A VERSATILE OSCILLOSCOPE

1/-

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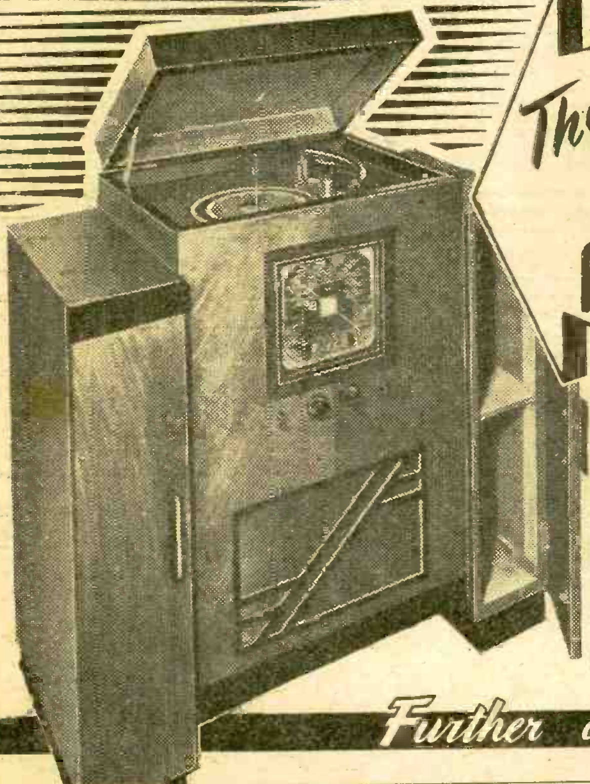
JULY, 1952

EDITOR:
F.J.CAMM

PRACTICAL WIRELESS



The PW 3-SPEED AUTOGRAM

Further details

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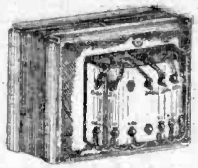
TAPE RECORDING
ELIMINATING HUM IN MAINS AMPLIFIERS
TELEVISION INTERFERENCE
CONVERTING TO PUSH-PULL
SURPLUS MERCURY VAPOUR RECTIFIERS
SHORT-WAVE SECTION

DUKE'S



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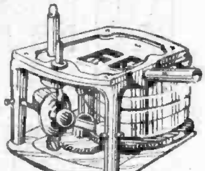

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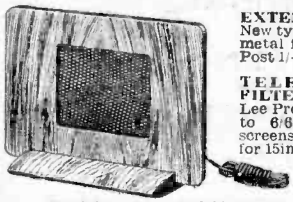

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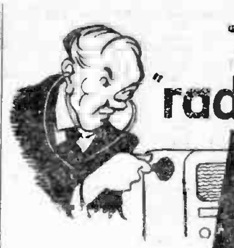

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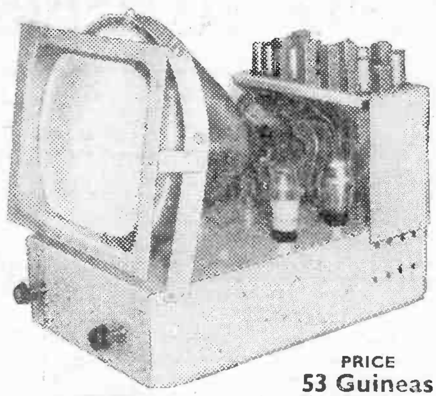

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Practical Wireless

EVERY MONTH
VOL. XXVIII, No. 549 JULY, 1952

Editor F. J. CAMM

20th YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

The White Paper On Broadcasting

THE Charter granted to the BBC on the 1st January, 1947, and the accompanying Licence, were due to expire soon after the present Government came into power, but to allow time for the conditions of the new longer-term Charter to be examined and considered by Parliament, a short-term Charter was granted for six months to expire on June 30th, 1952.

The Government has now considered the recommendations of the Broadcasting Committee, which sat under the chairmanship of Lord Beveridge, and also the proposals which the late Government set out in a White Paper issued in July, 1951. They have also considered the views expressed in both Houses of Parliament. The Government has now issued a White Paper on the Broadcasting Committee of 1949 setting forth its proposals in regard to the new Charter and Licence. In many instances the Government accepts, as did their predecessors, the recommendations of the Broadcasting Committee, but in some important respects they propose alternative arrangements. On the question of monopoly, the successive Licences, says the White Paper, have not, of themselves, established the BBC as the sole authority for all broadcasting in the United Kingdom. The BBC has, in fact, enjoyed an exclusive privilege because successive Governments have decided that, although the Postmaster-General is empowered to licence any number of persons to operate broadcasting stations, he should not licence anyone other than the BBC. It is realised that this monopoly has not been abused and that "it has done much to establish the excellent and reputable broadcasting service for which this country is renowned, and that the BBC have become an important part of the structure of our national life. Their services must remain intact and the Corporation should be the only broadcasting organisation having any claim on the revenue from broadcast receiving licences." The new Charter and Licence, which are to come into force on 1st July of this year, will, therefore, provide for the BBC to continue broadly on existing lines. The Government says that it is unwilling to see any change in BBC policy towards sponsoring or accepting advertisements, and the existing restrictions on commercial broadcasting, without the consent of the P.M.G., will be preserved. Some additional safeguards will be incorporated to avoid the possibility that the Corporation might be subordinated to political ends.

The Government has come to the conclusion that in the expanding field of television, provision should be made to admit some element of competition when the calls on capital resources, at present needed for other purposes, make this feasible. The Government reserves the right to decide the terms and conditions under which competitive television would operate.

Other recommendations for action by the Government made in the report are: The licence fee system will be continued to meet the cost of home broadcasting and the B.B.C. is to receive a definite percentage of the revenue. The Corporation will receive 85 per cent. of the net licence revenue for the first three years of the next ten-year Charter. The present division of responsibility between the Government and the B.B.C. for the overseas services will continue. The B.B.C. should have the same position of independence in regard to television for the home as it has in sound broadcasting. The rate of development of V.H.F. sound broadcasting must necessarily be subject to economic circumstances and the control of capital investment. An Advisory Committee is to consider the best methods of introducing higher frequency broadcasting, including the form of modulation to be adopted and consultation with the radio industry will be essential. The Committee is of the opinion that the relay exchanges should be left to private enterprise and that licences should be granted for a term of ten years in the first instance with power to the Government to take over compulsorily then or by two years' notice. There is not to be a Minister for Broadcasting, and the Postmaster-General will continue to be responsible for the exercise of the Government's powers under the general authority and direction of the Prime Minister.

The new Charter will require the Corporation to delegate to Scotland, Wales and Northern Ireland and to the English Regions powers which will afford them a reasonable measure of independence and greater variety and initiative in respect of programmes.—F. J. C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers issued during the year ended March 31st, 1952.

Region	*Number*
London Postal ..	2,394,000
Home Counties ..	1,677,000
Midland	1,776,000
North Eastern ..	1,961,000
North Western ..	1,660,000
South Western ..	1,085,000
Welsh and Border Counties	749,000
Total England and Wales	11,302,000
Scotland	1,150,000
Northern Ireland ..	213,000
Grand Total	12,665,000

The above total includes 1,457,000 for television, an increase of about 71,000 during the month.

Philips Receivers as Prizes

PRIZES offered by Thomas Hedley & Co., Ltd., in their competition, which is now running, include a number of Philips radio sets.

Philips Electrical, Ltd., point out that, by agreement with Thomas Hedley & Co., Ltd., the sets are not being supplied direct. The fortunate people who win one of these sets as a prize will receive it through a local Philips dealer, who will be paid in full on presentation of his account to Thomas Hedley & Co., Ltd.

Radio Beacons for Lighthouses and Light Vessels

TWENTY-WATT duplicate radio beacons for lighthouses and light vessels at over forty locations on and around the coasts of Great Britain, Northern Ireland and the Republic of Eire have been ordered by Trinity House. A contract to supply the equipment has been awarded to Marconi's Wireless Telegraph Company, Limited. The equipment will comply with regulations laid down at the Conference for the re-organisation of Maritime Radio Beacons in the European Area held at Paris in April, 1951. The work of this conference resulted in a considerable expansion of the maritime radio beacon facilities, together with the regrouping and modernisation of existing stations in the European area. It also promulgated the frequencies, services, power, timing and location of such beacons.

A plaque in memory of Guglielmo Marconi, the radio pioneer, was affixed to 71, Hereford Road, Paddington, London, recently by the London County Council to commemorate his residence at the house in 1896-97.

British Relay Wireless, Ltd.

BRITISH RELAY WIRELESS, LTD., and associated companies announce the appointment of Mr. Barry King as Commercial Manager of the B.R.W. Group of Companies.

Over the past seven years Mr. King has successively occupied the positions of Chief Internal Engineer and Chief Planning Engineer, responsible for the territorial development of the B.R.W. Group and for the development of additional services such as Relayvision, Relaygrams and Set Renting.

Higher Power Transmitter for Falklands

THE Falkland Islands, one of Britain's southernmost possessions, is to have a higher power transmitter for broadcast entertainment. A contract to supply a 5 kW. medium frequency installation has been won by Marconi's Wireless Telegraph Co., Ltd. Delivery of the transmitter with associated equipment and spares is scheduled for early summer of this year.

The Falkland Islands, a group of some 100 small islands near the south-east tip of the South American continent, has a population of over 2,000. In 1929 a wired broadcasting system was installed, but it was not until 1942 that its first transmitter began operation, working on a low power of only 45 watts. The new installation, at Port Stanley, will bring the local programme to the entire population.

Liberian Transmissions

THE Government of Liberia is anxious to ascertain whether the Government Broadcasting Station, ELBC, at Monrovia, is sufficiently powerful for transmissions to be picked up in this country. The transmissions, on a wavelength on the short-wave band, are made daily, and if any wireless enthusiasts in Britain would care to assist in this survey they are requested to write to Liberian Government Public Relations Officer (10), 20, Hereford Road, Ealing, London, W.5, who will be glad to forward details of the survey and to refund all postal expenses.

Pye at Oslo Exhibition

AN export radio receiver, manufactured by Pye, Limited, of Cambridge, was chosen for the "Design from Britain" exhibition which opened in Oslo, Norway, on May 3rd. The object of the exhibition, which was sponsored by the Society of Industrial Artists, The British Council and the Council of Industrial Design, was to boost the prestige of British goods by showing examples of good design and quality.

The radio receiver, Model "G" (Pye PE39), was presented in a moulded cabinet, and is a striking example of British craftsmanship. As a receiver in the medium price range, it offers a very high standard of performance and reliability and, being designed for world-wide reception, is "tropicalised" to withstand varying climates. It has six bandspread short-wave bands as well as medium and medium-short waves.

Wenvoe Television Transmitting Station

THE BBC announces that it is hoped to open the new television transmitting station at Wenvoe, near Cardiff, on medium power, on August 15th. The Postmaster-General, Earl De La Warr, P.C., has agreed to perform the opening ceremony.

British Wireless Dinner Club

THE 29th annual general meeting and dinner of the British Wireless Dinner Club, founded by wireless officers of the 1914-18 war, took place at the Junior United Services Club on April 25th. Principal guest, Sir John Cockcroft, C.B., F.R.S., the atomic scientist, spoke on the debt that atomic development owed to basic wireless and radar practice.

The president for the ensuing year is Admiral A. J. L. Murray, C.B., D.S.O., O.B.E., who succeeds Mr. G. M. Wright, C.B.E., and the vice-president is Air Vice-Marshal C. W. Nutting, C.B.E., D.S.C.

R.I.C. Guest

THE Duke of Edinburgh will be the guest of honour at the second annual dinner of the Radio Industry Council at the Savoy Hotel, London, on Tuesday, November 25th.

University Broadcasting

ST. ANDREWS UNIVERSITY wishes to run its own broadcasting station and Mr. J. Coatman, formerly North Regional Director of the BBC, and now Director of Research in the Social Sciences at St. Andrews, believes that an important function can be served by university broadcasting.

The broadcasts would be used to make important university lectures widely available and to train students in broadcasting.

The cost of setting up a station at St. Andrews has been estimated at less than £1,000, the reception range being about 30 miles.

"Down with Interference"

THIS is the title of a booklet which is being distributed to radio and electrical dealers and servicemen throughout the country, as a guide to the best way of suppressing interference.

"The increase in the use of electrical appliances, coupled with the expansion of the television service, has resulted in interference suppression becoming a real problem," the booklet says. "Quite soon it may become a matter of legal obligation."

The booklet has been prepared and issued by the Radio and Electronic Component Manufacturers' Federation in co-operation with the Radio Industry Council and contains a list of suppression circuits and recommendations for their use.

The booklet is unobtainable by the public.

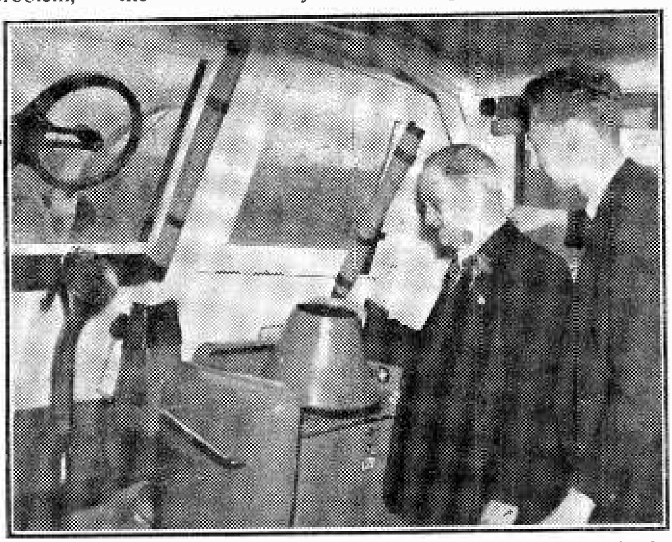
First Transmitting Licence

VETERAN marine radio operator "Bill" Davies, O.B.E., of Liverpool, holder of first P.M.G. transmitting licence, is, at 74, still in active service, now on the Liverpool-Douglas route (S.S. *Mona's Isle*). He was shown the last marine radar equipment on the Cossor research vessel, *Blue Coral*, at Manchester. The ship, with its crew of seven, battled with heavy seas from Penzance to reach Trafford Docks, Manchester, in time for the Northern Radio Exhibition.

American Relay

IT is understood that arrangements are being made for a link between the U.S.A. and Great Britain for television relays.

The link will make use of both V.H.F. and U.H.F. equipment and that in the course of the relay the definition will be changed from the American system to the English and that the course will take the signal via Iceland.



"Bill" Davies being shown the latest Cossor Mk. II Marine Radar display console by radar officer Peter Woodhead in the chart room of the Blue Coral.

THE P.W. 3-SPEED AUTOGRAM

CHASSIS CONSTRUCTION AND GENERAL ASSEMBLY NOTES

(*Continued from page 267, June issue.*)

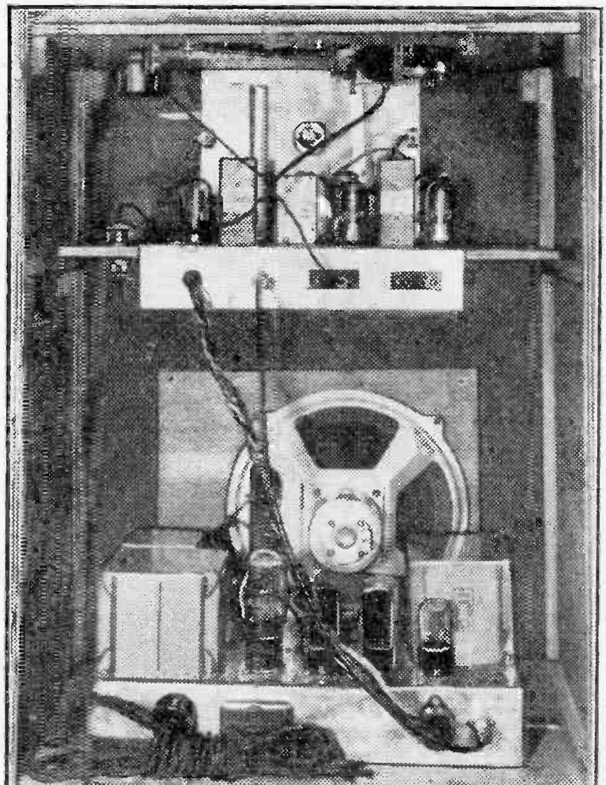
THE first part of the constructional work consists of chassis making, and as already explained, there are two alternatives for the tuner and pre-amplifier unit. As shown on page 266 last month, in the prototype this unit was made on a baseboard so that it could be slid into the cabinet in place of a shelf which was originally there. This can be seen clearly in the illustration below. It will be noted, however, that a strip of aluminium was fitted to the front and rear in the same manner as with a standard chassis, to accommodate controls and socket strips, and the layout was kept within the bounds of these strips so that exactly the same layout could be adopted on a standard type of chassis. In the original the wooden shelf was of metal-covered plywood, but it will be assumed that in the majority of cases a standard chassis will be used and placed upon a shelf or even suspended from the motor-board where a wide type of up-to-date cabinet is employed.

Full details of the chassis for the tuner will be found on page 296. A sheet of stout gauge aluminium 17in. by 14½in. will be required and it should be cut out round the edges, as shown, the drilling holes for the corners being very carefully marked out to ensure accurate registration. These corners may be either riveted or fitted with nuts and bolts. To accommodate the cord drive for the tuning dial a rectangular opening is required, and this must be carefully positioned to avoid the cord catching on the edges of the chassis.

Chassis Cutting

Many constructors find difficulty in carrying out a professional-looking chassis constructional task. We find that it is desirable so far as possible to do all drilling and cutting whilst the chassis is in a flat state. It can be supported more easily in this way and both sides of the chassis may be used as a working surface. Drill small pilot holes before cutting the large valve-holder holes, and open these either with one of the disc cutters such as the Lufbra or a press-type tool such as the Maxi-Q. Cut through until the edges show on the reverse side and then turn over the chassis and complete the work from the opposite side. In this way a clean hole will be obtained without a rising burr which will afterwards have to be removed. Note that all holes which are not marked on the chassis with a size are of ⅛in. diameter.

The H.T. positive anchoring point in our case was drilled to ⅜in. and an insulating washer was inserted to carry a short stand-off pillar on the underside. In place of this, if the constructor desires, a single insulated mounting tag may be used and screwed to the underside, but make quite certain that there is adequate clearance between the "live" tag and the chassis. When all holes have been drilled and the edges cleaned up as necessary the sides of the chassis must be bent over. There is no doubt that the most satisfactory way of accomplishing this is to use a good metal bender, made up either of 1in. square iron bars held with bolts at either end, or by clamping a stout wooden board on the bench and sliding the runner part of the chassis under this. For sharp, clean edges the metal clamp is to be preferred, and for the sides a strip of stout timber must be cut to exact dimensions to clear the ends already bent over. The small turned-in edges which clamp the side and end runners together may be bent over by holding in a bench vice.



Rear view of the complete equipment.

Amplifier Chassis

The chassis for the amplifier calls for a little more work, as the mains transformer and chokes which are specified are intended for mounting with the soldering lugs projecting below the chassis. This provides better screening and also reduces the length of connecting leads. For the chokes it is possible to make do with two holes for each or to cut a rectangular slot. Both arrangements are indicated on the chassis details shown below and it is left to the constructor to adopt whichever he finds easier. For the mains transformer, however, in view of the number of connections which have to be made a rectangular hole is essential. The simplest way of cutting this is to mark it out carefully, and then to drill all round just inside the edge of the line with the ⅛in. drill. If an electric drill is being used this will not take long. A cold chisel may then be used to cut between adjacent holes and the ragged edge afterwards cleaned up with a file. As an alternative, a single hole (⅛in.) may be drilled exactly in each corner of the opening and cuts made along each edge from hole to hole with an abrasive hacksaw blade. There are no other difficult points on this chassis and the cutting and bending should proceed exactly as in the case of the tuner chassis.

Component Mounting

Before wiring, all parts have to be mounted, and again it is desirable to proceed according to your particular ability. Some constructors prefer to mount everything in its place and then to wire up, while others prefer to mount only the valveholders and very small items first, wire these up, and then add the bulkier parts gradually. This does make the chassis easier to handle, but whatever system is adopted, systematic wiring is essential to avoid leaving out or wrongly connecting important leads.

