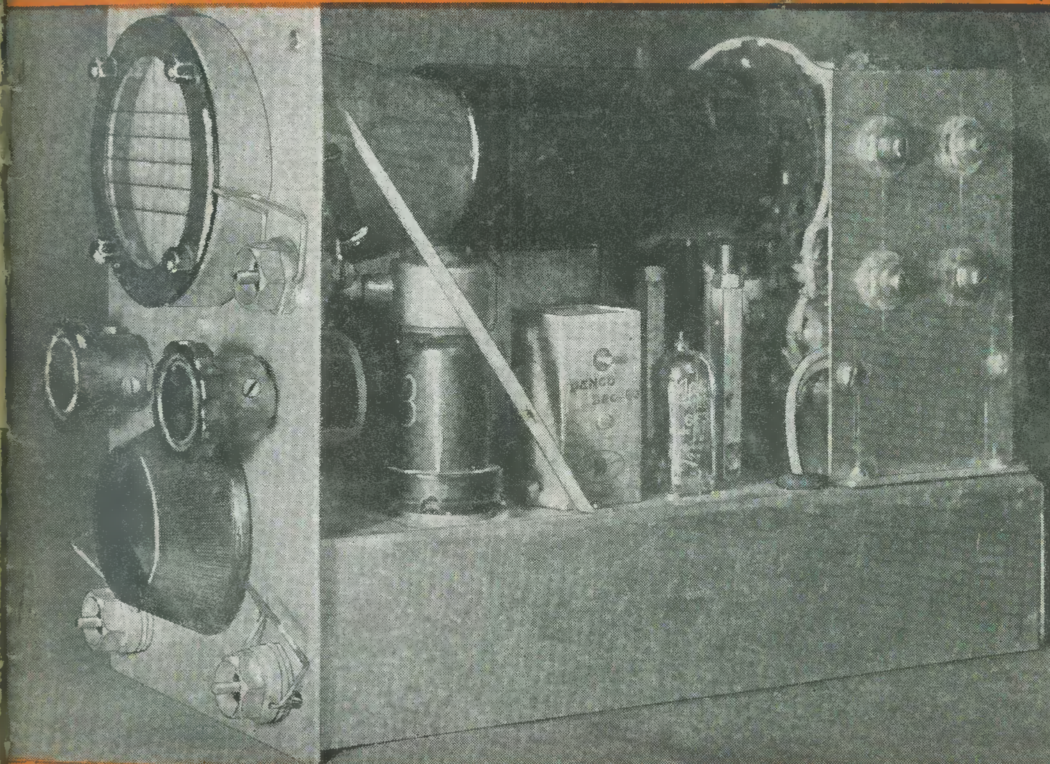
Published by Amalgamated Short Wave Press Ltd. 57 Maida Vale, Paddington, London W.9 and Printed by A. Quick and Co. Ltd., Jackson Road, Clacton-on-Sea.

SCOPE

Vol. 5
Number 2
SEPT.
1951

RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



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Radio Constructor

Vol. 5, No. 2 **Annual Subscription 18/-** **September, 1951**

Editorial and Advertising Offices—57, Maida Vale, Paddington, London, W.9
Tel. CUNningham 6518.

Edited by C. W. C. OVERLAND, G2ATV

CONTENTS

Editorial

The National Radio Show is taking place whilst this magazine is being printed and distributed. This event can be said to open the radio constructor's season, for it seems to be a fact that activity does drop during the warmer months, for obvious reasons.

What will you be doing this winter? Our guess is, much the same as last. Maybe you'll try something different, as far as you personally are concerned, but there will be no additional fields. This is not to say that the activity in some fields will not increase.

We think, ourselves, that TV will continue to be popular, though on a somewhat smaller scale than hitherto. Magnetic recording is a bit of a problem for the average radio man—he just hasn't the necessary skill and equipment, by and large, to tackle the mechanical side efficiently. But he can buy a deck, and still have plenty of fun from the electronic side.

A subject which appears to be of increasing interest, as far as we can judge, is the radio control of models. Here, again, we come up against the problem of the mechanical side, but this can be solved by co-operation with a model engineer. The latter, usually, is lost on the radio side, which is our speciality. In this issue appears an introduction to a series of articles on this topic. We shall be pleased to receive comments and suggestions from interested readers.

G2ATV.

NOTICES

THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid. Articles should be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtmen 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.

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

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

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. 10: A Midget 2-Valve AC/DC Receiver

This circuit is suitable for a two-valve "midget" receiver and takes advantage of the small size of the 117L7 or 117L7GT to give a compact layout.

As the 117L7 takes a heater current of 0.09 amps, it would be necessary to use a parallel resistor to enable it to work in an AC/DC receiver with other mains valves. In this particular circuit, this problem is overcome by using the cathode current of the 117L7 to heat a separate 1.4 volt valve.

Circuit Details

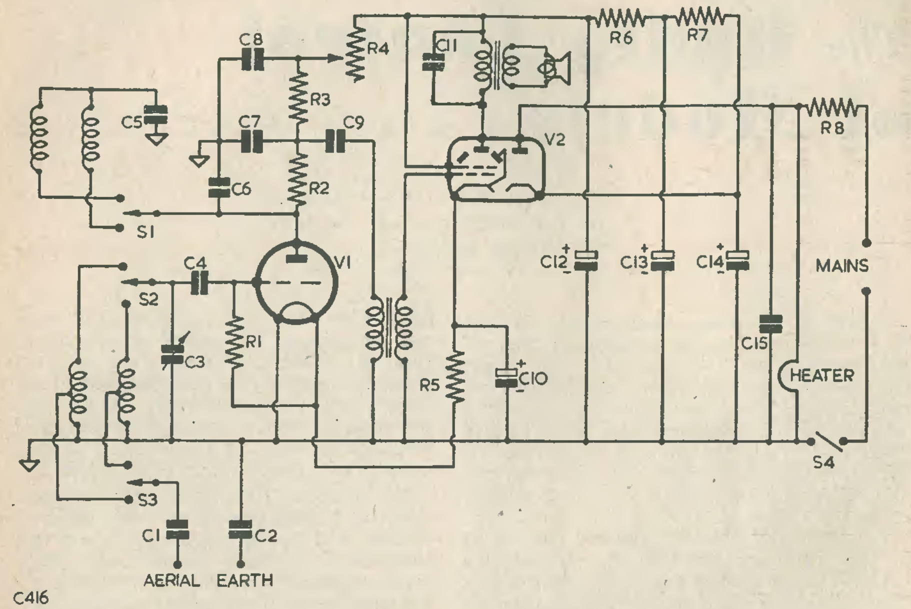
The circuit is very straightforward, the aerial feeding into a leaky-grid triode detector with reaction, the latter being controlled by the potentiometer R4. A midget "intervalve" transformer is shunt-fed by the triode, its secondary being connected to the output valve, which is part of the 117L7. The transformer should have a ratio of between 1 : 3 and 1 : 6 inclusive.

To prevent the loss of too much HT voltage and to avoid using a bulky choke, a slightly unorthodox smoothing circuit is shown in the diagram, this consisting of three capacitors connected together by low value resistors. No rectifier limiting is needed here as the input impedance offered to the rectifier anode is fairly high. It will probably be found, after the 117L7 has warmed up, that the additional HT current will cause too great a voltage drop in the line-cord, R8, to enable the requisite 117 volts to be obtained across the heater. When the output stage has been completed, the value of R8 should be experimentally reduced until correct working is obtained.

With 5.2 volts grid bias the cathode current of the 117L7 should be approximately 47 mA. As different valves will present slight variations on this figure, a 28 ohm resistor should be connected up temporarily in place of the filament of V1 to ascertain that the correct current is flowing, and thus prevent any accidental burn-outs. A voltage of 1.4 (or very slightly less) should be built up across this resistor. The cathode current of the 117L7 may be increased by reducing the value of R5 and vice versa. (V1 should not be connected until both R8 and R5 have been correctly adjusted).

Construction

The circuit may be built up in very compact form and, apart from the usual requirements of using short connecting leads, etc., needs little attention to layout. However, it should be remembered that the 117L7 dissipates a large amount of heat, and good air circulation is needed around this valve. The intervalve transformer should not be mounted close to the aerial coils or to the speaker transformer. To prevent interaction, the axes of the transformers and the aerial coils should all be at right angles to each other.



Midget 2-Valve AC/DC Receiver

Component Values

C1	— 0.001 μF, 500 W.V.	13, 14.	— 16 μF, 250V. Wkg.
C2	— 0.01 μF, 500 W.V.	C15	— 0.01 μF, 500V. Wkg.
C3	— 500 pF, solid dielectric.	R1	— 500 kΩ
C4	— 200 pF.	R2	— 10 kΩ
C5	— 300 "	R3	— 100 kΩ
C6	— 200 "	R4	— 100 kΩ
C7	— 200 "	R5	— 76 Ω
C8	— 0.01 μF	R6	— 200 Ω
C9	— 0.01 μF.	R7	— 200 Ω
C10	— 25 μF, 25V. Wkg.	R8	— 1,340Ω line cord (see text)
C11	— 0.002 μF.	V1	— 1G4
C12,		V2	— 117L7 or 117L7GT

TELEVISION INTERFERENCE. Published by the Incorporated Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1. Price 2/–, postage 3d.

This is one of the well-known "Amateur Radio" series, and it deals with a subject which is becoming of geat importance to every amateur transmitter. As television spreads, and the viewing hours become longer, more and more transmitters find that they are causing interference and have to "go QRT" for longer periods. This need not be so in most cases—the remedy is to clean up the transmitter, to stop harmonic radiation, and in some cases to fit filters to the televisor. TV design is at fault in some instances, when the trouble is best dealt with by the manufacturer.

All the above problems are dealt with in a lucid manner by this booklet. There is also a very useful appendix listing some 500 commercial televisors, and giving in each case details of the circuit and the sideband used, and, where applicable, the IF and oscillator frequencies in Mcs, and the vision and sound image frequencies. G2ATV.

The Radio Control of Models . . .

By A. C. GEE, G2UK.

THE FIRST OF A SERIES OF ARTICLES ON THIS SUBJECT, WHICH WE HOPE TO PUBLISH BI-MONTHLY.

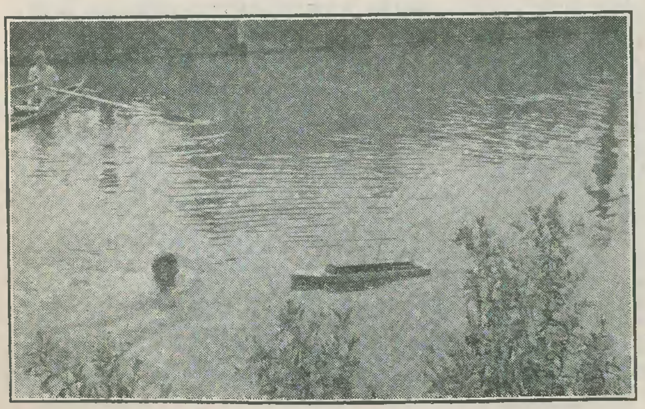
ONE of the latest developments in our hobby to become popular is that of the radio control of models. The great increase in popularity of model aircraft construction and flying has acted as a powerful stimulus to the development of radio control gear, and the entry of several commercial firms into the market with suitable components and equipment has further encouraged many to tackle this subject.

It is generally accepted that the best results in this field are obtained by co-operation between aeromodellers and radio constructors. The building of the aircraft, its tuning up and flying offer quite enough problems to keep one person well occupied, and the specialist experience needed in this class of work is best found amongst members of the aeromodeller fraternity. Similarly, the radio side presents its own problems, which are best sorted out by those with some experience of electronics.

Whilst the radio control of model aircraft is, and will no doubt remain, the most popular application of this technique, radio control can, of course, be applied to model ships, cars or railways. Model ships offer great scope for ingenuity because the weight restrictions which necessarily apply to aircraft do not apply to ships. The gear can consequently be made much more elaborate so as to give control of a wide range of movements.

We propose running in this magazine a series of articles dealing with this topic. The articles will appear at irregular intervals as material for them accumulates. We are quite beginners ourselves in this subject, and we shall be learning the technique in the best possible school—that of experience. As a start, we purchased one of the commercial kits and, with the help of an experienced aeromodeller, installed it in a 42″ wingspan diesel driven model aircraft. Our experiences, mistakes, and their remedies will be recorded in a later article.

We also have under construction a 30″ model launch, in which we propose to test home constructed control gear and more



Technical Hitch!

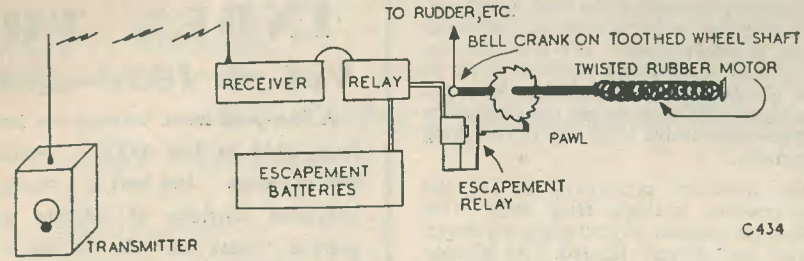


Fig. 1: *Diagram showing the sequence of apparatus used.*

elaborate installations than are possible in model aircraft. As our knowledge progresses, so we shall record it in these pages. In passing, may we ask readers who have already had some experience of this work to write in, telling us of their experiences. We shall be very pleased to publish letters or articles on this subject.

A few words on the general principles and present practices adopted in model control work may not be amiss. The simplest and most frequently used system employs a single transmission channel, in which the radio impulses operate a relay in the receiver. This relay makes and breaks current which actuates an escapement or servo mechanism. This servo mechanism consists of a relay, the armature of which is so designed that when it moves, ratchet pawls travel over a toothed wheel, turning the latter as they do so. This rotary mechanism is then translated into linear movement by cranks, rods, etc., so that the rudder, elevators, or similar mechanisms can be operated.

A modification to this servo mechanism has recently appeared, in which the toothed wheel is rotated by twisted rubber skeins or by a lightweight clockwork motor, the pawls then releasing the wheel tooth by tooth. In this way, a small relay needing little energising current, and consequently using only lightweight batteries, can be employed instead of the more powerful and heavier set-up otherwise needed. See Fig. 1.

Obviously, any type of receiver/transmitter system can by used, provided the receiver is small and light enough to be within the carrying capacity of the craft, and that it is able to produce a current change somewhere in its output circuit sufficiently large to actuate a relay.

Progress in model control work has been held up in the past by lack of sufficiently sensitive relays and simple receiver circuits capable of producing a large change in output current. However, the development of the thyratron or gas-filled triode type of valve has helped the design of lightweight radio control gear enormously. By the use of this type of valve it becomes possible to design a single valve receiver capable of operating a relay. The saving in weight of both the receiver itself and the batteries has made this type of circuit pre-eminently suitable for model aircraft work.

