MIDGET 12-WATT STATION

1/-

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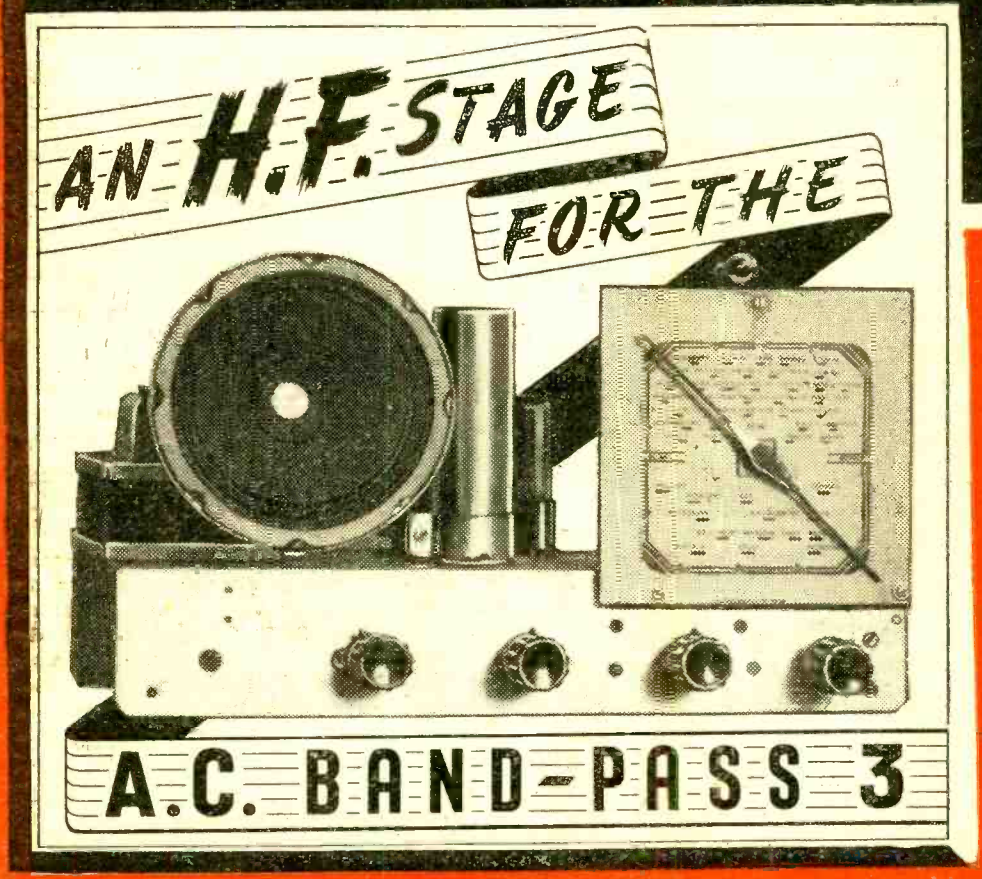
EDITOR:
F.J.CAMM

PRACTICAL WIRELESS



IN THIS ISSUE:

Practical Wireless

EVERY MONTH
VOL. XXIX, No. 557 MARCH, 1953

Editor F. J. CAMM

21st YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

V.H.F.

HAS the BBC come to the conclusion that V.H.F. does not warrant further expenditure or development? We ask this question because it received high recommendation in the Beveridge Report, and suggested that the BBC should develop this system of broadcasting which, it is claimed, provides reception practically free from interference.

Transmissions on frequency-modulated V.H.F. are regularly radiated from Wrotham and we wonder why the BBC has not invited the vast army of radio experimenters in this country to co-operate with them by sending in reports on those transmissions. There are radio amateurs in every part of the British Isles, even in the remotest villages and hamlets. These are the knowledgeable listeners, able to send intelligent reports and draw proper conclusions from the transmissions. The BBC has on tap the unpaid and enthusiastic services of these keen experimenters, whose experience goes back in a high percentage of cases to the earliest days of radio.

The paucity of information on the subject and the comparative silence of the BBC implies that the results of experiments have been disappointing. It will be remembered that America became almost wildly enthusiastic about V.H.F., but after an experimental period they changed their views. It is true that they are still using frequency-modulated V.H.F.

21 THIS YEAR!

THIS journal celebrates its coming of age in September this year. The first issue of this journal was published on September 24th, 1932. From 1932 until 1940 it appeared as a weekly publication. In its early years it had eleven weekly competitors. To-day ten of those do not exist. We naturally expected fierce competition in our early years and we certainly had it! But one by one these journals died, unable to meet the competition which we put up in return. Those were the days when a new receiver was described practically every week—in every journal except P.W. The specifications for those receivers were more like a wholesaler's catalogue than a straightforward specification for a receiver. Practically every supplier of each individual component was listed and the amateur was left to take his choice. It is not surprising that he struck difficulties as a result of this. In some cases the components could not be accommodated on the base-board. In others the characteristics were so widely different from those required by the circuit that the set was unstable.

The basis of our editorial policy, from which we have not departed, is that only the parts used in the prototype receiver were specified. We did not give alternatives and as a result readers were able to achieve the same results as we did. If they struck snags we were easily able to discern the cause of the trouble.

The second part of our policy was that we answered readers' questions free of charge. Most other journals charged a fee, anything from 2s. up to 5s. per query. Needless to say, the trade welcomed our policy and they rallied round our banner. To us the reader comes first, and this is in the best interests of the trade. We exercise the greatest care in our selection of advertisers and, if an advertisement appears in these pages readers may rest assured that we have investigated the bona fides of the proprietors. Wherever a reader fails to obtain satisfaction we stand behind him. It is a pleasure to us to note that many of our advertisers have regularly supported this journal from its commencement. It is also with justifiable pride that we can say that P.W. has a larger circulation to-day than ever and it is an ever-growing circulation.

Our September issue will be a special number, a souvenir issue with more pages and many special features. We shall have more to say about this as the time approaches.

PREMIUMS FOR TECHNICAL WRITERS

THE panel of judges appointed by the Radio Industry Council to award premiums for technical writing will soon be considering what articles qualify for the awards this year. They are made to non-professional contributors of technical articles on radio, published during 1952 in any journal on sale to the public.

The awards are of twenty-five guineas each and up to six are awarded each year. F.J.C.

ROUND the WORLD of WIRELESS

Broadcasting Receiving Licences

THE following statement shows the approximate number of sound licences issued during the year ended November, 1952. The grand total of sound and television licences was 12,844,740.

Region	Number
London Postal ...	1,792,499
Home Counties ...	1,501,761
Midland	1,375,000
North Eastern... ...	1,804,256
North Western ...	1,445,881
South Western ...	1,051,966
Welsh and Border ...	703,579
Total England and Wales	9,674,942
Scotland	1,142,779
Northern Ireland ...	213,229
Grand Total	11,030,950

These figures include licences issued to blind people without payment.

Capt. R. T. Paul

CAPT. R. T. PAUL, C.B.E., R.N.(retd.), A.M.I.E.E., has joined the Equipment Division of Mullard, Ltd., as commercial manager, co-ordinating the activities of the three product groups—radio, telephone and electronic equipment.

Capt. Paul's distinguished career in the Navy included acting as Chief Signal and Radio Officer to the Allied Naval C.-in-C., Expeditionary Force, and he was responsible for the naval signal, radio and radar organisation for the Normandy invasion. Later he was in charge of the naval wireless network and was the first chairman of the Western Union Communications Committee (Naval).

Sir Harold West

SIR HAROLD WEST, Sheffield's Master Cutler, has been elected chairman of the reception committee for the annual summer meeting of the Institution of Mechanical Engineers to be held in the City next July. Between 600 and 700 members of the Institution are expected to attend. Dr. J. M. Whittaker, Vice-Chancellor of Sheffield University, has been elected vice-chairman of the reception committee.

Elections for members of the executive and reception committees to arrange the three-day visit of delegates have been made from the Yorkshire branch of the Institution.

Germany Honours British Radio Amateur

THE German Amateur Radio Society has elected Major Rowland Shears, a Senior Development engineer at the Electronics Laboratory of Burndept, Ltd., Erith, their Honorary Member Number One.

This is in recognition of the services he rendered German amateur radio, first in forming a club and later obtaining transmitting licences from the German Post Office.

Major Shears became a licence holder at 16, and now operates a transmitter which he describes as "the most powerful permitted by the licence." Under the call-sign of G8KW he has contacts in all parts of the world. At the end of the war he was responsible for the rebuilding of the German Broadcasting Station at Langenberg, and later the organisation of the police radio communications throughout the British Zone.

Realism in Sound Broadcasting

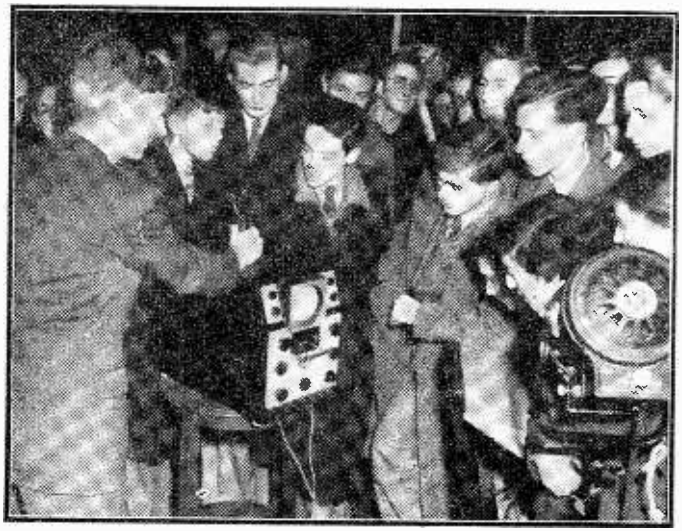
IN a lecture on "Sound Broadcasting" for children at the Institute of Electrical Engineers in London, Dr. K. Sturley, head of the engineering training department of the BBC, explained some of the difficulties that sound presented to the technicians.

He allowed children to see their own voice vibrations on a cathode ray tube.

Equipment in R.A.F. Austers

IN order to standardise the V.H.F. equipment in Austers engaged in artillery co-operation, the R.A.F. is to install in all these machines the Plessey transmitter-receiver type P.TR.61. This makes communications available on six channels within the band 116-132 Mc/s., the crystals controlling which may be changed in flight.

Specifically designed for light and medium aircraft, the transmitter receiver, which is particu-



Clive Simpson, of Laleham, Middlesex, talks into the microphone held by Dr. K. Sturley, of the BBC, during his lecture on sound at the Institute of Electrical Engineers, London.

larly simple to operate by virtue of single knob tuning on both sections, has already been adopted by the Belgian and Netherlands Air Forces, and by civil airlines in many parts of the world.

Honour for Vidor Executive

MR. WILLIAM R. T. MILNE, Personnel Officer for the Vidor-Burndept Group, appeared in the Colonial Office list of the New Year's Honours with the Order of the British Empire.

Mr. Milne served from 1930 to 1952 in Nigeria and was lately Civil Service Commissioner there.

Obituary

WE regret to announce the death in Bridgewater Hospital on December 27th of William Thomas Gibson, O.B.E., M.A., B.Sc., M.I.E.E., of Ivy House, Chard, Chief Valve Engineer of Standard Telephones and Cables Limited and Manager of their Ilminster laboratories and factory.

Born in 1899 at Northampton, he set up the valve laboratory of Le Matériel Téléphonique in Paris in 1928, and the Newark, New Jersey, valve laboratory of Federal Telephone Laboratories in 1932.

W. T. Gibson was a member of the Institution of Electrical Engineers and served on the committee of its South Western Sub-Centre. He was a member of Chard Rotary Club and of Chard Musical Society. His hobbies were music and photography.

Delivering the "Goods."

IN Manchester recently, Mr. J. Allanson, a Vidor representative, emerged from a shop and noticed that his van had been opened at the rear. Although it was dark, he could see the form of a man inside, so he slammed down the shutter, locked it and drove his uninvited passenger to the nearest police station.

The police extracted the "goods" from the van and the short ride cost him no less than five pounds. Mr. Allanson received high praise from the police for the presence of mind he had shown.

New Instalment Scheme

EKCO dealers are being invited to participate in a scheme which will draw in the large number of would-be purchasers of radio and TV who have difficulty in finding the 33⅓ per cent. of total price with which to include a H.P. agreement.

The dealer's first step is to conclude an Agreement with Bowmakers who handle Ekco H.P. The potential customer then pays in through regular Bowmaker channels weekly, monthly, or even irregular, payments of as much as he can afford. When these payments total 33⅓ per cent. of the total price of the set he has chosen, a normal H.P. agreement is signed and the set is delivered.

Remainder of payments are made in the normal way.

"Welcome to Britain"

FOLLOWING the "Welcome Stranger" programmes broadcast during Festival Year and 1952 with Eamonn Andrews as host to visitors to London, another series of "Welcome" programmes, this time "Welcome to Britain," starts on February 15th in the Light Programme. Although listeners will again be meeting visitors from Home and Overseas, the series will be presented in a different form, and each programme will last for an hour.

European Songs

IN the various European broadcasting sections of the BBC in Bush House are many foreign recordings not often heard in the domestic services.

Light Programme announcer Roy Williams has drawn on these for a new nine-weekly series which he begins on February 7th under the title "Songs of the Traveller."

End Licence Demand

THE Liberal Party Council of Canada, in session at Ottawa recently, decided to demand the ending of radio licence fees and to ask for permission for private broadcasters to transmit their own television programmes.

Revenue Minister, Mr. McCann, however, stood by the Government's policy of holding its own rights in the Canadian Broadcasting Company.

Private Call Service

THE personal radio-message service already in operation in New York and Cincinnati has been inaugurated in Cleveland, Ohio, U.S.A.

The subscriber wears a vest-pocket size receiver pre-tuned to 43.58 Mc/s on which he hears his own personal call sign, the signal for him to contact the service office for the message.

Aberdeen Coronation Award

TO mark the coronation of Her Majesty Queen Elizabeth, the Aberdeen Amateur Radio Society is to issue a certificate to any amateur who contacts four member stations of the society between January 1st, 1953 and December 31st, 1953.

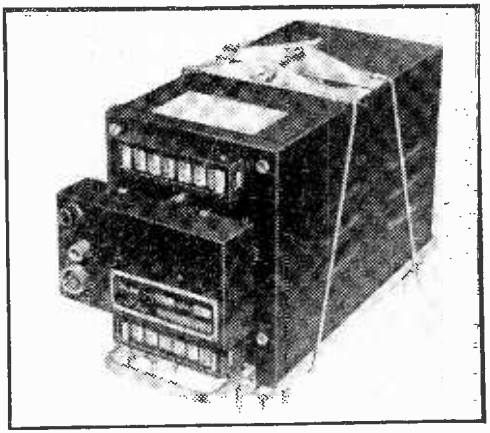
In addition, stations located in any other "Aberdeen" in the world will automatically be elected to honorary membership of the society. To claim the certificate, only the call signs of the stations contacted, date and time of QSO's need be submitted.

Claims should be sent, together with 2s. 6d. (50 cents Canada U.S.A. and Possessions), to Aberdeen Amateur Radio Society, 1-6, Blenheim Lane, Aberdeen.

No Effects from Fire

THE recent fire which broke out at the Hirwaun, Glamorgan, factory of Thorn Electrical Industries Ltd. has not interrupted the production of Ferguson radio and television receivers.

In spite of damage to machinery and property, no noticeable effect is expected, as much production work will be transferred to other Thorn factories.



The Plessey transmitter/receiver, type P.TR.61, fitted with standard remote-control adaptor, which is being installed in R.A.F. Austers.

The "Modern" High-power Quality Amplifier—1

DETAILS OF THE 1953 VERSION OF THIS POPULAR AMPLIFIER, FOR WHICH A TUNER UNIT WILL ALSO BE DESCRIBED

By R. Hindle

THE "Modern" quality amplifier has proved to be a very satisfactory unit in practice, filling the needs under all normal domestic circumstances, and when working with the type of speaker and ancillary equipment for which it was designed it is doubtful if any modification will make a noticeable improvement in the excellent quality of which it is capable. Inevitably, however, questions have been asked about possible improvements, and these run on two lines :—

A. Can any circuit elaborations be incorporated that will increase the basic fidelity of the circuit ?

B. Can the output be increased whilst retaining the quality of reproduction ?

With regard to B., the most obvious method of increasing output is to use the output valves, in this case 6V6's, as tetrodes instead of as triodes, but this measure would be to the detriment of quality. It is better, if quality is to be maintained, to use larger valves, triode connected, and in this later version of the amplifier a pair of KT66 valves has been used, giving 14.5 watts output with 450 volts HT. There is a price to pay for the increase in audio power made available, of course. The power equipment has to be designed on a rather more lavish scale and a more generously proportioned (and consequently more expensive) output transformer is required to carry the increased H.T. current and audio signal. There is a school of thought that firmly holds that an undistorted output of this order is the minimum for high-quality listening, however, and certainly the results are very impressive. On the other hand, the KT66 valves can be run very satisfactorily with a smaller H.T. supply and, with no more than 350 volts available, over 6 watts of very fine quality are produced with, of course, a considerable saving in the cost of power equipment.