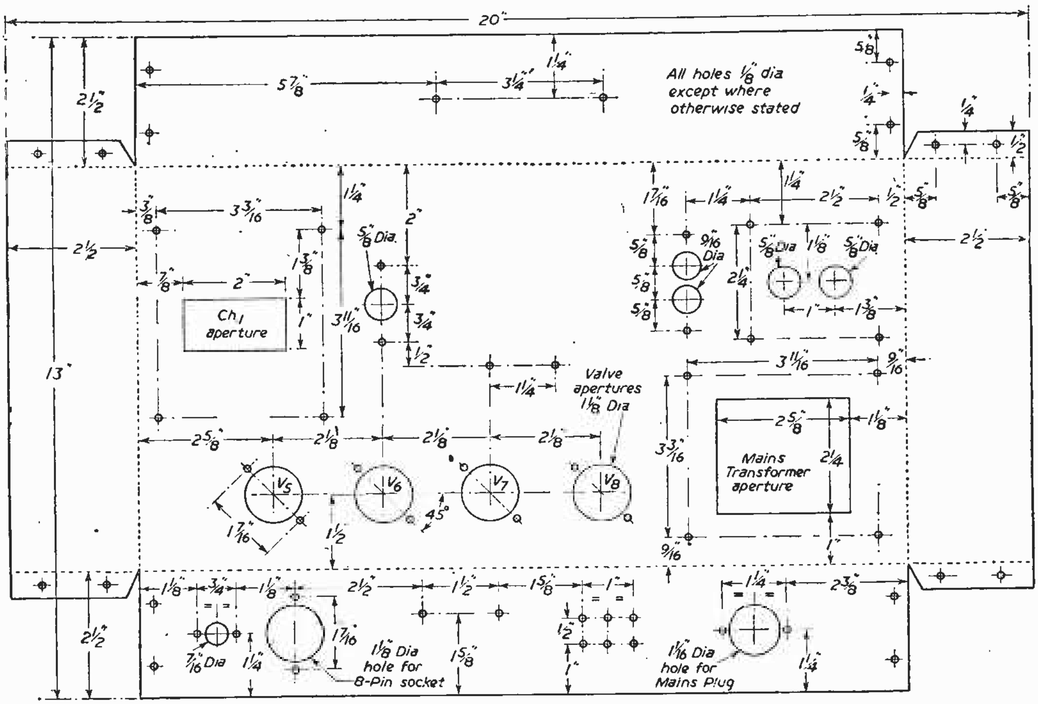
Many constructors can wire from a theoretical diagram and full circuits were given in the last issue. Shortage of space does not permit of our giving reduced scale diagrams of the wiring this month, but they will be given in the next issue to assist those who can manage from a rough guide. As already mentioned, a full-size blueprint is available, price 3s. 6d., and this includes all details, including the theoretical circuits and list of parts.

Circuit Correction

For those who wire up from the circuit it should be pointed out that the cathode follower load coil, L1, shown in the tuner circuit, has been connected to the wrong side of R13. The circuit will function with the connection as shown, but improved results will be obtained when it is connected direct to the cathode of the diode side of V3.

Component Wiring

It is no doubt unnecessary to remind constructors that the electrolytic condensers must be connected with the correct polarity, but some readers have expressed doubts concerning the correct connections for standard tubular condensers. The small 0,1 condensers which are specified for this receiver, and many others which are available, carry a black ring round one end of the condenser casing, and this denotes that the connecting lead at that end of the condenser is joined to the outer foil. This does not have to be earthed, except where it is placed in such a position that one side of that particular condenser



Drilling details for the amplifier and power pack chassis.

is connected to earth. It should, however, be connected to the "cold" side of a circuit, that is, the "earthy" side of a circuit. For instance, if such a condenser were used as a L.F. coupling condenser the outside foil would be joined to the grid of the valve, and the other side to the anode of the preceding valve. Where the condensers are used for decoupling, however, the outside foil connecting lead is taken direct to earth.

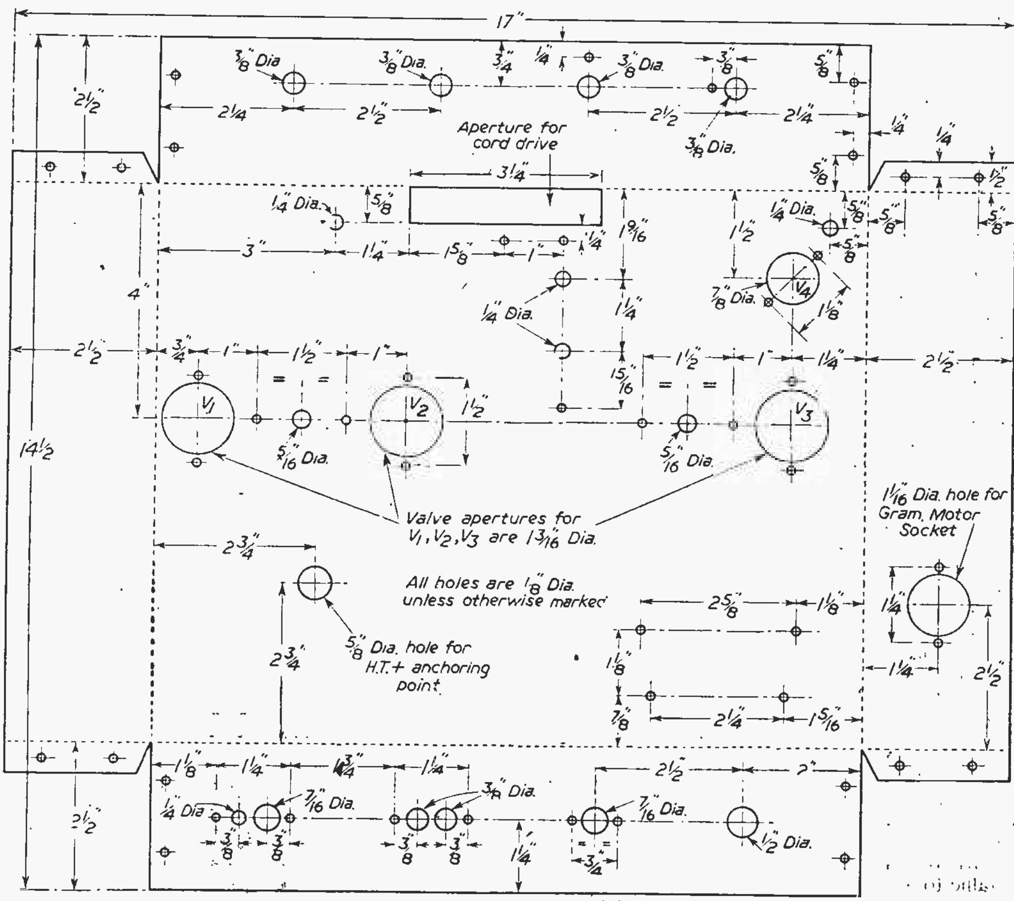
Many of the resistors will be found to have leads sufficiently long to enable a portion to be cut off so that they may be connected from point to point without adding any leads. They will be sufficiently rigid to avoid the necessity for using screened sleeving unless it is required to make the wiring look "pretty," but except where long leads pass close together and there is a risk of sagging with resulting short-circuits, sleeving is not really a necessity. Many constructors, again, use coloured sleeving to identify various parts of a circuit—red for H.T. carrying leads, black for "earthy" leads and so on.

Connecting Plug and Socket

When making connections to the multi-point connecting plug and to the strips on the tuner chassis, use red and black flex to ensure that no possible cross-over arises with disastrous results when the two chassis are interconnected. Preferably use rubber-covered flex for the L.T. and plastic covered for the H.T. The mains leads may be cotton-covered over plastic or similarly identified. Furthermore, when this part of the wiring has been completed make a cross-check by connecting a battery or meter to each end of the separate leads, as it is fairly simple to go wrong and cross over when dealing with eight separate leads, and as the mains supply leads are included the result of a mistake may be quite expensive.

There is only one more point which may be mentioned on the constructional side and that concerns the radio-gram switch. This is actually of the two-pole change-over type, and there are a number of alternative types which may be used. As will be seen from the blueprint, we actually used a Yaxley wafer intended for quite a different purpose, but which lent itself to the use of two poles with two positions. Bulgin make a rotary change-over switch which may be used although it has a short spindle and will call for the use of a connector or some means of extending the spindle so that it lines up with the other controls on the panel.

(To be continued)



Drilling details for the tuner and pre-amplifier chassis.

TV Interference with Broadcast Receivers

CAUSES AND SUGGESTED CURES

By H. H. Jay

MANY complaints are made by television users about interference with their reception and much time and money has been expended by firms and individuals in moderating this interference. Much less has been heard of the interference caused to broadcast receivers by the television equipment, possibly because the disturbance is only serious at close range. The actual number of listeners affected is small at the moment, but as the number of television transmitters increases so will the interference.

The trouble has two main manifestations. In the first, the broadcast receiver shows an apparent fall in sensitivity, increased background noise and distortion of the received signal when this is of moderate to low strength. In the second form, the set, even on strong local signals, shows distortion and loss of quality, often accompanied by a strong whistle resembling a heterodyne, and a high and variable hum level.

Direct Pick-up

The cause of the first form of disturbance seems to be direct signal pick-up from the transmitter. Not all receivers are affected, but the constants of some input circuits seem to be such that they form an effective grid impedance at TV frequencies and so pass on a considerable voltage to the grid of the first valve. The characteristics of this stage are seldom linear so cross modulation results between the TV signal and the normal broadcast. Sum and difference frequencies are then produced of which a few pass through the I.F. stages to reach the A.V.C. and second detectors. The bias so produced reduces the apparent signal strength of the wanted programme and increases the detector distortion.

In cases where the television signal does not penetrate beyond the first grid, partial rectification can take place and this results in a symmetrical amplification of the wanted carrier.

The cure is a simple wave-trap made as a single parallel tuned circuit and wired in the aerial lead, preferably inside the set and as close to the aerial coil as reasonably possible. A simple plate screen between the trap and the main coil is usually adequate, but the new coil can be potted if desired.

The dimensions and winding of the trap coil are a matter of experiment because the loading of the aerial is a variable factor. A good trial winding is six turns of 14 or 16 s.w.g. wire on a ⅝in. diameter former spaced to a length of ¾in. This can be tuned by a ceramic semi-variable trimmer of 15 pF capacity. The connections to the circuit should be by the two middle turns, Fig. 1. The coil can be tuned by wiring a crystal detector in series with a microammeter or a pair of phones across the condenser. When set up, provide an iron core from a tuning coil and a short piece of brass rod about ⅜in. diameter.

Start by varying the condenser, using a non-metallic tool. If no readings are obtained, insert the iron core a short distance into the coil and try again. A reading then indicates that the inductance of the coil is too low and the turns should be brought closer together. If no signal can be tuned with the iron core, substitute the brass slug. Success then indicates too high an inductance and the coil should be opened out or a turn removed to correct the matter.

Inductive Pick-up

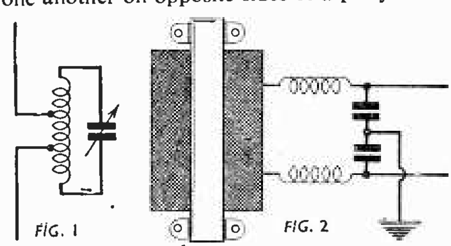
The second source of interference is the line time-base of the television set itself. The trouble tends to be most pronounced on the long waveband because some of the radiated harmonics are close to the frequency of the Light programme. The real cure for this trouble is screening of the television set, its removal to a greater distance and possibly a change in the run of the aerial feed. None of these remedies can be applied without the co-operation of the owner, and when this is lacking other palliatives must be sought.

The first and simplest device is a pair of good condensers of about .5 μF capacitance and rated for at least 750 volts working. Wire one from each side of the transformer primary to earth. The condensers may sometimes need supplementing with a pair of H.F. chokes, particularly when the receiver is of the A.C./D.C. type. Fig. 2 shows the arrangement. The chokes can be of 650 turns each of 32 to 34 s.w.g. wire wound on a ¾in. diameter mandrel. The axial thickness should be about ½in.

Where the interference reaches the set through the aerial, the run of the lead in can be changed so as to increase its separation from the television set. Screened downlead with the screen earthed to the receiver earth can be used with advantage. The best material for this purpose is the co-axial feeder stocked by some dealers in surplus material. The screening should extend as far as possible towards the top of the aerial. After such an alteration it is wise to re-trim the first tuning coil.

Another remedy that is sometimes effective is to coat the whole of the inside of the receiver case with graphite in colloidal form. The coating should be bonded to the earth of the set and it will then provide a surprising amount of screening.

If none of the above remedies prove sufficiently effective, the receiver will have to be moved either to another part of the room or to another room altogether. The type of interference now being discussed usually occurs when receiver and television set are near to one another on opposite sides of a party wall.



Figs. 1 and 2.—Trap coil and mains suppressor circuits.

Tape Recording

PRINCIPLES INVOLVED AND DIFFICULTIES EXPLAINED BY W. J. DELANEY (G2FMY)

THERE is an increasing interest in tape recording and, as may be seen from our correspondence pages, difficulties are experienced in obtaining satisfactory quality. There are three main factors which are concerned here, the actual amplifier which is employed, the speed of the tape, and the type of recording head which is used. Other factors can enter into the question, but it has been found that these are the principal causes of trouble. Dealing first with the recording heads, home-constructed units can be made to give quite good results, but there is difficulty in obtaining a suitable gap. Generally speaking, the high-note response is controlled by the gap, and the manufacturer is usually in a better position to construct a head with a suitable regularly-cut gap than the home constructor. The lower frequencies are generally controlled by the speed of the tape. It is appreciated that the record on the tape consists of sine waves, and a high note is a sine wave occupying a minimum of space, whilst the low note is a long-drawn-out wave. Obviously, therefore, if the tape travels at a fast pace past the play-back head it is possible to lose some of the effects of the lower frequencies, and there are set speeds now regarded as standard which should always be adopted, so that tapes may be used on different instruments without change of pitch. If a tape is recorded travelling, for instance, at a speed of 7½in. per second, which may be regarded as a kind of general speed suitable for either speech or average music, then if it is played back at a faster speed the pitch will rise and vice versa, in exactly the same manner as a gramophone record.

Suitable Speeds

It may be pointed out that the speeds regarded as standard are 3¾in. per second for speech only, 7½in. for general use, 15in. for hi-fi results, and in the case of tapes used on broadcasts by commercial concerns the speed is as great as 30in. per second. Obviously, in the interests of economy the amateur uses as slow a speed as possible, the difference in playing time between these speeds being that a 1,200 ft. tape will play for approximately half an hour at 7½in. per second, but for only a quarter of an hour at 15in. per second. For quality reproduction, therefore, a slow speed is the first requirement, and this means that a really reliable motor must be used to avoid "wow" and other wavering effects. The use of a single motor, with gearing for record and play-back, is not desirable in this connection. Separate motors for each purpose with high-speed rewind facilities should be used, and the amplifier should be designed on the most generous lines. It is possible to use only two valves and carry out all operations by suitably switching the various stages, but this cannot lead to high quality results. Separate play-back circuits are desirable, whilst even the recording output stage and the play-back output stage should be separate. They both operate in a more or less similar fashion, but the introduction of switches to make circuit changes will undoubtedly prevent the best performance being obtained.

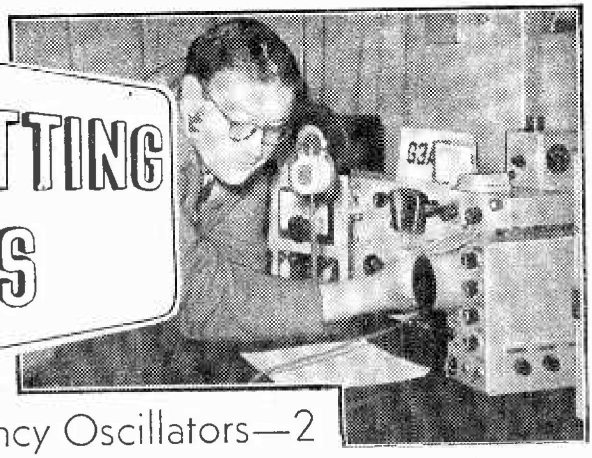
Erase Head

The question is often raised as to whether it is necessary to use a separate head for erasing. Why, we are often asked, cannot a permanent magnet be used? Certain commercial units do, in fact, use a P.M., but it is usually found, even when Alnico or similar high-efficiency magnets are employed, that complete erasure cannot be effected, and the result is a noisy background. If the tape is used for experimental work continued use only results in the background becoming noiser and noisier, until eventually it is almost useless for quiet musical passages. A good erase arrangement with suitable head is, therefore, another "must" for those who are in search of high quality. In the course of experiments with a very well-known make of tape deck it was found that a noisy background became evident after continued use, in spite of the use of a good erase arrangement. After inspection it was eventually found that this was due to a very slight roughness on the recording head which was not visible except under the microscope, and this removed rather more of the surface of the tape than usual. The coating had got into the gap and the application of the usual brush failed to remove all of this. The particular design was such that it was found possible to place a piece of cellophane tape across the head for the recording tape to run over without seriously affecting results, but it cleared up the difficulty of the noise. No difficulty was experienced with the tape "sticking" to the tape.

Dual Tracks

In the interests of economy another feature which is often adopted is the use of twin tracks, only slightly less than one half of the tape being used for the track, and the tape being reversed and lowered or raised so that the return track is made by the side of the first one. Opinions seem to be divided as to whether this is a good arrangement for quality reception. The narrower track, with a suitable head (the position of the gap must, of course, be suitable for the half-track recording and play-back), can give a miniature form of the normal recording, but it is definitely an economy move and as such is probably to be avoided by the quality enthusiast. We shall be glad to receive details of reader, experiences and experiments in connection with this particular branch of the hobby, and in the meantime we shall be publishing in the next issue details of a high-quality amplifier suitable for use with a standard tape deck.

TRANSMITTING TOPICS



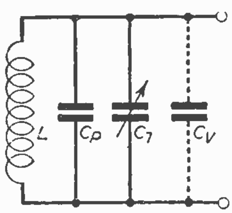
Variable Frequency Oscillators—2

CONSIDERATIONS IN TRANSMITTER DESIGN By O. J. Russell, B.Sc. (G3BHJ)

(Continued from Page 258 June issue)

PREVIOUSLY we considered the effect of slight capacity variations due to the valve upon the stability of the V.F.O. In Fig. 1 we repeat the diagram showing the tuned circuit and associated capacities. C_p represents the padding capacity, which is made up of a fixed capacity deliberately added to spread the tuning range so that C_t, the tuning condenser, just covers the required tuning range, thus giving an open calibration on the V.F.O. tuning dial and facilitating accurately setting to frequency. C_v represents the valve capacity.

There is a very simple rule to remember in considering the effects of capacity change upon the tuned circuit frequency. For small capacity variations, the percentage change in frequency is half the percentage change in capacity. Thus, a 2 per cent. change in capacity produces a 1 per cent. change of frequency. This is strictly true only for very small capacity changes, but practically the rule is adequate for normal changes. Thus it enables us to calculate the capacity change necessary to tune over a required frequency range. Thus, if a V.F.O. intended to produce a 7 Mc/s signal is required to cover 7.000 Mc/s to 7.300 Mc/s, the 0.3 Mc/s change in 7.0 Mc/s is near enough a frequency change of 4.3 per cent. As the frequency change is half that of the capacity change, we shall need to produce a capacity change of 8.6 per cent. to produce the required frequency change. To be on the safe side, and allow a little overlap at the band edges, we can provide a little extra capacity change, and if we make this 10 per cent. there will be a comfortable tuning range spread nearly all over the tuning dial. A little simple arithmetic will show that, in fact, there will be about 50 Kc/s additional tuning range. Thus, with a total tank capacity of 1,000 pF. for a 3.5 Mc/s fundamental V.F.O., the tuning capacity if only 40-metre band operation is required will be 100 pF. The calculation of coil inductances is not discussed here, for that is a simple application of readily available charts and tables. In fact, a V.F.O. covering 7.000 Mc/s to 7.350 Mc/s, will also more than cover the 14.0 to 14.4 Mc/s band, and will cover the 28 Mc/s band up to 29.4 Mc/s. As the winding of a tuning coil to an exact inductance value is an extremely difficult undertaking, it is much easier to wind the inductance to the nearest convenient size, and adjust the value of padding condenser to bring the frequency to the required value. This may be done by making the padding capacity up to value with a "band setting" variable. Our practical V.F.O. tuned circuit will now look like Fig. 2, with a smaller fixed padder, a pre-set variable to set frequency, and the main tuning condenser. A further refinement sometimes fitted is a "QSY" control to enable very small frequency shifts of a few kilocycles to be made above and below the operating frequency. This can be



L ...Tuning inductance

Cp.. Padding and swamp fixed capacitor

CT.. Band tuning condenser

CV.. Valve capacitance.

Fig 1.—V.F.O. tuned circuit.