The gas-filled triode was first introduced to the amateur radio constructor in an article in 'QST', July 1938; here the **Raytheon QY4** valve was described, and a suitable circuit for its use in a one-valve radio control receiver was given. The war prevented its general release in this country, but **Hivac** have now made this type available to the amateur with their **XFGI.** This valve measures 40 mm long, 10 mm wide and 7mm thick. It weighs only 4 grammes. Its size and weight are, therefore, a negligible proportion of the total weight of the receiver and its batteries. The filament requirements are 1.5V @ 50 mA. The anode voltage required is 45, which can be supplied by two 22.5V hearing aid batteries. Maximum anode current is 2.5 mA, and this will drop to 0.25 mA on receipt of a signal in a suitable circuit. Relays sensitive to this current change are now available in this country.

The basic circuit for this type of receiver is shown in Fig. 2.

The super-regenerative type of receiver lends itself very satisfactorily to adaption to radio control purposes. A single valve version can be designed to give an anode current change of two to three mA with only 45V HT.

More elaborate models can be constructed without unduly increasing the total weight, in which an amplifier and/or a separate quenching valve may be incorporated. It is also possible, too, to design a simplified superhet type of receiver, which may prove desirable in certain circumstances, although weight considerations necessitate considerable ingenuity in designing such receivers.

In the instances considered so far, the receiver operates a single relay only. This means that the number of operations which can be carried out is very limited. As already indicated, the relay can be made to operate an escapement mechanism which, in turn, moves the rudder, etc. But, even with the help of the escapement mechanism, each movement has to take place in a fixed sequence. The simplest example is that of rudder control. The escapement mechanism can turn the rudder, say, to port. The next movement must be to centre the rudder, and the one following that moves it to starboard. Then back to centre, to port, to centre, to starboard, and so on. So if, say, the rudder is centred and the next sequence movement is to starboard, and we want to put it over to port, we have to transmit three rapid impulses to first carry the rudder through starboard, then centre again, and on to port. This disadvantage is not so great as it would at first appear as, if the movements are made rapidly, the rudder can be got over to 'port helm' before the boat or aircraft has had time to react to the transitory 'starboard helm'.

In order to overcome the inherent objections to the above system, various multi-channel circuits have been devised using one transmitter and receiver only. The most simple of these employs a modulated transmitter, and "tuned reeds" in the audio circuit of the receiver. These reeds are of such a length that they vibrate in sympathy with the audio notes modulating the transmitter carrier. At the end of each reed is a contact which, when the reed vibrates, makes connection with another contact suitably placed. Current can thus be passed to the appropriate mechanism. The chief disadvantage of this system is that no commercial "reed units" are as yet on the market, and the home construction of reliable units is beset with many difficulties. Alternatively, where weight considerations are not of importance, an audio filter system can be incorporated in the receiver, and the outputs from the filters used to actuate relays.

So much for the receiving side. The question of suitable transmitters is relatively simple, as quite low power is needed and battery operated gear is sufficient in most cases. The frequencies allocated by the GPO for model use are 26.96–27.28 Mcs and 464–465 Mcs, and the input to the final stage must not exceed 5 watts. So far, the 27 Mcs channel appears to be the most popular, for obvious reasons. A single valve self-excited oscillator type of circuit is sufficient for the more straightforward types of control unit, but the more complex systems are better if crystal controlled.

We hope this somewhat sketchy introduction to this subject has at least enabled readers to understand the general principles, and will make them realise that almost infinite variation and ingenuity can be applied in devising particular systems. In the next article, we hope to deal with the installation of one of the commercially available control kits in a 42″ span model aircraft.

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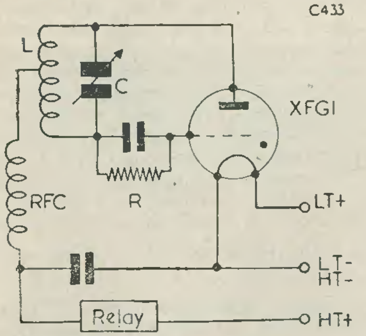


Fig. 2: Basic Circuit of a Single Valve Radio Control Receiver.

QUERY CORNER

A "Radio Constructor" Service for Readers

Vertical Non-Linearity

I have a television receiver which has recently developed a bright band extending horizontally across the picture. Within this band the focus is rather poor and the picture is cramped. Not having an oscilloscope, I am rather limited in my search for the possible cause and would welcome any advice which you are able to offer.

D. Spearing, Watford.

The combination of defects mentioned by our correspondent, namely a light band extending across the picture, poor focus within the band coupled with cramping, can only originate from one source, severe hum on the EHT line. This diagnosis assumes that the EHT is derived from a 50 c/s transformer and not from an oscillator or the line time base flyback; because, for the defects to occur, the supply frequency to the EHT pack must bear some definite fixed phase relationship to the frame time base speed, otherwise the band on the picture would be continuously in motion. For the EHT voltage to carry a large hum component, the reservoir capacitor must almost certainly have become disconnected, and under this condition the waveform superimposed on the EHT will appear as in Fig. 1. The magnitude of the ripple will depend upon the load on the power pack, and it will therefore be largest when a relatively low resistance bleeder network is employed.

When the EHT voltage is at its peak value the picture will appear brightest, and as the frame time base normally runs at the frequency of the mains supply the brighter part will appear as a stationary band extending horizontally across the picture. The cramping within the bright area of the picture occurs because at the increased EHT voltage the deflection sensitivity of the tube is reduced, and thus the same deflection voltage moves the scanning spot over a smaller distance. It is this effect which invariably directs the attention of the fault finder towards the frame time base, as being the most likely cause of the non-linearity, and it may not be until every conceivable capacitor in the unit has been checked that the EHT pack is suspected.

The cure for the trouble is obviously a matter of replacing one or both of the smoothing capacitors in the EHT power supply, and whilst on the job it may well be worth while fitting a fuse in the circuit to protect the rectifier and transformer against an accidental short circuit. Such a short, if it occurs in the reservoir capacitor, can ruin the rectifier and transformer, both relatively expensive items and frequently difficult to replace. The fuse should be connected in series with the EHT winding on the transformer at the earthy end, and should have a rating of about 50mA.

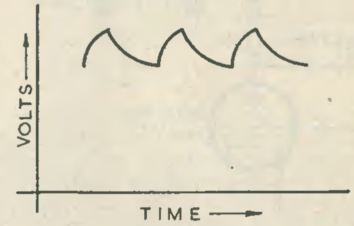


FIG. I
THE UNSMOOTHED EHT VOLTAGE
C424

QUERY CORNER

"Rules"

(1) A nominal fee of 2/- will be made for each query.

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

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

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

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

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

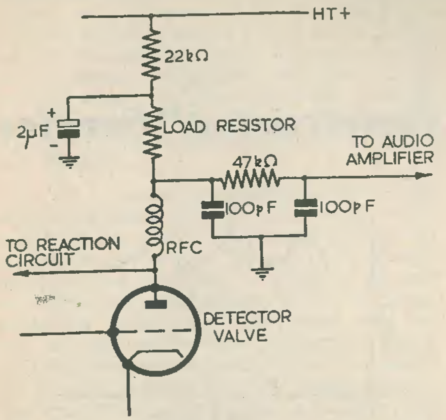


FIG. 2
RF FILTER IN ANODE CIRCUIT OF DETECTOR STAGE

Unstable Reaction

For short wave DX work I have built a 1—V—1 receiver which is used mainly on the 10 and 20 metre bands. Whilst the results obtained are reasonably satisfactory, I believe that the sensitivity could be improved if the reaction control could be made to operate more efficiently. The point on the control at which oscillation commences varies, thus making it very difficult to hold the receiver in its most sensitive condition. Is it possible to improve the control? W. Oxen, Hillingford.

Erratic reaction is normally due to either poor or insufficient screening or faulty RF filtering after the detection stage.

Commencing with the problem of screening, it is most important that the receiver is constructed on a metal chasses if first class results are to be obtained. Some short wave receivers are assembled on wooden chasses because of the ease with which components can be mounted on the base board but, generally speaking, this simplified construction is obtained at the cost of operating efficiency. However, to simply employ a metal chasses does not solve all the problems, as a satisfactory layout must be planned. In this connection, a great deal of trouble can be saved by obtaining all the major components before any assembly work is attempted.

As a general guide the layout should be arranged so that the valves, tuning capacitors and coils are above the chassis, leaving the below-deck area clear for such sundry components as resistors and fixed capacitors. When two or more tuning coils are employed a screen must be interposed between them, the ideal arrangement being to completely screen the detector stage from the remainder of the receiver. The only exception to the above generalisations occurs when switched coils are used, when it is preferable to mount the coils on either side of the switch, which is positioned below the chassis. With this arrangement it is not necessary to individually screen coils which are switched into the same circuit, but it is important that screens are employed between the sets of coils for different circuits.

Regarding the possible lack of RF filtering, this is quite a common cause of instability in a straight receiver, and can have disastrous effects upon its operating efficiency.

The usual symptoms are either general receiver instability due to a large RF signal reaching the audio side of the set, or erratic damping of the detector output circuit by the first audio stage. The cure lies in modifying the anode circuit of the detector stage as shown in the circuit diagram Fig. 2. The additional filtering used in this circuit ensures that no RF signals reach the audio stages, and at the same time prevents the first audio valve from damping the detector. The filter choke must be designed to work on the wavebands covered by the receiver, all-wave chokes being available for the general purpose sets.

In conclusion, it is worth mentioning that if the receiver is fed from an HT battery which has been in use for some time, a 2μF capacitor connected directly across the HT lines may assist in preventing instability. This is because a battery has a very definite resistance which can be regarded as being a load common to all the valves, and as a result it forms a common impedance across which intercoupling between stages can occur.

Extension Speakers

Can you recommend a simple method of connection of an extension speaker to a commercial receiver which has no provision for such an extension? E. Swain, LEEDS.

There are two methods of connecting an extension speaker to a receiver; one is to join the speech coil of the additional speaker directly across the coil of the permanent speaker, and the other method is to make connection to the anode of the output valve as shown in Fig. 3.

In many ways this latter arrangement is the most desirable, as it eliminates the difficulty of making connection to the speech coil leads of the permanent speaker, but it does require an additional transformer which may be saved by using the first method.

Using the arrangement indicated in the diagram, the output valve is operated as a choke coupled amplifier, the transformer of the permanent speaker acting as the coupling choke. Thus if it is desired to cut this speaker out of circuit, a switch must be used in the secondary circuit of the transformer. When using both speakers together, the matching to the output valve is no longer optimum, but the degree of mismatch should not be sufficiently great to cause a noticeable reduction in the quality of reproduction.

Should the receiver be of the AC/DC type, a second capacitor must be connected in the earthy lead to the extension speaker. This capacitor is shown dotted in the diagram.

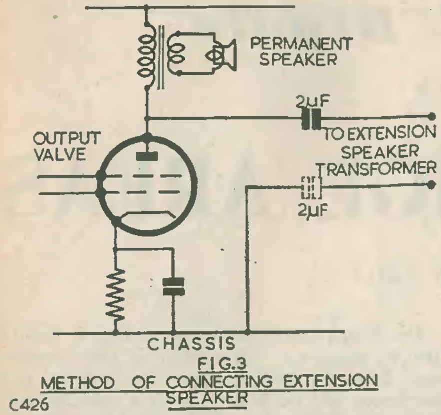


FIG.3
METHOD OF CONNECTING EXTENSION SPEAKER

TRADE REVIEW

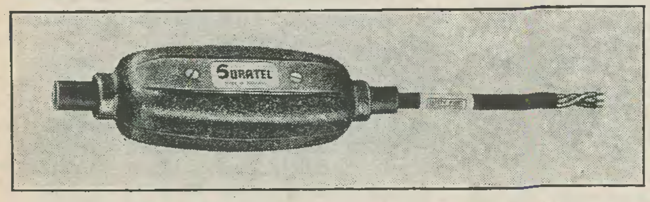
RADIO AND TELEVISION SUPPRESSORS FOR WOLF CUB DRILLS

Wolf Electric Tools Ltd. the manufacturers of portable electric tools, announce the introduction of "Suratel" Suppressors for the Wolf Cub Home Constructor Drill and for both radio and television. Both Suppressors are the successful result of prolonged experiment and research work in close collaboration with G.P.O. Engineers.

The "Suratel" Radio Suppressor is guaranteed to eliminate interference on the B.B.C. Broadcast wave lengths to the limits specified in B.S.S. 800 and complies with B.S.S. 613 and B.S.S. 1082. It is of a special neat streamlined design in an attractive black wrinkle finish and weighs approximately 6 ozs.

Compactly housed in a strong pressure die-cast which is effectively earthed, it is fitted at one end with a short length of TRS cable for connection to a three pin plug. The other end is free to take the drill cable which is passed through a cable sleeve and connected to the clearly marked terminal panel which is exposed by removal of the top half of the casing. All Cub Drills in present production include tag eyelets fitted to the cable ends to facilitate this connection.

Iron cored wave wound inductors are incorporated and all electrical parts are well insulated making it completely safe from shock hazard.



THE "SURATEL" RADIO SUPPRESSOR FOR WOLF CUB DRILLS.

Designed specifically for the Wolf Cub Drill 200/250 voltage range and with a maximum current rating of one amp, it is, of course, most important that the "Suratel" Radio Suppressor is fitted and used only according to the instructions supplied. Properly connected it will eliminate interference even with a poor aerial installation. The "Suratel" Radio Suppressors are priced at 23/6d. each and are obtainable from Wolf Stockists and Dealers throughout the country.

Unlike the Radio unit the "Suratel" Television Suppressors are fitted *inside* the Cub Drill body, as close to the commutator as possible in order to achieve maximum efficiency. Cub owners should return their machines to the nearest Wolf Service Depot where a "Suratel" will be fitted at a standard charge of 8/6d. including return postage. Similarly, when ordering a Cub Drill the Suppressor can be included at the extra charge mentioned. It should be noted however that they are available only for use with 200/250 voltage Cub machines.

A Folded Dipole

for

AP TV FRINGE AREAS

By R. J. DENLEY

Living on the AP fringe area, and not getting all the desired signal strength from a standard 'H' aerial, consideration was given to the construction of a type more suitable for this area. This was expedited by the purchase of an ex-WD Polythene Insulator Patt 58449, which was extremely suitable for the purpose of dipole construction.

The question of what to use for the elements was settled by using copper for the dipole itself and, as the cost of this is rather high, steel was used for the director and reflector. This has given extremely good results, signal strength being more than 50% greater than that obtained from the 'H' aerial.

If the insulator mentioned above is not easily obtainable, a suitable alternative can be made from a block of polythene 8″ long by 2⅝″ wide by 1″ thick, as shown in Fig. 2. If the WD insulator is used, it will be found to have a metal tube moulded through the centre. This should be cut off flush with the polythene and then carefully drilled out with a ½″ drill, followed by one of ⅝″. Drilling should be from each end, to leave a gap of an inch in the centre. The back of the insulator should then be cleaned up flush, and in the centre the hole marked 'D' should be drilled half-way in to meet the hole running through longitudinally, care being taken not to go too deep—just sufficient to make an entry for the co-axial, and not removing the shoulders which will position the copper tube at the correct distance. The holes 'C' should then be opened out to 5/16″, and holes 'A' cleared later.