Circuit

The circuit is given in Fig. 1, from which it will be seen that comparatively few changes have been made from the original "Modern" circuit. The first valve is a straight audio amplifier stage. V2, a double triode, is a cathode-coupled phase inverter. The first half accepts the output of V1, an amplified version of which appears across the load, R9. The anode current of this half passes through the cathode resistors R6, R8, across which a signal in phase with that at the grid is produced. R6 is also in the cathode circuit of the second half and consequently the signal across it is coupled to the second half, the grid of which is tied to earth from a signal point of view by C5. R7 and R12, being stoppers, can be ignored from the audio signal point of view. The signal to the cathode of the second half is in phase with that to the grid of the first half, which is equivalent to saying that the grid signals are anti-phased, as is required for push-pull working. The anode circuit of the second half also passes through R6, across which it also produces a signal which is exactly

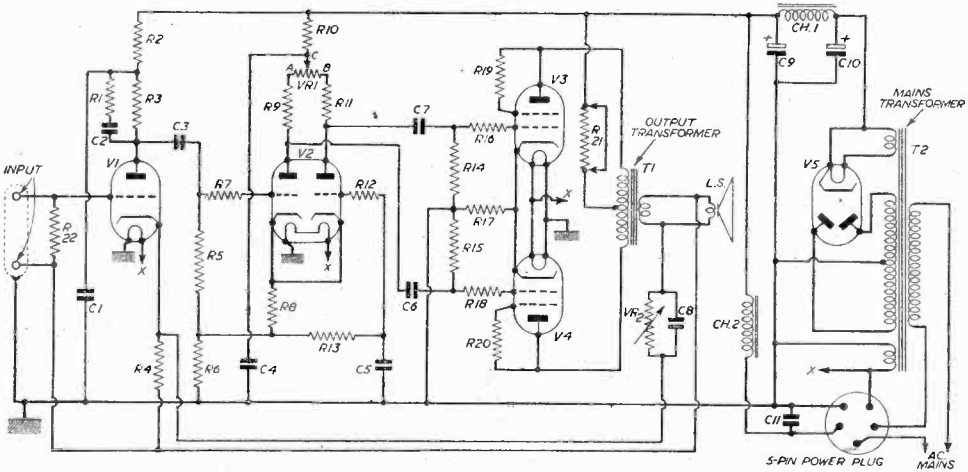


Fig. 1.—Theoretical circuit of the amplifier. A list of parts appears on page 124.

out of phase with that caused by the first half so that, in effect, only the difference between the two signals is passed to the second half and the two halves settle slightly out of balance such that the signal from the first half is slightly greater than that from the second half. This out-of-balance ratio is not serious in practice and the automatic operation completely outweighs the disadvantage of the slight unbalance.

Equalising Circuit

For the purist, however, there is a way to bring the circuits into even closer balance, and here is the first deviation from the original design. The theory of automatic balancing deals with anode currents and not anode voltages; by using different values for the two anode loads, R9, R11, the *voltage* outputs can be equalised, and it is the voltage output signal that is required to drive the output valves. The actual sizes required for this purpose can be calculated, assuming valve characteristics and resistance values to be accurately as specified, but in fact both valves and resistors vary from specification. One theoretically correct combination is 52K Ω for R11 and 45K Ω for R9. To adjust for variations in components used, however, a potentiometer VR1 is introduced. With the slider C at the A end of the element the whole of VR1 is added to R11 in the circuit of the second half of the valve; at the other extreme, the slider at B, VR1 is added to R9, and the second half is left with only R11. Between these extremes any intermediate state of balance can be set up. R9 is made 39K Ω and R11 is 47K Ω. These are standard values in the 10 per cent. tolerance range, which should be used in these positions. Now, if a 10K Ω potentiometer is used (wirewound) and the resistance between A and C is made 6K Ω the load on the first half will be 39K Ω plus 6K Ω, i.e. 45K Ω as specified above, whilst the load to the second half will be 47K Ω plus 4K Ω making 51K Ω also as specified previously, but moving the slider from this position one way or another will serve to balance for any imperfections in components.

In the H.T. lead to the output transformer is inserted a resistance, R21, to be used in balancing, VR1 being adjusted for minimum signal across this resistance. As an indicator, an output meter is preferable, but a pair of earphones will serve quite well. These should be of high resistance (or, if they are low resistance they should be coupled through a transformer across R21) and condensers of, say .01μF should be interposed between each end of the resistor and the phones (or transformer) to keep out D.C. When the balancing is complete R21 can be removed from the circuit, or shorted out. By taking the indication of balance in the output circuit the balance adjustment will take into account also differences in the output circuit, including output valve differences, and the setting will not hold if these valves are changed or reversed. It is wise to mark which valve is to be used in which socket when the balancing is completed.

It will be necessary to mute the loudspeaker whilst balancing with earphones or otherwise it will be impossible to hear when the position of minimum signal is reached. This is best done by disconnecting the loudspeaker from the secondary of the output transformer and in its place a resistor about equal to the speech coil impedance (i.e., 3 ohms or 15 ohms as the case may be), should be connected. Remember the power that might be dissipated across this resistor; if the amplifier is fully loaded during balancing operations, the full audio output rating of the amplifier will be dissipated and a resistance of suitable wattage will be needed. A "humdinger" resistor will be quite suitable and it is not necessary to go to any trouble to see that its resistance is exactly the same as the speech coil impedance.

The output KT66's are fed one from each half of V2, R16 and R18 being grid stoppers. A common cathode biasing resistor, R17 is used. As the output signals have been balanced the signal currents through this resistor from each output valve will cancel and no useful purpose would be served by including a bypass condenser. It is, of course, common to omit such a condenser in push-pull output circuits because, should the valves be unbalanced, feedback in this resistor will tend to reduce the degree of unbalance, but in the present case balancing has been carried out and the bias resistor is not relied upon for the purpose.

Feedback Circuit

A variable resistor, VR2, has been introduced in the present case in place of the fixed resistor specified in the earlier version. It is interesting to see the effect of varying the feedback ratio and, when no elaborate test equipment is available to trace distortion and instability, it is possible to ensure that there is a

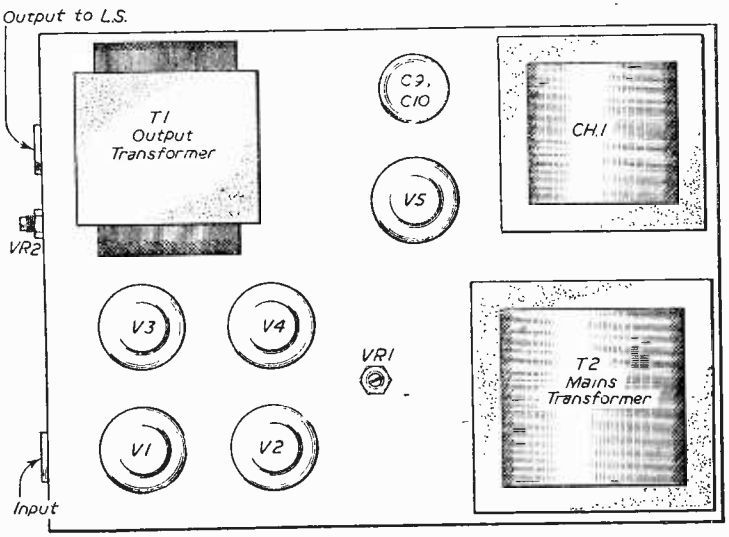


Fig. 2.—Suggested layout of the main components.

sufficiently wide margin of stability by reducing the resistor below the operating point temporarily. It should be possible to reduce the resistor quite appreciably before instability sets in or the operating setting decided upon is too low. At the other end of the feedback loop, it is possible to effect an economy by using the cathode bias resistor of V1 as the feedback resistor, thus eliminating the condenser and resistor previously used.

The weak link in the chain of an amplifier with feedback is generally the output transformer, and the symptoms produced arise from the undesired phase-shifting of the higher frequencies, generally above the audio range, making the feedback positive instead of negative at those frequencies and so setting up oscillations that undo all that has been done in an attempt to improve quality. Quite expensive transformers have been produced for incorporation in feedback amplifiers and this is the only theoretically perfect solution to the problem. Unfortunately, few of us can afford the price of such a component and the earlier amplifier was designed specifically to see what kind of results could be obtained using a cheaper component. The network R1, C2 was introduced to help in this connection and the action is to reduce the gain at the frequencies likely to be sufficiently phase-shifted to give trouble so that they would be of insufficient amplitude to cause trouble. This filter is retained and an additional precaution is taken. C8 is introduced across VR2. This increases the degree of feedback to those higher frequencies and corrects the undesired phase-shifts that have taken place. A still further step is taken by using a triode in V1 position in place of the pentode previously used, thus reducing the forward loop gain somewhat, though it is still found quite adequate for the purpose. The result is an all-triode arrangement, such as has always been considered the ultimate for best quality.

Earth Returns

A final modification incorporated in this design is the apparently complicated method of arranging earth returns. When designing amplifiers to give high gain for small signals it is necessary to take careful precautions with earth return wiring so that no part of the return path is via the chassis. The method is similar to that used in short-wave equipment of returning all points in one circuit to the same earth point. The present is not a case requiring high gain for small signals and generally such precautions are not taken. At the same time, this amplifier is inherently hum-free and has a remarkably quiet background, so that it is worth while taking extra precautions to keep hum out of the input circuit where feedback cannot help in suppressing, particularly as the speaker wiring is actually in the input circuit and, of course, may wander about the house.

It will be seen that a screened two-core cable is used for the input. Actually a twin-core TV coaxial cable was used for this purpose, being neat and very effective. The actual connector used is a miniature, four-pin plug and socket with metal skirt, such as is easily obtainable. The cable braid is connected to two pins and the equivalent sockets are connected to the amplifier chassis. The remaining two pins go to the cable inners for the input signal and the earth return.

As before, power is fed via a five-pin connector to the associated feeder and the mains switching is also operated from the feeder via two cores of the five-core connecting cable. Thus, any of the "Modern" series of feeders will be suitable with appropriate modifications to the output circuit to allow for the return earth feature.

Construction

The layout used in the prototype is similar to that used for the earlier model and is given in Fig. 2. The position of the preset variable resistors is indicated. These will not require adjustment after the preliminary setting-up process unless valves are changed or unless, in the course of time, balance is lost to some degree due to uneven ageing of the valves. Screwdriver adjustment is all that is required, therefore, and these need not be accessible when the equipment is built into its cabinet.

The need for introducing the compensating resistor in the internal/external speaker switching, given in the previous article in the July, 1950, issue, has been queried. In actual fact, the addition of extra speakers in parallel in the output of the feedback amplifier makes no noticeable change to the volume of sound from the original speaker. This is because the feedback is thereby reduced and consequently compensates for the changed load conditions. At the same time, if the degree of feedback is to change to allow for the additional speakers it can no longer be of the optimum degree decided upon from a quality point of view and the suggested circuit does allow for constant

(*Continued on page* 130)

COMPONENT LIST FOR FIG. 1. THE AMPLIFIER

R1—47 K Ω
R2—33 K Ω 1 watt
R3—47 K Ω 1 watt
R4—680 Ω
R5—1M Ω
R6—15 K Ω
R7—4.7 K Ω
R8—470 Ω
R9—39 K Ω 1 watt
R10—22 K Ω 1 watt
R11—47 K Ω 1 watt
R12—4.7 K Ω
R13—1M Ω
R14—100 K Ω
R15—100 K Ω
R16—4.7 K Ω
R17—220 Ω 4 watt
R18—4.7 K Ω
R19—100 Ω
R20—100 Ω
R21—100 Ω
R22—(if required) 1M Ω

VR1—10K Ω wirewound
VR2—10K Ω wirewound

C1—8 μF 450 V elec.
C2—200 pF 350 V
C3—.1 μF 450 V
C4—8 μF 450 V elec.
C5—.25 μF 450 V
C6—.25 μF 450 V
C7—.25 μF 450 V
C8—{ .001 μF 350 V for 3 ohm speaker / 500 pF 350 V for 15 ohm speaker
C9—16 μF 450 V elec.
C10—8 μF 450 V elec.
C11—32 μF 450 V elec.

V1—Brimar 6J5 (or 6SJ7 strapped as triode)
V2—Brimar 6SN7
V3—Osram KT66
V4—Osram KT66
V5—Brimar 5U4

5 Volts 3 Amps
6 Volts 5/6 Amps
CH1 20 H. 150/200 mA
CH2 20 H. 50 mA

T1—To match speaker to 4,000 ohms (i.e., 16 : 1 for 15 ohm speaker or 36 : 1 for 3 ohm speaker)
T2—Mains transformer 450 0 450 Volts 150/200 mA (depends on needs of feeder used)

Increasing the Output

A SMALL AUDIO AMPLIFIER WHICH CAN BE USED WITH MOST TYPES OF OLD SET

By K. C. Ireland, A.R.I.C.S.

THIS little amplifier was especially built to be used with a 12-year-old set. The requirements were :

High-quality output.

Low cost.

Must be easily connected to existing set without extensive alterations.

Of small dimensions to enable the complete amplifier to be installed inside the existing cabinet.

To reduce the cost it was decided to use the existing power supply for the H.T. current.

The amplifier was to be used in conjunction with a 1937 five-valve superhet, using 4-volt valves. This set was satisfactory in all respects save that it lacked the crisp high-quality output expected to-day. As the audio section consisted of a single pentode fed directly from the signal diode of the previous valve, a 2D4A, there was insufficient amplification available to introduce a negative feedback system. It was, therefore, decided to build a two-stage amplifier and connect this into the circuit and dispense with the existing output valve but retain the coupling system which included the volume control.

The cabinet was of large dimensions, being 18in. high by 15in. wide by 10in. deep, and of substantial construction. In addition to the chassis the cabinet contained an 8in. P.M. speaker, and it was found that by using a little care and all available space to employ a 10in. speaker in its place and still leave room for a small amplifier.

The alternative to a new amplifier was to incorporate a further audio stage prior to the pentode output, but this would have entailed much rebuilding, further complicated by finding room on the chassis for the additional valve and components. There would have been also the risk of over-running the mains transformer if a further 1 amp were taken from it to provide heater current for the new stage. It was felt that an amplifier using modern 6-volt valves would be a better proposition. The amplifier valves were supplied with heater current by means of a small filament transformer obtained from an advertiser in the pages of this journal. The total heater consumption is only .75 amps. The H.T. current required is in the region of 50 milliamps, and only a few more than that consumed by the single pentode of the set. It was felt that the small additional current could safely be provided from the present rectifier.

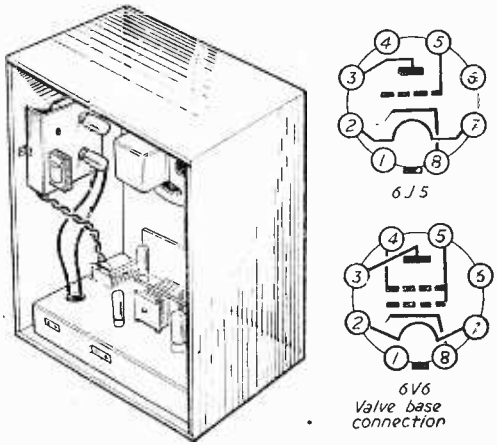


Fig. 2.—Position of amplifier in existing cabinet and valve base data.

The Circuit

The circuit chosen was quite conventional in design (Fig. 1), and utilises a 6J5 as a first-stage amplifier and a 6V6 as output. Both valves are easily obtained on the surplus market, and were chosen for this reason. The first acts as a voltage amplifier and is resistance coupled to the 6V6. Anode decoupling is used between stages consisting of a 5,000 Ω resistance and 8 μF condenser. No bias condenser was found necessary in the cathode circuit of the 6J5.

Negative feedback is provided over the whole amplifier by feeding back a portion of the signal from the L.S. speech coil to the cathode grid system of V1.