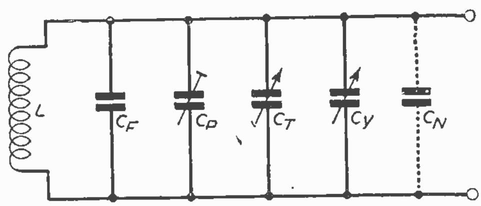


Fig 2.—Practical V.F.O. tuned circuit. C_F padding condenser (e.g., 500 pF.); C_P variable padding (band-setter) (e.g., 500 pF.); C_T main tuning condenser (e.g., 100 pF.); C_Y "QSY" control (e.g., 5 pF.); L tuning inductance; C_N optional negative coefficient temperature-compensating condenser (see text).

effected by using a small variable of about 10 pF. in parallel. The alternative to a band-setting condenser, is to adjust the fixed padding by adding small condensers to bring the tuning range to within the limits of the main tuning condenser. This is a task involving a considerable amount of fiddling with various small fixed condensers, but it does eliminate the variable bandsetter. Should a band-setting condenser be accidentally altered, the V.F.O. calibration may be upset, necessitating careful resetting. A fixed padding condenser ensures a stable calibration.

Condensers

Stability being the watchword, all capacitors must

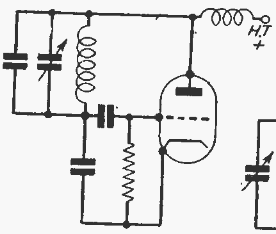


Fig 3. — The Colpitts oscillator.

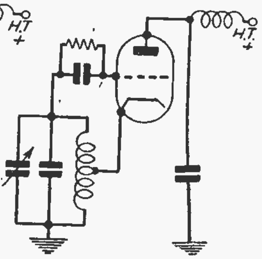


Fig. 4.—The grounded anode Hartley (so-called "electron-coupled" oscillator).

be of stable types. The tuning capacitors should have rigid thick vanes with wide plate spacing, so that vibration will not cause any appreciable alteration of capacity. The fixed condensers must be of stable silvered mica or ceramic types. Paper or stacked foil types are not recommended. If it is desired to compensate for temperature changes, part of the padding capacity must be replaced by a suitable negative coefficient ceramic condenser. Without going into details, the experienced amateur will be able to estimate the temperature drift over a given range and to calculate the equivalent of this in capacity change. Thus, a .005 per cent. frequency change represents a .01 per cent. capacity change. With a total tank capacity of 1,000 pF., this corresponds to a 1 pF. change. A suitable negative coefficient condenser of the right value of capacity and temperature coefficient to produce the same change is thus required. However, it is infinitely simpler to use a "variable temperature coefficient" condenser. This is a trimmer, with a coefficient variable from positive to negative as the screw slot control is turned. The capacity, however, remains constant. It is only necessary to fit such a condenser and adjust it until any temperature effects are reduced as far as possible. In any case the V.F.O. tuned circuit should be enclosed in a ventilated compartment to screen it from heat from valves, and also to screen it from draughts. If this is done the temperature in the screened box will only alter slowly, and renders temperature compensation unimportant. Failure to screen from draughts on the other hand may cause an annoying phenomena with temperature compensation. The small temperature-compensating condenser can change temperature quickly with draughts, while the large coil only slowly alters temperature. This can cause an annoying fluctuation unless draughts are screened off. Opinions are divided about the value of temperature compensation, therefore, and it is by no means a necessity.

One final word on tuning components. Both coil and condensers should, of course, be rigid and of low-loss construction. However, it is a desirable feature to have a linear frequency scale, so that the tuning dial can be accurately calibrated, and the frequency band is spread uniformly round the dial. With the tuning capacity forming a small part of the total capacity across the coil, as in Figs. 1 and 2, this is *not* achieved by using a straight-line frequency type of condenser. As we have seen there is a direct relationship between percentage frequency change and percentage capacity change under these conditions. A linear tuning scale is, therefore, obtained by the use of the straight-line capacity type of tuning condenser with the semi-circular vanes. Other types of condenser will produce distorted frequency calibrations and should not be used.

Typical Circuits

Typical popular V.F.O. circuits are shown in Figs. 3, 4, 5 and 6. All these have specific points which must be carefully watched for optimum results. In Fig. 3, we have a Colpitts type of oscillator. This is capable of good results if intelligently designed, but it has obvious disadvantages. This output is taken directly off the oscillator anode connected to the tuned circuit, so that the following stage may easily disturb the oscillation frequency. The need for an anode choke is a further disadvantage as the quality of the

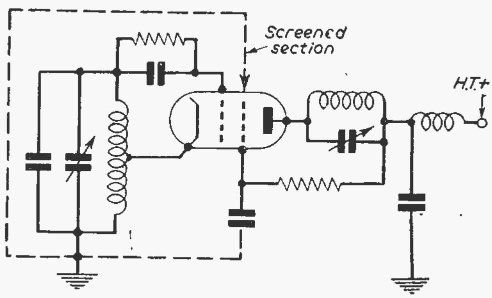


Fig. 5.—"Electron-coupled" form of the grounded anode Hartley. The oscillator output is coupled from the screen-enclosed oscillator section via the electron stream, if a fully screened valve is used.

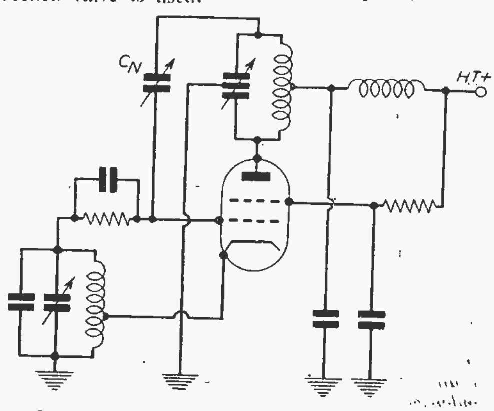


Fig 6.—Neutralised anode circuit form of "electron-coupled" oscillator.

choke can influence the Q of the tuned circuit. It is, therefore, the grounded anode Hartley oscillator of Fig. 4 which is more popular. This circuit is erroneously called "electron coupled," even in the illustrative triode form. The "electron coupling" does *not*, in fact, refer to the production of oscillation, but to the fact that in the pentode or tetrode form of Fig. 5, the screen grid which plays the role of the triode anode of Fig. 4 is earthed and screens the tetrode anode circuit from the oscillator section. Energy is coupled to the output anode through the fluctuating stream of electrons. Thus, the efficiency with which the oscillating portion is shielded from loading effects in the anode circuit is critically dependent upon the efficiency of the screen grid as a true electrostatic shield. With the old types of screen-grid valve in which the screen was flared out and brought right up to the glass envelope, the tuned circuit could be within a completely shielded box, through which the valve protruded with the screen-grid flange forming a continuation of the metal shielding. Under these conditions oscillatory energy was literally "electron coupled" to the anode circuit. Modern valves have rather less effective shielding than this, although the skirted construction is now again being employed in transmitting valves of high sensitivity. For V.F.O. use the 6AG7 has good isolation properties. For the interests of stability, the anode circuit is usually left untuned and a choke is employed. However, in V.F.O.s, using a tuned anode circuit, the pulling effects of the anode-tuned circuit may be nullified by employing neutralisation. This with an oscillator valve such as a 6L6 can enable a high output to be obtained, so that for portable or emergency work one could use such a V.F.O. by itself as a transmitter with several watts output. However, for normal purposes, over-running a V.F.O. is undesirable, and the plate-neutralised electron-coupled oscillator is mentioned only as an unusual arrangement of value for special applications. (Fig. 6).

Even with the normal electron-coupled oscillator, and with a choke-coupled anode output, there are a number of not so obvious points which seldom receive adequate publicity. Thus the cathode tap is quite critical for the highest stability. Careful adjustment is necessary, with variation of H.T. potential at each adjustment to find the position least affected. However, before one can do this, the screen circuit must also be adjusted. The screen-dropping resistor is critical. This is because variations in screen potential tend to have the opposite effect to anode voltage changes. Thus by switching in and out a large dropping resistor in the H.T. supply line, a large change in H.T. voltage can be effected. Monitoring will enable the effect of this to be observed. If the screen dropper is now adjusted in steps, a position can be found where the change of frequency due to changing H.T. voltage is at a minimum. This is the optimum screen circuit condition. It is clear that if finally the overall H.T. supply is stabilised, the net stability will be of a high order. However, it is much sounder to obtain maximum stability *before* applying stabilised H.T., as this will then ensure very high overall stability. H.T. stabilisation is definitely *not* a cure-all to be applied to make a chirpy V.F.O. produce a passable note, but the final touch of refinement to be added to a well-designed, highly stable V.F.O.

Influence of the Valve

In Fig. 7 we have the cathode condenser tap version of the electron coupled oscillator. The advantage here is that no tap is taken to the coil, and that the effective tapping position can be readily adjusted to any desired value by adjusting the values of the two condensers forming the capacity potentiometer across the tuning coil. This will affect the tuning, of course, but once set for the optimum tap point, a variable band-setting condenser will enable the tuning range to be set to the desired band.

As the influence of the valve upon stability is an important point, it is an advantage to couple it, only loosely, to the tuned circuit. This may be done by tapping it only across part of the tuned circuit. This, in effect, transforms down the influence of the valve, so that variations due to loading, etc., are reduced. As the transformation depends upon the square of the turns ratio, tapping only a third from the top produces nearly a two to one improvement, while tapping half-way down produces a four to one improvement. However, as one taps down the coil, the voltage developed across the valve is correspondingly reduced.

(To be continued.)

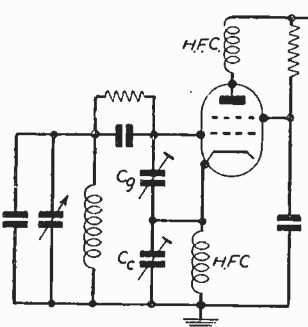


Fig 7.—Condenser tap version of the "electron-coupled" oscillator. This is not to be confused with the similar Clapp circuit. C_g and C_c are cathode tapping condensers of, say, 100 pF. and 500 pF., respectively.

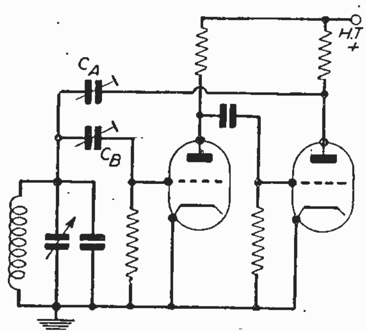


Fig 8.—The Franklin oscillator. C_A and C_B are 0-15 pF. trimmers.

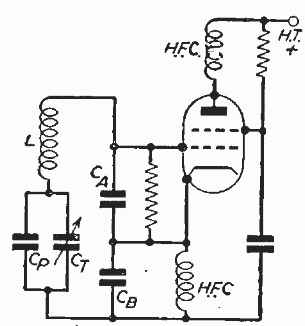
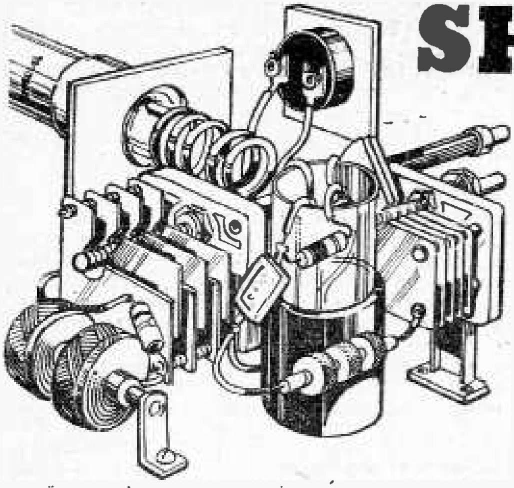


Fig. 9.—Clapp oscillator. Total effective tuning capacity is approximately C_P plus C_T, which may be, say, 35 pF or less. $C_A = C_B$ which may be 500 pF. to 1,000 pF.



SHORT-WAVE SECTION

By A. W. Mann

EXPERIMENTAL short-wave receiver construction, if tempered with discretion, has a lasting fascination. Some experimenters appear to take pride in the fact that their receivers are most of the time in a partly dismantled state. That sort of thing is a sheer waste of time.

Unsuitability of circuit is often the excuse, but is more likely to be associated with unsuitable modifications.

If on test a receiver is found to be stable in operation, the removal of its existing defects can be taken in hand. Should instability be in evidence, to locate the cause and effect a cure should be the first task.

With limited practical experience this may be difficult. A good book dealing with the fundamentals of radio servicing will help considerably and prove to be well worth its cost.

Those who find that an experimental receiver on test is beyond further improvement are fortunate.

While the maximum all-round efficiency should be the goal, the limitations of the chosen circuit should not be ignored. Once satisfaction is obtained it will prove best in the long run to leave well alone.

This applies equally to battery and A.C. mains type receivers and associated apparatus. Until one can build successfully the designs of others, personal ideas and modifications should not be attempted.

Unit Construction

The time comes when the owner feels the urge to build something more ambitious. Rather than take the risk of dismantling a perfectly good receiver in cases where component stocks are limited, it is worth while to consider building a number of separate add-on units. R.F. and L.F. amplifiers are two examples. A useful amount of groundwork can be accomplished in this way, and one has the satisfaction of knowing that a satisfactory receiver is the basis of the contemplated experiments.

Should the final tests indicate that it would be worth while going a step further, the receiver and units should be drawn out in combined form for rebuilding on a single chassis of suitable dimensions. In the interests of stability, due attention should be paid to inter-stage screening.

In the commercial field diecast chassis are favoured in short-wave receiver design. This is without doubt the best type of chassis, but outside the scope of the amateur. Stout gauge aluminium sheet or cadmium-plated steel will, however, be found satisfactory.

The efficiency of the steel chassis is, however, lower than that of aluminium, and because of this it is the practice to cadmium-plate this type of chassis.

Screened Coils and I.F. Transformers

While interstage screening is used to a considerable extent by amateurs, individually screened coils are not. The writer much prefers the former method for various reasons. Should the experimenter prefer to screen plug-in type coils the effects of such screening should be taken into account, and coil screens of comparatively large diameter—that is, when compared with the standard plug-in coil—should be used.

It is as well to bear in mind that interstage screening correctly applied is sound design, while on the other hand to overdo the application of it will result in a lower standard of efficiency.

Commercial communication type superhets are examples of efficient screening. It should be pointed out to the home-constructor, however, that where screened coils and I.F. transformers are to be used the chassis face should not be depended upon as a bottom screen. An integral screening base should be used, otherwise instability may result.

In addition, special attention should be paid to the mounting of screened components in order to ensure sound electrical and mechanical contact.

Coil Packs

The choice between plug-in coils and switched coil packs rest with the individual, and is one on which I should not care to advise. There are a number of very efficient units available, the price differing according to the range covered. Constructors are strongly advised, however, to follow the maker's recommendations as to suitable circuits, or build sponsored designs in which the chosen unit is incorporated before attempting to experiment. By doing so one has a basis of comparison.

Certain ex-Service communication receivers, including the R1155, do not incorporate a built-in power supply. Several firms advertising this type of receiver, however, can supply a commercially-produced power unit or, as an alternative, full details and the theoretical circuit of a tried and proved design for home construction. In addition, they are prepared to quote for the complete kit of components, including a built-in power output stage.

Under the circumstances it is surprising to note that some constructors prefer to build power supplies of their own design. Hum trouble appears to be common. Complete articles have in the past been devoted to this subject, and I do not propose to offer further comment other than to draw the reader's attention to Newnes "Practical Wireless" Service Manual, in which considerable space is devoted to the subject.

On Your Wavelength

By Thermion

Fans at the Northern Show

MY regrets to all those who called at our Stand at the recent Northern Radio Show, but were unable to see me. I gather that one or two of the more rabid protagonists of ridm and cryning (the O.E.D. really should include these two words of mine in their next edition, because they are almost onomatapœic) were after my blood, and I am sorry that I did not meet them because I am quite certain I could have converted them and brought them back into the paths of musical rectitude. My thanks, too, for all those readers who left messages of regard. Perhaps I shall have the pleasure of meeting the disappointed ones at the National Radio Exhibition at Earls Court.

" Unnecessary Amenities "

A PRESS cutting dealing with the speech made by the Archbishop of Canterbury at a meeting of the S.P.C.K. surprises me, coming from one who should welcome the fulfilment of some of the prophecies in the Bible. He was referring to the cost of printing which he rightly says is mounting beyond reasonable proportions, and he thinks that as a result we shall become an illiterate people because there will be no money left with which to purchase reading matter. Here he shows himself sadly out of touch with worldly matters. The fact is that the sales of newspapers, periodicals and all types of books, technical, fictional, biographical and travel, are selling in greater numbers than ever before. The point, however, he wished to make and which was really the gravamen of his speech was that the moment was inopportune " when, as a nation, we are in extreme financial peril " to increase the unnecessary amenities which are gradually becoming accepted as necessities of modern life. He thought that television is likely to become one of such amenities, and, to some extent, he criticised radio and other mechanical substitutes for the Caxtonian method of conveying information. Would Cantuar like scientific progress stopped? Is not the Bible the world's best seller in spite of radio or perhaps because of it? Radio has brought religion to far more people than the Church has done. Churches nowadays are mostly empty on the day of worship and on the Church holidays. It is said that radio and television are changing the pattern of our national life, and this statement is made as if it were an undesirable thing to change the pattern of our national life. Did not Gladstone's Education Act change the pattern of our life for the better, because it taught everyone to read and to understand for himself? No longer was it necessary to go to Church to hear a parson interpret the Bible for those who could not read. Scientific progress has always been attacked by those who wish to live in the past, people with static minds who are resistant to change. The printing machine changed our national life, and so did the stage coach, the bicycle, the motor-car, the aeroplane, the telephone, the gramophone, the cinema. The fact that radio and television are the greatest scientific developments of all times should be welcomed by those whose avowed task it is to spread the Gospel. For one man in front of a microphone can address the world as his audience instead of prating well-known textual shibboleths from the Bible to a handful of disinterested people. In view of the criticisms of our life so frequently made from the pulpit, Dr. Fisher should welcome the means of addressing a vaster audience and carry his mission beyond parochial bounds. However, whatever Cantuar says, radio and television will continue to advance and exert its beneficient influence. He should remember the motto of the BBC: " Nation shall speak peace unto nation."

New " Fury-Four "

MY paragraph concerning the collection of old sets brought me a number of letters from readers who do not collect them but continue to operate them. I was surprised to find so many readers still working the famous " Fury-Four " in its two versions—battery and mains. It may interest them to know that I have the original receiver and, but for very mild replacements, it is practically as it was. Selectivity, of course, is not so good as can be obtained from modern components and circuitry, but the quality is excellent. This prefaces what I set out to say, namely that an entirely up-to-date version of the " Fury-Four " is now on the stocks in the PRACTICAL WIRELESS laboratory, and it will shortly be described in this journal.

Standardisation

I WAS most interested to read John Scott-Taggart's article on standardisation in a recent issue, because I have some decided views about it myself. I do not like the word to start with. It suggests a no-change policy, otherwise where is standardisation? Desirable though standardisation may be, we certainly have not achieved it. We have, in some cases, defeated the very object of standardisation, which was really originated by Whitworth, because every so often an existing standard is scrapped. This means that some firms continue to operate the old standard whilst some operate the new. As B.S.I. standards are not compulsory, but are only recommendations, the position is made even worse. There are far too many standards, anyway.

Sponsored Programmes

AT the moment of going to press it seems unlikely that the Government will approve sponsored radio programmes, and I wonder whether this country really wants them. From correspondence it would appear that the British public is reasonably satisfied with the programmes it at present gets.

Presenting Technical Information*

AN ACCOUNT OF EFFORTS TO ACHIEVE STANDARDISATION OF TECHNICAL TERMS, ABBREVIATIONS AND CIRCUIT PRESENTATION

By John Scott-Taggart, M.I.E.E., M.I.Mech.E., F.Inst.P., F.I.R.E. †

(*Continued from page 251, June issue.*)

THE element which heats an indirectly heated cathode is called simply a heater. Screened pentode is preferred to R.F. pentode. A filament in a valve is a cathode heated by a current which passes through the whole or part of it.

In radar terminology, anti-clutter gain control is preferred to swept gain or temporal gain. Transponder is the device (e.g. in an aircraft) which receives pulses from an interrogator (or from a radar station), and, in response, transmits pulses for recognition purposes. Responder is the receiver for these transmitted pulses. An echo is the R.F. energy received after reflection from an object ; the term is also used to describe the effect of the R.F. energy on a radar display. A blip is a momentary deflection, or change of intensity, on a C.R.T. display, produced by the signal from a responsor ; in I.F.F. technique this is referred to as a response. Grass is the approved term for deflections from the timebase on a C.R.T. due to electrical noise. Jitter is random departure from temporal regularity of repetition—usually applied to pulse repetition. Snow is the speckled background on an intensity-modulated display, due to electrical noise. Range-amplitude display and range-bearing display are terms for what are also called Type A (if timebase is a straight line) and Type B displays.

Incidentally, the I.E.E. prohibit radar as a noun while admitting radio as a noun ; the Inter-Services Glossary encourages the noun radar and subdivides it into primary and secondary radar (the latter involving automatic retransmission from the responding object).