As the insulator was not quite mechanically strong enough to withstand the swaying of a gale, it was backed with a backing plate of 12 swg brass as shown. The drillings in this should be a replica of those in the insulator; the latter can be used as a jig for this purpose except in the case of hole 'D', which must be carefully positioned to correspond with its counterpart.

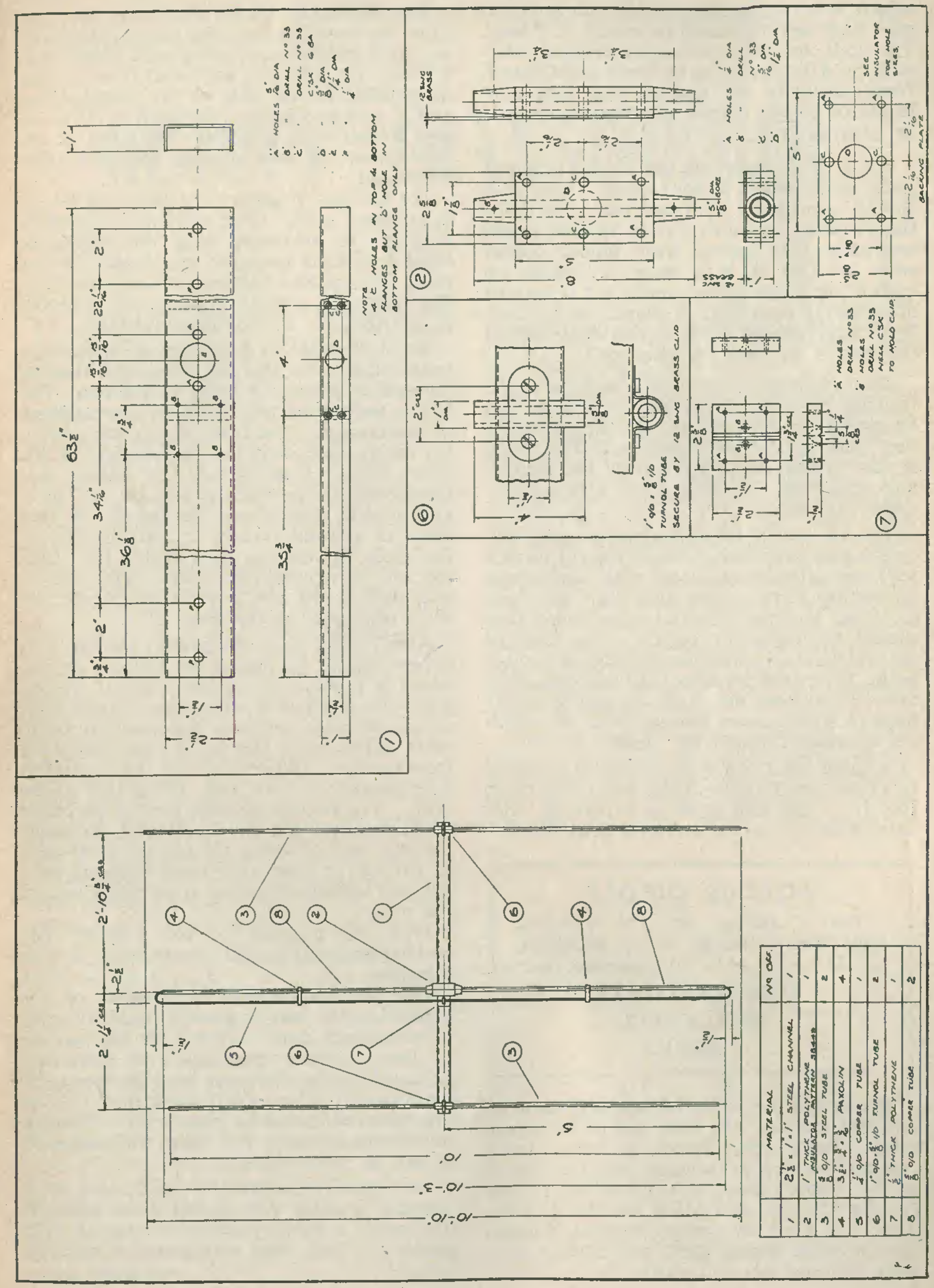
The polythene block shown at Fig. 7. should then be made up. The holes 'B' are counter-sunk from the back sufficiently deep to give the heads of the 6 BA screws a quarter-inch clearance from the steel channel. The V shaped slot should be approx. ⅛″ deep and can be cut with a triangular file. The drawing gives other dimensions. The 6 BA × ½″ cs screws are inserted through holes 'B' and the space above the heads filled with polystyrene cement which is allowed to harden.

Work can now be carried out on the steel channel; this can be of different metal or other dimensions if due allowances are made, but a wider section than 2½″ is not advised. It will be noted that the spacing of the director and reflector is 0.1λ and 0.15λ respectively; this has given quite a compact aerial.

Fig. 1 is self-explanatory with one exception. A watertight connection is made in the recess of the channel. This is done as follows. Cut two sections of ¼″ brass to fit in the recess between flanges. Drill and tap 6 BA two holes in each to correspond with holes 'C' in the channel. Fit the brass pieces carefully so that, with the channel, a watertight box with open top is obtained. A metal cover plate should then be fitted in such fashion that this plate can be detached easily, yet the box remain watertight when in place. A rubber or ebonite bush can now be fitted in hole 'D'; this completes the work on the channel.

The two Tufnol tubes shown in Fig. 6 can now be made up. A "flat" about 1/16″ deep should be filed on one side, the exact width of the channel. This will locate the tubes and help prevent displacement of the director or reflector. The two clips shown are bent up to be a tight fit on the tubes. Temporarily hold the tubes and clips in position, and mark the fixing holes with a scriber through holes 'F' in the channel.

The dipole itself can now be put in hand. Two lengths of ⅝″ diam. *hard drawn* copper tube with thick walls is needed. Copper gas



tube is ideal; lightweight stuff should be avoided. Each section should be exactly 5′1″ long. The ends are next thoroughly cleaned internally for a distance of an inch or so, and tinned. Next, solder to one end of each tube a 6″ length of 16 swg copper wire, leaving some 4″ or so protruding.

The ¼″ OD copper tube can now be prepared This, again should be *hard drawn.* Allowance should be made for 1″ at each end to fit inside the ⅝″ tubes; this inch should be well tinned externally and bound with tinned copper wire so that it is a snug fit inside the ends of the larger tubes, in which it is sweated after having been bent to shape. A concrete floor large enough to take the whole layout flat makes an ideal "workbench".

The polythene insulator is now fixed to the backing plate by 0 BA or ¼″ screws, not forgetting washers under the heads where they bear against the polythene. The whole is then offered up to the face of the channel and fixed with $\frac{3}{16}$″ bolts, again with washers under the heads.

The free ends of the dipole are now prepared by running over with a rough file (to form a key) and after being coated with polystyrene cement (to form a watertight joint) the ends are fitted into the insulator, into which they should fit reasonably tightly. The ends of the protruding 16 swg wires are pushed through holes 'D' in the insulator and backing plate and left sticking out, and the dipole finally fixed by 4 BA screws through holes 'B' which are extended through the dipole.

A small brass clip should now be made up to fasten the ¼″ tube to the polythene block Fig. (7.). The clip must be a tight fit with fixing holes to suit the screws already fitted.

FOLDED DIPOLE

The Drawings on the Previous Page are Available as a Blueprint, size 27″ × 17″, at 2s. 2d. post paid, from

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The paxolin strips, item 4, are next made up and laid in pairs, one each side of the dipole tubes. Holes are drilled in each, being carefully located to coincide with the centres of the copper tubes. 4 BA clearance is used for the ⅝″ tube, and 6 BA for the ¼″ tube. They are fixed by screws inserted through the top strip, copper tube, and bottom strip, with the usual nut and washer.

The Reflector and Director tubes are then fitted by inserting into the tufnol tubes, with an equal amount protruding each side. Two ⅛″ holes are drilled in each steel tube as close as possible to the ends of the tufnol tubes, and ⅛″ split pins inserted to retain the Director and Reflector in position. The ends of the steel tubes are now plugged to make them watertight.

We are now ready for the fitting of the 80 Ω co-axial cable. This should be carefully prepared by trimming back the rubber or other insulating covering and braid for one inch, plus another half-inch of covering only. The polythene is next trimmed back to expose a quarter-inch of centre conductor.

To fit, the cable is first inserted through the bush fitted in the channel, afterwards binding the end to prevent it being pulled out. The 16 swg wires from the dipole are now soldered to the co-axial, that from the upper tube to the centre core, and the bottom one to the outer braid. Care should be taken that these wires are as short as possible and positioned well away from the metal. A thin sheet of paxolin is now cut slightly larger than hole 'D' and two slots filed in it to keep the two wires about ¾″ apart. The paxolin is placed in the box over hole 'D' and the wires positioned in the slots.

About ½-lb of good quality paraffin wax is next melted by placing in a clean, dry tin which is inserted into water kept at boiling point in a suitable container. Great care should be taken with this operation—in particular naked flame should be kept well away from the wax. When the latter is fully molten it is poured into the box, filling this to the brim. Try to keep the cable joint in the centre of the box until the wax has set solid. Probably the best way of doing the process is to pour in the wax a little at a time, allowing each quantity to become almost solid before adding the next.

With the addition of the junction box cover plate, mechanical construction is now complete.

For weatherproofing, the whole of the exposed metal work is given a couple of coats of aluminium paint—do not let any get on to the insulating materials. As there will be considerable vibration in high winds, all screw heads and nuts projecting from insulating materials should be given a dab of shellac to prevent shifting; the paint will take care of this in other places.

As regards mounting, I have used a 2″ diameter wooden mast (metal is not advised). The aerial is fixed by means of two 'U' bolts made of ¼″ mild steel with threaded ends, the

Continued on P.54

Choosing an . . . OUTPUT TRANSFORMER

By ERIC LOWDON

YOU have just designed a new receiver, and are quite certain that the frequency response is as good as it can be under the circumstances. Bags of negative feedback, valve line-up carefully considered, low distortion detector, voltages just right, and so on.

The components are all carefully specified. Valve types, resistor values and ratings, and whether carbon or wirewound; Capacitors, too, are accurately specified as mica, paper, or electrolytic; the capacitances are clearly stated and the voltage ratings.

But the output transformer—this Cinderella of radio components—what sort of treatment does *it* receive? It is specified, of course, but often as not in a very vague manner. For example: Output transformer, ratio 25 : 1, to deliver 8 watts. Just that and no more. No mention of its primary inductance, which is one of its most important characteristics. It is this which makes all the difference between a good transformer and a bad one.

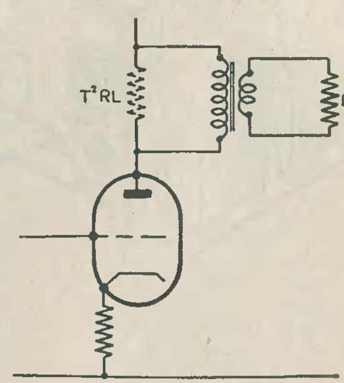
A transformer with inadequate primary inductance—and there are plenty of them to be had in the shops — will make the beautiful response curve of your amplifier look like something brought in by the cat. It will accept a faithful reproduction of your favourite record from the output valve, and deliver a horribly mangled and mutilated version to the speaker.

Why, then, should there be plenty of inductance in the primary? Well, take a look at Fig. 1. Here we have an output valve feeding a transformer of turns ratio T, with a load resistor RL, the speech coil of the speaker, connected to its secondary. As we know, this arrangement gives an effective load resistance at the valve anode—that is to say across the primary—equal to the square of the turns ratio T multiplied by RL, in other words T^2RL. This effective resistance is shown in broken lines, and its value should be equal to the recommended load for the valve.

A numerical example will make this quite clear. Suppose the recommended load for the valve is 4500 ohms, and we wish to use a speaker having a 3 ohms speech coil. In this case the required transformer ratio must be 38.7 : 1 since $38.7^2 \times 3 = 4500$. In practice, of course, the ratio need not be so exact as this.

But, as we can see from the diagram, the reactance of the primary is in parallel with the reflected load resistance. If the primary inductance is, say 3 henries, its reactance at 50 cycles will be approximately 940 ohms. This in parallel with the reflected load of 4500 ohms gives an effective load of only 780 ohms! The response will thus fall considerably at the low frequencies. As the frequency is increased, so also will the primary reactance increase, and at 5 kcs will be approximately 90,000 ohms; the parallel effect of this on the load resistance will be negligble. Thus, in order to aviod a poor low frequency response, we must make the primary inductance high, and so obtain a high parallel reactance.

There is another reason for having a high primary inductance, especially where the amplifier has a low output impedance such as is obtained with triodes or pentodes with negative feedback. An output valve with its



C263 FIG.1

correct load is rated to give a certain maximum undistorted current output. If, however, the load is effectively reduced at low frequencies, due to the parallel effect of the primary reactance, then the signal current will increase beyond the safe maximum, and will result in a particularly objectionable form of distortion.

This amplitude distortion, as it is called, becomes negligible only when the primary reactance is some three or four times as great as the load resistance, in this case about 18,000 ohms. At 50 cycles this would call for a primary inductance of 40 to 50 henries!

In single valve output stages it is difficult to obtain very high inductances due to the passage of heavy DC currents through the valve and windings of the transformer. The economical maximum for components in such circuits is in the region of 6 to 7 henries and will usually be somewhat less than this. Nevertheless, the principle remains. If you want reasonable quality use as high an inductance as possible. Eschew cheap and nasty components. Reputable manufacturers will always be prepared to supply you with all the relevant data concerning their products.

With push-pull circuits, of course, it is relatively easy to obtain high inductances of more than 50 henries, though measurements on some of the alleged push-pull transformers at present on the market would lead one to believe otherwise.

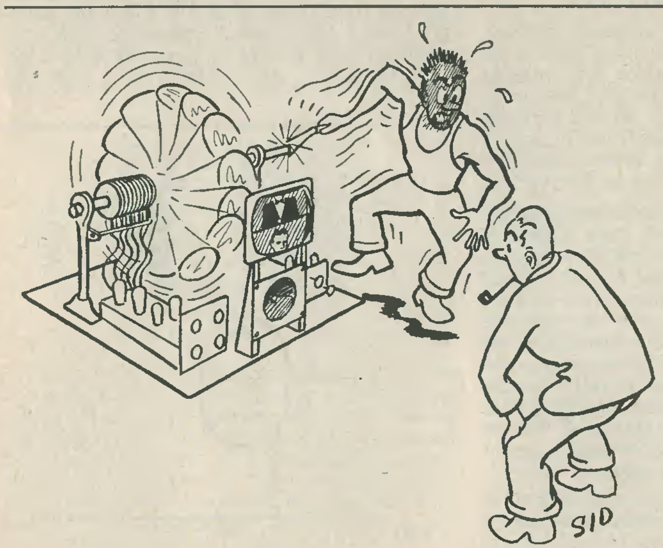
In conclusion, then, when you buy an output transformer always ask the value of the primary inductance. It is just as important as the turns ratio, and if a maker cannot or will not give a figure, you can be sure that it is not worth having.