Construction is simple, and the whole amplifier was built on a metal chassis 6in. by 6in. by 1½in. deep. All components must be of small size, but nothing special is

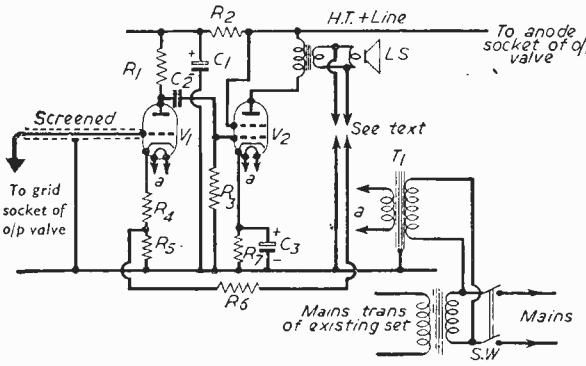


Fig. 1.—Theoretical circuit of the amplifier.

LIST OF COMPONENTS

R1—25,000 Ω.	Two Octal valveholders.
R2—5,000 Ω.	C1—8 μF Elec. 350 v.w.
R3—100,000 Ω.	C2—.1 μF Mica.
R4—1,000 Ω.	C3—50 μF 25 v.w.
R5—100 Ω.	T1 { Heater transformer.
R6—500 Ω.	{ 6.3 v. 1.5 amp.
R7—240 Ω (2 watt).	V1—6J5.
	V2—6V6.

required. All resistances can be of the ½-watt type with the exception of the cathode bias resistor for the 6V6 (V2) which should be of 2-watt rating.

It was not found necessary to screen any lead except that to the grid of V1.

The underside of the chassis is shown in Fig. 3, which also shows the wiring and connections to existing receiver.

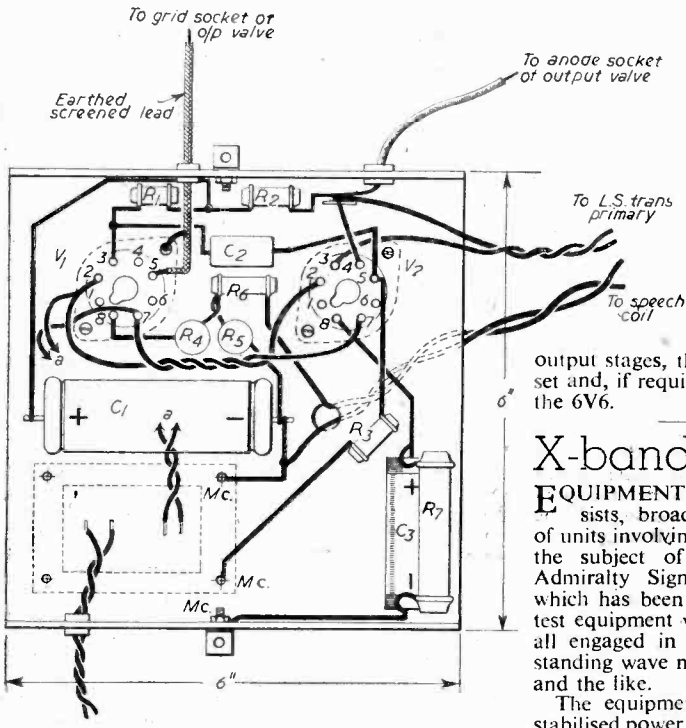


Fig. 3.—Practical wiring diagram.

Modifications

No under-chassis alterations are necessary to the existing set. The following external modifications and connections are required :

Remove the output valve.

Connect H.T. line of amplifier to anode socket of output valveholder in set.

Connect inner wire of screened lead from amplifier to grid socket of output valveholder in set.

Connect amplifier chassis to set chassis as negative line.

Wire heater transformer primary of amplifier across primary of set transformer.

Disconnect leads from set to loudspeaker transformer primary and reconnect primary to speaker leads coming from amplifier. Join together the free ends leading back to chassis. This is necessary to provide a source of H.T. at the anode socket.

Connect the appropriate leads from amplifier to speech coil of L.S. If, on testing, there is severe distortion this indicates a positive feedback and not negative. Reversal of these leads should cure this trouble.

The set volume control will still be operative, and the on-off switch will operate both set and amplifier.

If, after test, all appears satisfactory, screw the amplifier to the inside of the cabinet. Fig. 3 shows the method adopted in the original model.

To assist ventilation and dissipation of heat a small metal shield was provided to the underside of the top of the cabinet and a slot cut in the top edge of the cabinet back.

The amplifier will provide sufficient output to adequately load a 10in. speaker.

If the existing speaker is mains energised, the energising coil can remain as the smoothing choke and only the connections to the transformer primary need be disconnected and reconnected to the amplifier.

No tone-control system was provided for as it was felt that the negative feedback system should improve the frequency response to an extent as to make this unnecessary.

If the existing set does contain the usual top cut tone control normally provided with pentode output stages, this should be disconnected from the set and, if required, wired across anode and earth of the 6V6.

X-band Test Equipment

EQUIPMENT for a microwave test bench consists, broadly, of mechanical components and of units involving circuitry. This latter group formed the subject of a development contract for the Admiralty Signals Research Establishment, from which has been evolved a tailored range of X-band test equipment which should fill a long felt want for all engaged in microwave measurements involving standing wave measurements, frequency calibrations, and the like.

The equipment comprises high and low voltage stabilised power supplies, a modulator and a selective amplifier.

Selective Amplifier

This instrument may be used as a selective or broad band amplifier over the frequency range 300-6,000 c.p.s.

As a selective amplifier the maximum sensitivity of the unit is such that an input signal of 1.6 microvolts produces full scale deflection on the output meter with a signal-to-noise ratio of not less than 26db.

The selectivity of the amplifier in the selective condition is such that if the input signal frequency is detuned by 10 per cent. the reading on the output meter is halved.

There are two independent input sockets, each of which is provided with a gain control. The amplifier also has a calibrated attenuator, a fine gain control and two output sockets. One of these latter is for a cathode-ray oscilloscope and the other for an external output meter.

The input impedance of the instrument is 5,000 ohms.

Initial development of this equipment, which is still in limited production, was carried out by The Plessey Company Limited, Ilford, Essex.

Simple Electronic V.T.V.M.

A VACUUM TUBE VOLTMETER WITH THE MINIMUM OF COMPONENTS

By L. Baker

ANYONE who has used a vacuum tube voltmeter knows it has decided advantages over the ordinary type voltmeter, the most outstanding advantage being the fact that the V.T.V.M. draws little or no current to actuate the meter needle from the circuit under test.

Most of the ordinary type voltmeters are of the 1 K Ω P/V type and take 1 mA to drive the needle of the meter to full scale. When, for instance, the A.V.C. voltage of a receiver has to be measured, it often arises (when working with the ordinary V.M.), that the resistance of the meter itself (usually of the order of 10 KΩ) is placed in parallel with the A.V.C. load resistor, which is usually 1 or 2 MΩ. This means that at the instant of measurement the A.V.C. load resistor is *not* 2 MΩ, but of a lower value than the resistance of the meter connected in parallel with it. This is not the case with the V.T.V.M., which has an input resistance of the order of millions of ohms. The instrument to be described has such an input resistance, is neat and compact, does not have complicated switching, needs few parts, but these must be kept to the tolerance limits where stated. It has only one valve, serving as power rectifier and meter actuating triode, centre zero scale which enables both + and — voltages to be measured without reversing test prods. One setting of the zero control is all that is necessary for all ranges.

The Circuit

A glance at Fig. 1, shows the circuit diagram of the unit with self-contained power supply. The valve (V1)—a type 7N7 is a dual triode with separate cathodes which also serves to deflect the meter (M1), which is an 0-1 millammeter with an internal resistance of 100 Ω. The power transformer, T1, can be home made, or if a transformer giving 250 volts to C.T. is to hand it can be used. T1 also supplies 6 volts for heater of V1. If an existing transformer is to be used for the power supply it will be necessary to insulate one end of the secondary winding and use the remaining two which are connected to plate and heater of the power section of V1. Note that the power section of V1 has its grid and plate strapped together making it act as a diode rectifier.

Making the Power Transformer

As the power transformer for the unit is not called on for a very heavy current drain it can be made quite small and compact. In the original model the core stampings of a heavy duty O/P transformer were used. The original bobbin of cardboard was retained, all the old wire being stripped off. 1,760 turns of 28 S.W.G. were wound on for the primary, with interleaving of thin paper every 500 turns approximately. Bearing in mind that there is not much room on the bobbin, the wire should be laid as evenly as possible, and all precautions taken to avoid shorted turns. The start of the primary was soldered to a thin piece of flex and passed out through the cheek of the bobbin. The same applies to the finish of the primary and to all the terminating wires except for the 6-volt heater where the wire of the coil itself was left protruding about 8 in. through the cheek on both start and finish. When the primary is completed, insulate it with a few turns of Empire tape after having given the wire a thin coat of shellac. Wind 2,000 turns for the secondary and insulate as before using a few layers of insulating tape. The secondary is wound of 30 S.W.G. enamel wire. Now wind on 50 turns of 18 S.W.G. wire for the heater voltage and insulate well. Give the whole bobbin a coat of shellac and when dry reassemble the core. The tag board of the transformer was retained in the original model and the connections were soldered to this.

Chassis

The chassis was made of 16 S.W.G. steel and drilled for valveholder transformer, and calibration resistor R3. The panel is also of 16 S.W.G. Sizes and location of main parts are given in Fig. 2. Test prods were fashioned from discarded ball point pens of the long plastic type. The ink tube was removed. Connecting wires were soldered to a short piece of round brass filed to a point at the opposite end to the connecting wire, and the brass smeared with " Durofix " and pushed through the hole for the ball point.

The whole unit was enclosed in a simple cabinet of half-inch wood (with holes in back for power lead and ventilation). The finished cabinet was stained and given a thin coat of varnish.

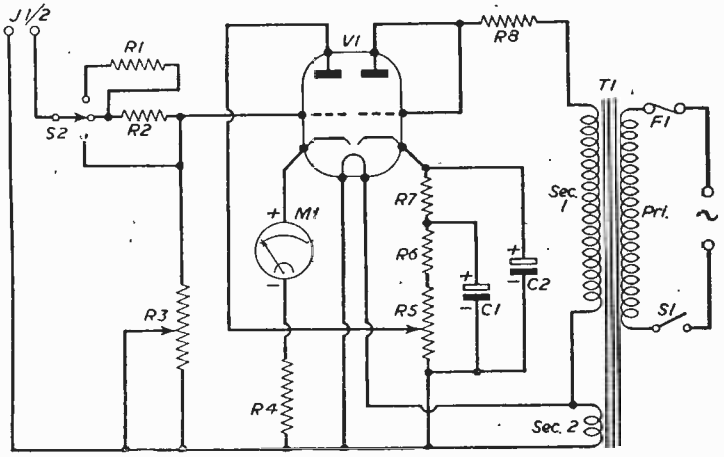


Fig. 1.—Theoretical circuit of the V.T.V.M.

Wiring

After mounting the parts wiring can be commenced. This process is quite simple but it is advisable to use only soldered joints and wire short and direct.

Components

All fixed resistors are ± 2% of value stated. Suitable combinations of resistors may be connected in series or parallel to produce the required total, but where this is done, both or all the resistors must be of the same tolerance value. If some old parts are already to hand, i.e., switches, resistors, etc., these may be used, but be sure that the values are correct, and in the case of resistors check their value with a volt. When 1 volt is accurately obtained remove the meter and connect the V.T.V.M. and observe reading. Adjust calibration control to make meter read 1 volt.

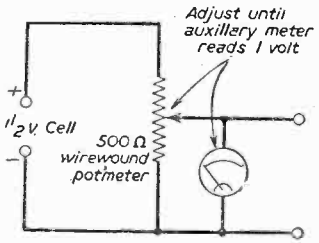


Fig. 3.—Temporary hook-up for calibrating the meter.

Reverse test leads and note reading on opposite side. If reading there is not 1 volt as it should be, remove test leads from the input jacks of V.T.V.M. and recheck zero. Repeat performance as before and adjust R3 until accurate 1 volt readings are obtained either side of zero. It may be necessary to try a few resistors in the R4 position to establish the zero—1 volt either side. When completed seal R3 with a drop of nail varnish, and care should be taken not to disturb it once set. Check the 25 volt range with a battery of, say, 12 volts and the 250 volts with a source of approximately 200 volts. All readings should be compared with a good low resistance meter of 1 K Ω per volt or more, to ensure accuracy of V.T.V.M. due to possible error in value of some of the resistors used.

When completed the original model was found extremely useful in measuring all D.C. voltages with great accuracy from .1 of a volt through to 250 volts D.C. It was capable of measuring minute voltages in circuits which called for a meter having an extremely high input resistance, and everything considered it was found to be a valuable accessory in the workshop, and well worth the time and money spent in building and calibrating it.

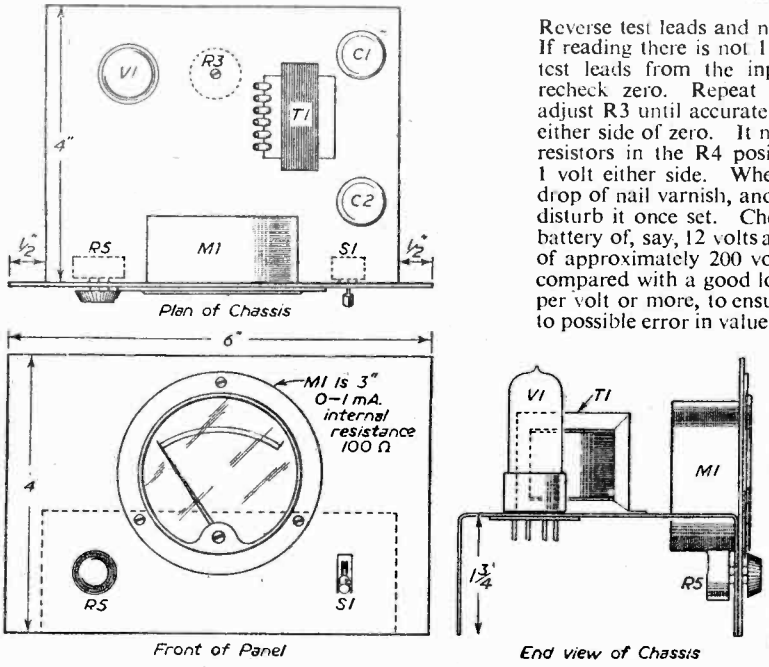


Fig. 2.—Details of the chassis and assembly.

good ohmmeter before installing. The switch must make good contact otherwise operation and observations will be erratic.

Calibration

The scale of the meter is removed and a duplicate copy of the arc is made on thin white card, marking the exact centre of the scale. Each side of the centre point is divided into five equal divisions, and these are marked for 0-2.5, 0-25 and 0-250 volts either side of centre scale. If this operation is done with a good compass, a fine pen point and drawing ink, no trouble will be experienced. With all wiring done and rechecked, switch on and allow two minutes for valve to heat. The needle will climb toward or past centre scale. Rotate zero control (R5) to bring needle to exact centre zero. Hook up temporary calibration circuit, as shown in Fig. 3. With a good quality meter adjust the wire-wound potentiometer (Fig. 3), to give an output of 1 volt. (The better the meter used for this operation the better will be the calibration.) Do not use a meter less than 1 K Ω per

PARTS LIST

All resistors 1 watt ± 2%.

R1—10M Ω.	**R5—25,000 Ω (pot)**
R2—820,000 Ω.	**R6—68,000 Ω.**
R3—250,000 Ω(pot).	**R7—1,000 Ω.**
R4—2,700 Ω.	**R8—2,200 Ω.**

Note :—R3—Semi-variable type potentiometer.

C1, C2, 8 x 8μF Electrolytic.
S1, S.P.S.T. toggle.
S2, S.P. 3-way wafer.
J1, J2 } Insulated input jacks.

M1—0-1 milliammeter (int. res. 100 Ω).
F1—500 mA. fuse.
T1 { Mains transformer. PR1, 220/230 volts. Sec. 1, 250 volts 20mA. Sec. 2, 6 volts 3a. (see text).

SUPER-REGENERATION

A FIELD FOR THE SERIOUS-MINDED RADIO EXPERIMENTER

By E. G. Bulley

THE super-regenerative circuit is credited to E. H. Armstrong, who developed this type of circuit as far back as 1922. Since its origination, however, many variations have appeared, and various applications found. Nevertheless, this type of circuit lost favour in professional circles, but was always popular prior to the war with the radio amateur. This, perhaps, can be attributed to the fact that such circuits are fairly cheap to construct.

With the outbreak of war, the super-regenerative circuits, along with others, were once again investigated by various research engineers and applications found in radar, telemetering and remote control circuits.

Because of the uses found in wartime equipments, it is the writer's opinion that much more work will be carried out in this field. However, the reader whose hobby is that of experimenting with circuitry will find this field most interesting and not costly, and above all ideal for exploring the V.H.F. bands.