Component Coding

Components in a diagram are identified by coded references which consist of a letter (or letters) followed by a number or letter (e.g. C2, SWB). Some of the coded references will be new to many technicians (e.g. TR, MR, FS, RV, BY) and the addition of letters instead of numbers in some cases (e.g. SWA, SWB, SWC) does not accord with radio custom. Many of the changes are a result of Post Office telephone practice ; telephone engineers in the past have used many relays and switches and comparatively few resistors, capacitors and valves, whereas radio engineers have used few relays and switches. Telephone engineers have not used R1, R2, R3, etc., but have coded their resistors YA, YB, YC, etc. ; their capacitors were labelled QA, QB, QC, etc.

Confusion became intolerable when electronic and telephone engineers used each other's techniques and so a queer compromise was agreed and is now laid down in B.S. 530 : 1948, Supplement 2. The following list shows the more important agreed references. Most letter references are followed by numbers to distinguish them (e.g. C2, FS4, TR2) but switch-like components are, as an exception, given distinguishing letters (A, B, C, etc.) ; thus several switches in a diagram might be called SWA, SWB, SWC, not SW1, SW2, SW3 ; similarly, plugs would be labelled PLA, PLB, PLC, not PL1, PL2, PL3. Components distinguished by letters instead of numbers include switches, jacks, test jacks, plugs, sockets and links (including mains voltage selectors).

Full-stops should not be inserted between letters and numbers when coding components ; thus, C.3 is wrong. Incidentally, it is CV. 1234 not C.V. 1234.

Mandatory

Aerial ..	.. AE	Rectifier ..	.. MR
Resistor (fixed)	.. R	Valve (any)	.. V
Capacitor (any)	.. C	Diode ..	.. V
Inductor ..	.. L	C.R.T. ..	.. V
Transformer	.. TR	Fuse ..	.. FS

Normally Used

Potentiometer	.. RV	Meter ..	.. M
Variable resistor	.. RV	Pick-up	.. PU
Battery ..	.. BY	Switch ..	.. SW*
Loudspeaker	.. LS	Plug ..	.. PL*
Microphone	.. MC	Socket ..	.. SK*
Headphones	.. TL	Jack ..	.. JK*
Vibrator	.. VB	Test jack	.. TJ*
Piezo-electric		Relay ..	.. RL*
crystal	.. XL	Link ..	.. LK*
Lamp ..	.. LP		

(* Followed by letter.)

Optional

Artificial line	.. AL	Thermocouple	.. TC
Attenuator	.. AT	Thermistor	.. TH
Blower ..	.. BL	Terminal or	
Earth ..	.. E	tag post	.. TP
Spark-gap	.. SG	Terminal strip	.. TS

Complicated rules are laid down for ganged wafer switches and full details cannot be given here. The parts of a wafer switch might be called SWAa, SWAb, etc., where "a" represents the wafer side nearest the front panel ; a second wafer switch might have parts labelled SWBa, SWBb, etc. If the contacts on both sides of any wafer are the same, the contact pieces extending through the wafer, the entire wafer is designated by the letter that would have been used for the side of it nearer the front panel ; thus the wafers in a switch might well be designated SWBa, SWBc, SWBe, etc.

Abbreviations

A distinction may be made between symbols used in formulae (I for current, V or E for electromotive force, L for inductance, etc.) and unit

* *Based, by permission, on an article by the same author in the "Naval Radio and Electrical Review."*

† *Admiralty Signal and Radar Establishment.*

abreviations such as A for ampere, V for volt, μ for microfarad. There is a tendency (a rule with I.E.E.) for most symbols to be in italics; thus *R* is used in a formula and R in a circuit. Some of these abbreviations are often wrongly used. Thus, mf, mF, mfd should be replaced by μF. The letter m should be used for milli- (e.g. mA for milliampere) meaning millionths. The widely used μμF (micro-microfarad) is now replaced in the Services by pF (picofarad), which means the same thing. Capacitances marked on diagrams should be in picofarads up to 999pF; above this they are marked in μF. Thus, .0005 (or 0.0005) μF should be 500pF.

The abbreviation (in texts) for thousands is k, e.g. 5kΩ for 5000 ohms. Capital K is wrong; thus, 500Kc/s should be 500kc/s and 30KW should be 30 kW. The abbreviation for millions is M, e.g. 5MΩ.

Common abbreviations are cm (centimetre), in (inch), ft (foot), lb (pounds), db (decibels—not dB or DB), V (volts), A (amperes). These abbreviations should never have full-stops after them (unless punctuation demands them) and should never be pluralised by adding s; thus, 20lbs, 15dbs, 7ins are all wrong. An exception is "in"; if necessary, a full-stop may be used after it if confusion might otherwise arise. The plural of e.m.f. is e.m.f.'s but units are never pluralised. The abbreviation amp (without full-stop) may be used but only adjectivally, e.g. 5-amp fuse.

There are special rules for diagrams. A capital K is (illogically) to be used for thousands. Resistances below a thousand ohms may be marked, for example, 300Ω or simply 300; a thousand ohms or over is marked by a number and K or by a number followed by K and Ω. Thus, 1 K or 1 KΩ is used. A million ohms or over is indicated by a number followed by M with or without Ω. Thus, 1 M, 1 MΩ, 3.5 M, 5 MΩ are correct. Capacitances up to 999 pF are indicated by a number followed by pF or simply p. Microfarads are indicated by a number followed by μF or simply μ. Thus 20 μF or 20μ is correct, but not 20; the μ must always appear.

In texts it is always wrong to omit the initial nought in, say, 0.23 or 0.005. It is arguable whether this is necessary in circuit diagrams but the nought is certainly desirable where the first numeral after the decimal point is not a nought; thus, in a circuit 0.5 μF should be used and not .5 μF. The test is whether the omission of the decimal point (in the printing or through a draughtsman's error) would lead to misunderstanding. In mechanical drawings the initial nought before a decimal point is omitted.

Miscellaneous Rules

The following miscellaneous rules should be noted: In scientific papers a comma is not used to indicate thousands; a small gap is used instead. Thus, the popular 250,000 becomes 250 000. This does not apply to page numbers, dates and patent numbers. The abbreviations & and &c are not used, but etc. is permissible. No comma should (says the Institute of Physics) appear after e.g. and i.e. or after namely. Specific quantities should be in figures, e.g. 10 volts, 60 db, 3in. Other numbers up to a hundred should (according to the Institute of Physics) be spelt out, e.g. fifty-seven varieties (despite Heinz), twenty blunders, five stations, a hundred pipers and a' and a'; but 101 varieties, 120 valves. (Should Tennyson have written "Into the valley of death rode the 600"?) The I.E.E. says figures should start at 10; another society says 25.

Tables should be numbered separately, e.g. Table 4. Figures are given as Fig. 3 not Figure 3. Photographs are given figure numbers by I.E.E. and are not described as Plates. The solidus (a rich man's oblique stroke) should be reserved for ratios. This washes out D/F, L/T, R/F; the Admiralty retains W/T as an exception to avoid confusion with the abbreviation for watertight. There are some exceptions; thus a 240/480-volt supply means these are alternative voltages, whereas 240-480-volt supply would include intermediate voltages

Should A.C. and D.C. be used in such terms as A.C. current, A.C. voltage, D.C. voltage? The I.E.E. says no, and puritanically requires spelt-out evasions which render these useful abbreviations useless. Most engineers use these terms adjectively to convey an idea, and it is consoling to find the Inter-Services Glossary cheerfully referring to "D.C. or A.C. voltage"; B.S. 1597 : 1949 uses these terms repeatedly. One feels that full stops will ultimately disappear in abbreviations using capitals. Our broadcasting authority calls itself BBC and the Admiralty would appear sometimes to favour HF, DF, LT, etc; meanwhile, full stops are safer.

It is widely agreed that double consonants should be avoided in words like focused, biased, riveted, pivoted, jacketed. Spell viz. *namely* (which is how it is pronounced). There is a strong tide flowing in favour of -tor instead of -ter as an ending for instruments such as adaptor, convertor; it is to be hoped we never adopt mixor, rectifior or wipor. The plural of henry is henrys, not henries. Roman numerals have lost their gentility and MCMLII is to be avoided (use 1952). Even Service Mark numbers (e.g. Mk. IV) must now use arabic numerals (Mk. 4). The decline and fall of the roman numeral is emphasised by its retention to indicate sub-sub-paragraphs. Only a Greek chorus could do justice to the woe of the classicists. No doubt we shall, in due course, follow the American lead and speak of mathematical formulas and maximums (we already speak of dramas and cinemas).

The various standards committees are rather weak and inconsistent in spelling, partly because spelling, like pronunciation, is always in a state of flux. The various inter-Services Standardisation Committees cannot even standardise the spelling of inter-Services (at least six variants are used).

Diagrams

The more important diagrams are classed as circuit diagram, block diagram, wiring diagram (enables wiring to be traced but does not show the physical layout of wiring), wiring layout (shows physical layout of wiring), component layout (sometimes called component location diagram, as its purpose is to show the whereabouts of various components), functional diagram, servicing diagram (might show waveforms and test-voltages). A simplified circuit is one which shows the essentials for explanatory purposes. The noun schematic is banned (except by I.E.E. who, however, objects to schematic diagram). As an adjective this pretentious word is usually meaningless and almost always wrongly used; it is thought to give dignity to the most naïve and platitudinous diagram.

Diagrams should be drawn so that the main sequence of cause to effect goes from left to right. Thus, the aerial of a receiver would be on the left, but the aerial of a transmitter would be on the right. The best arrangement of valves in a complicated diagram needs careful thought. The main process must be first clearly visualised. Subsidiary circuits (e.g. a local oscillator or A.G.C. valve) should be drawn outside the main signal chain (preferably below it). There may be no medical term for a "fear of white spaces," but the disease exists; there is no virtue in arranging a circuit so that all the space is nicely filled. On the other hand, a fairly balanced composition can often be achieved without loss of clarity; for example, successive valves in a chain should preferably be of the same size and on the same level. A heavy earth-line (with an earth symbol attached) should usually be drawn, connections to it being drawn not as dots (which would be too large) but as filled-in semi-circles. In general, positive voltage points should be above the earth-line and negative voltage points (e.g. negative bias) below it. Anode, S.G. and cathode resistors are arranged vertically. Earth symbols may be arranged at any angle or even upside-down; this is Post Office practice but rather unusual in radio circuits; "abnormal" earths are useful in cramped or complicated circuits but are usually unnecessary. In H.T. supply circuits where rectifiers are employed, the rectifier devices (e.g. diodes) should preferably be drawn horizontally; several other similar recommendations appear in B.S. 530 : 1948.

According to B.S. 530 : 1948 crossings may be shown either by the lines simply crossing each other—as in Fig. 1 (a)—or by the use of a semi-circular bridge (loop)—as in Fig. 1 (g); the bridge is deprecated unless considered essential. The B.S.I. show timidity in admitting this meaningless and unnecessary exception. The bridge is definitely old-fashioned and is no longer used in Admiralty, Army and Post Office diagrams. The R.A.F. are exceptions; Farnborough uses bridges, while Chessington uses simple crossings but with gaps. In complicated circuit diagrams with many crossings, bridges look confusing. Admittedly, a little mental readjustment is needed to admit the simple crossing if one has been used to bridges. The chief argument in favour of bridges was that when lines simply crossed, a junction dot might appear either as a result of a draughtsman's error or in the course of printing; what should have been a crossing thus became a junction. A second objection was that it put the reader to too great a strain to scrutinise the diagram to see if there was a dot or not. Neither objection is now valid because of the new rule that a junction should *never* be shown as in Fig. 1 (j) or (k), i.e. like a crossing with a junction dot; one of the lines should be made to join a short distance away—as in Fig. 1 (c)—or one or more (but not all) lines should join at an angle not a right-angle as shown at (d), (e) and (f). The arrangement at (m) is inadvisable because, if badly drawn, it might be mistaken for a bridge crossing. The arrangement (k) is not permissible because if the dot were missing it would be the same as the crossing (b). The normal four-wire junction is shown at (c) and, though inelegant, it can never lead to misunderstanding. Nowadays, therefore, it is not necessary to look for a junction dot; if such a dot is missing (through a fault of draughtsmanship or printing) no harm is done, because the position of the lines indicates a junction. A line should never change direction when it crosses another line—as shown in Fig. 1 (h)—because this looks like a junction without a dot. A test question which covers all cases is: "If the junction dot were omitted, could the arrangement be interpreted as a crossing?" If it could, the arrangement is wrong.

The combined weight of the B.S.I., the learned societies and Government departments (not to mention the U.S.A.) is pressing for the abolition of the bridge crossing and the retention of two conventions is clearly undesirable.

Another rule that may be regarded by some as a change of policy is that connecting lines may slope at any angle and may even be curved. The convention that connecting lines must be horizontal or vertical or a combination of both is no longer enforced; clarity is more important than elegance. Nevertheless, this latitude should not be abused; a plethora of lines at various angles can look like a dog's dinner—a professional draughtsman's nightmare. Input and output terminals should, if possible, appear at the edges of the circuit, not buried somewhere in the centre. In most circuits there is no need to insert an H.T. or G.B. "battery" or to join all the H.T. points together; in some explanatory circuits it may be advantageous to do so. There is no need to join wires to a common earth; there is a growing—and commendable—tendency to scatter separate earth symbols wherever this makes for clarity (e.g. in decoupling circuits); the process can, however, be overdone and can complicate rather than simplify the circuit. In general, it is desirable to restrict the number of crossings, especially in simplified explanatory circuits; a little rearrangement of the wires often reduces the complexity of a circuit. A "fear of crossings"—wholesome enough in traffic—must not be allowed to become a phobia. Where several units are to be joined, the wire connections may sometimes be omitted, suitably lettered or annotated arrowheads being provided, usually at an edge of the circuit. Heater connections to valves are nearly always omitted, arrowheads at the valves being lettered (e.g. x, x).

The drawing of a circuit in a way that makes it self-explanatory is often troublesome but always rewarding. Some technicians boast that they really enjoy puzzling out obscure circuits; one wonders whether they would make a salary-rise application in the form of an acrostic.

If any reader feels the above rules or recommendations are all a "bind," it is consoling to know they are equally binding on and for an F.R.S.

APPENDIX

Some useful reference books are listed below. The B.S. books are issued by British Standards Institution, 24, Victoria Street, London, S.W.1.

Technical Terms

B.S. 204 : 1943—Glossary of Terms used in Telecommunications.

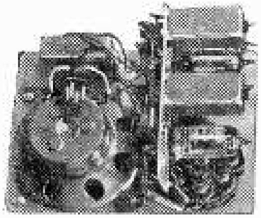
Five supplements:
(1) Waveguide Technique.
(2) Radio Propagation.
(3) Fundamental Radio Terms.
(4) Radar.
(5) Piezo-electric Terms.

B.S. 205 : 1943—Glossary of Terms used in Electrical Engineering.

(*Concluded on page* 326)

The "PRACTICAL WIRELESS" MINI FOUR BATTERY PORTABLE

A 4-valve battery superhet receiver designed to receive 4 Pre-Set Stations, three on medium waveband and one on long waves to suit local conditions. Each station is obtained on the set by the turn of a rotary switch. No tuning is necessary.



It is of midget size, being only 4¼in. x 6½in. x 4¼in. when completely built, and is very easily assembled from diagrams supplied.

Cost of all components to completely build the set, including a drilled and cut chassis and panel, and new valves, **£9/10/0** (or less valves for **£6/7/6**). Plus Portable Carrying Case. **16/6.**

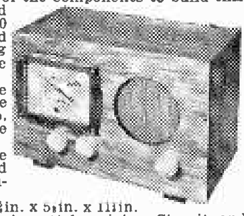
A blue print showing complete practical component layout and wiring diagram, together with an individual component price list, is available separately, **1/6.**

Our Mains Units available in kit form are suitable for use with this set.

THE "WIRELESS WORLD" 3-VALVE SET

A Midget 3-valve T.R.F. Receiver for operation on A.C. mains, covering long and medium wavebands.

We are able to supply all of the components to build this set, as designed, and specified in the Feb. 1950 issue, including the drilled chassis, valves and moving coil speaker, etc., at the following prices :—



To construct complete chassis, less dial and drive assembly, **£5/5/0.** Ditto, including dial and drive assembly, **£6.**

To construct the complete Set, including dial and drive assembly and cabinet, **£7/3/6.**

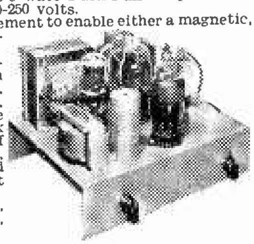
Overall size of cabinet is 7¾in. x 5½in. x 11½in.

A reprint of the designer's article, giving Circuit and Assembly Instructions (this is available separately for 9d.), together with a Practical Component Layout is included with each of above assemblies.

A QUALITY "PUSH-PULL" AMPLIFIER KIT

A Kit of Parts to build a 6-8 watt Push-Pull Amplifier for operation on A.C. mains 200-250 volts.

Incorporates a simple arrangement to enable either a magnetic, crystal, or lightweight pick-up to be used.



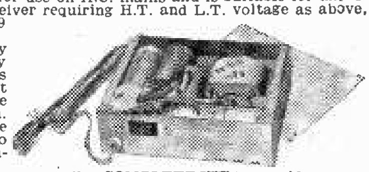
A 10-watt Output Transformer is designed to match from 2 to 15 ohm speakers. Tone control is incorporated. The overall size of the assembled chassis is 10in. x 8in. x 7½in. high. Price of kit complete in every detail, including drilled chassis and valves, **£6/12/6.** Component layout is supplied.

Price of assembled chassis, supplied ready for use, **£8/2/6.**

"PERSONAL SET" BATTERY ELIMINATOR

A complete kit of parts to build a Midget "Alldry" Battery Eliminator, giving approx. 69 volts and 1.4 volts.

This Eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver requiring H.T. and L.T. voltage as above, or approx. to 69 volts.



The kit is quite easily and quickly assembled and is housed in a light aluminium case, size 4¾in. x 1½in. x 3¼in. Price of complete kit, with easy to follow assembly instructions, **42/6.**

In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled Unit 7in. x 2½in. x 1¼in. Price **47/6.**

★ *Send 9d. P.O. for our STOCK LIST, showing many KITS OF PARTS for Sets and Battery Chargers and "hundreds" of Wireless Components. When ordering please include 1/6 to cover cost of postage and packing.*

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R109—8 VALVES SHORT-WAVE RECEIVERS, enclosed speaker and vibrator pack for 6 volts 1.8-8.5 mc/s., complete in metal case, **£7/15/-.**

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CONTACTOR TIME SWITCHES. 10-hour movement, 2 impulses per second. Thermostatic Control in soundproof Cases, **11/6.**

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RESISTANCES. 100 Assorted values. Wire-ended ¼-2 watts, 12/6 per 100.

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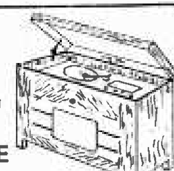

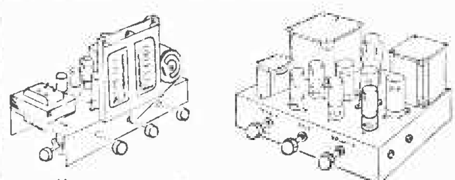

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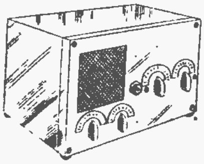

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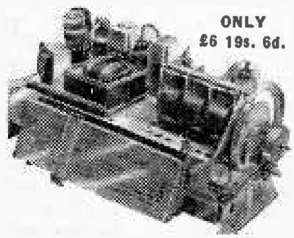

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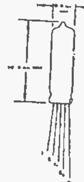

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CV386	0.75 v.	25 ma.	Pentode	4 9

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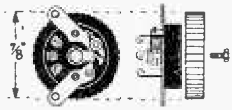

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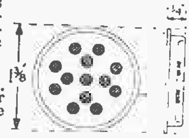

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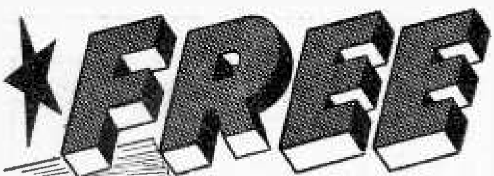

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Eliminating Hum in Mains Amplifiers

HINTS ON DESIGN AND THE IMPROVEMENT OF EXISTING APPARATUS

By F. G. Rayer

THE hum level of some amplifiers is rather high, and this is particularly noticeable when the amplifier provides a considerable degree of gain, or when the initial cost was an important factor, as a result of which the minimum amount of smoothing was incorporated. Experiments show that it is possible to design an amplifier in such a way that hum is kept at a very low level indeed, without much extra cost. Even with half-wave rectification, background hum may be so much reduced as to be almost wholly inaudible even when no item is being reproduced—a state of affairs which is definitely not so with many moderately priced amplifiers. It is therefore proposed to discuss this desirable result, and to indicate how it may be achieved. Though a detailed circuit is given, it is not suggested that an existing amplifier be abandoned in favour of this new circuit. Instead, the latter may be used to indicate where modifications and improvements are possible in the existing amplifier. On the other hand, there is no reason why this circuit should not be followed exactly if an amplifier is being built. It provides quite a high degree of amplification, with an output sufficient for most ordinary domestic purposes.