A Folded Dipole for AP TV Fringe Areas

continued from Page 52

channel being drillled to suit some four inches from the dipole on the reflector side. ¼″ nuts and washers are used to draw the bolts tight so that the aerial is firmly clamped. It is advisable also to fit lock nuts here, as anything working loose can cause considerable trouble. (The cost of insuring an aerial is quite reasonable, and should be seriously considered.—Ed.) The co-axial cable can be neatly clipped to the mast when erecting.

For those desirous of making a similar aerial for the Sutton Coldfield transmissions, I would suggest the following dimensions as a basis to work on—a little experimenting will probably prove beneficial. Director: 7′ 6″. Overall length of Dipole: 8′ 1″. Reflector: 8′ 2½″. Spacing of director from dipole, centres: 1′ 8½″. Spacing of Reflector: 2′ 3¾″. Spacing of two sections of dipole to remain at 2½″.



RUFUS

THE RADIO CONSTRUCTOR

"WHEN I GET UP TO 300C R.P.M. THE FRAME LOCKS SOLID!"

R1355 AND RF26—

Single Chassis for Sound and Vision

By L. A. Barker

CONSIDERING that the oscillator circuit of the RF26 unit is operating at a higher frequency than that of the received signal, it was judged that the sound channel would produce an IF in the region of 11 Mcs if the unit was turned to the vision frequency. Therefore the circuit diagram of Fig. 1 was built into the power pack section of the R1355.

In bringing this double IF arrangement to the attention of readers, the writer has it in mind that no constructional modifications will be necessary to the receiver to change over from Sutton Coldfield to Holme Moss transmissions when the new station is put into commission, the changeover being effected merely by inserting slugs into the three grid coil formers in the RF26 unit. These coil formers are already screw-tapped and will take the same size slugs as the R1355 IFT's which can be easily obtained.

For the benefit of readers situated in the London area, it is suggested that the RF25 unit may be arranged to produce the double IF in place of the RF26 unit.

The 11 Mcs IF is "picked off" pin 7 of the Jones plug in the R1355 by fitting a 7 pF concentric trimmer beneath the chassis right against theeplug. It is essential to have a short conn ction here in order to avoid pick up of undesirable signals from the 27 metres and 41 metres wavebands, and even two inches of wire might be detrimental. A larger value than 7 pF for the concentric trimmer is also undesirable for the same reason, and further, the first IF grid circuit is aperiodic to avoid complications. The choke for this stage has been obtained from the R1355, being most suitable on account of its miniature size. These chokes may be removed from the R1355 as they serve no useful purpose for TV, but they must be replaced by shorting links to ensure that the control grids of the respective valves are not unbiased. They appear to be wound in three sizes. and one of the medium size was chosen for this position. The writer has not found it necessary to use screened lead above the chassis to the top grid connection of either V1 or V2.

Another of the chokes referred to has been used to filter the output from the detector diode before feeding to the triode section of V3.

The two 11 Mcs IFTs are of American origin, and bear the number 293 in black print on the top of the screening can. They are of very robust construction, and each IFT consists of two windings of nine turns of heavy gauge wire, the windings being displaced and separated from each other by about two and a half inches. Each winding is slug tuned, and shunted by a capacitor and resistor which form an integral part of the IFTs as manufactured originally.

VR65 valves have been used for V1 and V2, being spare from the R1355 as the writer has removed two IF stages from the video channel. 6AC7s or EF50s could be used in lieu of VR65, and for V3 a VR55 has been used but the EBC33 or 6Q7 could be utilised equally well.

No great precautions have been taken with regard to decoupling, but no trouble has been experienced with either instability or cross-channel interference between sound and video. Only one capacitor of 200pF is used between V1 and V2 across the heater power supply.

A pre-amplifier is used by the writer owing to the very poor signal strength in the locality—some 80 miles or so from Sutton Coldfield—and also in view of the magnitude of signals of transmitters working in the 27 metres and 41 metres wavebands. The use of a pre-amplifier in conjunction with the R1355 may appear to be superfluous, but bearing in mind the complete rejection of IF channel breakthrough and the fact that two or three of the video

IF stages can be removed, resulting in considerable economy in power, the overall results justify this course, though the writer prefers to retain three stages here in order to maintain bandwidth. Readers in good signal areas may find the use of a pre-amplifier unnecessary, but it is useful for pushing a powerful signal through while lining up on the transmissions, if no signal generator is available.

The writer runs the whole of the vision and sound receivers, up to and including video stage and double-diode-triode audio stage, and a two-valve pre-amplifier, from a mains transformer rated at 250—0—250V @ 80 mA and 6.3V, and the transformer is not being overrun, although there is no reserve of power to run the output stage. Therefore the sound is being fed into the pick-up socket of an all-wave receiver, but any normal type of power output stage may be fitted into the spare valve space if the cathode follower has been removed, provided the power supply is adequate for the extra load, and, most important, the stage be well decoupled.

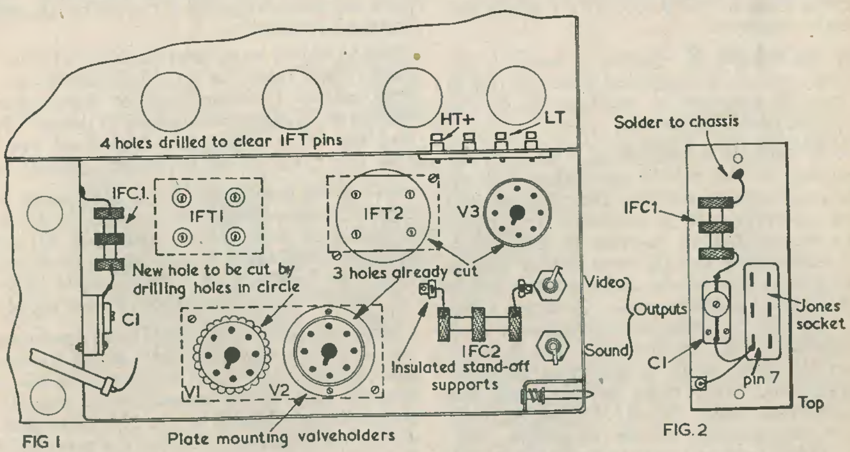
The most laborious part of the constructional work is the preparation of the chassis to take the valveholders and IFTs. There were three holes originally, and it is necessary to make a further one for V1. This can be accomplished by drilling a series of small holes in a close circle and then by exerting pressure. The result is not immaculate, but has been disguised by fixing the valveholders to the small two-hole plate which was originally used in the R1355 power section to support the rectifier valves.

The IFTs and valveholders are placed side by side, and no inter-stage screening has been found necessary. Before fixing, ensure that the valveholders for V1 and V2 are Mazda octals if it is intended to use VR65s.

All capacitors and resistors are best mounted directly between the points they link, without the use of tag strips, but three stand-off insulated supports should be used to hold rigid the IFC2 and C9. IFC1 is best mounted by soldering directly to C1 and to the chassis. Output is taken from C11 to a Pye plug at the rear of the chassis side by side with a Pye plug for the video output.

Alignment was carried out without the use of a signal generator by tuning the RF26 unit to the vision channel for maximum response. It was found very convenient to use phones with a coax socket for this operation, listening first to the vision signal then transferring the phones to the sound output from the second Pye plug.

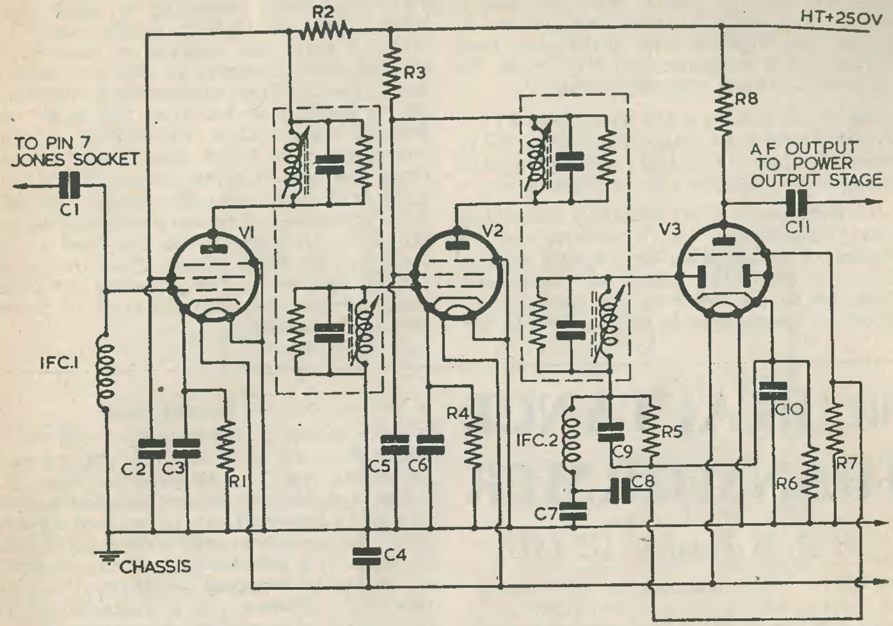
Alternate cores of IFT1 were adjusted one turn each at a time, when it was very simple to locate the sound signal as the tuning is broad. Next, IFT2 was brought into line by adjusting each core for maximum signal. A very slight detuning of the oscillator trimmer of the RF26 unit towards the sound channel, i.e., slight increase in capacitance, brought volume up to good headphone strength, and upon connecting up the CRT and time base



Underside view. The HT line in FIG.1 goes directly to terminal indicated above.

Inside end view

C266



C265

Fig. 2: *The circuit of the additional sound channel.*

COMPONENT VALUES AND PARTS

C1, 7 pF concentric
C2, 0.1 μF 350VW
C3, 0.1 μF 350VW
C4, 200 pF mica
C5, 0.1 μF 350VW
C6, 0.1 μF 350VW
C7, 200 pF mica
C8, 0.1 μF
C9, 150 pF mica
C10, 25 μF 50VW
C11, 0.1 μF 350VW
R1, 150 Ω ½W
R2, 5 kΩ 1W
R3, 5 kΩ 1W
R4, 150 Ω ½W
R5, 1 MegΩ ½W
R6, 5 kΩ 1W
R7, 500 kΩ ½W
R8, 50 kΩ 1W
2 IFT's, 11 Mcs.
2, IF Chokes
2, Mazda octal valveholders
1, 10 valveholder
1, Co-ax socket
3, Stand-off insulated supports
3, Valve top-cap clips
V1, 2, VR65
V3, VR55

unit the vision signal was observed to be ample and good in detail.

If a preamplifier is used remember that too high a gain will produce feedback, and although the audible signal from both channels may be powerful the CRT face will probably show only a white raster or at best a very faint image, and perhaps with the lines curved on peak whites. A modest gain only is required, and in this connection it is very convenient and desirable to have a good bandwidth in order to pass both channels, and to this end damping resistors of 5 kΩ may be connected across the tuned inductors of the preamplifier if none are already fitted. Good and inexpensive preamplifiers may be obtained easily at present from the surplus markets, costing less than the price of home construction. It is felt unnecessary, therefore, to give circuit details of this item of equipment. If one is used, care must be taken with the heater connections in order to avoid shorting the LT through the screening braid of the co-ax lead between the preamplifier and RF26 unit, as this braid is at earth (chassis) potential.

One of the W plugs at the front of the R1355 can be removed, to make room for a valve-holder to supply HT and LT, with an old valve base to fit carrying leads to the preamplifier.

A further point about the RF26 unit. The writer believes that the bandwidth can be broadened by reducing the setting of the concentric trimmers beneath the chassis and which are in parallel with the tuning coils. Maximum capacitance is indicated when the two short black lines—or, in some cases, silver spots—are together and in line. It is wise to mark the original settings before making any adjustment in case the signal is lost. The oscillator trimmer does not require to be reduced as much as the other two, because the circuit is operating at a higher frequency. The vision and sound channels come in at a much higher setting of the tuning scale with a considerably wider "spread". Final trimming can be completed by means of the series trimmers which are fixed to the "wall" of the RF26 chassis above the ganged tuning capacitors. The screening can which totally encloses the unit will need to be left off for accessibility.

THE REACTANCE TRANSFORMER

By R. F. Fautley, G3ASG

It is well known that a transmission line one quarter of a wavelength long can be used as a matching device between two differing impedances, provided that the characteristic impedance of the line is a certain calculated value.

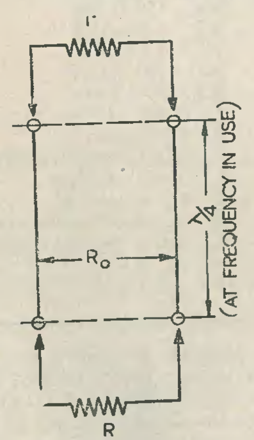


FIG 1
THE QUARTER-WAVE TRANSFORMER

C137

This value must be such that: characteristic impedance, $R_o = \sqrt{R \times r}$ where R is the generator or "sending end" impedance, and r is the load (see Fig. 1).

For example, it is required to feed the centre of a half-wave aerial with an untuned 600-ohm line. As the aerial centre impedance is about 70-ohms, it is obvious that direct connection of the line to the aerial would result in a bad mismatch. However, if a quarter-wave line of correct characteristic impedance (R_o) is inserted between feeder and aerial this mismatch can be obviated. The correct value of R_o for the quarter-wave transformer is given by:

$$R_o = \sqrt{600 \times 70} = 205 \text{ ohms.}$$

An alternative method of correctly matching a generator to a load is by means of a "reactance" transformer. This system does not seem to have attained the popularity of the quarter-wave transformer among the amateur fraternity, although it performs the same functions using materials of very much smaller physical dimensions.

In Fig. 2, R represents the generator impedance which is to be matched to a load r, where $r = \frac{R}{n}$ and R is a higher value impedance than r. An inductance, L, is added in series with the load to increase its impedance, but in so doing the load becomes partly reactive. This inductive reactance can be balanced out by a parallel capacity C, leaving the total impedance across the generator terminals purely resistive and of the correct value.

The correct values of inductive and capacitive reactance can be shown to be:

$$X_L = r\sqrt{n-1}$$

where $n = \frac{R}{r}$

Table 1

Turns	µH	Turns	µH	Turns	µH
1	0.12	12	5.3	23	13.07
2	0.32	13	5.94	24	13.84
3	0.6	14	6.6	25	14.6
4	0.95	15	7.28	26	15.38
5	1.38	16	8.0	27	16.18
6	1.8	17	8.4	28	16.93
7	2.35	18	9.4	29	17.72
8	2.9	19	10.1	30	18.54
9	3.45	20	10.83	31	19.3
10	4.02	21	11.57	32	20.08
11	4.65	22	12.33	33	20.83

Coil diameter = 1½ inches.
Wound 16 turns per inch with 20 SWG wire.

and $X_C = \frac{nr}{\sqrt{n-1}}$

Consider the example used to illustrate the quarter-wave transformer method where $R = 600\Omega$, $r = 70\Omega$, and $n = \frac{R}{r} = \frac{600}{70}$,

then: $X_L = 70\sqrt{\frac{600}{70} - 1} = 189$ ohms.

and: $X_C = \frac{\frac{600}{70} \times 70}{\sqrt{\frac{600}{70} - 1}} = 222$ ohms.