This article is written to assist such experimenters, and before proceeding therefore, it is necessary to appreciate what is meant by the term regeneration.

It can best be defined as the production of an oscillatory condition, which at the same time is prevented from becoming a sustained one by means of a quenching action.

Super-regenerative receivers are most successful at V.H.F., and with valves such as the 6F12 and 6L18 that are today available, little difficulty will be encountered on this score.

The regenerative receiver utilises a detector valve with reaction, and thereby, when the reaction is increased above a certain limit (dependent upon circuit conditions), oscillatory phenomena is created. This oscillatory condition must not be maintained, so to overcome this, another voltage is introduced into the detector. The frequency of such a voltage must be above audibility, and must be introduced in such a way as to cause the oscillatory condition to cease every half cycle of frequency. This frequency is commonly known as the "quench," and can be introduced into the grid or the anode of the detector valve. Nevertheless, it is as well to mention, however, that this quench frequency can be created by a separate oscillator valve or by using the detector valve itself.

An important point one must bear in mind, is that the frequency of the quenching voltage is such as to avoid the possibility of a sustained oscillatory condition. Such a condition can result from the quench voltage frequency being too high. On the other hand, a quench voltage whose frequency is too low will undoubtedly create a high pitched signal note which will be audible. It is, therefore, essential that great care be taken in this matter, so that the created oscillatory condition can be stopped at every negative half cycle.

Basic Circuit

A basic super-regenerative detector which is self-quenched is shown in Fig. 1. This circuit is of the inductive type and trimmed by a suitable condenser C1. A similar circuit to that of Fig. 1 is that of a capacitive tuned arrangement shown in Fig. 2. This circuit is also self-quenched. Both these circuits, however, depend upon the relationship between C3 and R1 for the periodic blocking of the oscillatory condition.

Fig. 3 is a typical super-regenerative circuit, wherein a separate quench circuit is utilised. This circuit, although having a separate valve for quenching purposes, is capacitive tuned.

Advantages and Disadvantages

There are many advantages as well as disadvantages with this type of circuit, however, and for the convenience of this article both will be discussed so as to enable the reader to appreciate them. The main feature of the super-regenerative receiver is its very high sensitivity, especially at very high frequencies. The higher the frequency, the higher the sensitivity. It can therefore be appreciated why this type of receiver is successful at V.H.F. Nevertheless, a disadvantage which cannot be overlooked is that of the noise factor. One will notice that as the sensitivity is increased so is the inherent noise, in the

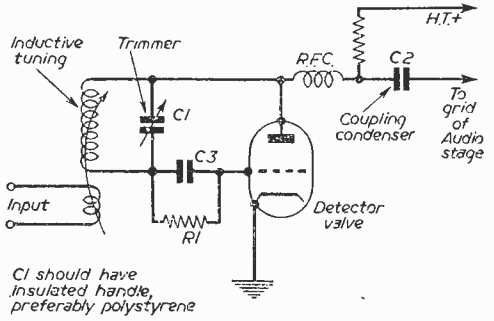


Fig. 1.—Basic self-quenched inductive circuit.

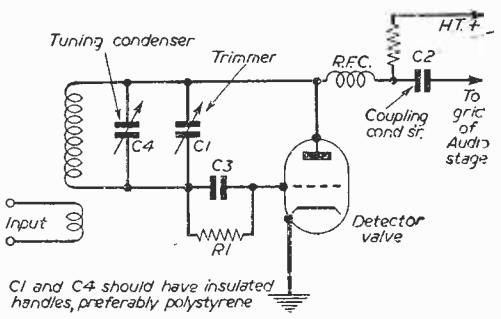


Fig. 2.—Basic self-quenched capacitive circuit

form of a continuous hissing sound. This noise can be reduced, however, by sacrificing some of the sensitivity of the receiver.

Receivers of this type suffer from what may be termed "Body capacity" effects. It is, therefore, essential to include suitable R.F. filters in the feeds, as well as foolproof screening. It may be as well to mention, however, that this capacitive effect can be the result of the coupling of the aerial to the detector being too tight. Furthermore, the matching of the aerial is important, because dead spots in the tuning will occur if the tuning is again too tight. Nevertheless, the loosening of the coupling usually overcomes this fault.

In the case of the self-quenching circuit, smooth operation can be had if one pays special attention to the grid condenser and resistor, namely C3 and R1 in Fig. 1. The reason for this is that these components determine the frequency and amplitude of the quenching voltage.

A characteristic of the super-regenerative circuit is the continual hissing when one is tuning to a specific signal. This does, however, disappear as soon as the signal is tuned in. The absence of this hissing phenomena usually indicates that the quenching voltage is insufficient.

Warning

In conclusion, it is felt that it is necessary to mention that all super-regenerative receivers radiate R.F. energy which causes unwanted interference. Care must, therefore, be taken to prevent this happening. This can be done most satisfactorily by preceeding the detector stage with a suitably designed R.F. stage, not forgetting, of course, to screen the receiver as previously mentioned.

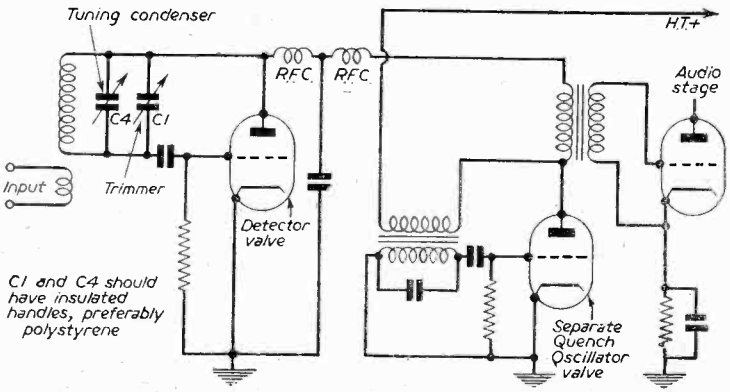


Fig. 3.—Basic externally quenched (capacitive) circuit.

The "Modern" High-power Quality Amplifier—1

(*Continued from page* 124.)

feedback conditions. It is up to the constructor to decide. If it is desired to get the last ounce of power available from the amplifier to the speaker he will avoid the use of such a compensating resistor so long as he will accept changing feedback degree. On the other hand, if he wishes to have optimum feedback under all circumstances he will include the resistor and sacrifice part of the amplifier power when working on the internal speaker alone.

Setting Up

When the amplifier is completed and the wiring checked it can be connected to the mains for D.C. tests, but little can be done until the feeder is available, unless an audio generator is available. To operate the amplifier alone, of course, it will be necessary to short-circuit the mains switching points of the output power socket and to tie the input and earth return sockets of the input plug to earth. If the amplifier is to be used with a feeder not providing a D.C. path across its output, or if the amplifier is likely to be switched on without a feeder, R22 should be included across the input of the amplifier.

Let it be assumed, however, that a suitable feeder has been completed and the two units have been plugged together. It will be noted that there is no input condenser in the amplifier. This must be included in the feeder, but it is usual to do so anyway and a condenser in the main amplifier merely reduces the effective coupling capacitance. It is as well to disconnect the feedback circuit at first. Quite reasonable quality should be available without feedback, though there will probably be some hum. It is bad practice to use feedback on an inherently bad amplifier, and if results without feedback are not what they should be the faults must be found first and corrected. Be careful, however, not to overload the amplifier without feedback. Only a very small input signal will be needed, so start with the feeder volume control right off and then advance just far enough to give a comfortably loud signal.

Balancing can be done with or without feedback being applied. First set the moving arm of VR1 to the relative resistance positions indicated earlier. These need not be measured with exactitude. A rough estimate of the position that will put just over half of the resistance between A and C will do. Now connect the indicator, be it output meter or 'phones, across R2, using isolating condensers of say .01 to .1μF. to keep the H.T. out of the indicator. A steady signal is preferred for balancing, such as the note of a signal generator or maybe the tuning note transmitted before programmes start.

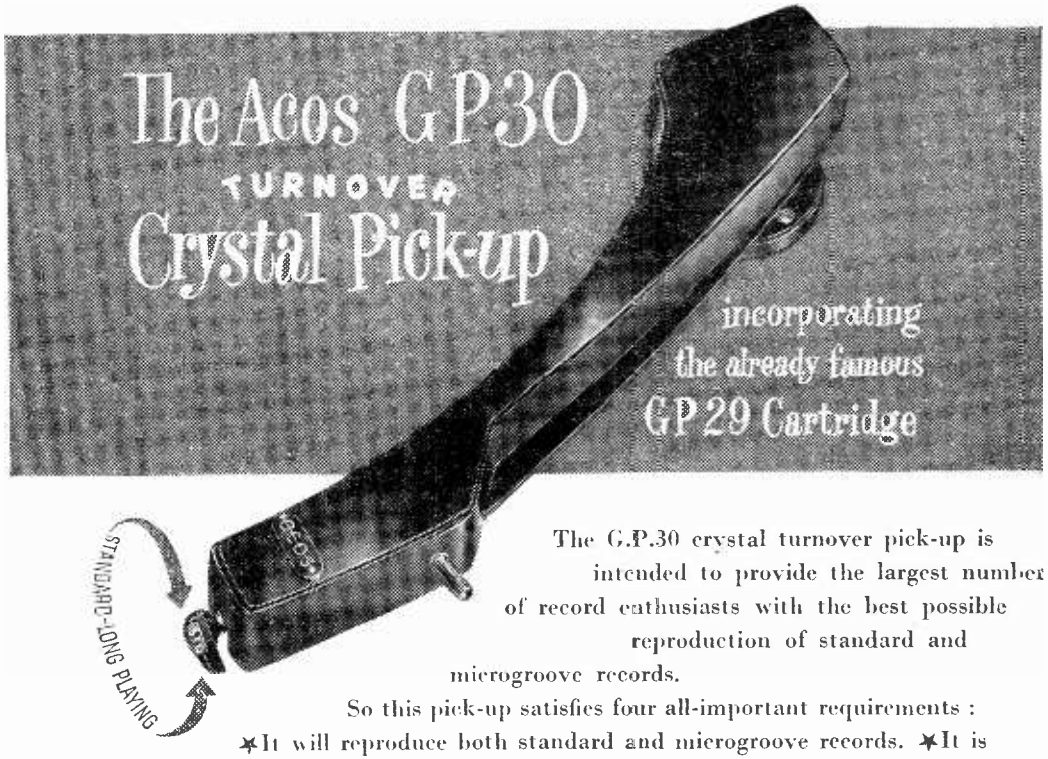
The operation of balancing is simply to rotate VR1 to the position of minimum signal in the indicator. It is unlikely that such perfection as an absolute null on an indicator so sensitive as a pair of 'phones will be obtained, nor is it necessary but with a fully loaded amplifier the signal in the prototype was reduced to negligible proportions. The minimum point should not run off the control unless, of course, there is a serious mismatch of resistors or valves.

(*To be continued.*)

Here it is...

The Acos GP30 TURNOVER Crystal Pick-up

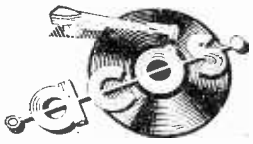
incorporating the already famous GP29 Cartridge



The G.P.30 crystal turnover pick-up is intended to provide the largest number of record enthusiasts with the best possible reproduction of standard and microgroove records.

So this pick-up satisfies four all-important requirements : ✶It will reproduce both standard and microgroove records. ✶It is simple to operate ; a turn of the front knob brings either stylus into use. ✶The output characteristics give balanced, distortion-free reproduction with minimum surface noise when used in conjunction with commercial equipment such as the normal radio set. ✶It is extremely kind to the record—giving long record life. The careful design gives exceptional tracking capabilities at the low stylus pressure of ten grammes.

Price in Great Britain **£2.10.0** *plus P.T.* 21/5*d.*



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On your Wavelength

by THERMION

The W.F.S.R.A. Again

IN the February issue I dealt with the aims and objects of the World Friendly Society of Radio Amateurs. I did so at the express invitation of readers who wished to know more about it as a result of the publication in this journal of a notice concerning the "Bedfast" section of this society. I fairly summarised all of the information I have been able to obtain. Re-reading the article I do not think any reasonable person could take exception to what I had to say. Mr. F. Allan Herridge, however, the S.E. Regional representative, has sent me a letter of protest at the tone of my comment. He says that he has been a member for two and a half years and can, therefore, speak from personal experience entitling him to answer some of my comments. He says that my "biggest *faux pas* is the contention that the society can do nothing to further the objects of world friendship. I would stoutly maintain that each and every one of us as individuals can do much towards this end. It should be obvious that world wars are caused mainly through ignorance of the other fellow and his way of life. Through our correspondence, our contacts over the air, and through personal contact, we can learn of our fellow amateurs overseas and they become friends to us. To my knowledge we have members in 18 countries."

According to the secretary the membership to date, after 17 years, is 142—not a very large band of Gallahads to crusade throughout the world to promote world friendship. However laudable that object may be, it certainly did not prevent the last war and as far as I have been able to trace it has made no impact at all on the one country which is disturbing world peace, namely Russia. How many members has the W.F.S.R.A. in Russia? Am I not right in saying that no one in Russia to-day would be permitted to own an amateur radio station except as a member of the Ogpu?

I said last month that the promotion of world friendship is a political issue best left in the hands of politicians. Their efforts towards world friendship through UNO and NATO are well known. They could be seriously hampered in their efforts, which are backed by their respective governments, by any society which is not nationally recognised.

Regarding the society service scheme, the reader informs me that this is a newly formed section, hence its limited coverage. It is composed, says he, of members who give their services voluntarily, which, he thinks, is a rare phenomenon nowadays. It is not rare. There are literally thousands of societies in this country, working for the good of others in one way or another, whose services are voluntary. My critic seems hurt because I dismiss their Bedfast Club in one short sentence. He tells me that "this is one of the most valuable and appreciated of the society's services. Any amateur bed-ridden, disabled, or otherwise unable to follow his hobby is made a member free and can receive letters through the Pen-Pal section, books and magazines." It will be interesting, therefore, to know how many honorary members have been created under this scheme. Out of a total membership of 142 would I be incorrect in saying that it is about a dozen?

The unsettled state of the world is not likely to be rectified in this way, especially as the dissident nations are ruled by dictators where democratic government, likely to be affected by public opinion, is unknown.

I was taken to task for referring to the society as a club. It is a distinction without a difference, for the terms are synonymous. My critic tells me that notices of the society have been published in a contemporary and one notice has appeared in the official journal of the R.S.G.B.

Newcomer in the Record Field

I AM very interested to note that the famous firm of Philips has now entered the gramophone record field and records bearing their famous name are now on sale. Well-known artistes are making recordings for them. The company will have under exclusive recording contracts such famous British artistes as Gracie Fields, Flanagan and Allen, David Hughes, Gary Miller, Jean Carson and Johnny Brandon. Various musical directors will be used and the first issue contains the names, Norman Warren, Geoff Love, Bruce Campbell, Geraldo and Peter Yorke. They are not exclusively employing any musical directors as the company intends to promote a policy of experimenting in the arranging field and building up names to world prominence. The gramophone recording field has been a closed corporation for many years, especially to those with musical qualifications every bit as good as those who are recorded, but who cannot even get an audition. If a gramophone war is to start it can only be to the benefit of the purchaser. The Philips policy will enable unknown people to achieve fame. They intend to build up British personalities for world exploitation. Recording is to be undertaken for the time being by Universal Programmes Corporated, of Portland Place, and recording will be at Portland Place and Conway Hall.

Education for Technicians

I CONGRATULATE E.M.I. Engineering Development, Ltd., who, at their factory in Wells, Somerset, in co-operation with E.M.I. Institutes, have inaugurated a new approach to the further education of industrial technicians and junior technologists. All employees over the age of entry to the normal apprenticeship and part-time day release scheme have been given the opportunity to further their technical knowledge and obtain professional qualifications. The employees enter for a special, self-education home study course of training under the supervision of a tutor who makes regular weekly visits to give individual and class tuition during working hours. Periodic tests are given as in a school or college and progress reports are made out for each student. The courses are run over the usual academic session from September to June.

A Midget 12-watt Amateur Station

A COMPACT, COMPLETE TRANSMITTER AND RECEIVER

By T. W. Dresser

RADIO, in any of its varied forms, still remains probably one of the most interesting and one of the least costly of hobbies even today, and it is a pity that many enthusiasts are prevented, either by the present-day cost of transmitting gear or lack of accommodation to install the equipment, from following their pastime in their leisure hours as they would like to do. And certainly rack-built transmitters, commercial communication receivers and the equally important keying desk call for a good deal of space in themselves without considering the extras.