Decoupling and Smoothing

Frequently the anodes of the early stage are supplied with current taken from a point also common to the output valve anode, and where this is so the addition of further decoupling or smoothing can bring about a reduction in hum which is immediately apparent. Fig. 1 shows how this is done. Here, instead of the .25 MΩ anode resistor of the 6J7 and the 100 KΩ anode resistor of the 6J5 being taken directly to the positive high-tension supply line, the 20 KΩ resistors are interposed, with 2μF condensers returned to chassis. As a result, the H.T. supplied to the earlier valves is almost wholly free from ripple.

The value of the resistors is not critical, and components as low in value as 5 KΩ each will bring about a noticeable improvement. Where the anode current of the valves is not high, the values may be increased beyond 5 KΩ without causing excessive voltage drop. For average purposes, 20 KΩ is suggested. If 4 or 8 μF condensers are to hand, these could be used instead of the 2 μF components shown, but increasing the capacity beyond 2 μF actually makes little practical difference.

An existing amplifier in which all the anode supply points were common, and which had rather excessive background hum, was found to be enormously improved by the addition of these resistors and condensers.

The circuit also shows how additional smoothing may be arranged by adding a second smoothing choke in the H.T. positive line, with a further smooth-

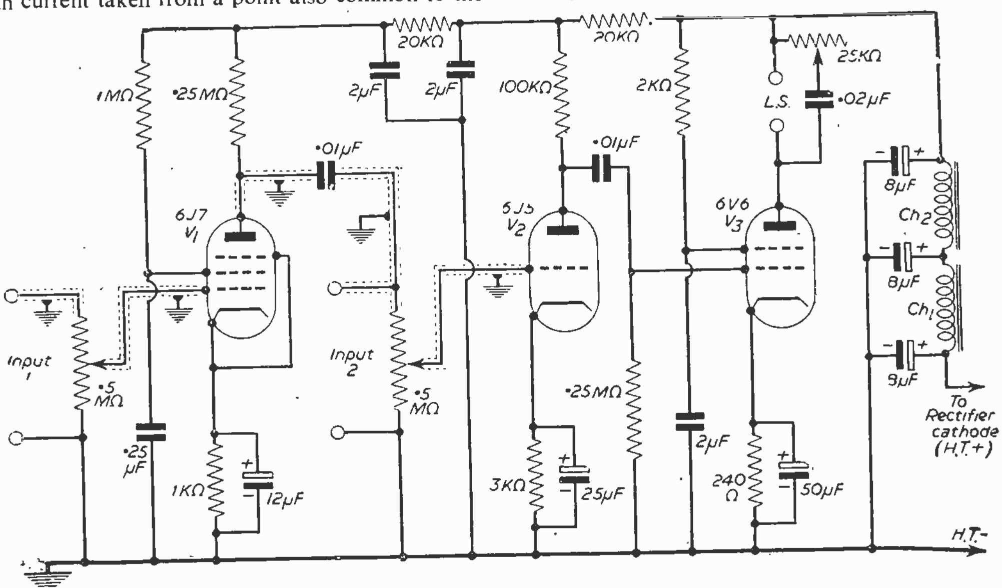


Fig. 1.—Amplifier circuit showing screened leads, etc.

ing condenser returned to H.T. negative. This was found to bring about a *slight* improvement. If the existing smoothing choke is a fairly good component with a reasonably high inductance, this addition of a second choke should be regarded rather as a refinement. In no case was it found to reduce hum as much as did the introduction of the resistors and condensers previously mentioned. But it is worth considering if the existing choke is of poor quality, or the quietest possible background is to be achieved.

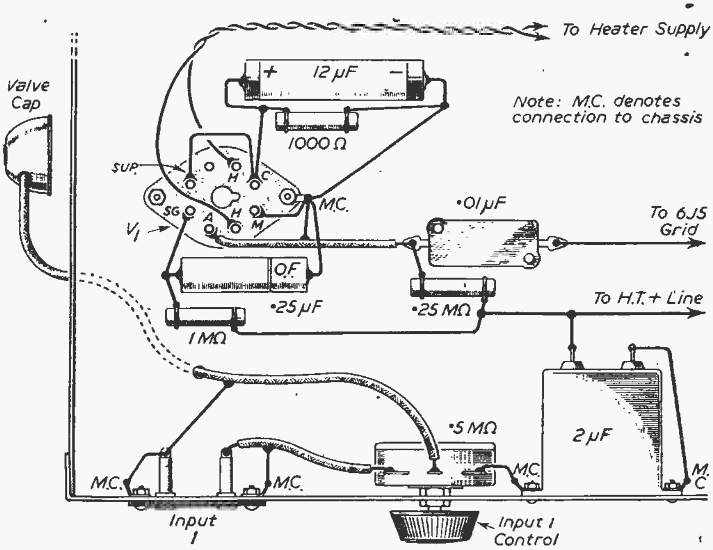


Fig. 2.—Wiring diagram of the 6J7 stage.

8 μF condensers are shown, and increasing these to 16 μF was found to bring about no worth-while improvement. However, where the H.T. consumption of an existing amplifier is heavy, increasing the value of the smoothing condensers might prove helpful, if they are at present too small in value.

Besides reducing the voltage to a suitable figure, the two screen-grid resistors, with their condensers, serve to remove ripple from the screen-grid supplies to the 6J7 and 6V6. The condenser and resistor should be wired as near to the valveholder tag as practicable in each case.

Screening Against Pick-up

If any hum is picked up by the earlier valves, or wiring, this will be amplified with the signal, and may reach serious proportions. A careful layout, with grid leads and associated wiring kept away from connections carrying A.C., together with some screening, will take care of hum introduced in this way. The leads which most require screening are shown in Fig. 1. Of these, the grid circuit of the 6J7 is most important. The "Input 1" sockets are intended for low-volume inputs (e.g., microphone); the "Input 2" sockets are for higher inputs (e.g., gramo pick-up). Any hum introduced at the second input point will receive much less amplification than that introduced at the grid circuit of the 6J7, but, even so, it is worth while taking care with the 6J5 grid circuit.

If the leads coming from microphone or pick-up are at all long, or pass near the amplifier, or near leads carrying A.C., they, too, should be screened. The screening braiding, in common with that actually in the amplifier, is connected to the amplifier chassis. In the event of the amplifier being an A.C.-D.C. unit, with chassis common to one mains-supply lead, screening braiding with an outer insulated covering will be desirable. Failing this, it may be possible to earth the braiding to a separate earthing point in order that no danger of shocks arises when touching it.

Layout Considerations

Fig. 2 illustrates the 6J7 stage of the amplifier in Fig. 1. It is in this stage that particular care is necessary, because of the subsequent amplification given to any hum present. The heater supply leads are kept well clear of anode and grid leads; the screen-grid by-pass condenser (.25 μF) is close to the screen-grid tag of the holder, as is the resistor. Where the condenser is marked with a ring, or the letters "O.F.," to indicate the outside foil, this particular end of the component is best taken to the chassis. The metallising, or screen, of the valve is also taken to the chassis, and the grid lead is screened right up to the top cap. If the valve is of the plain glass type it should be enclosed in a valve-screening can, but this is not necessary with a valve having a metal shell.

It is possible that some of these points will have been attended to in an existing amplifier, unless it is of very simple type. If so, and hum is still at a higher level than the user wishes, the other modifications can be tried, and should bring about a considerable improvement. The 25 KΩ variable resistor and .02 μF condenser in Fig. 1 are the usual top-cut tone control, and not associated with the question of removing hum. Existing tone controls, if any, may be left unchanged.

A Versatile Oscilloscope

A 2½IN. C.R.T. TEST INSTRUMENT FOR WORKSHOP OR SERVICE DEPARTMENT

By N. J. Wadsworth, B.Sc.

THE Cathode Ray Oscilloscope described in this article is perhaps slightly more complicated than some, but is very adaptable and gives good results under conditions where many fail.

In order to keep the size of the chassis small, and so save bench space, a 2½in. cathode-ray tube is used. This enables a comparatively low E.H.T. to be used, and removes the need for either an E.H.T. transformer or a multiplier circuit and, at the same time, gives reasonable definition. In order to reduce panel space it was decided to omit shift controls, and in practice this seems to be quite satisfactory. (In the very rare cases when they are required a magnet can be used at a small distance to produce the deflection.) SP61's are used throughout as they are easily and cheaply available on the surplus market.

The Y-axis amplifier is designed to have a good frequency response, coupled with a high gain. In order to preserve the high-frequency response and avoid trapesium distortion, push-pull output was decided on. If the oscilloscope is to have little effect on the circuit under test its input impedance must be at least 2 MΩ. If, however, the input is fed to a 2 MΩ potentiometer as a gain control, considerable distortion of complex waveforms occurs at mid settings of the potentiometer due to the input capacity of the first valve and stray wiring capacities shunting the "earthy" portion of the potentiometer. To overcome this the signal is fed into a cathode follower, with a potentiometer as its cathode load. In this case the input impedance may be kept very high (it is over 10 MΩ in this case) and, at the same time, a low-resistance potentiometer is used as a gain control, thus removing this serious defect of most amateur-built oscilloscopes. A one-valve amplifier is used to feed the output stage, and the gain of this is switched to give either a sensitivity of about 8 mV/cm. (3 mV rms. gives a deflection of 1 cm. peak-to-peak) over a frequency range from 3 c/s to about 300 Kc/s, with a useful gain above 1.5 Mc/s, or a sensitivity of 2 mV/cm. (800 μv rms. gives 1 cm. peak-to-peak deflection) up to about 60 Kc/s. This sensitivity is such that if the input is connected across the coil of a crystal set the received signal is shown on the screen. In order to preserve the low-frequency response of the amplifier, unbypassed cathode resistors are used throughout. This is because, as the time constant of the 150 Ω resistor bypassed by a 50 μF capacitor is only 0.007 second, considerable phase shift would be caused at frequencies below 60 c/s. This is another common defect in oscilloscope amplifiers. As it is the phase shift is only 5 deg. at 30 c/s, corresponding to a time constant of 1/15 sec.

The timebase shown is a transitron-Miller integrator with a paraphase amplifier, giving sufficient sweep voltage to fill or overfill the tube at all frequencies. A sweep amplitude control is provided. The timebase frequency is switched in five ranges, covering from 2 c/s to 30 Kc/s with considerable overlap between ranges. A sync amplifier and buffer valve is provided and the input taken from a terminal on the front panel. This may be used for external synchronisation direct, or if internal synchronisation is desired a wire brought out nearby may be connected to the terminal. This feeds the input with a signal of suitable amplitude from the Y amplifier. This arrangement works satisfactorily but if desired a change-over switch could be used. Provision is made to use the sync and paraphase amplifiers as a separate X-axis amplifier when this is required. This is of lower gain and inferior frequency response to the Y-axis amplifier, having a sensitivity of about 300 mV/cm. (100 mV rms. produces 1 cm. trace) and uniform gain between 20 c/s and about 70 Kc/s, and useful gain at 500 Kc/s with the gain control at the maximum. At the mid position of the gain control the upper frequency limit of its response is reduced to about 8 Kc/s. This is typical of amplifiers having this input circuit and shows the enormous advantage of the cathode follower type. It is tolerated in this position as the X-axis amplifier is normally used for audio frequencies, as, for example, when testing amplifiers for phase shift or distortion. At the maximum position of the gain control the phase shift is only a few degrees at 30 Kc/s and effectively zero below 15 Kc/s. Thus it is suitable for use for this purpose, if the gain control can be kept at maximum. This can be arranged by varying either the gain of the amplifier under test or the input voltage.

In order to provide for connection to the deflection plates of signals large enough not to need amplification the four plates are brought out, through coupling net works to remove D.C. voltages, to four terminals on the tube mounting panel. This ensures that the wiring capacity is kept to a minimum. The time constant of the coupling circuit is 0.5 sec. and so its response is only 3 db down at 0.3 c/s and the input capacity is only a few pF greater than that of the tube itself. In normal use the outputs of the X and Y axis amplifiers are connected to these terminals.

The grid connection of the tube is also brought out through a capacitor, and a diode used to prevent the grid being driven positive. This connection may be used to modulate the brilliancy of the trace (Z-axis modulation). One application is the insertion of timing pulses. These are short pulses of exactly known repetition frequency which appear on the trace as bright or dark spots. They may be produced by passing the square wave output of an audio-oscillator through a differentiating circuit with a time constant about one-twentieth of the repetition time of the square wave. In this way the repetition frequency may be varied at will and is always accurately known. This technique is useful when the relative timing of two events is wanted very accurately, the oscillator frequency being adjusted until two adjacent bright spots fit on the traces of the two events. The time difference is then the reciprocal of the oscillator frequency.

CIRCUIT

The Y-axis Amplifier

The circuit is shown in Fig. 1. V1 is the cathode follower input. R3 is the bias resistor and VR1 the cathode load gain control. The output from this is taken to V2, the main amplifier. With S1 in the position shown, the valve has an anode load of 57 KΩ and hence a high gain. However, the valve and wiring capacities limit the high-frequency response and to improve this S1 may be closed, thus restoring full H.T. to G2 and reducing the anode load to 10 KΩ. In the former position the low-frequency response is limited by C4 and can be improved by increasing this capacity. The output

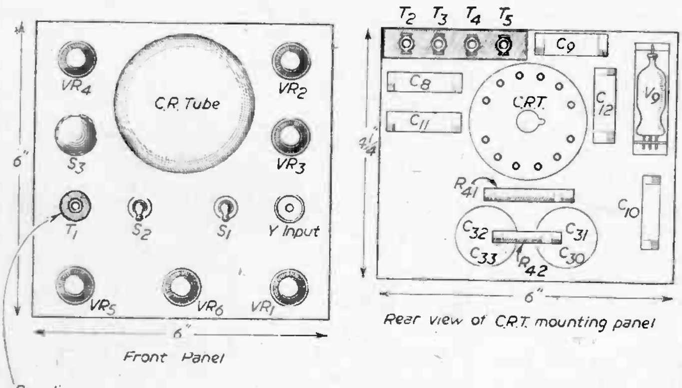


Fig. 3.—Panel and C.R.T. mounting details.

from V2 is fed to the output stage, V3 and V4. These are a cathode-coupled push-pull pair with 10 KΩ anode loads. This is sufficient to give full deflection without overloading. If it is desired to mix two signals for the Y-axis deflection without interaction, this may be done by feeding the second signal through C7 to the control grid of V4. The output from these valves is taken to the Y plate terminals as described above. The voltage for internal synchronisation is taken from the cathodes.

The X-axis Amplifier and Timebase

V6 is the timebase oscillator. S3 is the coarse, and VR4 the fine, frequency control, while VR5 provides adjustment of the sweep amplitude. When S3 is in the lowest position the timebase is switched off and R34 provides bias. The grid stopper R32 is essential to prevent parasitic oscillations, resulting in a very short, non-linear sweep. V7 is used either as the sync amplifier, with VR6 acting as the sync control, feeding through C24 to the junction of R34 and R36, or as the input valve of the X-axis amplifier with VR6 acting as gain control. V5 is a paraphase amplifier used either with V6 to provide sufficient timebase sweep or with V7 as the X-axis amplifier. The gain is determined by R27 and R28 or R29. S2 is used to switch from timebase to X-axis amplifier. When using the amplifier it is necessary to switch off the timebase by S3 as otherwise it acts through the common H.T. supply and produces a deflection.

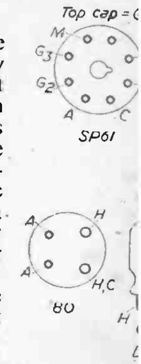


Fig. 4.—C.R.

The Cathode-ray Tube

The focus and brilliance circuit is conventional, the first and third anodes being fed from the main

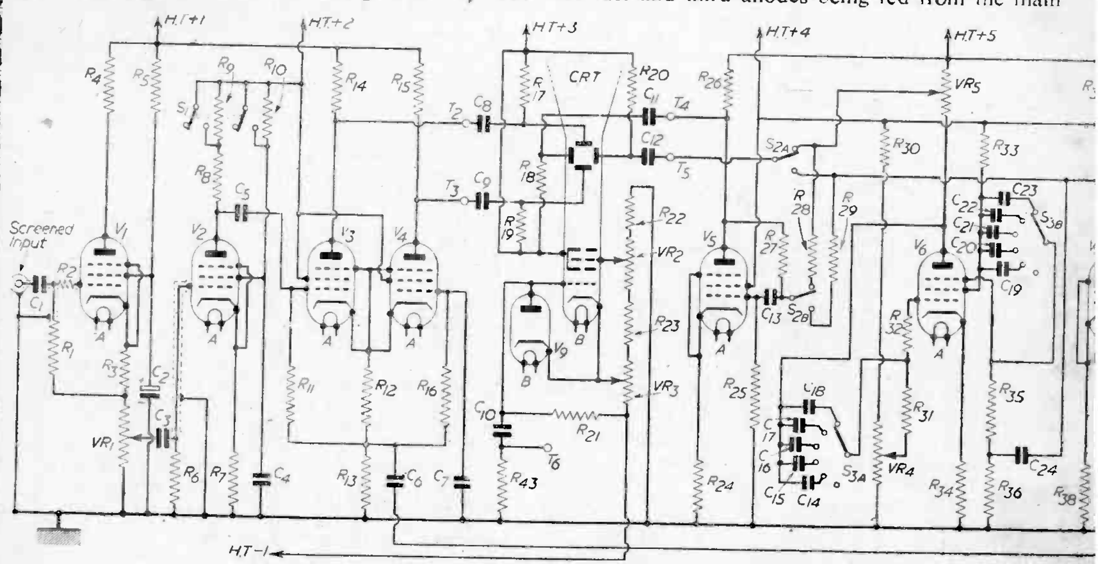
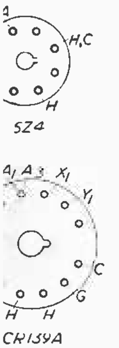


Fig. 1.—Theoretical circuit of the Versatile Oscilloscope.

H.T. line and the cathode from a separate negative supply. In this way the tube receives its 800 v. EHT without a voltage multiplier or special transformer. VR2 is the focus control and VR3 the brilliance control. R21 and C10 provide for the application of modulation to the grid, while V9 acts as a safety device to prevent the grid being driven positive. The value of R21 depends on the grid to cathode leakage of the tube; if it is too large it will not be possible to black out the tube. R43 ensures that C10 is kept charged to the potential of the grid, and so no large charge flows if connections are made to T6 with the oscilloscope switched on.



d valve base

The Power Supplies

These are quite conventional. A 350-0-350 volt transformer is used, giving 370 volts across C28. The supplies for the Y-axis amplifier and the timebase are separated to prevent interaction. After one stage of choke capacity smoothing the H.T. is taken to the anodes of the valves. The H.T. supply to the screen grids is passed through a resistor to reduce it to 250 volts. It is, however, necessary to feed V1 and V2 from separate supplies as, with a large low-frequency input (say a 30 c/s square wave), the large current swing of V1 is enough to affect the voltage of H.T.+2 and produce an unwanted deflection. With the circuit shown there is no effect of this sort, even with V1 overloaded at 30 c/s. The supply for the first and third anode of the C.R.T. is taken from the reservoir and smoothed separately. In view of the very small current a large resistor may be used, together with a small paper capacitor. The negative H.T. supply is taken from a metal rectifier and smoothed by two 1 µF capacitors and a 150 KΩ resistor. It is essential that this supply should be well smoothed if the brilliancy is not to be modulated at 50 c/s when T6 is earthed. A separate transformer is used to supply the heaters of V9 and the C.R.T. in view of their high cathode potential.

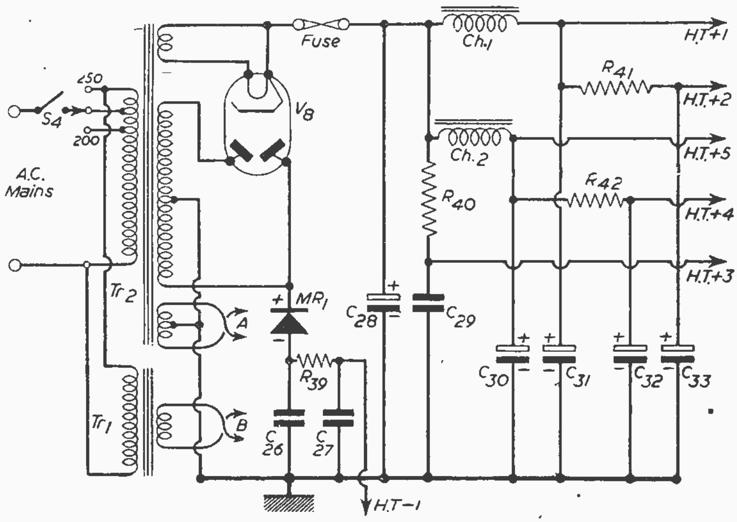


Fig. 2.—Theoretical circuit of the power supply section.