The actual values of L and C will, of course, depend on the frequency in use and can be deduced from the reactance formulae:

$X_L = 2\pi fL$

and: $X_C = \frac{1}{2\pi fC}$

where f is in cps,
L is in henries,
C is in Farads
and X_L and X_C in ohms.

As an inductance bridge does not usually happen to be part of the average amateur's gear, Table 1 will enable the coil to be wound to sufficient accuracy. The capacity can be in the form of a variable capacitor having a maximum greater than the calculated value. The capacitor is then adjusted for minimum standing wave ratio on the feeder.

The reactance transformer can be used to match low impedance generators to high impedance loads by adding the inductance to the generator branch, as in Fig. 3. The L and C values are calculated as before.

Both forms of transformer suffer from the disadvantage that *accurate* matching can be obtained for one frequency only. In the case of matching feeders to aerials for amateur use, however, if the calculations have been made for a frequency near the middle of the band in use, the amount of mismatch when working towards the edges of the band is small enough to ignore.

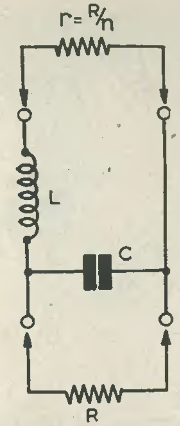
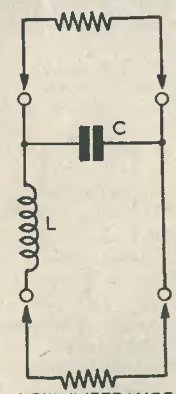


FIG 2
THE STEP-DOWN REACTANCE TRANSFORMER

C138

HIGH IMPEDANCE LOAD



LOW IMPEDANCE GENERATOR

FIG 3
THE STEP-UP REACTANCE TRANSFORMER

C139

A Visual Alignment Signal Generator

By D. ALLENDEN, Grad.I.E.E.

THE advantages of the cathode ray tube method of aligning the intermediate frequency stages of receivers, using a frequency modulated signal, are well known. In spite of this, however, the method is not widely used, one reason being the bulk and cost of much of the equipment at present available commercially. The normal set-up consists of a frequency modulated oscillator operating at a mid-frequency of several megacycles, a normal signal generator whose ouput is caused to beat with that of the FM oscillator to produce the required output frequency, and an oscilloscope, complete with deflection amplifier, on whose screen the response curve is displayed. In other words, a combination of three instruments is required. By stripping each instrument of all those features which, although of value in a general purpose equipment, are not applicable to the process of visual alignment, the set-up becomes simplified to the extent that the whole of the necessary apparatus can be accommodated in a single self-contained unit of small dimensions. This article discusses the design and construction of such an instrument.

A brief outline of the operation will first be given. A simple oscillator is frequency modulated by a 50 cps voltage derived from the AC mains supply. In the absence of this modulating signal, the oscillator generates a constant amplitude signal at a frequency of 465 kcs. When modulated, however, the frequency varies symmetrically above and below 465 kcs, the maximum deviation being variable up to ± 20 kcs. This output is applied to the IF stages of the receiver to be aligned. The output at the set demodulator varies according to the shape of the receiver response curve, and this output is amplified

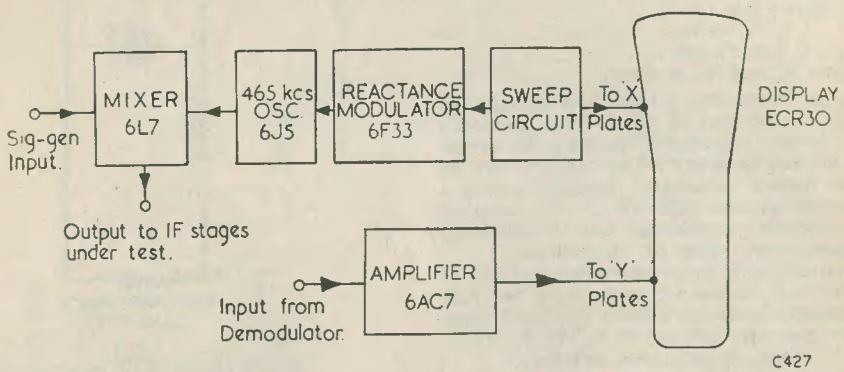
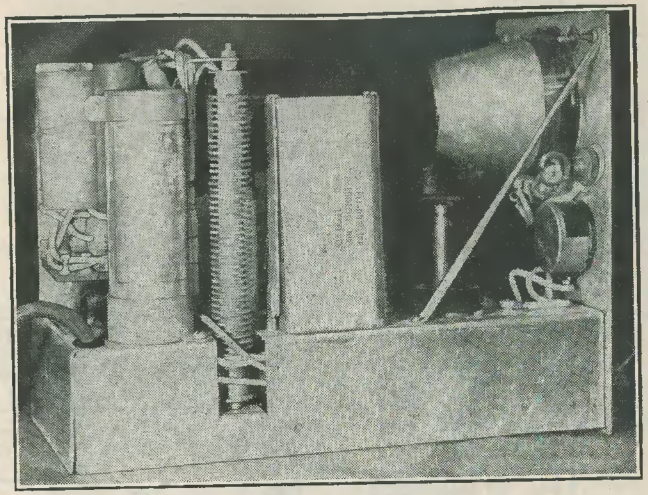


Fig. 1: *Block diagram of visual alignment generator.*



THIS VIEW TOGETHER WITH THE COVER ILLUSTRATION, GIVES A GOOD IDEA OF THE ABOVE-CHASSIS LAYOUT.

and fed to the vertical deflection plates of a cathode ray tube. As the horizontal sweep voltage applied to the tube is a 50 cps sine wave, the lateral movement of the spot is automatically synchronised with the variation in frequency, and a stationary response curve appears on the CRT screen. The effect of every adjustment of the trimmers is thus directly visible, and the set can be adjusted until the desired response is obtained. The sequence can be seen by reference to the block diagram Fig. 1.

It is proposed to explain the design in some detail so that it may be easily modified by constructors who are desirous of using valves and components other than those specified. Some effort has been made in this instrument to keep the physical dimensions as small as possible, consistent with using a reasonable size of screen. The constructor who has plenty of room will, therefore, be able to take considerable liberties with the design.

The cathode ray tube employed in the instrument is an ex-WD VCR 139A (Mullard ECR30). Any small tube can be employed, however, if the necessary variations in the power supply are made. This is one of those few jobs where the cheaply-obtainable long persistence tube can be employed. All the valves except one are types which are readily obtainable on the surplus market. Even if all the parts have to be purchased, it should be possible to construct the instrument for under £5.

The power supply arrangements will first be considered. In the interests of economy, of both cash and space, an ordinary receiver type power transformer was selected, its rating being 300–0–300V at 30 mA, 6.3V at 2A, and 5V at 1.5A. This was the smallest size obtainable. By employing rectifiers needing no heater supply, the 5V winding could be used to feed the CRT heater, and the 6.3V winding to feed the rest of the heaters. Since the VCR 139A tube requires only 4V at 1A, a resistor of 1 Ω has to be included in the heater supply leads. This was quite easily catered for by using resistance wire of suitable gauge and length for the leads. If it is desired to use a 6.3V tube (3BP1 or 3FP7 are both suitable) the tube can be quite safely run at the lower voltage, in view of the low EHT voltage used. HT for amplifiers and oscillator is supplied at 300V by a bi-phase half wave rectifier using an OZ4 cold cathode rectifier. A 6X5 could be used in this position, if desired, and its heater supplied from the same source as those of the other valves. A negative supply for the CRT is provided by a half wave selenium rectifier utilizing half the HT secondary winding. In the case of the HT supply, resistance-capacitance smoothing is employed, using liberal sized capacitors. For the negative supply, which feeds the cathode ray tube only, a single reservoir capacitor is sufficient. Since the current drain on this negative supply is so small, the capacitor charges up to almost the peak voltage of the AC supply, which in this case is about 420V. The total voltage existing between the HT positive and the EHT negative

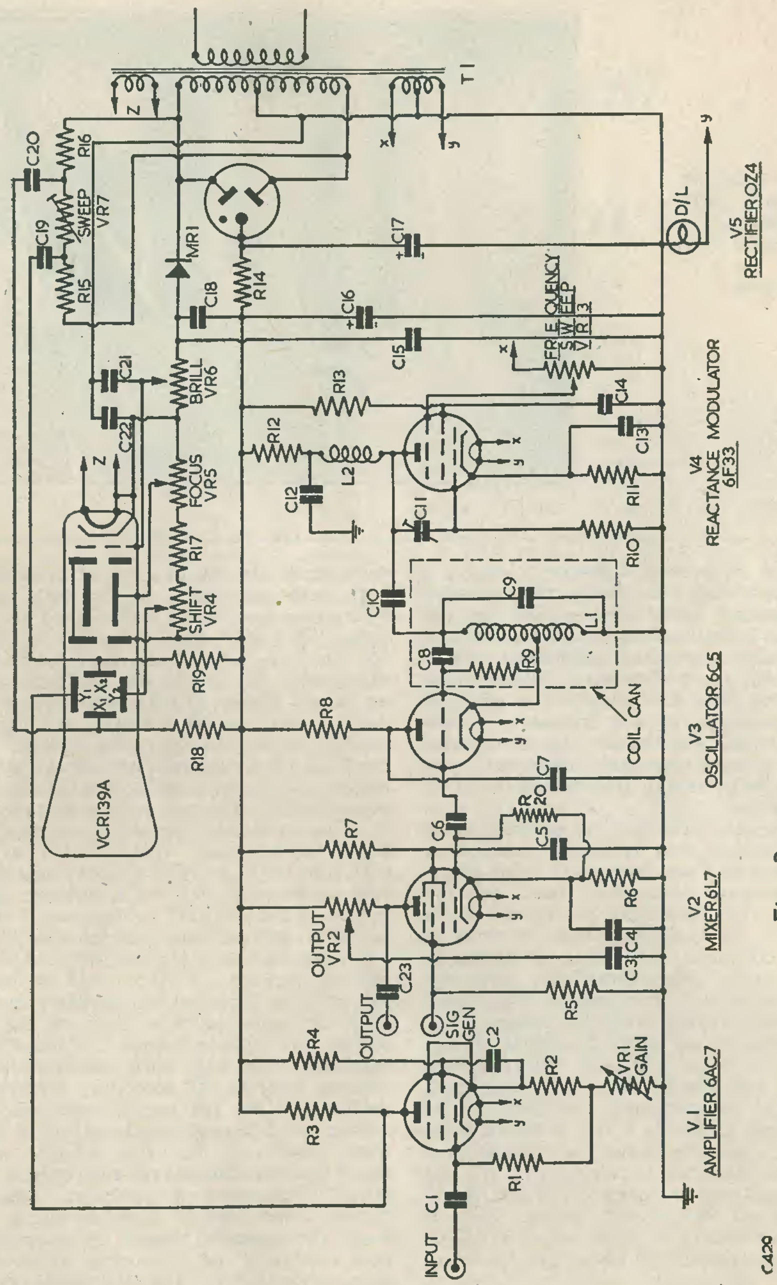


Fig. 3: *Complete circuit of the visual alignment signal generator.*

COMPONENT LIST

R1,	1 MegΩ ¼W	VR3,	5 kΩ (not critical)	C9,	50 pF
R2,	820 Ω ½W	VR4,	50 kΩ preset	C10,	0.01 μF
R3,	20 kΩ ½W	VR5,7,	100 kΩ preset	C11,	30 pF trimmer
R4,	47 kΩ ½W	VR6,	25 kΩ preset	C12,	0.25 μF
R5,	100 kΩ ¼W	V1,	6AC7 (6SH7, EF50, etc.)	C13,	0.5 μF
R6,	330 Ω ½W	V2,	6L7	C14,	0.25 μF
R7,	56 kΩ 1W	V3,	6C5 (6J5, 7193, etc.)	C15,	1 μF 1 kV oil-filled
R8,	20 kΩ ½W	V4,	6F33 (6F32, VR116)	C16,17,	24 + 16 μF 450V elect.
R9,	47 kΩ ¼W	V5,	OZ4, (6X5)	C18,	0.5 μF 600V wkg.
R10,	1 kΩ ¼W	V6,	VCR 139A (ECR30, 2AP1, 3BP1, 3FP7)	C19,20,	0.01 μF
R11,	470 Ω ½W			C21,22,	0.1 μF
R12,13,	27 kΩ ½W	C1,	0.25 μF	C23,	0.01 μF
R14,	2.2 kΩ 2W	C2,	0.5 μF	L1,	Denco 465 kcs BFO coil
R15,16,	220 kΩ 1W	C3,	0.01 μF	L2,	RF choke
R17,	470 kΩ 1W	C4,	0.01 μF	MR1,	Selenium rectifier 600V 5 mA min. rating
R18,19,	1 MegΩ ¼W	C5,	0.01 μF		
R20,	100 kΩ ¼W	C6,	100 pF	T1,	300-0-300V 30 mA, 5 or 4V 1.5A, 6.3V 2A
VR1,	50 kΩ	C7,	0.01 μF		
VR2,	50 kΩ	C8,	50 pF		

is thus about 720V, which is sufficient to supply the CRT. The fact that the deflecting plates will be at about the same potential as the HT supply, rather than at earth potential as in most applications of the CRT, is no disadvantage in this case, as no direct connections to the plates have to be made from the test circuits. The various potentials required by the tube electrodes are supplied by a potential divider network connected from HT+ to EHT—. This divider carries a current of about 1 mA, and is made up of fixed and variable resistors, the latter forming the usual focus, brilliance and Y shift control. The necessity for an X shift does not arise, but the Y shift is provided so that the base line of the trace can be set below the tube centre. The tube cathode and modulator electrodes are by-passed to earth by 0.1 μF capacitors. The use of push-pull deflection on the pair of plates nearest the anode eliminates most of the defocusing which is encountered when unsymmetrical deflecting signals are applied. The nearest pair of plates is accordingly used for the horizontal shift, and a very simple push-pull sweep is provided by connecting two equal-value fixed resistors and a variable resistor in series across the whole of the transformer secondary winding, the variable resistor being interposed between the two fixed ones. A variable sine wave voltage which is symmetrical about earth is available across the variable resistor, and this voltage is supplied to the horizontal deflecting plates via leaks and isolating capacitors. The time constant of these plate couplings must be large, to reduce the phase shift in them to negligible proportions. The variable resistor, like those in the tube network, is of the pre-set variety, and is mounted along with the others on a small sub-panel close to the tube base.

The Y plate which is not supplied with shift voltage is connected directly to the anode of a single stage deflection amplifier which steps up the output of the set under test. A 6AC7 was actually used in this position, but almost any similar valve could be employed. The use of a high g_m tube is recommended as in this way the anode load can be kept small and the response maintained up to relatively high frequencies, thus permitting RF envelope patterns to be displayed if so desired. The gain of the amplifier is controlled by cathode degeneration. Note that the screen grid is by-passed to cathode by a capacitor of liberal size. 6SH7, EF50 and EF54 are all suitable valves for use in this position.