I enlisted the aid of a friend, and working in his shack evolved a complete twelve-watt station which even the family could not object to on the score of size and which adequately fulfilled my desire to get on the air again. Fig. 1 shows the diagram of the station.

It will be obvious from a glance at the schematics that the "rig" devised, which consists of a 12-watt transmitter and a miniature superhet receiver, cannot possibly be the ultimate of its type, but it is efficient, extremely easy to construct—it can be finished in an evening with the aid of a few simple tools—it is ideal for the beginner and it also fulfils the purpose of the fellow who needs a stand-by rig. Its very compactness has a considerable measure of attractiveness after working large, rack-built transmitters, and, as any amateur will agree, plenty of DX work can be got with 12 watts C.W. In addition it has the advantage that it does not require elaborate apparatus with which to tune it before putting it on the air—a loop of wire and a flashlamp bulb are all that are necessary—nor does it require anything special in aerials. Any old length of wire at any height will serve the purpose although, of course, the higher the better.

Readers are reminded that it is illegal to install or operate wireless telegraphy equipment, except under the conditions of the licence issued for that purpose by the P.M.G. Full details of this may be obtained from The Engineer-in-Chief, Radio Section, G.P.O., London, E.C.4.

Circuit

The transmitter consists of a crystal-controlled 6V6 pentode oscillator working directly into the aerial, while the receiver is a two-valve superhet using a 6K8 as mixer-oscillator and a 6SN7 functioning as second defector and output stage. That half of the 6SN7 which operates as the output stage is arranged to feed either a 2½in. speaker, permanent-magnet type, or a pair of headphones as desired, by means of a phone jack in the anode circuit of the valve and the complete station—xmtr and receiver—is built on an aluminium chassis 8in. × 5in. × 2½in. deep with a front panel 8in. × 7in. high of 16 s.w.g. sheet aluminium. Mounted on the chassis are the mains transformer, metal rectifier, electrolytic condensers, all valves, transmitter tank coil, crystal holder and receiver coils and tuning condenser. Below the chassis are mounted all other components, including the smoothing choke which should be of the smallest possible physical dimensions consistent with good performance. A similar requirement also applies to the mains transformers; that used by the writer measures 3in. × 3in. × 2in. and was purchased from Davis & Vallance, of Leeds, two or three years ago, although there should be no difficulty in getting similar transformers, or smaller ones, from a number of sources today. The primary winding should be the usual tapped 200-250-volt winding and two secondary windings are needed; one for 6.3 volts at 1.25 amps, and the other a half-wave winding to give 250 volts at 70 mA, for H.T. Naturally this will not be centre tapped.

Aerial

In the anode circuit of the transmitting valve a "pi" network is used to make it possible to load almost any aerial, and eliminating the need to cut wires to specific lengths. Thus, providing it is not grounded or presents a danger to human life, any length of wire slung up roughly will enable you to radiate a respectable signal. This, incidentally, makes the gear very useful for "field day" operations, provided a little "wangling" is done with the power supplies.

The transmitter is intended only for use on 40 and 80 metres and coil data for both transmitter and receiver is given only for these bands on page 137 but it should be a simple matter to compute coils for the 20-metre band if they are required. Bandchanging, of course, is a simple matter merely involving changing the transmitting coil and crystal, and can be accomplished in a few seconds.

Receiver

While the receiver is a straightforward superhet, more or less reduced to essentials, it gives a surprisingly good performance even in conditions of bad QRM. The standard mixer-oscillator stage feeds into the second detector, one half of a 6SN7, which is fixed-tuned to an approximate frequency of 1,600 kc/s. Reaction is applied to the second detector to increase sensitivity, and this stage is then transformer coupled to the output stage, the other half of the 6SN7, and thence to the speaker or phones. Bandspread tuning on the oscillator is obtained by means of a small trimmer condenser paralleled across the main oscillator tuning condenser, and once the mixer grid tuning condenser has been adjusted to peak signal on the band it can be forgotten and any further adjustments made with the bandspread trimmer. To all intents and purposes this makes the receiver a one-knob affair.

All coils are home made, but a commercial 1,600 kc/s I.F. transformer can be bought and the secondary

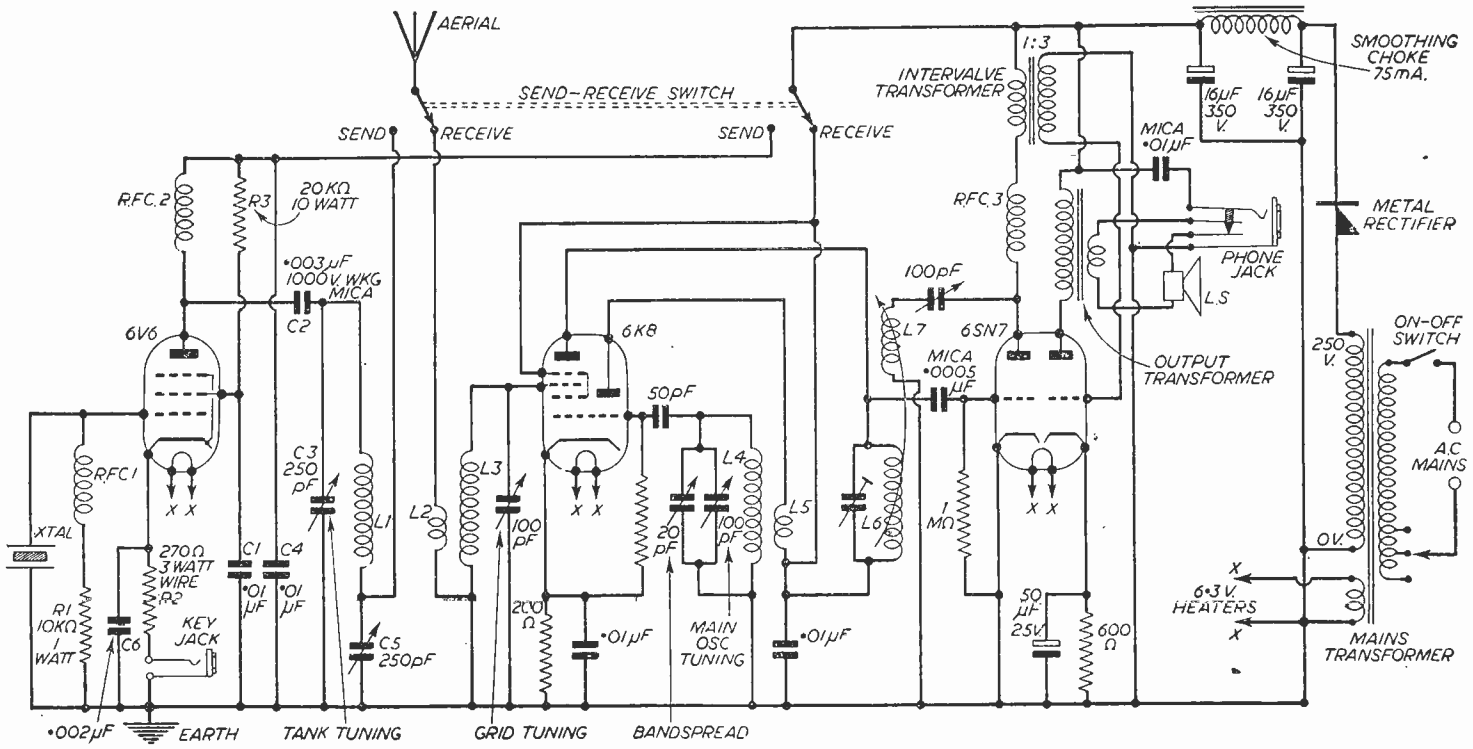


Fig. 1.—Theoretical circuit of the complete station.

LIST OF COMPONENTS

3 International octal valveholders.
3 Four-pin valveholders (for coil sockets).
Condensers (as indicated).
Resistors (as indicated).
Intervalve transformer, ratio 3-1 midget type.
Aluminium for chassis, bolts, etc.
R.F.C. 1 and 3, receiver type, pile-wound.
R.F.C. 2, small transmitting type.
(both miniature S.W. (Eddystone, Denco, etc.)).
One ceramic 2-pole 2-way switch.
Holder to fit type of crystal used.
Crystals for 40-and 80-metre bands.
Key jack and plug.
Phone jack and plug
2½in. P.M. speaker.
Mains transformer as text.
Smoothing choke, 10/15 Henrys to carry 75 mA.
2 16μF. electrolytics (16+16 in one can).
Metal rectifier for 75 mA. at 250 v.
1 50-μF. 24v. electrolytic condenser.
S.M. dial for bandspread condenser.

adjusted for use as the regeneration coil if the constructor wishes.

The chassis is wired up just like any other radio job, carefully, with short and direct connections and good, sound-soldered joints. There are no peculiarities or snags to anticipate, but the R.F. chokes in the transmitter grid and anode circuits should not be identical in order that parasites of the T.P.T.G. type should not be set up. Different makes will suffice to clear this possibility.

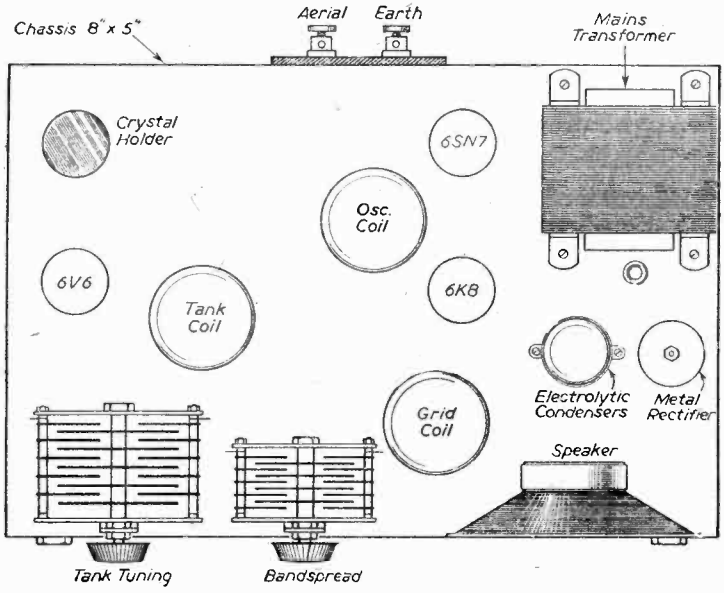


Fig. 3.—Above chassis layout.

Testing

Once the receiver and transmitter have been assembled and wired in accordance with the diagrams they should be checked over to ensure that the wiring is correct and all joints are electrically sound, and then the set can be put through its tests.

The procedure is quite simple. Starting with the receiver, attach an aerial, switch the send-receive switch to receive, and advance the reaction control until a slight plop is heard in the speaker or 'phones, just as you would do with a T.R.F. receiver. If no plop is heard, re-check the wiring, and if it is in order add a few turns to the reaction winding. Before doing so, however, try reversing the connections to the reaction coil.

When this stage is operating correctly the mixer stage can be tuned. It should be an easy matter to locate a signal in the band by adjustment of the oscillator tuning and bandspread condensers. When a signal has been found it should be brought up to its peak by means of the grid tuning condenser. That and the main oscillator tuning condenser can then be ignored and only the bandspread condenser used while you remain on that band.

Tuning the transmitter is even simpler, if that is possible. With the aerial connected and the send-receive switch in the send position, turn the condenser C8 to maximum and then rotate the tank tuning condenser C7 until oscillation occurs. A flashlamp wired into a single wire loop, as in Fig. 2, and held fairly close to the 6V6 will light up when the transmitter is oscillating. The next step is to ensure the maximum transfer of energy from the tank circuit into the aerial. This is done by reducing C8 in small steps, retuning C7 each time to retain resonance, and continuing the process until the lamp is at its dimmest. The assistance of another amateur in the district reporting as you go along would help considerably here, or listening on a spare receiver to a harmonic while the transmitter is being keyed would give a good idea of the strength of the radiated signal.

As much depends upon the coupling it is advisable to take some care with this proceeding. If the coupling is too tight the oscillator may behave

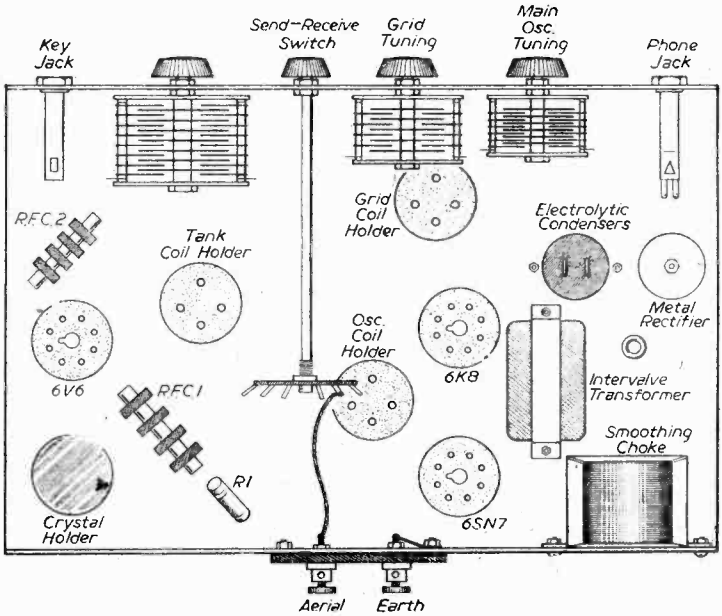


Fig. 4.—Below chassis layout.

erratically or even refuse to oscillate at all due to heavy damping; and, on the other hand, if the coupling is too loose there will be an inadequate transfer of energy from the tank coil into the aerial and consequently a weak signal radiated.

An alternative method of checking oscillation is to wire a 100 mA. meter to the key plug and insert it into the key jack. When the 6V6 has warmed up, with C8 at maximum as before, rotate C7 until the meter reading commences to drop. The point

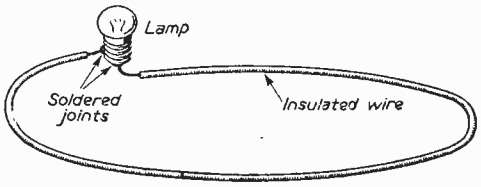


Fig. 2.—Simple oscillation tester.

of minimum current, or dip point is, of course, also the tune point, and should occur between 40 and 50 mA. with the 6V6.

In Figs. 3 and 4 are shown the top layout of the set and the below chassis layout respectively, and as many of the components, such as tuning condensers, ceramic switch, valveholders and metal rectifier are still obtainable at surplus dealers, and the coils are home-wound, the cost of building the station can be very cheap, in proportion to the pleasure that will be secured from it.

In conclusion, while this little outfit cannot be expected to compete with the 100-watters and the American kilowatters, it will certainly provide many pleasant DX contacts and many hours of fun. Moreover, it is small enough to put by the bedside for that last QSO before you fall asleep, if you wish, without calling down upon your head rude remarks about messing up the room.

TRANSMITTER COILS (L1)									
Band	Turns	Wire	Wound single layer on 1¼in. ribbed former (4-pin base)						
80 metres	35	22 DCC							
40 metres	17	22 DCC	Wound single layer on 1¼in. ribbed former (4-pin base)						
Receiver I.F. coil. L6 48 turns, L7 21 turns.			32 s.w.g. enamel wire, close wound on ¾in. former						
Receiver coils.	Grid						Oscillator		
80-metre band	L2	10 turns	L^3	36T	L^4	19 turns	L^5	9 turns	
40-metre band	L_2	8 turns	L^3	18T	L^4	15 turns	L^5	7 turns	
All coil formers, except I.F., 4-pin plug-in type.									

Radio Road Patrols

THE Automobile Association recently announced the introduction in the London area of the first stage of a national radio network designed to provide continuous two-way verbal communication between A.A. Patrols and their local headquarters throughout the country. The object is to ensure prompt help for motorists and motor-cyclists whenever a breakdown occurs on the road. All they will then need to do is to telephone the nearest A.A. office, who will at once direct a patrol to their assistance.

The Radio Patrols are a logical extension of the Association's radio-controlled Night Breakdown Services which have been operating in London, Birmingham and Leeds for some time and which now assist over 20,000 motorists in a year. The advantages of radio control will now be available to motorists in the London area throughout the 24 hours.

Initially the new service will cover a radius of approximately 20 miles from Fanum House, the the Association's London headquarters. This area has been divided into six zones, in each of which patrols with equipment for carrying out roadside emergency repairs will operate daily from 9 a.m. until 6 p.m.

Garage Links

The intention is to concentrate on the main London approaches and exits, although the flexibility offered by radio control will enable the patrols to be directed from point to point as need be. In this way they will supplement the existing A.A. Free Breakdown Service operated through garages. Some London garages which take part in the Breakdown Service already have their vehicles linked with the A.A. radio network.