Layout

The layout of the main components is shown in the diagrams. The C.R.T. socket is mounted on the tube mounting panel in the middle of the chassis, and the tube face is supported flush with the front panel in the hole shown. This hole should be lined to prevent the tube being scratched on withdrawing,

LIST OF COMPONENTS

R1—2 MΩ.
R2—330Ω.
R3—150Ω.
R4—15KΩ 2W.
R5—50KΩ.
R6—1MΩ.
R7—150Ω.
R8—10KΩ1W.
R9—47KΩ 1W
R10—200KΩ.
R11—1MΩ.
R12—70Ω.
R13—1KΩ.
R14—10KΩ1W.
R15—10KΩ1W.

R16—1MΩ.
R17—5MΩ.
R18—5MΩ.
R19—5MΩ.
R20—5MΩ.
R21—100KΩ.
R22—150KΩ.
R23—80KΩ.
R24—150Ω.
R25—1MΩ.
R26—15KΩ1W.
R27—47KΩ.
R28—33KΩ.
R29—33KΩ.

R30—1KΩ.
R31—1MΩ.
R32—1KΩ.
R33—22KΩ.
R34—150Ω.
R35—33KΩ.
R36—33KΩ.
R37—15KΩ1W.
R38—150Ω.
R39—150KΩ.
R40—1MΩ.
R41—7KΩ2W.
R42—5KΩ2W.
R43—1MΩ.

VR4—25KΩ WW.
VR5—25KΩ WW.
VR6—2MΩ.
S1—DPST.
S2—DPDT.
S3—2P6W.
S4—SPST. (Can be on VR3.)
C1—0.1µF.
C2—8µF.

C6—0.1µF.
C7—0.1µF.
C8—0.1µF.
C9—0.1µF.
C10—0.1µF.
C11—0.1µF.
C12—0.1µF.
C13—0.1µF.
C14—0.1µF.
C15—0.03µF.
C16—0.002µF.
C17—300pF.
C18—68pF.

C22—100pF.
C23—30pF.
C24—0.1µF.
C25—0.1µF.
C26—1µF.
C27—1µF.
C28—8µF.
C29—0.1µF.
C30 } 16+16µF.
C31 } Ali can.
C32 } 16+16µF.
C33 } Ali can.

VR1—5KΩWW.
VR2—100KΩ.
VR3—10KΩ.

C3—0.1µF.
C4—0.5µF.
C5—0.1µF.

C19—0.05µF.
C20—0.005µF.
C21—500pF.

CH1, CH2, 10H, 50mA. Tr.1, 230VPri., 4V1.5A, insulated to 1,000 V. Sec.; TR2, 230V.Pri., 350-0-350V., 100mA., 5V2A, 6.3 V. 4A Secs.; V1-V7, SP61; V8, 80 or 5Z4; V9, D1; C.R.T., VCR139A; MR1, J50; Fuse 100mA.

All resistors ½W. unless otherwise stated.

if possible with sponge rubber but failing this thick plastic tape may be used with success. In order to keep magnetic pickup by the tube as small as possible, the large mains transformer and the two chokes are mounted behind the tube and as nearly on its axis as possible; also their axes are placed parallel to that of the tube. In this way the pickup is kept small. The two chokes should be wired so that their fields are opposite, to reduce the constant field at the tube and so keep the spot central. A mu-metal shield round the tube is an advantage in reducing pickup due to this and other nearby apparatus. The valves are mounted in two rows, one down each side of the C.R.T., keeping the Y-axis amplifier on one side and the timebase and rectifier on the other. In the space below the tube, at the rear, are housed the H.T. smoothing capacitors C30-C33, while that at the front provides room for a tag-board holding the switched timebase capacitors (C14-C23) close to S3. Besides the tube socket and C30-C33 the tube mounting panel supports the H.T. smoothing and voltage dropping resistors, R41 and R42, allowing adequate cooling. V9 is fixed in one corner as shown and the deflection plate coupling capacitors C8, C9, C11, C12, together with R17, R18, R19 and R20 are mounted round the tube socket.

The controls VR1, VR2, VR3, VR4, VR5, VR6, S1, S2, S3, together with the Y amplifier input socket and T1, the X amplifier or sync input terminal, are mounted as shown on the front panel with the C.R.T. face in the centre. S4, the mains on/off switch, can be on the back of VR3, the brilliancy control, in which case care must be taken to screen the mains lead from the input socket, or it should be mounted elsewhere. Under the chassis is mounted the metal rectifier MR1 and its associated smoothing components. The rectifier is mounted between two anchoring posts, with a third supporting the live end of C27. TR1, the heater transformer supplying the C.R.T. and V9, is mounted on one side of the chassis as shown. The fuse-holder is mounted directly below V8. This may be either a commercial design or a tag strip of suitable length with the tags bent over to grip the fuse ends. It is also convenient to mount the reservoir capacitor C28 by V8. C1 and R1 are mounted above the chassis to prevent feedback, and screened top caps used for V1 and V2 to reduce pickup. It is advisable to mount a small screen between the timebase capacitors and C1 and the input socket to prevent pickup from the flyback.

The C.R.T. Heater Transformer

It should be noted that the secondary winding of TR1 runs at 400 volts negative with respect to chassis, and thus the insulation between it and the primary must be able to stand about 750 volts peak. This is considerably higher than normal. In order to be on the safe side the author rewound a normal 6.3 v. 1.5 A heater transformer. This proved quite easy. To do it the laminations are taken out and the first layer of insulation on the bobbin removed. This exposes the 6.3 v. secondary. This is then carefully removed taking care to count the turns. The original insulation is now exposed. Two layers of empire cloth are then wound tightly round the bobbin, taking care that they come right to the sides, and then

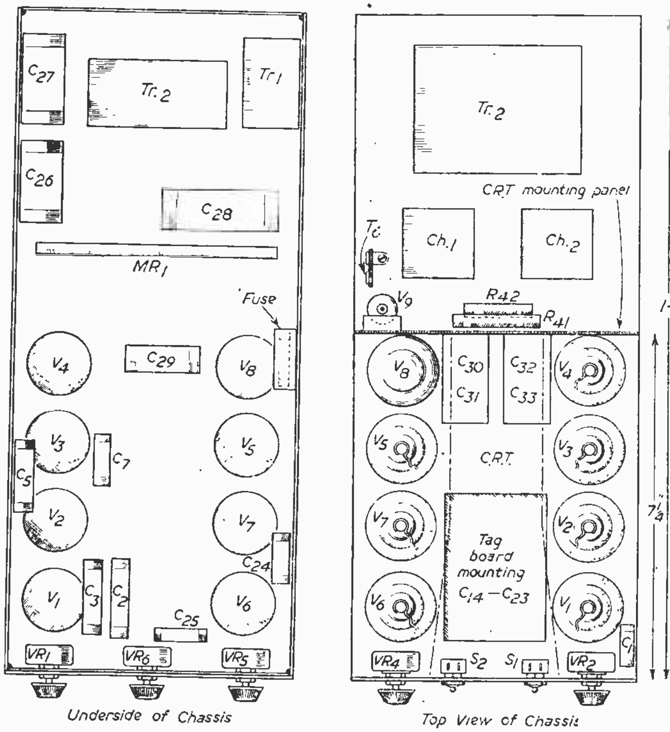


Fig. 5.—Views of the chassis showing layout of essential parts.

fixed with a short piece of plastic tape. The new secondary is now wound on. This may be done with the same wire as was taken off if inspection shows it is not damaged in any way, but it is better to use new wire of the same gauge. The number of turns needed is, of course, 4/6.3 times the original number. The smaller number of turns makes room for the extra insulation. The laminations are then replaced as before and the transformer is complete.

A table of voltages measured to chassis with a 1,000 Ω/V meter is given for guidance, but some variation with components should be expected.

Electrode Voltages

	V1	V2	V3	V4	V5	V6	V7
A	220	150	240	240	210	220	250
G2	240	250	250	250	250	200	250
C	50	2	22	22	2.5	1	2

C26	C27	C28	C30	C31	C32	C33
320	260	370	350	350	250	250

Radio Receiver Design at V.H.F.—9

By G. P. Lowther

(Concluded from page 262 June issue.)

BE generous with screening. In particular screen the anode and grid circuits of each signal frequency stage from each other by a screen passing across the valve base (chassis mounting) and between the anode and grid pins. Orientate adjacent coils at right-angles to each other. Keep all leads as short as possible; earth leads should preferably be not more than ½in. long. Use valve screens where necessary. Decouple, generously paying particular attention to filament leads which may have to be of screened wire.

Oscillation is best detected by coupling a diode and microammeter to the R.F. or I.F. output and observing whether there is a deflection in the absence of a signal. Remember, however, that if the receiver is sufficiently sensitive, first circuit noise may produce a deflection which, however, usually disappears when the first grid is short-circuited to earth. If a microammeter is not available, the oscillation can be heard through the speaker in the presence of a carrier of suitable frequency.

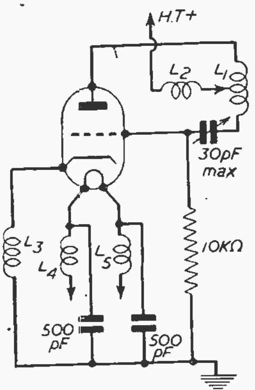


Fig. 46.—L_2, L_3 and L_5 are all H.F. chokes, consisting of 5-10 turns on a ¼in. former.

The circuit of Fig. 48, although not using special high-frequency valves, will tune from 30 Mc/s—80 Mc/s or 90 Mc/s using single turn coils in the signal and oscillator circuits. A 3 Mc/s I.F. is used.

The gain control (½ MΩ potentiometer) should be of the logarithmic type. If desired, a double-diode pentode may be substituted for the EBC33 to operate a loudspeaker.

(b) V.H.F. Converters

The converter depicted in Fig. 49 will operate satisfactorily up to about 200 Mc/s. It consists of a straight R.F. pentode feeding into a diode frequency-changer, the I.F. being 10 Mc/s-20 Mc/s.

The R.F. chokes L_1, L_2 and L_3 consist of 5-10 turns on a ¼in. former.

The R.F. choke L_4 consists of 5 turns on a ¼in. former.

For use on the 145 Mc/s amateur band, signal and oscillator coils of 1-1½ turns should be used.

The R.F. stage may be omitted if desired, the aerial being coupled directly to the frequency-changer tuned circuit.

Alternatively, a grounded-grid triode may be used in place of, or in addition to, the pentode (see Fig. 52).

The circuit of Fig. 49 may also be used as the basis for a complete receiver, 1 or 2 I.F. stages being added as in Fig. 48, but tuning at a higher frequency.

The filament chokes L_2 and L_3 can probably be omitted if only one R.F. stage is employed.

In some cases better results may be obtained by tapping the diode down the previous tuned circuit.

The aerial coil is best coupled end on, i.e., along the same axis as that of the grid coils and as tightly as possible. About one turn will be required for a 75Ω input impedance.

The converter of Fig. 50 employs a 12AT7 double triode giving good results up to about 250 Mc/s. Again the unit may be built into a complete receiver or used in conjunction with a normal broadcast set. In the latter case, the I.F. output from the converter is coupled to the aerial input of the normal receiver which is tuned to the intermediate frequency, this being finally adjusted to give freedom from interference. In all the H.F. amplifier stages the cathodes are shown fully decoupled since this is a stable condition. Nevertheless, as explained in the section on valve technique, greater amplification and decreased noise can be achieved by reducing the value of the cathode decoupling condenser.

If resonance of anode H.F. chokes proves troublesome (as shown by wide variations in gain with frequency) it may be easily overcome by connecting a 1,000Ω resistor in series with the choke. H.F. chokes are used as anode loads in parafeed coupling in order to avoid both the damping that a low value of resistor would introduce and the reduced anode voltage and consequent decrease in mutual conductance caused by a high ohmic resistance.

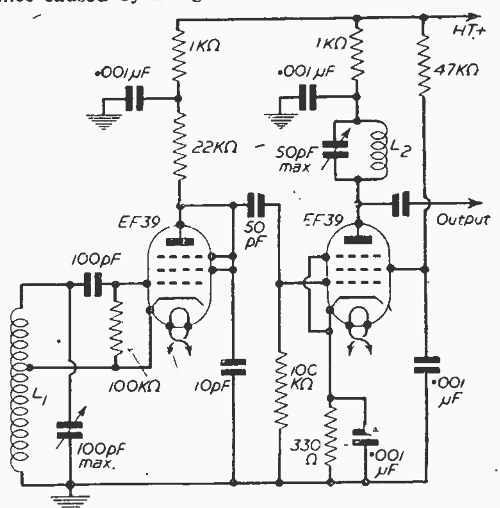


Fig. 47.—L_1 consists of 6½ turns 18 s.w.g. on a ½in. former, tapped 2 turns from the "hot" end. L_2 consists of 2 turns 18 s.w.g. on a ½in. former (this coil can be self-supporting).

(c) Straight H.F. and Detector Unit

The amplifier represented in Fig. 51 will operate up to 250 Mc/s and consists of two H.F. stages, the first being a grounded-grid feeding into a diode detector. Series tuning is used and although a wide band cannot be covered a range of about 30 Mc/s at 200 Mc/s is obtained. The tuning condensers should be kept as near maximum capacity as possible in order to obtain the greatest amplification.

The tuning inductances L_1 and L_2 require 1-2 turns of about 18 s.w.g. wire. All the other inductances are H.F. chokes consisting of 5-10 turns on a ¼in. or 5/16in. former.

The condensers C_1 and C_2 are necessary to match the stages and thus obtain maximum gain and should be about 10 pF. and 7 pF. respectively. The actual value depends upon the damping imposed by the valves as explained previously. The H.F. choke and 1,000Ω resistor from the diode anode to earth provide a D.C. return for the diode current, the resistor preventing the choke forming part of a resonant circuit. For reception up to about 170 Mc/s or 180 Mc/s, parallel tuned circuits may be used, the modifications being shown in Fig. 52.

The inductances L_1 and L_2 consist of 1 turn, all other inductances being H.F. chokes as before. The point at which the tuning inductances are tapped is best found empirically, but will be about one-third of a turn from the "hot" end.

(d) Super-regenerative Receiver (Self-quenched)

As much information is available about super-regenerative receivers, two circuits only will be given. In Fig. 53 is shown a single valve circuit operating up to about 300 Mc/s. while Fig. 54 shows a super-regenerative transceiver capable of operating at frequencies as high as 500 Mc/s.

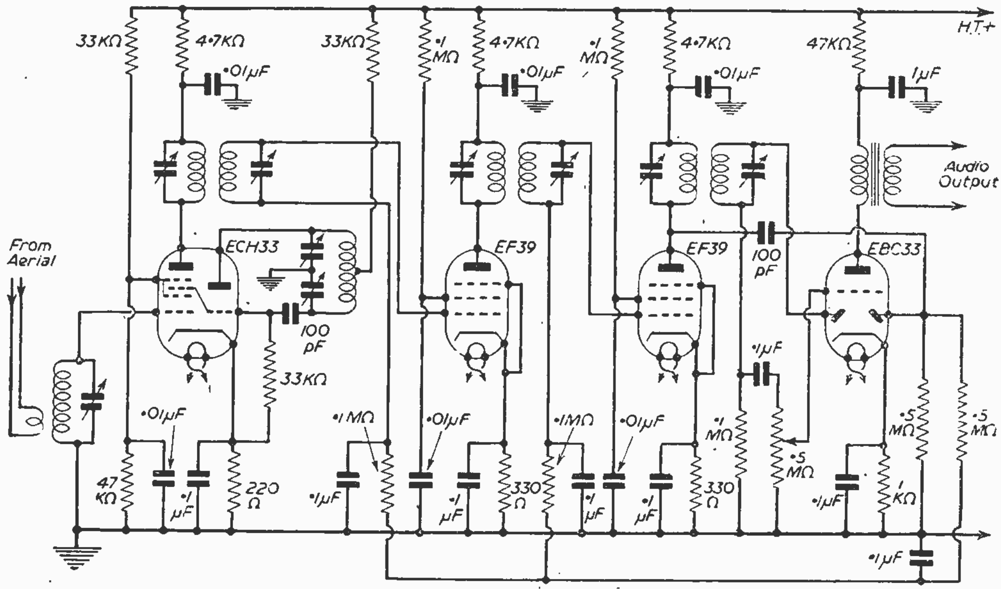


Fig. 48.—H.F. end of a complete receiver.

(e) V.H.F. Transceiver

The transceiver uses a separate quenching valve operating at a frequency of about 50 kc/s. which is speech modulated from the microphone. The high frequency oscillator can be used above 500 Mc/s. if an RL18 is used and the inductances consist of short lengths of wire (shape comparatively immaterial). At lower frequencies, i.e., below about

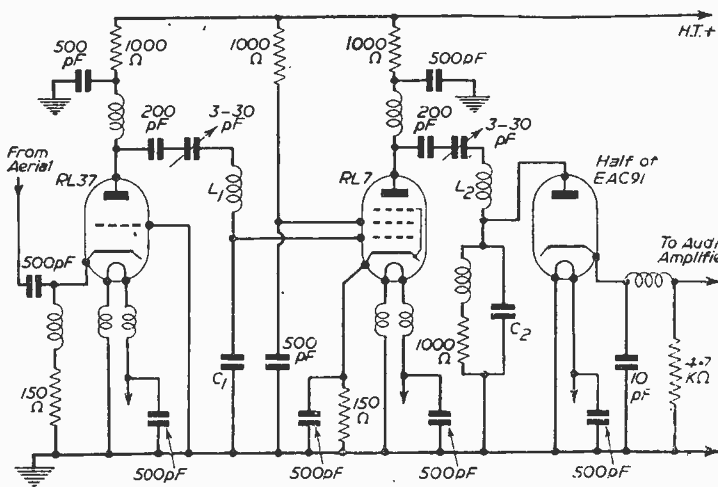


Fig. 49.—A V.H.F. converter.

200 Mc/s., parallel tuning will be found more convenient, as in Fig. 53. It should be noted that the use of a split-stator tuning condenser in this case, though not essential, gives freedom from hand capacity. The inductance L_3 will require about 600-700 turns on a 1in. former (air-cored), while approximately 100 turns will suffice for L_4.

The coupling between L_4 and L_5 and that between L_1 and L_2—L_3 must be found by trial and error, as must the tapping points on the high-frequency tuned circuit. The H.F. chokes should consist of 5-10 turns of wire—according to the frequency—on a ¼in. former.

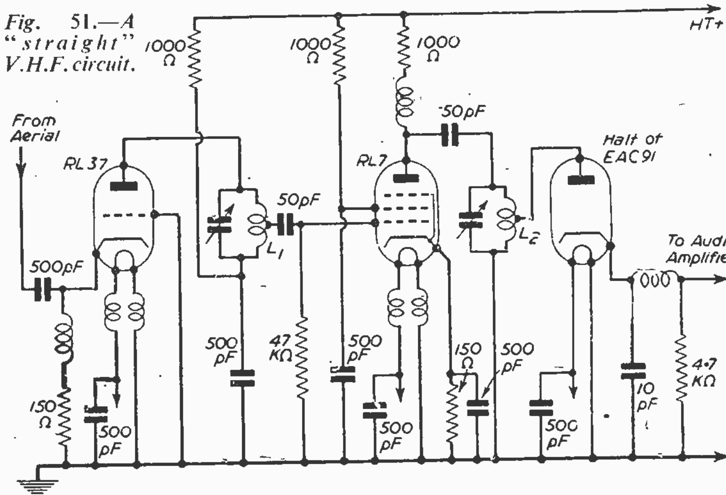


Fig. 51.—A "straight" V.H.F. circuit.