The frequency modulated oscillator consists of two valves, the oscillator itself and the reactance modulator. The oscillator circuitry is influenced by the fact that it has to work in conjunction with the modulator, so the latter

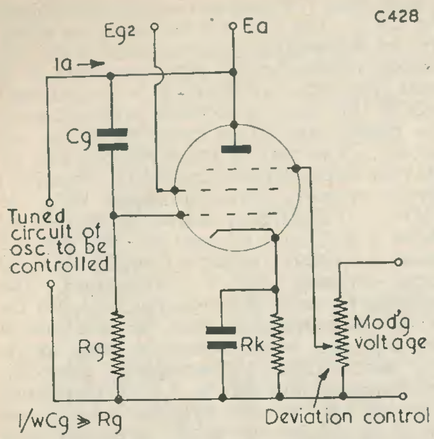


Fig. 2: *Basic reactance modulator circuit*

will be discussed first.

Consider a pentode valve connected as shown in Fig. 2. Let an alternating voltage V_a of pulsatance w be applied across the valve. A certain fraction of this voltage will be applied to the valve grid, the actual amount being dependent upon C, R and w. If R is made very much less than 1/wC, this fraction becomes RwC, and in addition to this the grid voltage leads on the anode voltage by almost 90°. In the case of a pentode, the valve load is small compared to the valve R_a and the anode current is $g_m.V_a=g_m.RwC$. The impedance across the terminals AB is thus $V_a/I_a=1/wCRg_m$ and this impedance is capacitive. If the valve is connected across the tuned circuit of an oscillator as part of the tuned circuit capacitance, the frequency of oscillation can be varied by varying the mutual conductance of the valve. If a low frequency signal is applied in such a way as to cause variation of g_m, the oscillator will be frequency modulated—the amount of deviation being proportional to the amplitude of the modulating signal. This signal may be applied to the grid of the valve, but a better method is to use one of the valves which are specially designed for this type of application. In these valves, the suppressor grid can be used to vary the g_m. The valve actually used is a Mayda 6F33. A somewhat similar valve is the Mazda 6F32, which is currently available on the surplus market as the VR116, CV1116, or V872. This latter valve closely resembles the ubiquitous SP61 in external appearance. Small variations in circuit constants will be necessary if the 6F32 is used, and the modified circuit is shown in Fig. 5.

The modulating voltage must be synchronised with the CRT sweep, and this is automatically ensured by using the 50 cps mains supply for both purposes. The modulating voltage for the reactance modulator is derived from one side of the heater winding. A variable control VR3 functions as a frequency sweep or bandwidth control. With the constants given, a maximum bandwidth of 40 kcs can be obtained. The capacitor C (Fig. 2) is actually a 30 pF trimmer, and can be adjusted to give the desired maximum bandwidth. Phase shifts in both the sweep and modulator circuits must be kept low in order that the sweep, as well as being synchronised with the frequency variation, shall be in phase with it. This will be discussed in greater detail later. It is most important that the amplitude of the output wave be absolutely constant, otherwise the results will be meaningless. The only variation in audio output at the set detector must be that due to the variation in frequency of the oscillator. The oscillator and modulator circuits must, therefore, be so designed that the modulating signal is not impressed on the output as an AMPLITUDE modulation. To ensure that this condition is met, the impedance in the anode circuit of the modulator valve is an RF choke, and the screen grid of the valve is by-passed for audio frequencies.

The circuit design of the oscillator must be such that the modulator valve can be connected across the whole of the tuned circuit. A Hartley circuit, in which the anode is at ground RF potential, is chosen. Any suitable triode can be used for the oscillator, the one actually used being a 6C5. The tuned circuit of the oscillator is a modified Denco 465 kcs BFO coil. The necessary circuit modifications are shown in Fig. 3. The adjustable dust core of the coil provides a means of adjusting the oscillator frequency to exactly 465 kcs. Note that the capacitance in the BFO coil is decreased to allow for the standing capacitance of the reactance modulator valve.

In order that IF's of frequencies other than 465 kcs can be aligned, a mixer circuit is incorporated. The ouput of the oscillator is fed to the mixer grid of a 6L7, and the oscillator grid is taken to a co-ax socket on the panel. The ouput to the set under test is taken from the anode of the 6L7, and an output control is included in the anode circuit. If it is desired to align, say, 110 kcs IFT's, then a signal generator set at 465± 110 kcs is fed into the oscillator grid of the 6L7, and the beat frequency is then obtained at the anode.

With regard to the layout of components, the first essential is to prevent any stray field from the mains transformer from deflecting the CRT beam. Use a good quality transformer with a shroud of heavy gauge steel, and mount it behind the tube, oriented in such a manner that any stray field which does exist is along the tube. The tube itself should also have a shield, preferably of mu-metal. The pre-set controls, as will be seen from the photographs, are mounted on a small panel at the rear of the tube, and holes are drilled in the case to permit these controls to be adjusted.

To adjust the completed instrument, first set the pre-set focus and brilliance controls to a suitable level, then adjust the X sweep control until a trace about ¾ screen diameter is obtained. The Y shift control should be adjusted so that the line is somewhat below centre. To adjust the oscillator frequency, set a signal generator at 465 kcs and feed its unmodulated signal into the IF stages of a receiver, via a very small capacitor. Now set the sweep control of the alignment generator to zero deviation, and couple its output to the IF of the same receiver. Tune the oscillator for zero beat in the speaker. Now disconnect the signal generator, but leave the alignment generator in position. Advance the Deviation control, when a hum should be heard in the speaker. Connect the input socket of the oscillator across the demodulator load of the receiver, and the response curve should be visible on the screen. If it appears inverted, reverse the Y plate connections.

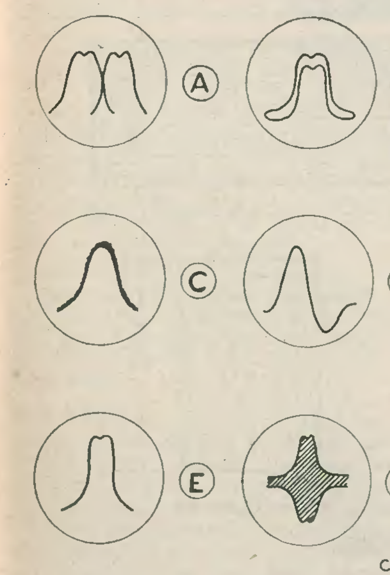


Fig. 4: *Typical screen patterns.*

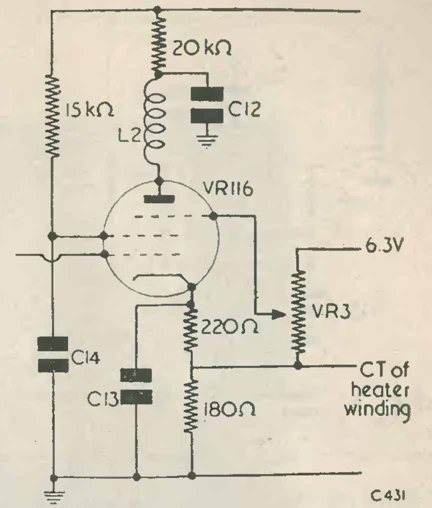


Fig. 5: *Showing modifications to reactance modulator when using a VR116.*

When using this instrument it is important to take the feed to the deflection amplifier from across the diode load, after the RF filter, but before the signal has been transmitted through any audio couplings which will, in the average receiver, distort the response curve owing to their short time constant. The time constants in the deflection amplifiers are deliberately made large to prevent this happening in the instrument itself.

Fig. 4 shows typical patterns which may be encountered when using the instrument. At A is shown the effect of phase shift in the receiver circuits. The forward and return traces are identical, but are displaced sideways instead of being superimposed on each other. This state of affairs should not be confused with that which would arise if the IF's were peaked at the wrong frequency, since in the latter case only a single trace, displaced to one side, would appear. B shows the forward and return traces displaced vertically by mains frequency hum pick-up. In C and D are shown the effects produced when connections are made to the wrong points in the receiver circuit, C being the trace obtained when unfiltered AF direct from the detector is fed in.

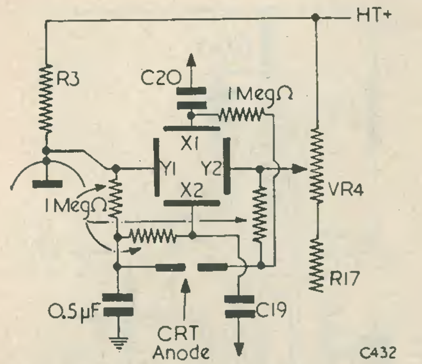


Fig. 6: *Modified CRT network for improved focus.*

D shows the effect of connecting to a point in the audio system beyond the detector; transmission through couplings of insufficient time constant has distorted the curve. E and F show the respective ideal traces obtainable at the detector and at the last IF stage. The AGC (AVC) should, of course, be put out of action when the receiver is being aligned, preferably by disconnecting the AGC line rather than by short-circuiting it to earth.

To use the VR116 in place of the 6F33, small alterations must be made. These variations are necessary because, although the 6F33 can be made to operate under the required conditions with the same bias voltage on both control and suppressor grids, in the case of the VR116 the suppressor and control grid bias voltages are not the same, the suppressor requiring less bias than the control grid. The suppressor is, therefore, returned to a tapping on the bias resistor, and the centre tap of the heater winding is also returned to this tapping. If a transformer having no centre tap on the heater winding is employed, a blocking capacitor must be inserted between the slider of the Deviation control and the suppressor grid. This capacitor should be large enough to avoid the introduction of undesired phase shifts.

It has been found that, due to the fact that one pair of plates is operated at a considerable negative voltage with respect to the final anode of the CRT, the focus obtainable falls short of the ideal. This was not considered a big disadvantage since, as the trace always occupies the same position on the screen, there is some slight risk of burning taking place. If it is desired to obtain improved focus on the CRT, the tube supply system shown in Fig. 6 may be employed. With this system, the anode is automatically kept at the mean potential of the deflecting plates, and better focusing is thereby achieved.

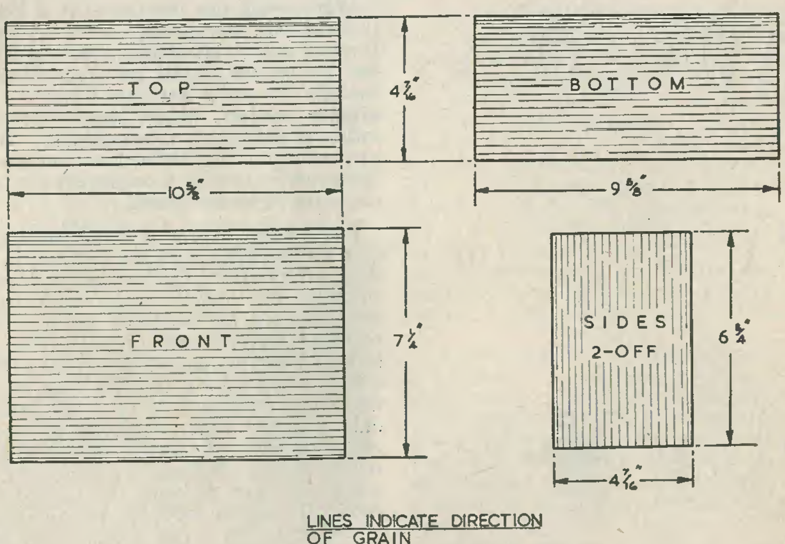
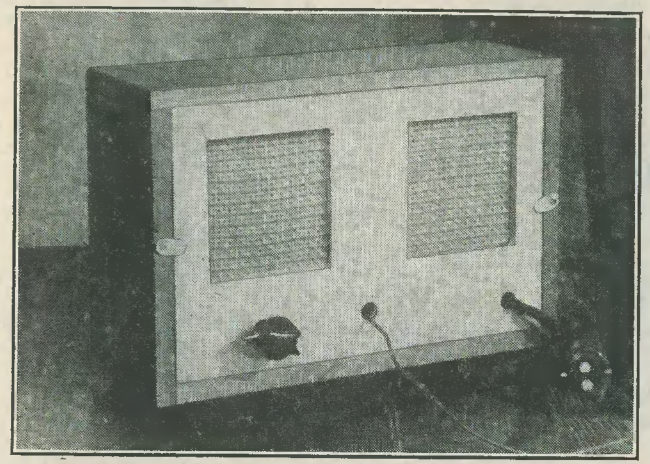


Fig. 1: The component parts of the cabinet. The material is half-inch mahogany.

A Cabinet for . . .



The Constant Companion RECEIVER

By J. R. DAVIES

Readers who have constructed the "Constant Companion" receiver will, no doubt, be interested in building a cabinet to house it; and, as the writer has made a simple cabinet for his own model, brief details are given in this article on the methods and materials employed by him.

Owing to the small dimensions of the receiver complicated work is not necessary. Half-inch mahogany was used by the writer, the cabinet being held together by simple butt joints.

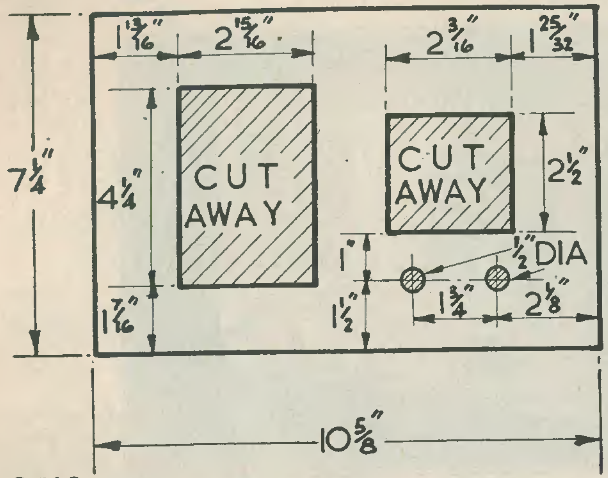
Dimensions

The various parts of the cabinet are illustrated in Fig. 1, the pieces shown here being the front, top and bottom, and two sides. It is very necessary to ensure that all saw-cuts are clean and are exactly square. The dimensions shown in the diagram are those of the various parts after they have been cleaned up. As the ends of the front panel and of the top will be visible, these, especially, must be well-finished.

It will be necessary to cut holes for the speaker and dial, etc., in the front panel before assembly, and the positions of these holes are shown in Fig. 2. The top of the front panel must also be rounded off, the side-view given in Fig. 3 illustrating how this is done.

The various parts of the cabinet are joined together as shown in Fig. 4. The pieces are held by butt joints (i.e. they are simply glued together as they are). These joints are well-glued and are reinforced with panel pins. Not many pins are needed and their positions are indicated in the diagram. The panel pin heads are taken below the surface of the wood by using a thin nail-punch.

When the glue has thoroughly set, the depressions above the panel pins are filled with wood-filler, several applications possibly being necessary owing to the fact that the wood-filler will shrink as it dries. The surplus glue and wood-filler are next removed and



C418

Fig. 2: Cutting out the front panel.