The first explorations into the use of radio for the control of A.A. Road Service were made before the war, but recent technical developments in this field have given an impetus to the experiments, and it has now been possible to evolve a sufficiently light and compact very high-frequency installation to be carried in the side-car boxes of the A.A. motor-cycle Road Service Outfits and to obtain efficient reception over a considerable range. The scheme now launched in London is regarded as the first full-scale operational experiment, and plans have already been made for extending the service, stage by stage, so that it will eventually cover all parts of the country where the demand is sufficient to justify it.

Further Transmitters

Sites have been surveyed for further transmitting stations to give local A.A. offices radio control over the men in the surrounding areas. It is hoped to establish the first of these in the vicinity of Guildford. Tests have shown that the range obtainable will probably be sufficient to operate the scheme throughout Surrey, in Sussex and Hampshire as far as the coast, and also north-westwards into parts of Buckinghamshire and Berkshire.

In addition to providing assured help for motorists in cases of mechanical and other troubles, the Radio Patrols will greatly increase the Association's ability to give road service in various ways; for example, in dealing with traffic congestion, providing help in accidents and other emergencies, and particularly in obtaining rapid reports of changing conditions when roads are affected by fog, snow, ice or floods.

Contact Operation and Maintenance

THE PROTECTION OF CONTACTS AGAINST ARCING AND INTERFERENCE GENERATION

By D. E. S. Isle

THE majority of radio and television interference may be traced to the operation of current-carrying contacts. If a little attention be paid to every contact in a system during maintenance schedules, then a major source of trouble will be eliminated.

In all fields of electrical and electronic engineering, contacts are called upon to perform their duties repeatedly, open to the atmosphere or to the gaseous products of processing plant.

In considering the circuit conditions which pertain to a reasonable length of life for such contacts, whether or not the current carried be high, we must not assume that any contact material is perfect, for indeed it is not, and it is only by careful maintenance and attention to circuit design that the worst conditions do not prevail.

When a circuit is broken by means of a pair of contacts, several separate conditions make themselves shown.

First, many circuits tend to exhibit a property analogous to inertia, the immediate result of this being a spark of continuous arc between the contacts, until the contact points or faces are too far apart for the ionisation of the air gaps to support the continuance of a current flow. Two different characteristics are shown by the use of contacts in A.C. and in D.C. circuits. The A.C. circuit is easier in some respects to control, in view of the fact that the voltage (for a 50-cycle supply) falls to zero every half-cycle, i.e., 10 milli-seconds. The D.C. circuit, of course, does not exhibit this feature, and thus it is with D.C. supplies and their control that we are mainly concerned.

Secondly, as a direct result of the above spark or arcing, a small quantity of the gas ozone is liberated between the contacts. Ozone is one of the most powerful oxidising agents known, as immediately on formation it breaks up into oxygen and nascent oxygen as follows :

Equation : $3.O_2 \Longrightarrow 2.O_3 \Longrightarrow (2.O_2 + 2.O)$

It is the nascent monatomic oxygen which causes the main contact deterioration, uniting as it does with the nearest available material which can be oxidised. Most metallic oxides are non-conductors, or semi-conductors, and it is the deposit of these materials which causes the majority of contact failures.

Thirdly, as a result of the heat generated by the arc taking place, there may be actual physical disintegration of the contact material, both at the surface and at the joint between the contact material and base material. This results in a contact face which is pitted and cratered, so that when the contacts remake the current rating per unit area is raised by a large factor, producing undesirable resistance and therefore reheating of the contacts. The current rating should not be higher than 100 amperes per sq. in. of contact area.

It may be seen from the above that, provided one uses conventional and well-chosen contact materials, the source of the trouble lies in the circuitry and the surges which appear across the contacts. Where the current is of a very low order, the above arc characteristics do not take place unless the circuit is highly inductive, but normal oxidisation does. This is overcome usually by arranging the contacts to "wipe" on making and breaking, thus giving a small measure of self-cleaning action.

The main source of trouble is therefore met in contacts carrying an appreciable current. These may be sub-divided into two classes, viz., power contactors and control relays.

Power Contactors

The problem here, especially with direct current, is to extinguish the arc at the contacts as soon as possible after its formation. The contacts usually are built up from copper laminations which make on to a plain copper block. Three methods are used, in conjunction, only when the current loading is very heavy.

(*a*) *Magnetic Blow-out :*

This consists of using the field of a permanent or electro-magnet to extinguish the arc by the mutual repulsion of the field of the magnet and of the arc itself.

(*b*) *Mechanically-assisted Release :*

There are many types of assisted release of the contactor armature, a common form being a manually-set triggering device which releases the armature under the action of a heavy spring.

(*c*) *Immersion of the Contacts :*

In order to improve the immediate insulation value of the gap between the contacts on releasing, the whole of the contact assembly may be immersed in insulating oil or in a similar liquid which has been manufactured specially for its insulating properties.

When all the above methods are applied it may be safely stated that no undue deterioration of the contacts will occur.

Control Relays

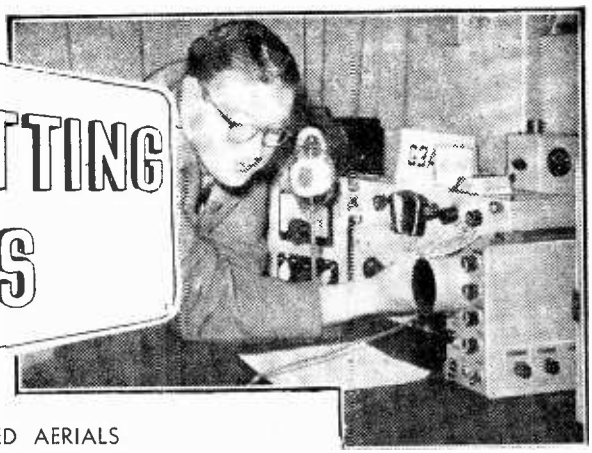
Different methods must be used for the protection of contacts in control relay work. These methods differ with the size of the relay in question and, indeed, where the size of the relay is large it is often wise to try and incorporate one or other of the methods employed for power contactors.

The spark at the contacts of a relay varies in intensity with the variables of the circuit in which the said contacts are used. Where the load to be switched is mainly inductive, there is far more necessity for the insertion of a spark-quenching device. Where the load is mainly resistive, the spark will be of lesser intensity. A mainly capacitive load is not often encountered, but where this is so, the circuit should be treated as for inductive loads.

The method is to absorb, as far as is possible, the oscillatory potential across the contact points. This is best accomplished by means of a capacitor

(*Concluded on page* 173)

TRANSMITTING TOPICS



END-LOADED AERIALS

By O. J. Russell, B.Sc. (G3BHJ)

FOLLOWING upon the centre-loading of aerial elements to make better use of short aerials, the use of "end" loading may now be considered. In view of the action of the centre-loading coil in displacing the high current portion of the aerial tuning system, so that the aerial carries a higher current, and consequently is a more effective radiator, it might be assumed that the "best" place for the loading coil is at the extreme end of the aerial (Fig. 1).

In practice, however, this is *not* satisfactory, and due to various considerations the extreme end of the aerial is not recommended as the "best" place for the loading coil. There are a number of conflicting factors, and it turns out that the most useful place for the auxiliary loading coil is at a position of approximately one twentieth of a wavelength from the free end. This immediately indicates that "end" loading is of value when the length of the radiating portion is one tenth of a wavelength or more. In the case of very short aerials, particularly for short, vertical rod aerials, the auxiliary loading coil is best placed in the centre of the element. It is only when the aerial is of sufficient length to give an appreciable amount of wire between the auxiliary loading coil and the base loading coil that the question arises. Hence end-loading (Fig. 2) is best employed for aerials that are at least one tenth of a wavelength long, and in this case the coil is still at the centre of the radiating element. However, as the radiator length increases above one tenth of a wavelength, the loading coil is retained at the position of one twentieth of a wavelength from the free end.

In the case of the top-band, when a "nominal" half-wave may be taken as 270 feet, the change over from "centre" loading to "end" loading thus occurs with aerials of 54ft., and longer wires are to be "end" loaded. The centre-loaded aerials that are shorter than 54ft. will, of course, still radiate much more effectively than an unloaded plain wire. However, the improvement in slightly longer wires that are "end" loaded is very appreciable.

Quoted figures for an "end" loaded wire one eighth wavelength long show how effective "end" loading can be. It will be noted that on the top-band one eighth wavelength is a nominal 61ft., which is only some 7ft. longer than the one tenth wavelength case at which

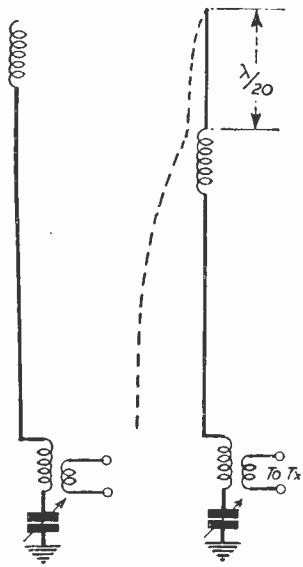


Fig. 1.—An extreme case of end-loading. Not recommended.

Fig. 2.—Correct postion for an end-loading coil. Current distribution shown dotted.

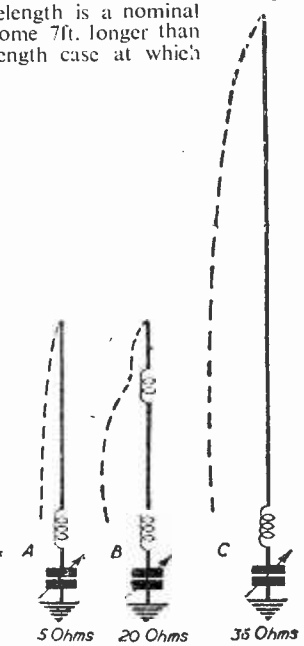


Fig. 3.—The 1/8th wavelength Marconi (A) if end-loaded, (B) becomes comparable to a full ¼-wave Marconi, (C) as its radiation resistance is greatly increased.

"end" and "centre" loading become the same. However, the figures for radiation resistance of an unloaded one eighth wave Marconi of the familiar series-tuned type is only some five ohms; this figure is increased to some 20 ohms by end-loading. This compares very well with the 36 ohms radiation resistance of a full quarter-wave Marconi, which for top band requires 132ft. of wire. In effect the 61ft. of wire is nearly as effective a radiator as the full quarter-wave of 132ft. length (Fig. 3). Clearly this is of very practical interest to the top-band enthusiast with limited garden space! It is also valuable as an expedient for efficient 80-metre operation in very confined quarters. However, despite the emphasis on the value of auxiliary loading coils upon the L.F. bands, where space considerations virtually dictate the use of "short" aerials, it is not generally realised that such end-loaded systems are perfectly practicable upon the higher frequency bands. In fact, for pack sets operating on 50 Mc/s., loading coils of this type enable a very short rod aerial to be used with high radiating efficiency.

Possibilities

The fact that a reasonable radiation efficiency can be obtained with shortened aerials offers some remarkable possibilities, as a 16ft. radiator operated as a Marconi will be highly effective upon 40 metres,

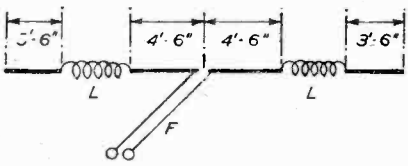


Fig. 4.—End-loading enables an efficient radiating system to be accommodated in a small space. The above aerial is some 16ft. in length, yet radiates effectively on 14 Mc/s.

being, in fact, one eighth of a wavelength long. This becomes more surprising still, in terms of 20 metres, as an end-loaded Marconi will be quite efficient on 14 Mc/s. when it is only 8ft. in length! These lengths, in fact, are only the case of the top-band end-loaded aerial scaled down for the frequency bands in question. However, as an end-loaded 4ft. aerial is the size for 10 metres (21 Mc/s. requires 6ft.), these possibilities open up new avenues for the flat dwelling amateur, as an efficient radiator for the DX bands can be accommodated in very small space. Indoor aerials of efficient performance thus come within the realms of practicability.

It should be remarked that the difficulty with indoor aerials is the problem of getting an adequate length of radiator. In a normal brick and mortar house the mere fact of being indoors does not cause any appreciable loss, and an efficient aerial works almost as well as if outdoors. In fact an indoor aerial does have the advantage that adjustments can be made without having to go outdoors! The writer's experience with indoor radiators has shown that there is no great difficulty about DX contacts—*provided* an efficient type of radiator is used. For obvious reasons the type of most suitable radiator for indoor use is not necessarily that for normal outdoor use. End-loaded aerials offer very great advantages in this respect, as the loading coil provides a more advantageous use of a limited length of radiator.

Previously, a "compressed" version of a dipole with centre-loading coils in each side was shown. To illustrate the fact that a compact loaded radiator for the H.F. bands can be constructed, Fig. 4 gives the dimensions of a centre-fed end-loaded "compressed dipole" for twenty metres that can be accommodated indoors in a modest sized room, as it requires 16ft. of clear span. Indeed, as previously intimated in earlier articles, if this clear span is not available, the extreme ends of the aerial may be allowed to hang down. One or two points to notice must be mentioned. It should be clear that these compressed aerials are derived basically from the quarter-wave Marconi, so that in "compressing" a half-wave dipole, each of the quarter-wave halves is end-loaded. In a similar way other aerial systems can be "compressed." However, in the case of parasitic beam arrays, one can *not* scale down the element *spacings*, although the elements can be compressed in length. However, as a close-spaced beam may have elements spaced by only one tenth of a wavelength, an indoor rotary for twenty metres can be built occupying a space of some sixteen feet by sixteen feet, by using a compressed director, a compressed radiator and a compressed reflector. Each element would preferably have two loading coils,

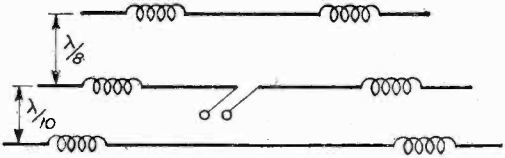


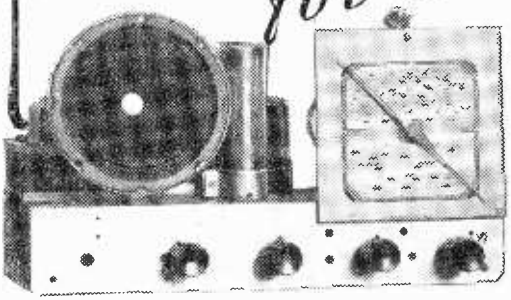
Fig. 5.—A compact close-spaced beam offers scope for experiment.

each one twentieth of a wavelength distant from the tips of the element. However, a considerable amount of juggling with element lengths for correct operation would be necessary, as such a close-spaced beam with "compressed" elements would tend to be very sharply tuned. Nevertheless, it must be noted that compressed element television aerials and a compressed element beam for 5-metre use have been recorded. Fig. 5 shows such a beam diagrammatically.

The Loading Coil

Finally, a word on the loading coil. As previously stated, low-loss construction with thick wire is desirable to avoid excessive losses in the coil. For end-loading as described, the coil should be wound with approximately the length of wire by which the element is short of the quarter-wavelength. Thus on top-band, assuming that a quarter-wave is 132 ft., a 62ft. length of wire would be end-loaded by a coil wound with 60ft. of wire. This would be inserted at a distance of 26½ft. from the free end, which is the one twentieth wavelength distance. Dimensions of aerials for various bands can be scaled down from the top-band dimensions. It should be noted that wires longer than 62ft. can, of course, be end-loaded up on top-band, thus 100ft. of wire requires a coil wound with 32ft. of wire to load it, the coil being placed again at 26½ft. from the free end. The coils are often made somewhat larger than specified here, and are not critical.

An H.F. Stage for the A.C. BAND-PASS 3



INCREASING THE RANGE OF THE RECEIVER DESCRIBED IN THE DECEMBER, 1952, ISSUE

THIS receiver, in its original form, lends itself very well to the addition of an R.F. stage. Two tuned circuits, with top-capacity coupling, are already present, and the R.F. valve may be added between these circuits, employing the coils already fitted. The addition of such a stage brings about a considerable increase in sensitivity, so that those stations already received will be heard at greater volume, and other, more distant, transmitters will also be received. Accordingly, it is felt that after the constructor has employed the receiver in its original form for a time it may be desired, in some cases, to add this extra stage. The necessary modifications can be made quite easily, and the circuit will then be one employing three pentodes (plus rectifier) and having a good degree of sensitivity. This should be particularly useful where reception conditions are poor or where only a small and comparatively inefficient aerial is possible.