(f) V.H.F. Test Oscillator

The test oscillator in Fig. 55 is very simple, since there is no need to provide modulation (though if required, it may be injected in series with the grid resistor). The milliammeter, although not essential, indicates by a drop in current when the valve is oscillating. If it is not used, care must be taken to keep the coupling between the oscillator and receiver fairly loose, or the valve may cease oscillating. Any V.H.F. triode—or pentode stapped as a triode—may be used, the limiting frequency depending upon the valve employed. A set of centre-tapped plug-in coils may be constructed for use with the test oscillator. ⅛in. copper tube or heavy gauge wire should be used or the calibration will not last long. If no other source of calibration is available, Lecher wires may be used for the purpose. These consist of two parallel wires insulated from earth and from each other and spaced 1in.-2in. apart. They are joined by a half or single turn coil at the oscillator end and are open at the other end. Their length must be not less than one wavelength, i.e., 7ft. at 150 Mc/s. When these wires are coupled to the oscillator, standing waves are set up with current antinodes, i.e., points of maximum current at distances equal to a half wavelength. These points may be determined by soldering short wires to a low-consumption flashlamp bulb and bridging the wires. The bulb will light at each half-wave current antinode. The first point will appear a half wavelength from the coupling point, but this is somewhat unreliable and the next point should be searched for. The distance between the two will be exactly half the wavelength at which the valve is oscillating. Thus if the distance in inches between the two points = L, f (Mc/s.) = 5905 ÷ L.

To light a bulb the oscillator valve will have to be of reasonably high power, e.g., an RL16, otherwise a valve voltmeter (described below) may be used as an indicator.

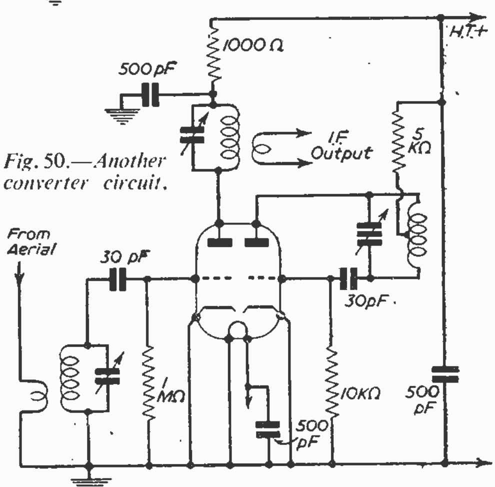


Fig. 50.—Another converter circuit.

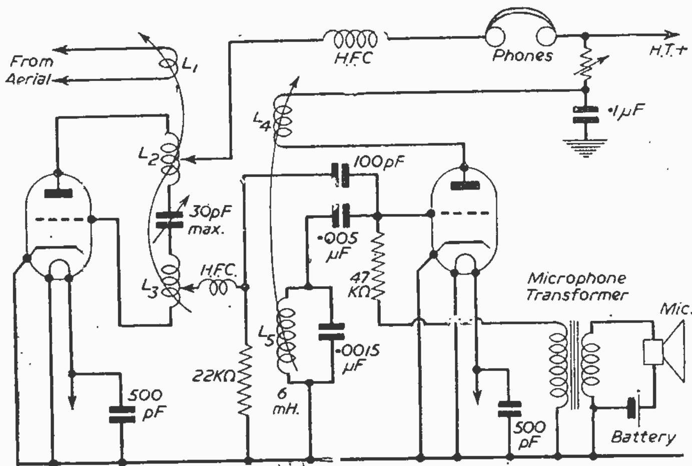


Fig. 52.—This circuit is suitable for 180 Mc/s.

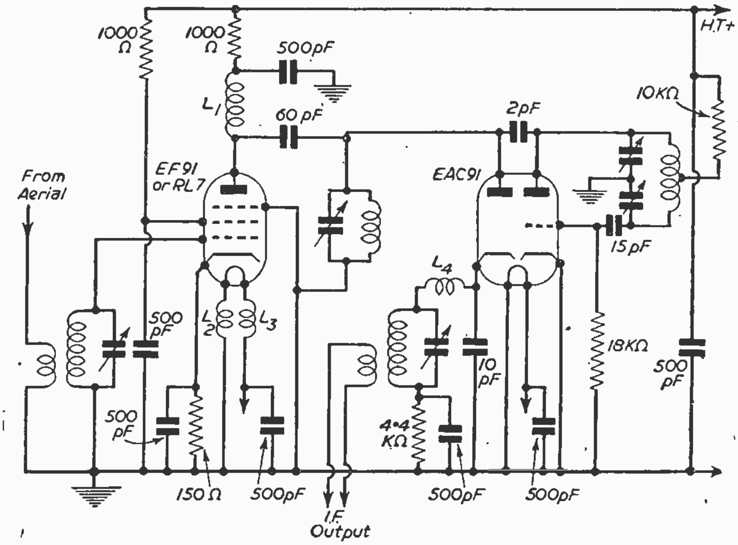


Fig. 54.—Another self-quenched super-regenerative arrangement.

(g) Valve Voltmeter

The circuit of Fig. 56, though perhaps scarcely meriting the title "valve voltmeter," is nevertheless a useful piece of equipment of indicating the presence of a high-frequency signal and even its approximate amplitude. The coupling coil L consists of ½ or ¾ of a turn of stiff copper wire from the diode anode to earth in the form of a loop with a total length of about 2in. The valve itself is one section of an EB91 double-diode which has a forward impedance of about 100Ω. Full-scale deflection will represent an applied voltage of approximately 0.5, this being across the low impedance coupling coil L. The actual value of impedance can be ascertained by connecting resistors across as explained previously, and thus the voltage across the high-impedance source may be roughly estimated, though there will, of course, be an appreciable loss due to imperfect coupling. In some cases the diode anode can be connected directly across the tuned circuit (which will have to be re-tuned, the diode adding a capacity of 4 pF or 5 pF) providing there is a D.C. path to earth. Above about 200 Mc/s. the coupling coil will resonate with the diode capacity and so will render measurements invalid.

The scale will be only approximately linear—when peak voltages will be indicated, while the lower end will be approximately square-law—measuring R.M.S. values. If a 0-100 microammeter is not available, a 0·1 milliammeter may be used with a lower value of load resistance: linearity will, however be impaired.

(h) Wavemeter

The wavemeter circuit of Fig. 57 is similar to that of the valve voltmeter and also uses an EB91. As the input impedance of the diode is low, it has to be tapped down the tuned circuit to avoid severe damping. A set of rigid plug-in coils may be constructed and calibrated from a calibrated oscillator or an uncalibrated oscillator and Lecher wires. The phone jack enables modulation to be detected.

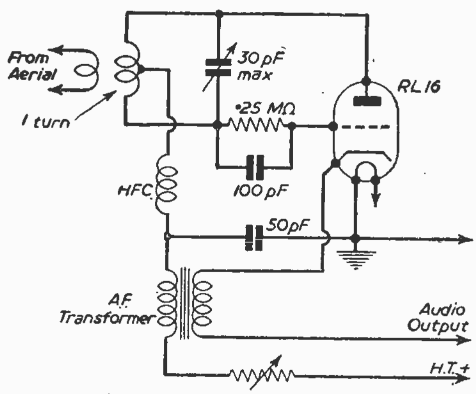


Fig. 53.—One form of super-regenerative circuit.

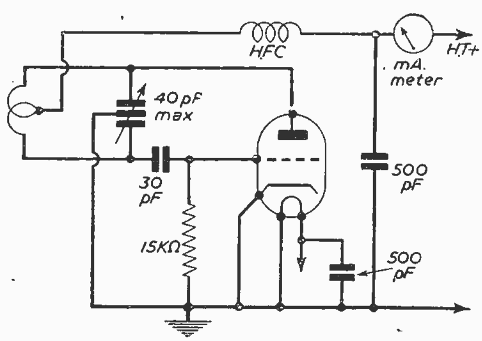


Fig. 55.—A V.H.F. test oscillator.

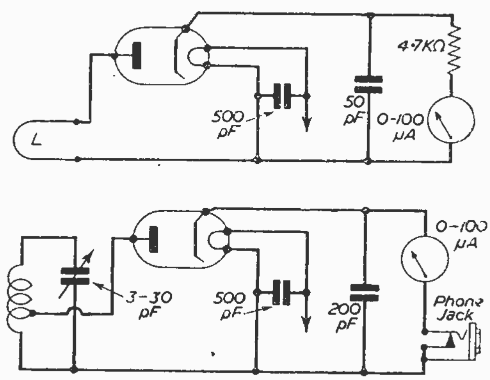
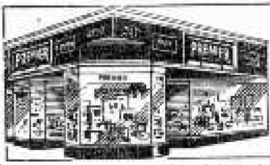


Fig. 56 (above).—V.H.F. valve voltmeter, and Fig. 57 (below).—A wavemeter for V.H.F. work.



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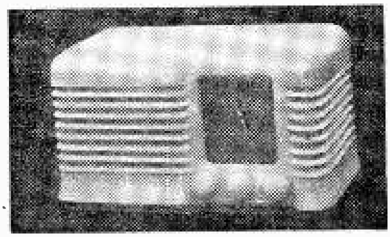

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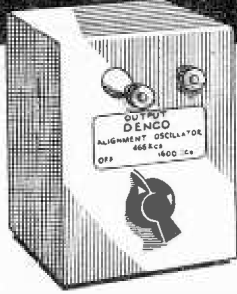

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BIET

CONVERTING TO PUSH-PULL

ADDING AN EXTRA OUTPUT VALVE TO A RECEIVER OR AMPLIFIER WITH THE MINIMUM OF TROUBLE AND EXPENSE. THE USE OF THE SCHULTZ PHASE-SPLIT CIRCUIT FOR THIS APPLICATION IS EXPLAINED

By James S. Kendall

OFTEN the amateur wishes to convert the output stage of a receiver or amplifier to push-pull, with the absolute minimum of extra components, whilst keeping the drive power the same but reducing the distortion. The Schultz phase-split circuit gives the answer to this problem. The basic circuit is shown in Fig. 1. In this the output transformer is changed for one that will handle the push-pull power. The resistance Rk is half that used for the original single valve stage. For instance, a pre-war set using a PenA4 will, before modification, have a bias resistor (Rk) of 150Ω, but when the extra valve is added, the wattage rating must be doubled and the resistance halved, i.e., dropped to 75Ω. The resistance Rc should be as high as possible without reducing the H.T. voltage excessively. A value of five times that of Rk is suitable.

It will be seen that the Mullard high-slope valves, such as the PenA4, EL33, and EL41, have a very great advantage over the international types, such as the 6F6, 6K6, 6L6 and 6V6, as the H.T. voltage need only be reduced by about 30 volts. This drop does, of course, cause a slight drop in power. The transformer should be checked to see that it will carry the current. The rating of the smoothing choke should also be checked as, if overrun, hum will occur.

The operation of the circuit is simple. As the grid voltage on one half of the valve is dropped, the anode current falls. As the grid of the second valve is held steady by the condenser to earth, the bias on the valve is decreased, resulting in a rise in anode current which very nearly balances out the change in the driven valve. The larger the combined resistance in the combined cathode circuit, the nearer will be the balance in the two anode currents.

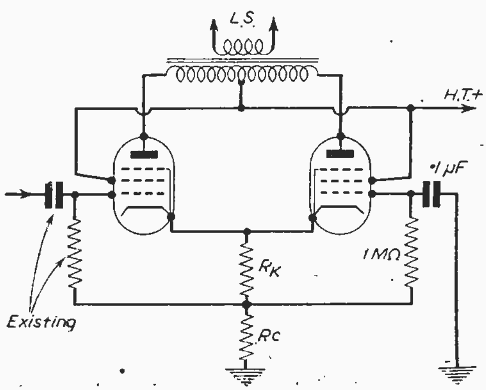


Fig. 1.—Basic circuit of the Schultz phase-splitter.

The most popular valve for the amateur seems to be the 6V6G, as it is so readily available from the ex-W.D. stores. This valve, with 250 volts on both the anode and the screen, requires a bias of 12.5 volts. This is developed across a resistor of 250Ω. The value of Rk will, therefore, be 125Ω, and the value of Rc at least 650Ω. The wattage rating of these resistors will be "bias voltage multiplied by the anode current," and this latter for two 6V6G is 0.1 amps. so that it will be 12.5×0.1, say, 2 watts to be on the safe side. Rc will have to be 5×1.25, say, 10 watts.

There will be a drop in H.T. volts to the valve of over 60 volts, and this will cause a drop in the output power of the stage. According to the maker's figures, a single valve with 250 anode and screen will give an output of 4.5 watts, but, two valves in push-pull with 180 volts anode and screen, will only give an output of 4 watts ! ! ! The voltage fed to the stage must, therefore, be increased. This latter can best be done by reducing the resistance of the smoothing circuit. If the transformer used is a 250-0-250 volt, the voltage at the cathode of the rectifier valve will be just under 1.4 times this, that is 350 volts. If the current drain of the receiver using one valve is 70 mA the resistance of the smoothing circuit would be some 1,400Ω. If two valves of the 6V6G type are to be used for the output, an extra 50 mA will be required, at a voltage 60 volts higher. A suitable circuit is shown in Fig. 2. In this, the smoothing choke has to be reduced to 300Ω. If a choke of this resistance is not available one of lower value can be used in series with a resistance of suitable value. The values of the condensers used for smoothing should be such that when multiplied by the choke inductance it is the same value as used in the previous set up. That is, if two 8μF condensers and a 20 h choke was used in the first place, and only a 5 h choke was used in the second, then, in the first case 16×20 equals 320, so in the second the total capacity must be 320 divided by five, equalling 64, and therefore two 32 μF condensers should be used.

It will be seen from the foregoing that the lower the bias required by the valve, the less will be the drop in the H.T. In A.C./D.C. sets where the voltage

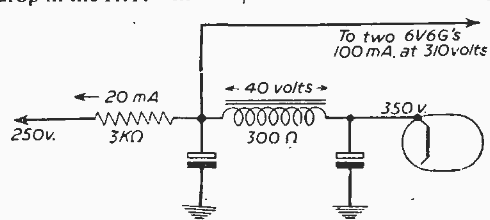


Fig. 2.—H.T. potential divider.

is limited, it is essential that the valves used should be chosen with care. In the international range the 25A6G is very useful as with a maximum voltage of 135 on both the anode and the screen there is some 90 volts that can be absorbed by the coupling resistor and the smoothing circuit. This will usually mean that the coupling resistor will only be three times that of the cathode resistor. On the other hand the 25L6G requires a bias of only −8 volts, but if the circuit is arranged so that there is a 40 volt drop along Rc, the H.T. to the valve will be dropped to about 180 volts. This slight drop from the maximum of 200 will give an output power of about 7 watts, but as the valves will each be taking some 57 mA it will be necessary to use two rectifier valves in parallel to take the total load—that is assuming that the normal 25Y5 or 25Z4G is being used.

For A.C./D.C. Circuits

In the writer's opinion the best valve for use in A.C./D.C. circuits of the type described in this article is the Mullard UL41. This valve is of the high-slope type and with 170 volts anode and screen, a power output of 9.0 watts for a distortion of only 4 per cent. can be obtained. In this circuit Rk would be 100Ω and Rc 500Ω, the output impedance from valve to valve (anode to anode) would be 4,000Ω.

To assist those readers who wish to experiment with this type of circuit, the table on the right shows the values of bias and load resistor required for a fairly wide range of valves.

Table of Values of Resistance for Rk and Rc for Various Valves

Valve	Rk	Rc	Extra H.T.	Wo
6AG6G	75	400	30	7.5
6AM5	30	1,400	75	8
6F6G	220	1,100	100	9.6
6K6G	250	1,300	90	7.8
6L6G	150	750	90	20
6V6G	120	600	63	9
7A3	75	400	30	7.5
7B5E	250	1,300	90	6.5
7C5	120	600	63	9
7D5	220	1,100	100	9.6
7D6	75	400	30	7.5
7D8	75	400	30	7.5
12A6	180	900	63	5.6
25A6G	220	900	85	4.0
25L6GT	80	400	30	7.5
35L6GT	95	500	20	5.0
KT32	50	250	40	7.0
KT33C	50	250	40	7.0
KT61	50	250	25	8.0
KT63	210	1,100	80	6.0
KT66	80	400	75	12.0
EL31	100	500	90	38.0
EL37	60	300	70	20.0
EL41	90	450	35	8.0
EL42	180	900	130	5.0

German Radio Exhibition

AFTER a lapse of two years the "Grand German Radio and Television Exhibition" will once more be held in Düsseldorf from August 22nd to 31st, 1952. All factories located in the Federal German Republic and in Western Berlin which produce wireless sets, television sets, radiogram attachments and phonograph records, as well as accessories and spare parts, will be represented without exception. They offer a comprehensive exhibition of the new designs in all fields.

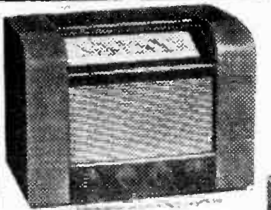
There are two fields which will probably interest the wireless specialist most: ultra-short-wave wireless, and television. As is well known, a few years ago Western Germany was forced by the pressure of existing circumstances to build up a network of ultra-short-wave transmitters because the Copenhagen Plan worked out in the autumn of 1948 made only a few relatively bad frequencies in the medium-wave range available to Germany. A virtue has meanwhile been made of necessity, and these emergency measures have been developed into a completely new kind of broadcasting, which to-day covers all parts of Western Germany, including Berlin. On March 1st, 1952, there were already 70 transmitters operating in the ultra-short-wave range, and about 30 per cent. of all wireless owners already had sets equipped to receive the ultra-short-wave ranges. A further 30 U.S.W. transmitters are to begin operations within the near future, whilst the industry is building U.S.W. ranges into all wireless sets intended for home consumption.

The German factories have been able to gain considerable experience, so that a study of the standards reached in the construction of U.S.W. receivers and transmitters should be of considerable interest to all visitors. The idea of building up a new type of broadcasting, with high-fidelity reproduction and free of interference, with the ultra-short waves forming a valuable supplement to broadcasting on medium and long waves (the latter only in Europe), is also gaining more and more ground in other countries. The radio exhibition in Düsseldorf promises to show many new models of wireless sets whose efficiency in the ultra-short-wave range will be amazing, and whose fidelity of reproduction will be far superior to anything known in the past. The valve factories have meanwhile developed new types of amplifier valves with the aid of which even low-cost wireless sets will be capable of bringing good ultra-short-wave reception. Wireless sets for all frequencies up to 30 Mc/s, with particularly good performance on the short waves, will be supplied for use in the tropics.

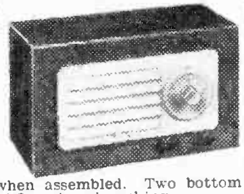
Components

Considerable progress has also been reported in all the other fields of electrical engineering. New types of aerial for very short wavelengths, interesting recording devices with magnetic tapes or steel wires and, above all, whole series of precision testing instruments for ultra-short waves and television are expected.

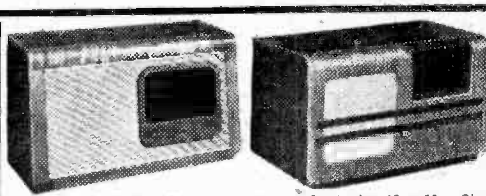
In conclusion, the Deutscher Amateur Radio-Club (DARC—German Amateur Radio Club) is again preparing a large show for its friends in the whole world, with a short-wave transmitter in actual operation, many pieces of equipment built by its members, and the colourful QSL cards. The publishers of technical radio publications and books, as well as the professional organisations of the radio trade and industry, will also be represented.



POLISHED WALNUT CABINET. Size 18 x 13 x 8½in. approx., complete with three wave band scale, size 12½ x 4in., scale pan, cadmium plated 5 valve superhet chassis with transformer, valveholder, and I.F. cut-outs size 14 x 6½ x 2½in., drum and back, 35/-, post paid. Knobs not supplied.



CONSTRUCTOR'S POLISHED CABINET. Size 10 x 6½ x 5in. approx., supplied in flatted form, grooved and ready to glue together. Complete with plastic front. 5 valve chassis, cadmium plated, size 8½ x 4 x 1½in., tuning scale, knob and back. Illustration as it would look when assembled. Two bottom knobs not supplied. 10/-, plus 1/6 post and packing.



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Pre-Aligned Midget 465 kc/s., Q.120. 9/- per pair.
465 kc/s. Midget I.F.s. Q.120, size 1½in. long, 1in. wide, ⅞in. deep. Pre-aligned adjustable iron-dust cores, pair, 12/6.
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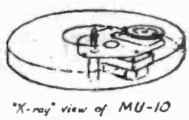

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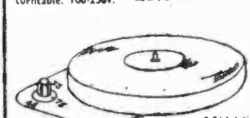

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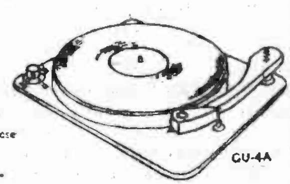

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Surplus Mercury Vapour Rectifiers

COMPREHENSIVE DATA OF SOME EX-SERVICE VALVES By E. G. Bulley

MERCURY vapour rectifiers suffer from what may be called "shelf life." This means that they deteriorate when kept for a very long inactive period. This can be attributed to the fact that the mercury present in the bulb contaminates the filament and thus destroys the emissive property. It is therefore essential when purchasing such valves to see that the filament coating is not spattered about the interior of the bulb.