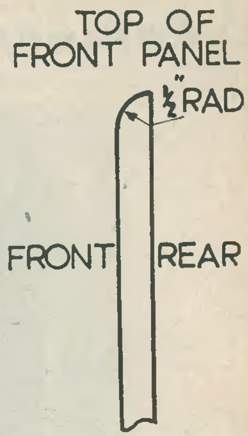
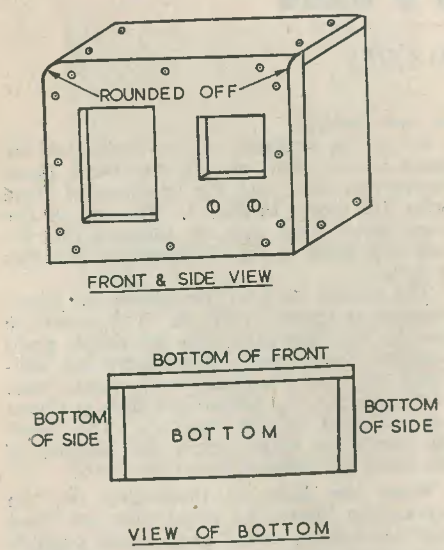


Fig. 3: Rounding off the top of the front panel.



C419

Fig. 4: The cabinet assembled. The circled dots indicate the positions of the panel pins.

the whole cabinet is cleaned up. It is then French-polished. It will be well worth while taking care over the French-polishing, as the whole appearance of the cabinet is greatly enhanced if this is done properly. When the polishing is completed, the inside edges of the dial and speaker apertures are painted with matt black enamel, paying particular attention to ensure that the enamel does not "spread" over the front polished surface.

Fitting the Receiver

It should now be possible to fit the receiver in the cabinet, the volume control and wave-change spindles lying central in their respective holes. It will be found that the speaker does not fall directly behind its aperture, but this will not detract from the final reproduction. The chassis should be removed again and a support for the dial made from thin aluminium or similar metal. The support is integral with the receiver and may be fixed to the two adjacent mounting holes of the loudspeaker. The dial will lie behind the dial aperture in the cabinet. If desired, a dial light can be fitted, this being connected between the resistance wire of the line-cord and the rectifier heater; the connection between these two being broken for the purpose. The holder

for the dial lamp should have both terminals well insulated from its mounting.

To protect the dial a small piece of ⅛" or $\frac{3}{16}$" Perspex is cut to shape and is made a push-fit into the dial aperture. The front of the Perspex should be flush with or just below the front surface of the cabinet. It may be held in position more securely with a faint touch of clear glue or nail varnish. Before fitting, it needs to be drilled to accommodate the projecting tuning spindle.

The next job consists of fitting two slats or runners under the cabinet. The dimensions are given in Fig. 5. The slats should be painted matt black before being fitted, and they may consist of any type of wood available.

The receiver chassis should now be fitted with two small right angle brackets on the front and rear "flaps" to enable it to be fastened down by means of two bolts which can be inserted through the bottom of the cabinet. The brackets should, of course, be tapped to accommodate these bolts. The heads of the bolts should lie between the two slats under the chassis. It is important to remember that these bolt-heads are "live" when the receiver is plugged into the mains.

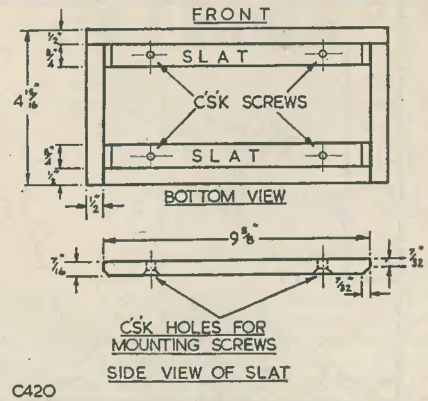
The Loudspeaker Fabric

The receiver is once more removed, the next job consisting of fitting the fabric behind the loudspeaker aperture. A very pleasing effect is given if fawn coarse-mesh fabric of the woven paper-string type (very popular and easily obtainable these days) is used. A liberal application of good "tube-glue" should suffice to fix the fabric to the inside of the cabinet. Whilst the glue is setting, the fabric can be held in place by "cut-down" drawing pins.

Two slats of contrasting wood are then stuck to the front of speaker aperture (Fig. 6). The writer used oak for the slats in his cabinet, although any other contrasting wood will suffice.

The back is next prepared. This is made of three-ply cut to the dimensions shown in Fig. 7 (a), and it should just fit into the back of the cabinet. When completed it is cleaned up and French-polished, the square apertures being covered on the inside with the same coarse-mesh fabric as was used for the speaker.

Four small pieces of wood of the dimensions given in Fig. 7 (b) are now made and are glued to the inside corners of the cabinet in the manner shown in Fig. 7 (c). These pieces of wood should be positioned such that their distance from the back of the cabinet is equal to the thickness of the plywood back. When the back is fitted, it should lie flush and bear against the four pieces of wood. Two small brass catches about half-an-inch long are



C420

Fig. 5: The runners which are mounted beneath the cabinet.

then made and screwed to the back of the cabinet as shown in Fig. 7 (d). These catches hold the back in position and pivot on small wood-screws

The cabinet is now completed and should have the same appearance as that shown in the photograph accompanying this article, and in the cover illustration of the May issue.

Alternative finishes

As some readers may find it difficult to obtain the half-inch mahogany mentioned above, they might find it worth while employing the details and dimensions given and use some other type of wood. Should the wood chosen not lend itself to a good finish, the cabinet can be covered afterwards with skyver, leatherette

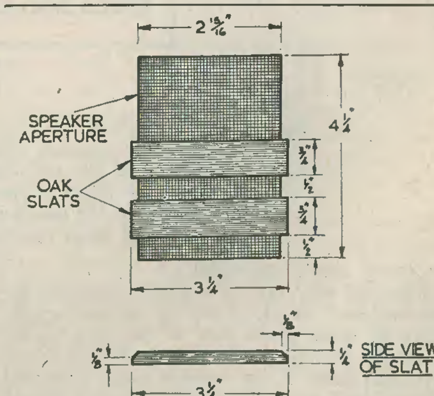


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Fig. 6: Fitting the contrasting slats to the front of the speaker aperture.

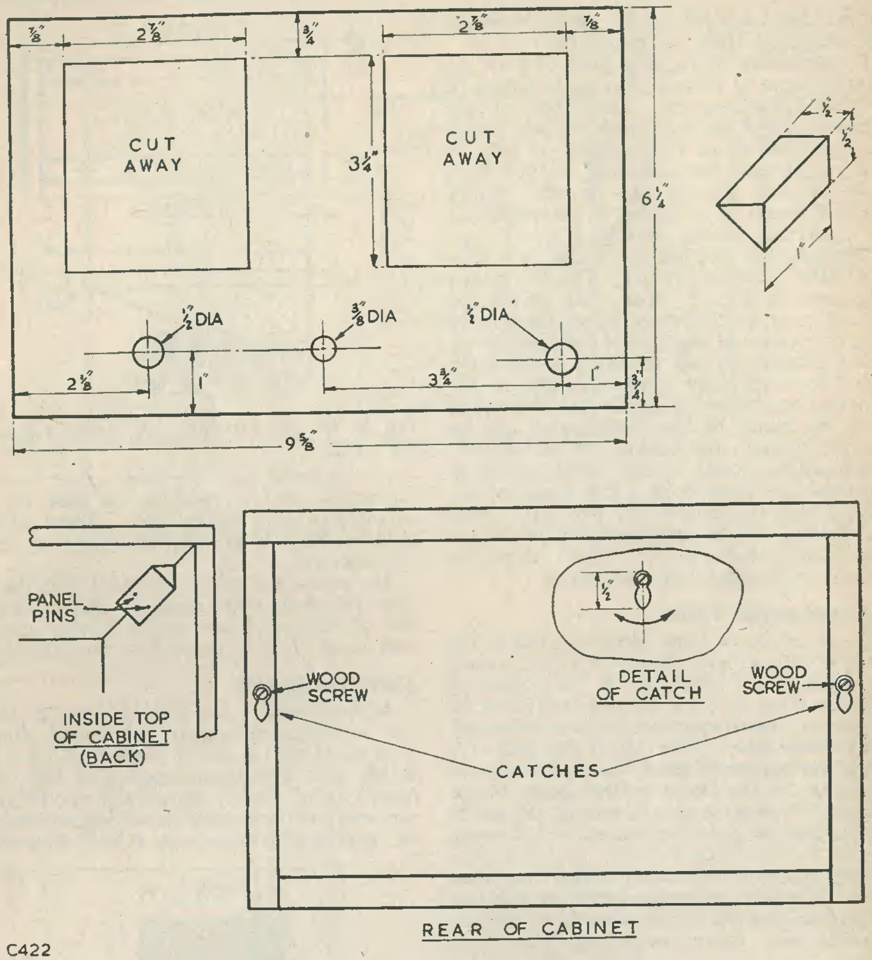


Fig. 7(a) The cabinet. The left-hand back of the hole is drilled to take the reaction spindle, the centre one for the aerial lead, and the right-hand hole for the mains lead.
(b) The dimensions of the stops for the back.
(c) Mounting the wooden stops in the cabinet.
(d) How the brass catches are fitted.

or some similar material.

Plywood may not be a good substitute for the half-inch wood, owing to the impracticability of using panel pins at the butt joints. However, plywood *could* be used for the front, top and sides, if the bottom piece consisted of any half to one-inch wood which would take the panel pins. The joints between the front and top and sides could then be strengthened by half-by-half inch battens fixed internally, into which panel pins could be driven.

In conclusion, the writer would like to mention that he was discouraged by several carpenters from using veneers for finishing the surface of the cabinet. He was told that, for small quantities at any rate, it would usually be found that the actual wood is cheaper to buy and easier to obtain than is the veneer.

Radio Miscellany

THE chief argument put forward by those anxious to ban sound and television broadcasts of sporting events well illustrates how little such people learn from history. The same old argument was proved wrong over a hundred years ago. At the time of the Exhibition of 1851, when photography was still in its infancy, it was solemnly suggested that no photographing of the Exhibition should be allowed. The grounds then put forward were that if people could see pictures of it they would no longer want to see it, and attendances would so decline that a loss would be incurred.

Well, well, well! We all know, to-day, that the 1851 Exhibition made an enormous profit despite the circulation of photographic reproductions.

In more recent years, the broadcasting of gramophone records was said to threaten a heavy curtailment of sales. Of course, it did nothing of the sort—in fact, it achieved just the opposite. Gramophone companies did bigger business than ever before.

Many sports and entertainments which have struggled for years on enthusiasm alone, and often no promise of future profit, have been so popularised by radio and television that to-day they have far bigger followings (and profits from gate money) than ever before.

CENTRE TAP *talks about*

BC & TV BAN – ARTISTES – BASIC SUPERHET – GLASS CUTTING

Perhaps I am a purist, but I feel disgusted that these self-styled "sportsmen" are so much more interested in making money than in the promotion of genuine sport. As far as professional football is concerned, I feel considerable satisfaction for the sake of the game that interest in the leading (and local) amateur clubs has increased since the advent of Pegasus. It could be further stimulated by properly handled broadcasting and television. Listener popularity would be well maintained if matches were selected on a zone basis, when the excitment of sympathy for one side or the other would create an interest stake in the regions where they are broadcast.

Music Hall

It is curious when you come to think of it, but the vast majority of our readers build sets for the pleasure of construction or experiment rather than for their primary purpose—to listen to! Listening, it seems, is for the most part limited to brief spells when they have nothing better to occupy their attention. Possibly there are but few programmes worth the trouble of re-arranging one's other activities in order to hear them.

I have long advocated less broadcast (and television) hours in order to devote the money saved to provide better programmes. Too much third rate material is used—apparently only to fill in the time in order to make up the scheduled number of hours. Even the programmes arranged for "popular hours" leave a lot to be desired at times. I sometimes think that listeners have lost their critical faculty, or else they despair of getting the BBC to do anything about it. I am quite sure that a number of our variety artistes would "get the bird" from a good, old-fashioned music hall audience—particularly the crooners.

I suppose there is some sort of hierarchy in the crooning world although I marvel how the order is arranged. They all work to the same pattern—or should it be called 'routine'?

Of the old time Music Hall artistes I remember, and those we know of only by early recordings or reputation, all had vivid and compelling personalities. And they didn't need Press Agents and bally-hoo to conceal their lack of talent. They sang songs, too, that really had melody and vigour. A little robust maybe, but they had more than a semblance of reality. Instead of sighing about love-sickness and self-pity they sang of our personal experiences—even to the lodger, the mother-in-law and yellow-haired barmaids.

After all, it has been Festival year and the BBC could well have given us programmes that reflected our national way of life and depicted the hearty mirth of a virile, masculine nation instead of an overdose of imported negroid cacophony.

In Triplicate.

A correspondent in our companion journal, the Short Wave News, sends a photograph and an account of three Basic Superhets he has built. I hardly think it is likely that anybody is going to "cap" it by sending along a picture of four!

As with the majority of other Basic Superhets that I have seen or heard about, these models have modifications to bring them into line with the constructor's individual requirements, or to suit components he already has on hand. That, of course, as pointed out in the Foreword was the original intention. It is as much to serve as a basis for a communications receiver design for the constructor interested in stage by stage experiment, as for the man who simply wants to build a business-like receiver for DX listening.

The Editor and I are always pleased to hear of the measure of success readers meet with, particularly if this is their first superhet. When the prototype was originally described in July, 1946, it was partially as a challenge to a statement appearing in a contemporary magazine that they did not propose to deal with the construction of such a design as they felt it beyond their readers!

The RF stage, BFO, Preselector, etc., described in the Data book are, of course, suitable for addition to any similar set.

Occasionaly enquiries are received regarding a VHF converter: one built with the Basic Superhet in mind was described in the SWN of March, 1948, and the description of a similarly designed "S" - meter appears in the same journal for December, 1948. These issues have naturally been long since out of print, although other readers are often able to help beginners by the loan of copies—another advantage gained by belonging to your local club or ISWL Chapter.

A Novel Idea

Following my recent comments on glass cutting, I have seen some excellent examples of cut and shaped perspex used for tuning dial covers, etc. One in particular, bow-fronted in both directions rather in the manner of a shallow dish, scarcely seemed like a home made effort.

The reader had fashioned two pieces of wood to form a mould and a former. Sheet perspex, ex-aircraft, of one-eighth inch thickness, was then heated in an oven until it was soft and flabby, laid in the mould and pressed into shape with the former. An old-fashioned letter press was used for this purpose.

After cooling, the edges of the hardened perspex were cleaned up with a file while the few rough patches were polished with increasingly fine abrasives until a glass-like surface was obtained. As the reader points out, such dial covers can be easily calibrated by engraving or die-stamping on the back and filling with coloured paints to give pleasing individual effects. The original sheet is cut to size by simply scoring deeply and then breaking.

This idea seemed well worth while passing on, and simple single bowed surfaces can obviously be quickly shaped in this manner.