From consideration of the circuit it will be seen that H.F. transformer coupling is used between the valves; this is a selective and stable form of coupling. Reaction is now not used, but the H.F. volume control is so arranged that the receiver is upon the point of oscillation when this control is at maximum, thus enabling the maximum degree of sensitivity to be achieved.

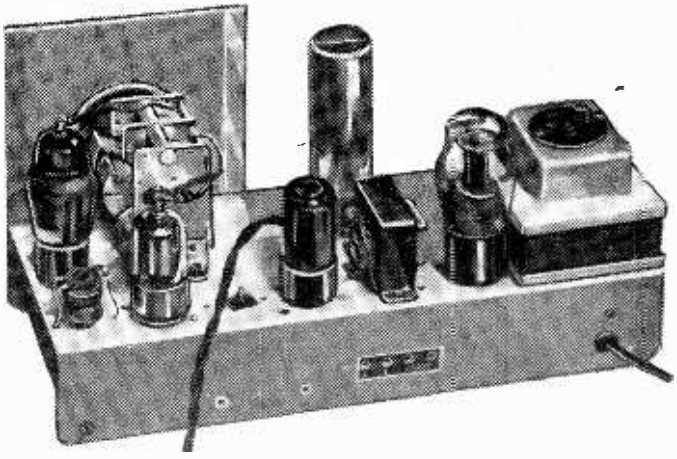
The same wavechange switch, gang condenser and coils are used. A few extra resistors and condensers are necessary, in addition to the 6K7 valve, and these are listed elsewhere. As a low-frequency form of volume control is now unnecessary, a .25 megohm fixed resistor replaces this. It is possible, of course, to leave the L.F. control in position—it would be useful, for example, if records are played with a pick-up. All the other sections of the original receiver remain unchanged.

Positioning of Coils

The aerial coils are mounted above the chassis, as depicted, with the H.F. coils below. This avoids coupling between aerial and H.F. coils, which could cause uncontrollable oscillation. Valves differ quite considerably in efficiency, and it should be noted that the receiver may go into oscillation when the H.F. control is at maximum sensitivity, with some valves. This is no particular disadvantage. At the same time, wiring to the wavechange switch should be as short and direct as possible to avoid unnecessary instability. The leads to the aerial coils should also be kept away from those to the H.F. coils.

The coils are mounted by flat spring clips (these are provided), and the notch in each coil is positioned as shown in order that connections to the tags will be correct. As before, the coils are quite separate, and the receiver can be tried upon the M.W. band, for example, before the L.W. coils are added.

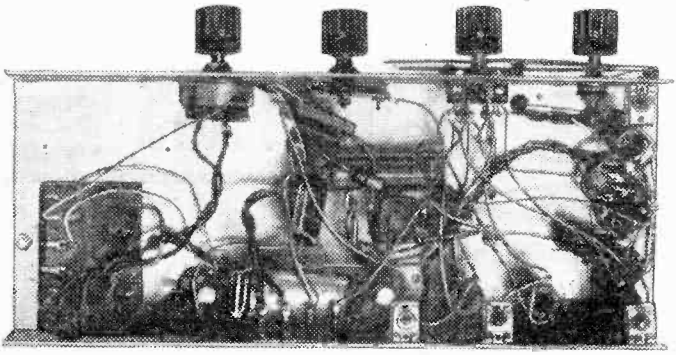
Wiring is straightforward and all leads are shown. Two leads pass up through the chassis to the gang condenser, being taken to the tags of the front and rear fixed-plate sections. On top, two further leads go from these sections, as shown (one to the 6K7 valve grid, and the second to the 2.2 megohm resistor



Rear view of the modified receiver.

and .0001 μF condenser). The grid lead of the 6J7 should be as short as possible.

The 6K7 and 6J7 valve heaters are wired in parallel with the 6V6 heater, and operated from the 6.3 volt winding of the mains transformer. The latter, if of the type originally specified, can easily supply current for a 6.3 volt .3 amp. dial-light, which is wired in parallel with the heaters if required.



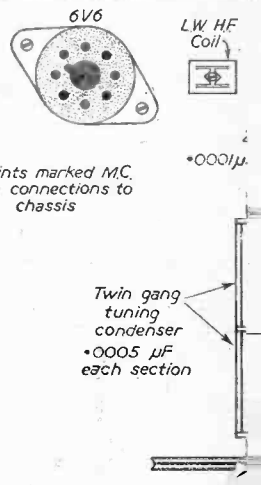
Underside view of the receiver.

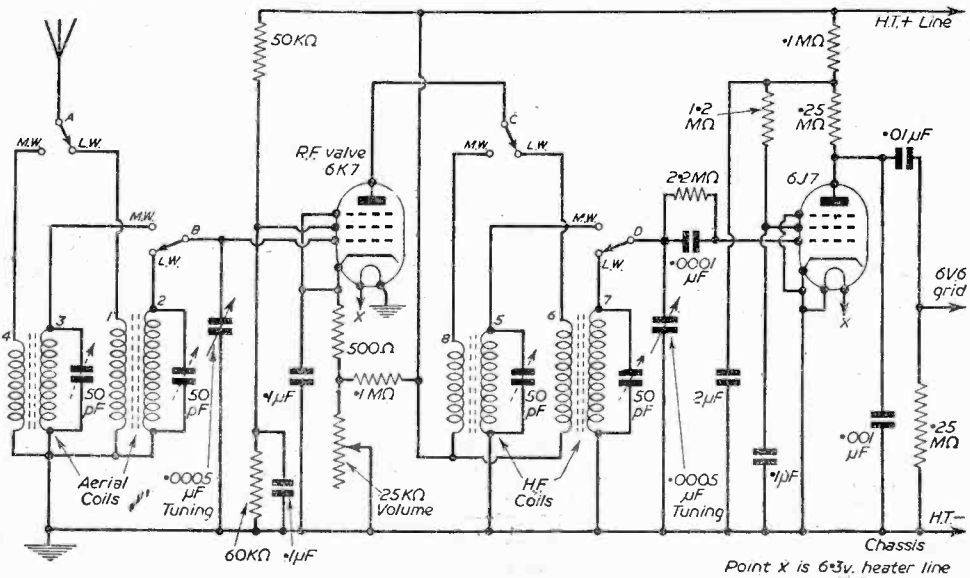
Some of the leads from the wavechange switch are numbered for identification. These are taken to the tags of the coils marked with the same numbers. All wiring should be checked carefully before trying the receiver, which should then work immediately it has warmed up. In particular, wrong wiring or short-circuits which may cause a shorted H.T. or heater supply should be looked for, since if the receiver is left switched on with such a fault, rectifier, smoothing choke or mains transformer may be damaged. No loose pieces of solder or fragments of wire should be left between valveholder or switch contacts or elsewhere.

Alignment Instructions

Maximum results will only be obtained when the tuned circuits gang accurately together, but adjustments are very simple in a receiver of this type. The coil cores should be set so that six or eight threads of the core-adjusting screws project, and the 50 pF condensers are set about half open. The local stations will then be heard if an average aerial is connected.

A station high in the M.W. band should now be tuned in. (The higher wavelength third programme transmitter is suggested.) The M.W. coil cores

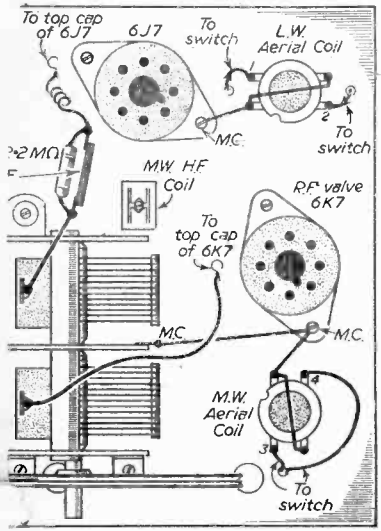




Theoretical circuit of the H.F. and Detector stages.

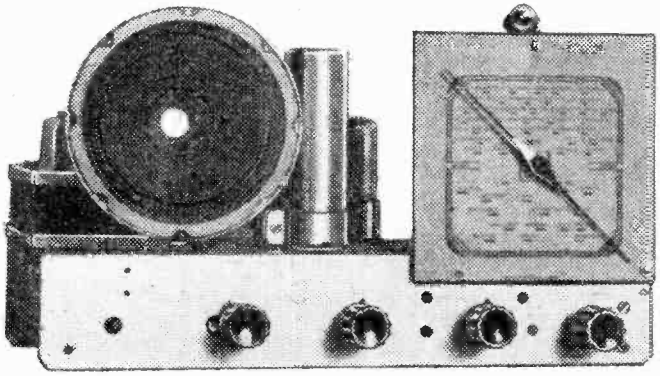
are now adjusted for maximum volume, and should peak quite sharply. If the dial pointer does not give an accurate indication this can be adjusted by operating the tuning control slightly and readjusting the cores. As the tuning condenser is closed, the cores require to be unscrewed to keep the station in tune, and vice versa. A correct dial indication can therefore be obtained, and both cores adjusted for maximum sensitivity.

The receiver is then tuned to a station of low wavelength, and the M.W. trimmers adjusted in the same way. This may make necessary some very slight readjustment of the cores, at a high wavelength. Afterwards, the wave-change switch is tuned to the L.W. position, and the procedure repeated with the L.W. coils.



ew of H.F. section.

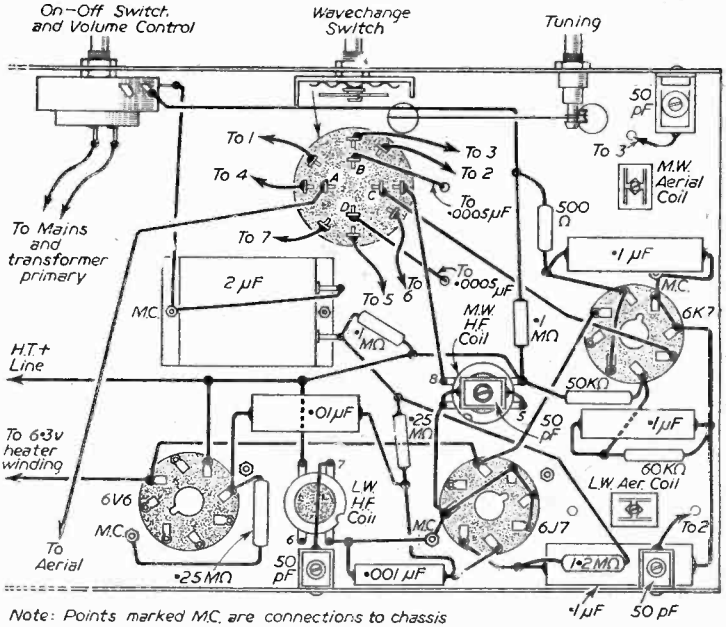
For maximum sensitivity it is only necessary to remember that the cores are adjusted at a *high* wavelength setting and the trimmers at a *low* wavelength, in each waveband. The gang condenser has split end vanes, and it is possible to bend these *slightly* to obtain perfect alignment throughout the M.W. band. However, this is scarcely necessary unless the absolute maximum degree of sensitivity is required. It should be undertaken carefully, otherwise it is preferable to leave the condensers untouched. If this method is used, the operation must commence at the low wavelength end of the band, proceeding step by step to the high wavelength end. If the reverse is attempted, subsequent bending of those sections of the plates which appear as the gang condenser is opened will upset the first adjustments made with the condenser closed.



The complete receiver.

Test voltages, using a 10,000 ohm per volt meter, were as follows, and may be used to check operation.

H.T. supply line—250 v. Positive tag of 2 μF condenser—200 v. 6J7 anode—50 v. 6J7 screen—30 v. 6K7 anode—250 v. 6K7 cathode, up to 60 v., according to setting of V.M. volume control. 6K7 screen—150 v. approx.



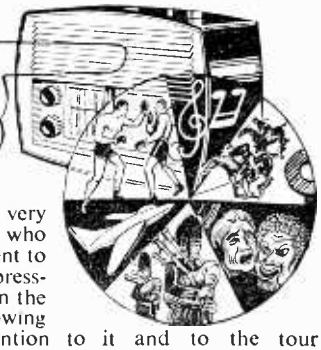
Note: Points marked M.C. are connections to chassis

Wiring diagram below chassis of the H.F. end of the receiver.

LIST OF COMPONENTS

potentiometer with switch.
; 500 ohm ; .1 megohm ; and .25
hm ½-watt resistors.
m 1-watt resistor.
condensers.
McMurdo octal valveholder.

Programme Pointers



By MAURICE REEVE

Mr. Pickwick

IT is only 130 years or so since Mr. Pickwick and his friends spent the most famous of all Christmases, that at Dingley Dell. And the conditions prevailing in that ever-to-be-lamented oasis from the past—wherein no one had any entertainment or food other than what he himself prepared plus nature's contribution of copious quantities of ice, frost and snow—pertained for many subsequent seasons. How things have changed! How the wheel has come round full circle! Now that we employ others to entertain us at miles and miles distance by turning on "that knob," we are even saved the necessity of having to cease our play in order to join the festive board. If ever two jobs were able to be done at one and the same time it is surely at the modern Yuletide. From morn till night we are, by turns, amused, soothed, enraptured, lulled, enraged, enthused, enlightened, exalted, exasperated and, finally, sated, without having to pause a second or raise an eyebrow other than to "turn that knob"! Go and give those carols a shilling, no, they are in "the box." Three cheers, Chelsea have scored—"in the box." Vic Oliver's funnier than ever—"in the box." The ravishing strains of "Enigma" are there, too—"in the box." What would Messrs. Snodgrass, Tupman and Winkle, the two Samuels themselves, Mrs. Bardell and all the illustrious company, think of our modern Christmas? Alas, we shall never know. But perhaps it is as well.

Varied Fare

Once again we were treated to as broad-minded and as generously varied a bill of fare as could reasonably be looked for. Something for most of us and a few things for all. As usual, the most eagerly-looked-for item was the tour round that considerable portion of the earth's solid and liquid surface styled the Commonwealth and Empire, culminating in the Sovereign's address. The latter was listened to with an especial eagerness as it was the first ever to pass the lips of a Queen. It was in every way a success: the context was of high purpose and firm determination whilst the delivery was a most felicitous combination of charming and youthful femininity and regal dignity.

The tour, too, was good, if not quite so colourful as in some past seasons. The contacts with Wynford Vaughan Thomas in a jet plane was a happy thought, but the failure to pop in and pay Kenya a visit was conspicuous. The Commonwealth didn't seem nearly so much of an entity as in seasons prior to the war. But then it isn't. Robert Donat's commentary provided just the right touch of beautifully modulated sincerity and enthusiasm.

Piano Recital

To follow this up with a very highbrow piano recital by one of our least exciting pianists seems a great mistake for all concerned. Surely it can only get a small and not very attentive audience, who must all be giving vent to their feelings and expressing their opinions on the Queen's speech following their enforced attention to it and to the tour immediately preceding.

Itma

Dear old Itma! What we have had to do without since Tommy Handley's lamented death is only realised when his programmes are resurrected. A very good one was put on—they were all, of course, very good—but the best can only be those with Col. Chinstrap in them. Both for high speed and faultless delivery as well as a script almost continuously sustained at the highest level of wit, originality and topicality, the Itma programmes have never had an equal. Although the war must have acted as a great stimulus, that same level was uniformly maintained right on afterwards and to the end. It does seem strange that nothing comparable has since been found, for I cannot admit that "Take It From Here," good as it is in odd moments, is comparable in all round, week in and week out excellence.

Out of Place

There were many excellent musical programmes which, in maintaining the Christmas spirit, never let down the catholicity of the art. But, here again, I thought the fifth symphony out of place and unlikely to attract any large number of auditors.

Wilfred Pickles' Christmas Party, which, incidentally, followed hard on the Queen's speech on the Light, was in his most intimate and appealing manner. I would award a special "oscar" to Gilbert Harding's programme "But Once a Year," a charming miscellany of thoughts on Carols, Christmas Cards, the real origin of Christmas, etc. It was the first time I had heard Mr. Harding away from one of his many team shows.

Die Fledermaus

The relay, from Sadler's Wells, of an act from Strauss's masterpiece, "Die Fledermaus," would have helped remind Mr. Pickwick that he did not own the earth when he was on it.

Any Questions, Life with the Lyons, Bedtime with Braden, Ray's a Laugh, Variety Fanfare, Welsh Rarebit, Family Favourites, These you have Loved and many other established favourites, not forgetting the BBC Symphony Orchestra, went into the enormous bran tub, or on to the Christmas tree—whichever simile you prefer—forming the season's programmes. Space precludes my dealing in detail with the many items I listened to. But I must not forget the interesting narrative of the famous Baccarat Scandal which, whilst incomplete in some important details, made an exciting item.