Another important point to remember when purchasing surplus valves of this category is that during the active life of these rectifiers the bulb darkens. This does not, however, indicate that the valve has served its useful life, but that the valve has been in use in equipment at sometime or other, and it will not therefore give the same length of life as a rectifier with a more or less clear bulb.

TABLE I

Surplus		British	U.S.A.
CV1072	=	RG1-240A	—
VU72	=	GU50	—
AU6	=	MU4250	—
AU2	=	RG5-500	—
VT42A	=	—	872A
CV32	=	2V.400A	866A
		ESU200	—
CV5	=	GU21	—
NU8	=	RG1-125	—

However, a very important operation must be carried out when one does purchase such valves, and that is, the filament only should be operated at its specified voltage for at least one hour. This will ensure that the mercury will be distributed correctly. This is essential, remembering that these valves have been in store for something like 10 years. Furthermore, failure to do so will result in cathodic sputtering arc back and the eventual destruction of the rectifier. The presence of mercury upon the anode will result in the anode developing a "hot spot," and if operated under such conditions the contaminated anode area will melt.

It is not the intention of this article to describe the actual operation of these rectifiers, as this has already been covered by the author in the October issue of PRACTICAL WIRELESS, 1948, but to assist the newcomer in using such valves.

Blue Glow

Before proceeding, therefore, it may be as well to mention that a characteristic of these valves is that, when in operation, a blue glow is present within the glass envelope, and this does not indicate that the valve has gone soft as with ordinary types of valve. So much for the pros and cons of purchasing these types of rectifiers, let us now consider the types available on the surplus market.

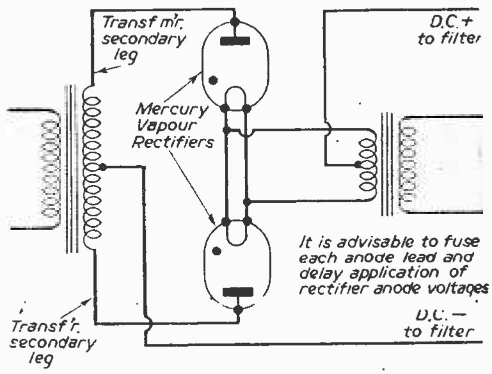

Fig. 1.—Basic circuit of a rectifier unit.

Perhaps the most popular type to the radio amateur is the 866A. This is to be found in a great number of amateur transmitting stations. The surplus number for this type is the CV32. Reference to Table 1 indicates the commercial equivalents to the surplus numbers, whilst Table 2 gives the electrical characteristics.

The rectifiers listed are mainly used by the amateur in what is termed a single-phase full-wave circuit. The basic circuit of this type is shown in Fig. 1 and this will supply the needs of the average amateur.

TABLE II

	Ef (volts)	If	P.I.V.	Max. Peak Ia	Max. Mean Ia	Condensed Hg Temps.
		amps.	kV	amps.	amps.	
CV5	4.0	11	11.6	4.7	1.25	25°—50°C.
CV32	2.5	5.0	10	1.0	0.25	25°—60°C.
CV1029	4.0	10	4	2.5	0.6	25°—60°C.
VU29	4.0	10	4	2.5	0.6	25°—60°C.
CV2946	14.0	10	4	2.5	0.6	25°—60°C.
CV1072	4.0	3.0	4.2	1.0	0.25	25°—60°C.
CV152	4.0	7.0	13	5	1.25	—
CV1355	4.0	11.5	10	3.0	.75	25°—60°C.
AU7	4.0	11.5	10	3.0	.75	25°—60°C.
AU2	5.0	11.0	11	2.5	0.5	10°—50°C.
NU8	2.0	5.0	4	0.6	0.125	—

Much naturally depends upon the rectifiers used. Before proceeding, however, it is as well to mention that there exist "relationship factors." These figures enable one to determine various voltage and current ratings necessary to produce the power pack. These factors do not, however, take into account the voltage drop in the power transformer, the rectifier valves or the drop across the filter, but it does enable the amateur to obtain an approximate value of the voltage that is being fed to the input of the filter.

Referring to the data of the CV32, one will note that these valves have a peak inverse rating of 10kV, and it is from this figure that the transformer secondary voltage can be determined. It may be as well to mention that as these valves have been in store for a fairly long period, to operate them at a lower peak inverse voltage is advisable. However, for the purposes of this article, the rating will be taken as in Table II.

The transformer secondary voltage per leg is equal to the peak inverse rating multiplied by a constant .353. This, when evaluated, is equal to 3,530 volts approximately. This is the R.M.S. value which is fed to each rectifier anode as shown in Fig. 1. Now, from this R.M.S. value one can then determine the approximate D.C. output voltage to the filter. This can be easily calculated by multiplying the R.M.S. value by another relationship factor, namely, 0.9, which becomes 3,177 volts D.C.

Anode Current

Another important characteristic is that of the maximum average anode current, which is the current the rectifier will withstand. Referring again to Table II, one will see that this current value for the CV32 is 250 mA. Now as there are two valves in biphase (see Fig. 1) the maximum average load D.C. is equal to twice the value of one rectifier, namely, 500 mA.

The output from such a pack as shown in Fig. 1 has now been determined, but it must be remembered that there will be a slight percentage change between the values determined which are for no load conditions and those obtained under full load; the latter will be somewhat less. This can be clarified by assuming that as the D.C. voltage output to the filter was 3,177 volts, but, say, under full load conditions this value dropped to 2,777 volts, then the voltage regulation of the power pack in question is as follows:

$$\frac{3177-2777}{3177}=.12=12\%$$

One must remember, however, that these figures used to determine the voltage regulation are only assumed, and are not actual or true figures obtained. The reason being that they were used to emphasise the fact that for a well-designed pack the voltage regulation figure should not be more than 10 per cent.

The reader will appreciate the importance of this figure when he realises that in amateur transmitters it is essential to maintain frequency stability. Nevertheless, the procedure described can be adopted for any of the valves listed so long as one uses the circuit shown in Fig. 1. Furthermore, it may be as well to state that the design of the actual filter section is beyond the scope of this article, but it must be remembered that special attention must be given to this section, otherwise a poor power pack will result.

Presenting Technical Information

(Concluded from page 306.)

B.R. 1897B (Admiralty).
E.M.E.R. Tels. A305 (Army).
A.P. 2867B (Air Ministry).

This book—issued by each Service under its own reference—is B.S. 204 : 1943 without supplements.

B.R. 1897A (Admiralty).
E.M.E.R. Tels. A306 Issue 2 (Army).
A.P. 2867A (Air Ministry).

This inter-Services book—issued by each Service under its own reference—includes nearly all that is in Supplements (1), (3) and (4) of B.S. 204 : 1943.

NOTE: The Admiralty issue B.R. 1897A and B.R. 1897B bound as one volume, B.R. 1897. Service personnel and commercial concerns having contractual relations with the Government will find all except certain radio propagation and piezo-electric terms in the Service books mentioned. Others should use B.S. 204 : 1943 plus the Supplements.

Circuit Presentation and Drawing Office Practice

B.S. 530 : 1948—Graphical Symbols for Telecommunications.

Two supplements:
(1) Component References.
(2) Waveguide Symbols.

B.S. 108 : 1951—Graphical Symbols for General Electrical Purposes.

B.S. 308 : 1943—Engineering Drawing Office Practice. (Under revision.)

B.S. 560 : 1934—Engineering Symbols and Abbreviations. Revised edition pending.

B.R. 1079(50), Part 1 (Admiralty).
E.M.E.R. Tels. A301 Issue 4 (Army).
A.P. 2867 (Air Ministry).

This inter-Services book—issued by each Service under its own reference—covers the same ground as B.S. 530 : 1948 and agrees with it, but has Service preferences; it contains B.S. 530 : 1948 Supplement (1) and the material in Supplement (2).

NOTE: Service personnel and commercial concerns having contractual relations with the Government will find what they require in the Service books mentioned. Others should use B.S. 530 : 1948 plus the Supplements.

Miscellaneous References

Authors' and Printers' Dictionary, by F. H. Collins (Oxford University Press). 7s. 6d.

London School of Printing—L.S.P. Style of the House. 6d.

London Mathematical Society—Notes on the Preparation of Mathematical Papers. 1s. 0d.

Institute of Physics—Notes on the Preparation of Contributions to the Institute's Journals and other Publications. 2s. 0d.

Institution of Electrical Engineers—Handbook for Authors. 2s. 0d.

Royal Society—General Notes on the Preparation of Scientific Papers. 2s. 6d.

Royal Society—Symbols, Signs and Abbreviations recommended for British Scientific Publications, 1951. 9d.

OPEN TO DISCUSSION

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Aligning Superhets

SIR,—I would like to help Mr. J. Thomas (N.W.2), who stated in the April "P.W." that the biggest snag of amateurs is the alignment of I.F.s in superhets, etc. Surely a Denco "alignment-oscillator" is just the instrument required? This unit provides two standard modulated frequencies of 465 kc/s. and 1,600 kc/s. at the turn of a switch. A DL92 valve is employed and all power supplies are derived from one grid-bias battery. I have used one for the past eighteen months with great success. They may be connected direct to aerial or intermediate stages of superhets.—ROBERT HANCOCK (Talke, Staffs).

Sign of the Times

SIR,—I recently went into six different radio shops in Gloucester for *an ordinary volume control with switch.* Five shops did not stock them—"no call for them now." The sixth had only *one* odd midget V.C. at a *fantastic* price.

One brilliant salesman suggested I should return the set to the makers!!

I just could not have believed it. Truth is indeed stranger and more bizarre than fiction.—A. J. S. (Gloucester).

Musical Frequencies

SIR,—In your May issue, page 199, Table 2, an error has been made in the frequencies of the notes; they should read:

C	D	E	F	G	A	B	C
256	278	323	339	364	431	483	512, etc.

—E. WORTHY (West Hartlepool).

[I do not agree with this correspondent, E. Worthy, about the frequencies I quoted for the notes of the piano. It is true there is a standard of pitch in which middle C=256. It is a mathematician's and physicist's convenience based on the idea of a fundamental note C consisting of 1 c/s the octaves of which would be $1 \times 2, 1 \times 2^2, \ldots 1 \times 2^n$. *In this pitch system, when* $n=8$ *middle C would certainly be 256. According to Caxton's New Musical Educator this system is called the Philosophic Pitch, on account of its mathematical origin. But the standard pitch for musical purposes and that to which a piano is almost certain to be tuned is the New Philharmonic Pitch in which middle C=261, as given in my article. The point made by your correspondent is largely academic. The method of calibrating an audio oscillator by means of a piano cannot be expected to produce laboratory accuracy, but I described it in preference to other methods because the average experimenter is more likely to have access to a piano than to a calibrated A.F. oscillator. The accuracy of the tuning of the piano and the ability of the experimenter to discriminate pitch are likely to provoke greater errors than a 2 per cent. difference in the frequency taken as the standard. See also Nelson's Handbook of Music and Musicians and Scroggies' Radio Laboratory Handbook (Piano as Frequency Standard).*—ROBERT D. PATERSON.]

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed.

Magnetic Wire Recordings

SIR,—With reference to Mr. V. Morley's letter on magnetic wire recording, although one can only suggest a possible cure for his apparatus I feel that the following may point to the seat of his trouble and perhaps help others.

I have been using, with pleasing success, a tape recording for the past year, the apparatus having a close resemblance as far as one can tell with Mr. Morley's. My first results carried out with a wire recorder were quite poor, and since my winding mechanism was home made I decided to invest in a tape deck, whilst still retaining my amplifier and oscillator. These comprised a conventional amplifier and 6V6 oscillator, oscillating at approximately 30 kc/s, feeding a low impedance head.

I fed my head from the speaker transformer secondary, the return line being through the chassis. At the same time the bias was fed from the oscillator into the head and its return made also through the chassis. The results were poor and with the usual 1 per cent. inspiration and 99 per cent. perspiration, the trouble was nailed down to the bias arrangements.

As with Mr. Morley's circuit, the oscillator was not over powerful, but theoretically powerful enough for feeding the head. On redrawing the circuit it became obvious that the recording head was shunted by the secondary winding of the speaker transformer, so that much of the oscillatory current was dissipated in the latter, resulting in the poor quality of reproduction.

The cure was effected by placing an H.F. choke in the lead from the transformer to the head.

I have noted the absence of such an isolating arrangement in other recorder circuits, and although these may work quite satisfactorily I feel that quite a considerable power saving from the oscillator would result with this small addition to the circuit.—A. P. BIANESS (S.W.17).

SIR,—The letter from V. Morley in the June issue of your valued journal might almost have been written by me! I, too, have been carrying out experiments for over a year along the same lines, but with different, if not better, results. Being more interested in the mechanical side I decided to have an amplifier made for me while I concentrated on the wire mechanism, my purpose being to have a long playing time so that I could record plays, etc., that I would be unable to hear at the time of the broadcast.

I have now completed (up to a fairly satisfactory point) these experiments, and find my three-hour (at 2ft. per second) recorder a great boon. Lately I have been working on the amplifier side, as I too could not get erasure of the wire by means of the oscillator unit, although I got a 25-volt bulb to light. However, I tried different values of condensers in this circuit until I eventually got about 95 per cent. erasure. My practice now is to erase with a strong permanent magnet and to remove the residual noise by means of the erase head at the same time. I use a commercially made erase head, but get better results with a home-made head for record and play-back—this head being the result of many weary experiments. I get very good top-note response; but never have I obtained anything approaching a real bass. I have heard several commercial recorders, both tape and wire, and I have never heard the bass notes of any orchestra to compare with that of an ordinary radiogram. I wonder if your correspondent is confusing a real bass with the woofy bump I so far have managed to get by cutting "top" completely?

In my amplifier I have treble lift, bass boost (about 30 times), variable bias control, volumeter, etc. I get best results with cheap wire costing about 4s. for half an hour's playing, wire diameter being .0036in.

I notice that Thermion is infected with the "tape" bug. However, whatever form of magnetic recording is decided on, the principle is the same, and I join Mr. Morley most heartily in hoping that you will get down to this question and publish articles dealing with this most fascinating subject. There have been many published circuit diagrams for "magnetic recorder amplifiers"; what I feel is most needed would be articles on head construction, screening to avoid hum troubles, kinds of screened cable to use, having regard to the fact that we are mostly concerned with L.F., positioning of components and leads, etc.—BRENDAN LAW (S.W.16).

Balanced Speakers

SIR,—Your correspondent G. Hurrell (N.W.9) is, I fancy, suffering from a prevalent modern complaint. A straight line, hi-fi amplifier is built or bought, at no little expense, and the result is disappointment. Why? The amplifier can only give from its one output source what is put into it, whether it feeds one, two or more speakers. Usually there is a pre-amplifier with tone control giving top cut and boost, and bottom, or bass, cut and boost. The control is set: top boost, bass cut, and the violin is wonderful. Or it is set: top cut, bass boost, and the organ's pedal notes are in the room; but not both together. Even with two speakers and a crossover network, in the first case, there is little to feed the bass speaker, and in the second vice-versa. For a long while I have held the opinion that to secure a proper balanced output three channels and three separate speakers are necessary. The frequency discriminating network should be in an early stage, each channel having a control to adjust the amount of top, middle and low being fed to each speaker. For the normal room the speakers may be: low, an 8in. speaker with flexible surround, middle, a 5in., and high a 3½in. The latter should be mounted high in the angle of two walls—a flare improves distribution. The other two may be in a corner cabinet, the low being not more than a foot above the floor. With single-ended outputs and small speakers the equipment is by no means expensive, while for a large room, or hall, push-pull outputs and large speakers give superb results.

The foregoing is based on over 50 years' experience of sound reproduction.—R. H. COWTAN (Rickmansworth).

Condenser Testing

SIR—I have read with interest the letter from Mr. Coombs in the June issue referring to my mention of condenser testing in the issue for February last. Whilst agreeing that the simple suggestion in my article is capable of elaboration, I am not sure that Mr. Coombs is on the right lines and his letter may mislead readers.

Lowering the P.D. across the test prods can hardly slow down the rate of flash on pF condensers as well as speed up the testing of large condensers. As a matter of fact the effect of reducing the D.C. voltage available is to slow down the rate of charge and so decrease the speed of flash, but as this fall is exponential it is not a very satisfactory method and as the voltage applied approaches the striking voltage of the neon the striking becomes erratic. If it drops lower than the strike voltage, of course, nothing will happen and the user may get the idea that the condenser is leaky. To slow down the flash rate to permit an estimate of capacity of smaller condensers requires an increase in charging time constant by using a still higher charge resistance or an increase in the discharge time constant by introducing a large resistance in series with the neon. The neon used by Mr. Coombs incorporates a resistance which is operative in the discharge circuit and therefore slows down the rate of flash. It was considered, however, that the testing of larger condensers of the paper type was more important because they are far more likely to be faulty than small mica types and consequently a neon without series resistance was originally specified. It is an easy matter then, if need be found, to add a resistance at the appropriate point.

So far as the supply voltage is concerned it is better to keep this much higher than the striking voltage of the neon so that the charge curve is substantially straight right up to the point of discharge.—R. HINDLE (Wallasey).

Programme Pointers

By MAURICE REEVE

MY notes, last month but one, on the supposedly "organised gloom" in the B.B.C. during the interregnum between the late King's death and funeral, could well have a short postscript dealing with the Easter programmes. Although they took on much of the pattern of former years, they seemed to be too grim, and too conscious of the occasion. Although Easter may be the complement of Xmas in the Christian ritual, they should not be on any terms of equality in the designing of programmes. But not even concert givers are allowed to behave naturally. I was present in the Albert Hall for the B.B.C.'s pre-Easter Wednesday performance of Bach's St. John Passion, where a special announcement through the loudspeaker underlined a printed slip inside the programme requesting the audience to refrain from all applause both before, during or after the presentation. So everyone, conductor, orchestra, audience, ushers, Uncle Tom Cobley and all, groped and stole around like a lot of naughty schoolboys during father's after dinner forty winks. Again, this is customary, but, I add, totally unnecessary and a gross piece of tyranny where tyranny is both unwanted and unnecessary. The artists are just as entitled to their rewarding applause as in the Messiah, or anywhere else.

So much was said and written about the Grand National broadcast fiasco that I will only express the hope that the public will not be asked to endure anything similar to it another year. I regretted that only half the two greatest soccer matches and the greatest rugger game of the year were put over, to wit, Scotland and England in both codes and the Cup Final. It had long been the practice to give the whole of these games, and jolly good broadcasts they make, too.

Folk Songs

Wholly delightful was the collection of "Songs from Country Magazine," a selection of the favourite folk songs culled from this enchanting programme during the past 10 years, selected, arranged and conducted by Francis Collinson with the Wynford Renyolds sextet, and with Heidi Anderson, Robert Irwin, Cyril Tucker, Martin Boddy and Clarence Wright as singers.

Documentary

An interesting and well documented and produced feature was "From Well to Tank." The story of petroleum and its by-products traced from the oil fields to the consumer. It ranged easily and interestingly from a service station in London to Bahrein in the Persian Gulf, via an experimental oil well in Lancashire, a tanker at Shell Haven, the Fawley refinery, the Sunbury Research station, and a Worcester depot. Raymond Baxter, Bill Hartley, Brian Johnston, John Arlott, Audrey Russell and James Pestridge entertainingly showed us around.

Another good documentary was "Portrait of an Airman," the story of a famous French pilot and man of letters, Antoine de Saint-Exupery. This was done through the medium of a series of interviews with various persons, each of whom told us something of the airman-writer as he or she had known him. It was a revised version of a previous feature.

Gigli

Gigli, who entertained us one Friday evening, is an artist in complete contrast. Lyrical, debonair, slick: with no apparent roots in the past, possessing a consummate technique and a romantic personality. Unlike Szigeti, Gigli did not test his musicianship in his choice of numbers, for, with two exceptions, his programme was entirely rubbish and of the lowest musical calibre.

Plays

"His Excellency," in Peggy Wells' adaptation of Dorothy and Campbell Christie's West-end success, made a thoroughly satisfactory Saturday-night Theatre. With Norman Shelley forcefully playing the role of the ex-docker occupying Government House to the discomfiture and enragement of most of those concerned, the piece proved very meaty and entertaining. "Evening Surgery," too, in the Wednesday evening "Curtain up" series, was thoroughly satisfactory. A nicely balanced story of what may be styled the old and the new orders in the medical profession was well rounded off with a happy ending and the balance of the argument tipped slightly in favour of the new. John Sharp and Donald Gray played the doctors well, and were admirably supported by excellent wives, daughters and town councillors, etc.

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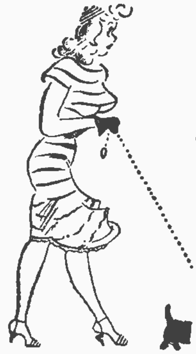

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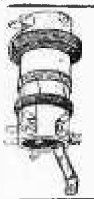

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