Glass Cutting

The same comments also revealed how much glass-cutting constructors do. It seems that quite a percentage of readers tackle it at some time either for dial fronts, meter windows, etc. For those who have not yet acquired the knack here are a few hints. Most of them would, I suppose, occur to readers by experience, but it invariably happens that the job requires good quality glass as distinct from old window panes, which usually contain flaws or have irregular thickness which causes distortion.

It is a good plan to practice on a few bits of waste glass before you start on the somewhat rarer good quality variety, and it is also assumed that the normal wheel cutter will be used. I can hardly imagine anyone buying a glazier's 'diamond' for occasional use.

Make sure you have a level surface and overlay it with a few thicknesses of newsprint.

Use a straight edge that will not slip, and allow for the thickness of the cutter.

Hold the cutter between the first and second fingers, so that you get a better pressure than is possible by holding it pencil fashion.

Don't try to plough a furrow, and don't go over it a second time.

Make sure the glass is clean and free from grease, or the wheel will skid instead of scoring the surface.

If for any reason the cut is not complete, turn the sheet over and start again on the opposite side.

We now come to the break, and this is the point where most inexperienced cutters fail. Half-hearted handling at this stage results in far more breakage than roughness, jerkiness or clumsiness do. Hold the glass between the index fingers and thumbs on each side of the cut. The knuckles of the first fingers, which are on the underside, should be nearly touching each other. Grip firmly and turn the thumbs sharply away from each other, when the glass will snap cleanly along the cut.

For very large sheets, the glass is best placed so that the cut comes over a straight edge, and a sharp downward push is applied to the unsupported side.

Once one has acquired confidence in cutting straight pieces the cutting of circles, ovals and fancy shapes, or even of tapping out shaped holes, soon comes with practice. I have twice had occasion to reglaze model 7 Avo's and each time, by observing these common sense points, it has been successfully managed with the first sheet.

IN YOUR WORKSHOP

This month J. R. D. chooses a subject which has recently been prominent in letters from readers—that of Modernising Old Receivers.

ALTHOUGH it might be considered a stretch of the imagination, it is nevertheless true to state that the average radio serviceman occasionally exhibits the qualities of a startled fawn or gazelle. Whilst the disillusioned and far too wordly-wise eyes of the serviceman hardly hold the naive and trusting expression presented by the fawn and whilst the question of natural grace is best left to introspection before the bathroom mirror, the mechanic, nevertheless, expresses an occasional inclination to shy violently away from others, particularly those of his own kind.

One of the main reasons for this, of course, is that the serviceman does not always look forward to talking shop in his spare time. However, if and when he does get together with his fellows, and if (to quote the RAF) the hangar door does remain open, then the conversation will nearly always turn to reminiscences and past triumphs. "Do you remember the set that So-and-So turned out in '35; the one which had the queer reaction circuit?" Or, "Do you remember that six-valve job made by Such-and-Such? What a devil it was to trim!" And so it goes on.

To turn from the conversation of the serviceman to the consideration of hard facts, it would prove very interesting indeed to find out how many old receivers are still in use and how many have been banished to attics and store-rooms where they nowadays do little except collect dust and dirt. A large number of these early receivers were both well-designed and carefully made; and it does not necessarily require a large amount of expense or trouble to so overhaul and alter them that they may be brought into service in a modernised form. The attraction of getting these old sets into working order once more is greatly enhanced when one remembers that the purchase tax on new receivers has only recently gone up to the present high value of 66 2/3 per cent.

Examination

When it is desired to modernise an old receiver the first thing that has to be done is to give it an examination in order to see how much of the original circuit can be retained. In most cases, the cabinet will be left more or less as it is, the work of overhaul and alteration being done on the chassis and on its components.

The modernisation of an old chassis can usually be carried out in three ways. First of all, the chassis can be overhauled and brought up to date by the simple process of replacing any components which have become old-fashioned and unreliable. Secondly, not only components but entire sections of the circuit can be replaced with more modern counterparts. Finally, the chassis can be stripped down and rebuilt, re-fitting any of the original components which do not appear to have suffered with time. Of the three methods, the writer usually favours the second because, unless the receiver is very venerable indeed, only part of its circuit will need alteration, the rest being usually good enough in its essentials to take the modern components which will be fitted to it.

Type and Age

It would be advisable at this point to examine what is offered by most of these old receivers, so that we may see what can be done with them. This can best be carried out by considering them from the point of view of their age.

Up to (and sometimes beyond) the early thirties, nearly all the sets put on the civilian market in this country utilised straight circuits. Reaction (or controlled instability, in some cases!) was usually provided with battery types, but not always with mains models. The most often-met circuits used an RF stage followed by an anode-bend or leaky-grid detector, extra tuned circuits being provided occasionally by band-pass couplings between the aerial and the RF stage. To overcome the poor selectivity of the straight circuit, most of the bette rtype receivers used large well-designed coils, reasonable results being then quite often obtained. Several of the more expensive receivers used as many pre-detector tuned circuits as was practicable, and it is possible to find some of these receivers fitted with four-gang tuning capacitors.

However, despite the amount of work put into them, straight receivers of this type are not of much use under modern conditions. The best thing that can be done with them, (if a "rebuild" to a superhet circuit is not contemplated), is to remove any reaction circuits that may be fitted, instal new detector and AF stages, and look upon the result as a high-fidelity receiver intended for local-station reception only. Many listeners are quite happy to receive only the stronger BBC stations, and a receiver of this type would hold a definate attraction for them

An alternative idea would consist of removing one of the pre-detector tuned circuits, (if there were more than two), and substituting an oscillator circuit in its place. The remaining tuned circuits would still give good RF amplification; and would also provide a good basis for the signal-frequency circuits of a frequency-changer. The remainder of the set would have to be rebuilt as a superhet, of course, hut the excellent "Q" offered very good RF gain and a corresponding freedom from second-channel interference. Unless the ranges covered by the old tuned circuits were unconventional, modern oscillator coils (particularly those with adjustable iron cores) fitted with variable padders should track with them quite well.

The Superhet

When the straight set began to disappear, its place in the commercial market was taken over by the domestic superhet. This started off originally with the old 110 kcs IF, which soon, however, changed over to the present 465 kcs. Again, it will be found that many of these early superhets were both well-designed and well-made, and that their chassis do not require so many drastic alterations as may, perhaps, be thought at first sight.

Apart from some typical faults which will be dealt with later, a surprising proportion of the IF transformers fitted to these early superhets could still be retained in a modernised version. If the transformers suffered from any fault of design, (going by present-day standards), it was usually that they were sometimes too loosely coupled, but a car their usefulness. However, a few "freak" circuits may be encountered occasionally, in addition to such things as leaky-grid or anode-bend second-detectors, single winding or aperiodic-coupled IF transformers, second detector reaction, and so on. Circuits such as this would, of course, have to be removed.

Added to this is the fact that many of the early superhets had rather weird and wonderful frequency-changer circuits; although these can usually be replaced by corresponding modern circuits very simply. AVC circuits were also the subject of much complex design; and it will be found advantageous to remove some of the more complicated versions which may occasionally be met.

From about 1935 onwards, most receivers settled down to the familiar four-plus-one circuit which is so familiar today. It is hardly an exaggeration to state that many receivers manufactured after, say, 1937 have basic circuits which are almost identical to those found in a modern receiver. The modernisation of such a receiver often consists therefore mainly of replacing faulty or out-of-date components and, (sometimes), of fitting more modern valves.

After the four-plus-one made its appearance, many manufacturers tried to make their sets more attractive by fitting different gadgets to them. Push-button tuning became fashion, and is still with us. Tuning-indicators also appeared (usually AVC-operated); and a great amount of design detail centred around the tuning scale.

The four-plus-one design remained fairly stable during all this time. Some manufacturers came out with a three-valve circuit in which the output pentode was combined with the second detector diode. The more expensive sets sported an RF stage before the frequency-changer; and one occasionally found a receiver whose AF section was a little more comprehensive than that offered by the conventional double-diode-triode and output pentode or tetrode. (*To be Continued*)

AC/DC TEST METERS W. H. Cazaly & Thomas Roddam. Published by Sir Isaac Pitman & Sons, Ltd. 180 pp. Price 18s.

This is a book which will be found very useful by all those readers interested in measuring equipment, whether for radio servicing, in the laboratory, or in the home workshop.

Moving coil movements are first dealt with as such, and then follow chapters on DC circuits, AC circuits and rectifiers, AC voltage ranges, AC ranges and current transformers, and B.S.I. specifications. Next comes a section on construction, followed by a chapter on power and capacitance ranges, and protective devices.

The treatment is, on the whole, practical and, as the authors state, "has been written for the man who does not possess a large outfit of expensive precision standards, a wide assortment of tools, and considerable experience in high-class instrument making. The constructional methods suggested, therefore, are perhaps unorthodox, but they should be within the scope of the professional or good amateur workshop". G2ATV.

How to Re-build AN AMERICAN MIDGET

By H. DUDLEY STILTON

I WAS playing about in the workroom the other day. Actually, although I say playing about, I was conducting a very interesting experiment. I have, as usual, quite a stock of rectifier valves waiting to be thrown away, as their emission is flat, and I was just seeing how many volts it would take to blow the filament. You can laugh, but it shook me—the valve tester gives up to 40V but, although you could read a newspaper (if you can get one!) by the glow, the filament showed no sign of going.

Deciding that I *would* blow it before I finished, I ran two leads from the mains, fastened them to the valve, and switched on. Believe it or not, the filament did not blow, but the main fuse did! There was a chorus of yells from downstairs, both male and female —and I do believe I did detect a note or two of blasphemy. Ah, well—such is life.

Tamen, as our Esperanto friends would say, to continue . . . I had just returned the shop to its smoothly efficient status ahem!—when they brought me in a repair job; one of those small, in fact, microscopic, American midgets. You know the type I mean, five valve, two waveband superhets—made to last until something goes wrong, then to be thrown away, as a new one can be bought more cheaply than it costs to have the old one repaired. An admirable idea—only no one ever throws them away.

This particular set had, I deduced, been repaired before. For as I drew it gently from its cabinet, everything ire ned out. Electrolytics, coils, and what have you; all in mad confusion. Now I can understand people fitting a replacement part, but I can never understand why they *will* leave in the old useless one, instead of removing it and fitting in the new part in its place. Anyway, that was the first job. Then I tested it for shorts, etc.

There was one capacitor, an electrolytic, which was definitely open. It was, also, a peculiar value, 6μF. Now all I'd got were 8's and 16's, so I put an 8μF in. Actually, I don't suppose those two valves were much good anyway! You see, the set did not utilise a line cord or a mains dropper—it used an 8μF—an electrolytic!

I was just going to stick an earth on, when Rex walked in. I think he came to tell me it was time to go home, but seeing I was busy decided to help. Now, as you all know, Alsatians are very intelligent animals; and mine is no exception. His idea of repairs is not to waste time with testmeters, etc., but to get on with the job. His first advance in this line is to smell it. If, after that, he can't quite fathom what is wrong, then he likes to see what it tastes like. Rex followed his usual procedure, but forgot to establish if it was an AC or an AC/DC set. It was the latter. It was also hot side up. I don't suppose Rex would bother normally about a little matter of 210V—but on a nice, long, wet tongue—Zowie! If your YL or XYL is trying to blackmail you into buying one of those home perms, Rex will show you his —and it didn't cost a penny.

Normally, I should have laughed myself sore at that, but this time ! ! ! I told you I was about to try an earth on the set, didn't I? Right! I had the bare wire in one hand, and as Rex knocked the set off the bench in his mad rush out, I suddenly found myself with a very heavy American midget in the other hand. Next thing I knew, I was on the floor; giving a darned good performance, if I do say it myself, of a person in the last stages of a jitterbug competition. Now everybody admires MY curly hair, too! And the way my ears stick out when I see an American midget—Boy, that really kills 'em. But I DO wish I could get the kinks out of my legs!

Where were we? Oh, yes, I was substituting for a resistor, wasn't I? Well, after the first shock, I had to fathom out some means of getting unhooked. I knew I was in the devil of a mess, and if I had to do as Dick Barton does, and wait until the next evening 'at the same time'—well, I pity me.

Oh. The things I called that dog—but he'd gone home. Then the manager came in.

"What on earth are you doing down there?" he asked.

"The bench is too high, I'm doing this one on the floor. PULL THAT D——N PLUG OUT ! ! !" I replied.

"Which one?" says he, bending down to see me better; but he bent down a little too far—then there were two of us!

By this time, I was so used to being tied up in knots that to see him going through the same thing struck me as being so funny that I just had to laugh; but with being vibrated to and fro, at a nice steady fifty cycles per second, it sounded more like a death rattle.

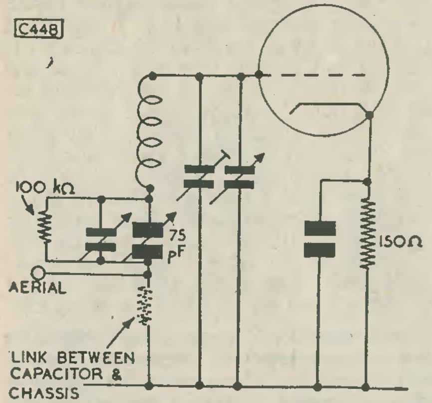
Yes, we got off in time. Remember that game, where you have a piece of cloth stretched tight, and you wind a handle, and the Gee-Gees wriggle along? Well, we wriggled along like that until eventually the plug came out.

How did it affect us? The manager is still managing—and me? Oh, I'm driving a coal wagon now ! !

from our Mailbag

Dear Sir,—A short time ago I sent you an article on an adaptor for Wrotham (see last issue—Ed.)...... I stated that there was room for experiment in aerial coupling. I have now abandoned the loop coupling to the HF stage which I suggested.

When adjusting the trimmer which is in parallel with the HF stage tuning capacitor I noticed a sudden increase of signal.



The Aerial is Actually Connected via a 20 pF Capacitor.

I thought this was due to pressure on the padder making a finer adjustment, until I noticed the same effect on touching the nearby L-shaped loop of wire between the variable capacitor and the trimmer. This is on the *earthy* side of these capacitors.

On further investigation, I find that the whole frame of this capacitor is insulated from chassis entirely, and then connected to the metal base by a short length of wire about ½" long.

This length of wire must have a slight resistance to HF at 94 Mcs, though on test it appears to have no resistance to DC.

It certainly provides a magnificent low resistance tapping for feeding in the aerial, whether this is a short horizontal wire or the main broadcast aerial.

The matching is very much more effective than my original suggestion, and has the added advantage of shorting any 7 Mcs breakthrough. I add a diagram.

I do not know if this will apply in *all* RF26 or RF27 Units, but it is an indication of the best way of feeding in the signals.

I would like to invite comments from the more technically minded on *why* this point, which is earthed to DC, provides the best matching for aerial input. It is *not* a question of a critical length of wire, as the aerial can be fed in anywhere along the capacitor frame with similar effect. Does anyone know why this variable capacitor is so conveniently isolated from chassis except by this little link?—H. S. Brodribb (St. Leonards-on-Sea).

AROUND *the* TRADE

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