OUTDOOR LISTENING

HINTS ON THE CHOICE OF RECEIVER FOR HIKERS, CYCLISTS, AND MOTORISTS

By W. J. Delaney (G2FMY)

ABOUT this time of the year the listener begins to look forward to outdoor activities and quite naturally the problem of outdoor radio crops up. There are, unfortunately, a number of problems which arise in connection with outdoor radio, and an attempt will be made to deal with them. Outdoor listeners fall roughly into three groups—hikers or walkers, cyclists and motorists. Each will find particular problems arising either from the question of portability or actual use.

Hikers

The hiker or walker will require a receiver which is of minimum size and weight, and in most cases his journeys will not take him far from his home, or at least his movements will be in a more or less restricted area. He can therefore decide upon a circuit which will give him the necessary choice of stations in that area, and will obviously be forced to adopt a receiver in which the all-dry type of valve is employed. This will remove the difficulty of accumulator supplies, and a simple battery of the combined type will provide the necessary voltages in a very compact form. It must be remembered, however, that these compact batteries are not intended for long periods of use, and as a general rule they should not normally be left running longer than a quarter of an hour. A period of rest will give the batteries a chance to recover and a longer general period of life will result. If it is particularly required to hear a programme of half an hour or longer, the overall life of the battery will be correspondingly shortened. The choice of the circuit, as already mentioned, will depend upon the locality and it is not possible to generalise. In one area it may be found that a three-valve straight circuit will give adequate performance, whilst if the set is taken into a neighbouring county it may be found that nothing at all can be received. A four-valve superhet, however, can generally be relied upon to provide some signal, although it cannot be said that it will definitely provide a choice of signals in all parts of the country. The Mini-Four is a good example of a receiver which answers all the above requirements. Such a receiver, however, with pre-set tuning, should not be taken far afield, as the same set of stations may not be so well received in the new area and variable tuning is therefore desirable for a set which is to be taken long distances.

Aerials

The question of the aerial is quite important, and many constructors prefer the throw-out type. Frame aerials wound round a case, or on a former fitted into the case, are directional and the set must therefore be turned about until maximum performance is obtained. The best position may not be convenient for some reason, and therefore a wire thrown over a tree branch may be more suitable. Such an aerial is not directional in such a marked degree, although it will generally be found that strongest signals are received in the direction off the free end of the wire. A further advantage is that height may be gained and will provide a stronger signal than a frame aerial at ground level. It will therefore be found that in general a less powerful type of circuit may be used with a throw-out aerial than a frame-aerial design. The advantages of the throw-out aerial may be obtained, with a set which has a built-in frame, by winding two or three turns round the case, if possible over the actual frame winding, and connecting a throw-out wire to one end of this additional winding and connecting the other end to earth. This will destroy the directional properties of the frame, and the exact number of turns of wire round the case should be found by experiment. Similarly, it may be found worth while to experiment with the aerial and earth connections, as the ends to which they are respectively joined will affect the strength of the signals.

With most portables it will generally be found worth while to obtain an ordinary straight metal meat skewer and solder about four or five feet of wire to it. The wire should be attached to the H.T.— terminal of the battery (or an earth terminal if one is fitted to the set) and the skewer pushed into the ground. In many cases it may be found that this alone will give adequate signals without the use of an aerial.

Cyclists

The cyclist is in a slightly more favoured position than the hiker—he does not have to be so particular concerning weight or portability, and he can travel further afield. Therefore he can make use of a larger type of receiver and, in fact, would need a more powerful type to cover all his possible travels. Undoubtedly a superhet is called for, and this may be in the form of an attache case or specially built to be accommodated in a saddle or pannier bag. Batteries may be larger, and a separate L.T. battery or small accumulator may be used to avoid short-period listening. As correspondence has shown, the apparatus may even be built to the cycle so that it may be used whilst riding. A small speaker clipped to the handle-bars, the cycle frame used as an aerial or a small whip-type aerial clipped to the front or rear forks, have been used very successfully, but a single headphone should not be worn in the interests of safety. When stationary, picnicking, etc., the conditions are parallel with those of the hiker and the previous remarks concerning aerials, etc., apply.

Motorists

Motorists are in a much better position, as weight and portability do not have to be considered. A further advantage is that they have unlimited power available, either in the form of L.T. (from the car battery) or in H.T. through the medium of a vibrator power pack operated from the battery. Thus a mains-type of receiver may be used if a car-radio is not fitted. A portable is useful for listening when halted, but usually is unsatisfactory for use inside the car whilst travelling, as the metal body acts as a most satisfactory screen and the self-contained aerial will pick up considerable interference. It is hardly

worth the trouble of fitting plug suppressors, etc., for a portable. In all other respects all the previous remarks apply, with the added point that the car body may be used as a most satisfactory aerial when halted.

Finally, a word of advice to all who use the radio in the open air. If at a picnic site or place where there are other visitors, please keep down the volume so that it does not annoy others. Nothing is worse than to travel to some picturesque spot, to be quite away from the toil and broil of a city, than to have someone come along and park themselves some distance from you and turn on a blaring radio. A little consideration for others is most important to all users of outdoor radio.

Calling a Taxi-cab by V.H.F. Radio

ANYONE in the London area wanting a taxi-cab has only to dial Waterloo 7722 and almost invariably within a matter of minutes one will be waiting at the door. Waterloo 7722 is the control room of Metropolitan Radio Taxis Ltd., from where contact is maintained with a fleet of radio-equipped cabs wherever they are cruising or waiting. By 'phone and V.H.F. radio a " dispatcher " in the control room acts as a direct link between the prospective hirer and the taxi-driver.

On a call being received a time-stamped instruction slip is immediately handed to the dispatcher who sends out a call for taxis in the area of the pick-up point. Radio-cab drivers in that area reply and give their exact position and identification number. In the interests of speed and economy the cab nearest the pick-up point is selected for the job by the dispatcher who knows London so well that he is able to give precise instructions to the driver. In every case these instructions are confirmed by the driver and, if requested, the hirer is informed by telephone when his taxi is on its way.

A cab may be only a few yards from the pick-up point so that before the fare has had time to put on his overcoat the driver is ringing the door bell!

The several hundred radio-taxis now operating in London provide a unique public service, day and night, all the year round. The dispatcher can route radio-cabs from place to place, or can be called up by a driver who has taken a fare from Central London to the suburbs and does not want to return empty. Drivers have assisted the police by sending back urgent messages to the control room to be passed on to Scotland Yard.

In addition, a taxicab can be pre-booked at no extra charge—a method of hiring that has been found extremely useful to people catching early morning trains or 'planes. For the business house a monthly credit account system has been found very convenient, particularly when several members of the staff require transport at the same time.

The Service

Metropolitan Radio-Taxis Ltd. is owned jointly by several of the largest London taxi operators. There is a Marconi V.H.F. transmitter of 20 watts located in the control station in London Road, just off the famous Elephant and Castle. This transmitter is paralleled by means of a land-line with an 8-watt transmitter located in a garage, opposite the old Crystal Palace site, on top of a hill in Sydenham, London, S.E.19. A typical taxi radio set is the Marconi type H.67 V.H.F. equipment used in the London General Cab Company's fleet, which is the largest in Great Britain. This fleet operates from the well-known Brixton Garage at Kennington, S.W.9, built in 1907 to accommodate taxis brought over from Paris—the first to run in London.

A quarter-wave long, whip-type aerial, fixed to the roof of the cab, is connected by a coaxial cable to the transmitter-receiver assembly. This is a two-way radio-telephone set developed for Marconi's Wireless Telegraph Co. Ltd., by British Communications Corporation Ltd., for a frequency range of 156-184 Mc/s. It is supplied from a power pack, giving an output of 112 milliamps at 300 v. for the transmitter or 50 milliamps at 250 v. for the receiver; together with a low voltage supply for the valve filaments.

To avoid the use of additional batteries, difficult to accommodate on a taxi, the London General Cab Company's radio equipment is operated from a power pack energised from the " Young " battery that is fitted as standard to all their cabs. The same 12-volt battery system is used for starting and lighting but despite the extra power demand from the battery, arising from the radio being in constant service, there is no appreciable effect on its life. This is partly due to the fact that careful attention is given to maintenance; the battery being regularly serviced by Brixton Garages.

H.M.V. New Auto Player

LATEST addition to the " His Master's Voice " range of record playing equipment is Model 2127, a high grade 3-speed automatic record player housed in a distinctive walnut finish cabinet. It is suitable for use with most radio receivers and radio-gramophones.

The record changing mechanism is an extremely versatile unit capable of playing up to eight 78 r.p.m. records, 10in., 12in. or mixed; ten 33⅓ r.p.m. Long Play records 10in., 12in. or mixed; or, by means of a button adaptor, single 7in. 45 r.p.m. records.

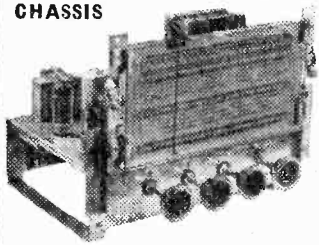
A special slip-on centre post, shortly to be available as an optional extra, provides for the automatic playing of up to eight 7in. 45 r.p.m. records.

The pick-up is a special featherweight type with an output sufficient to give ample volume from most instruments. Separate plug-in heads for 78 and 33⅓/45 r.p.m. records are provided.

Loading of records is made particularly easy by the novel design of the cabinet. Opening the door slides the turntable forward and raises the lid automatically to allow easy access to the mechanism.

Model 2127 is now available from " His Master's Voice " dealers, price 29 guineas, tax paid. The price of the 45 r.p.m. centre post is 17/6, tax paid.

A COMPLETELY ASSEMBLED "ALL-WAVE" SUPERHET CHASSIS



MODEL B.3.—A 5-valve 3-waveband Superhet Receiver, for operation on A.C. mains 100-120 volts and 200-250 volts, employing the very latest miniature valves. It is designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both Gram and Radio, making it the ideal replacement Chassis for that "old Radiogram," etc.

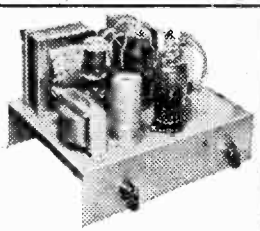
Brief specifications :—Model B.3—Valve line up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4. Waveband coverage, Short 16-50, Medium 187-550, Long 900-2,000 metres. Controls (1) Volume with on/off ; (2) Tuning (flywheel type) ; (3) Wave change and Gram; (4) Tone (3 position switch operative on Gram and Radio).

Negative Feedback is employed over the entire audio stages. Chassis size, 11in. x 7¼in. x 8¼in. high. Dial size, 9¼in. x 4¼in. Price, complete and READY FOR USE, excluding speaker, **£12/12/-**. (Carr. and Pkg. 7/6 extra.)

A QUALITY "PUSH-PULL" AMPLIFIER

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 7¼in. high. Price of kit complete in every detail, including drilled chassis and valves, **£6/17/6**. Component layout is supplied.

Price of assembled chassis, supplied ready for use, **£8/2/6**. Instructions, layouts and price list **1/-**.



A DUAL CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT

This comprehensive PRE-AMPLIFIER and TONE CONTROL UNIT provides full control of Bass and Treble in conjunction with a main Volume/Mixer Control. Can be used with any Amplifier and any Pick-up, the range of frequency control provided by the unit affording ample compensation for all types of Pick-up and all natures of recordings. I.e., English, American and Long Playing, without recourse to Pick-up correction. The extreme flexibility of the Bass and Treble Controls is such that the level of Bass and Treble can be set to suit any conditions irrespective of the volume output of the Amplifier.

Response characteristics are given in 12-watt Amplifier advt.

The Unit measures only 7in. x 4in. x 2in., including self-contained Power Supply, and can be accommodated either on or away from the main Amplifier, i.e., in the front panel of a Cabinet or any other position. Price including drilled chassis, valves (6SN7 and 6J5). **£3/16/9**. Complete assembly data is available separately for **1/-**. Completely assembled and ready for use, **£5/5/-**.

"PERSONAL SET" BATTERY ELIMINATOR

A complete kit of parts to build a Midget "All-dry" 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 4¼in. x 1¼in. 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 2¼in. x 1¼in. Price **47/6**.

A Genuine

SPECIAL OFFER !

PLESSEY 3-SPEED AUTO CHANGE UNITS

Brand New in maker's cartons, complete with mounting instructions.

£11 . 19 . 6

(Normal price is £23/10/-)

★ These units will auto change on all three speeds, 7in., 10in. and 12in.

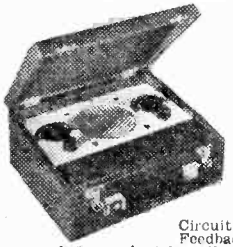
★ They play MIXED 10in. and 12in. records.

★ They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.

★ The size of the unit deck is 14in. x 10¼in. with 6in. above deck and 2¼in. below.

A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

Please include 7/6 packing, carriage and insurance.



A MAINS OR BATTERY PORTABLE KIT

A midget 4-valve Superhet Portable Set covering medium and long wavebands.

Designed to operate on A.C. mains 200-240 volts or by an "Alldry" battery. The set is so designed that the mains section is supplied as a separate unit which may be added at any time. The Kit therefore can be supplied (a) as an "Alldry" Battery Superhet Personal Set which can be accommodated in the Attache Case as illustrated (size 9¼in. x 4¼in. x 7in.). This is attractively finished in lizard, maroon, dark green, or blue rexine, (b) or as a Combined Mains/Battery Superhet Portable Receiver, for which a polished Wood Cabinet is available to accommodate both Mains Unit and Batteries together.

Circuit incorporates delayed A.V.C. and Pre-selective Audio Feedback. Kit is complete in every detail and includes ready-wound Frame Aerials, fully aligned I.F. Transf. and drilled chassis, etc. Overall size of assembled chassis 8in. x 4in. x 2¼in.

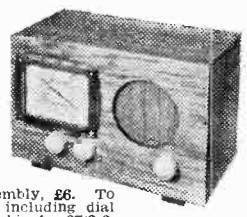
This receiver as illustrated can be completely built for approx. **£10** (plus Mains Unit if required). Send **1/9** for the fully descriptive Assembly Book which includes Practical Layouts and complete price list of Components.

THE "MINI FOUR."—A 4-valve Battery Superhet Receiver, designed by "Practical Wireless" to receive 4 Pre-set Stations, no tuning being necessary. The complete Receiver can be built for **£9/10/0** (plus case, **15/6**). Send **1/6** for Assembly Instructions, Layouts and Component Price List.

THE "MINI TWO-THREE."—Complete diagrams and layouts from which either a T.R.F.3-valve set or a 2-valve set (afterwards easily converted to the 3-valve) can be made for **£5/3/-** or **£4/3/6** respectively (plus case, **15/6**). Full Instructions, Layouts and Component Price List, 2/-.

THE "MINI TWIN."—The ideal set for the beginner ! A simple 1-valve 2-stage Battery Set covering Long and Medium Wavebands. Can be built for **37/6**, plus **9/6** for attractive Plastic Case and **14/9** for suitable headphones. Complete instructions, layouts and price list **1/3**.

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/-**. 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 7¼in. x 5¼in. x 11¼in.

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.

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

STERN RADIO LTD.

109 & 115, FLEET STREET, E.C.4

TELEPHONE : CENtral 5812/3/4.

An Automatic Polarity Corrector

A RELAY-OPERATED AID FOR MAINS EQUIPMENT

By M. C. Paul

THE hazards associated with the handling of A.C./D.C. type equipment are too well known to require comment here. High component prices do, however, necessitate the frequent construction and use of gear of this type where expensive components are few and design simple. In utilising such equipment in the home or workshop, it is wise to employ some means of checking mains polarity, and in this respect some form of

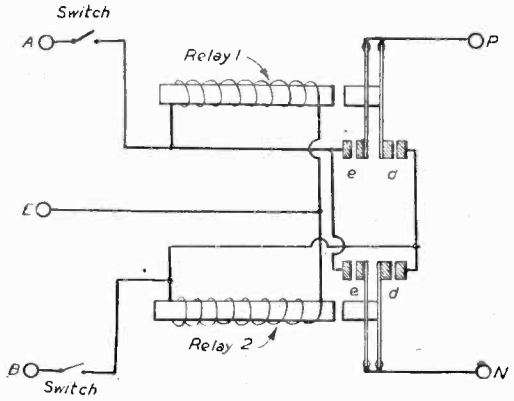


Fig. 1.—Standard circuit recommended by the author — e and d depict energised and de-energised positions respectively.

"fountain pen" type tester is the most useful, although several easy check methods suggest themselves. Such necessary and irksome testing is all too frequently neglected or forgotten, and the cost of a commercial "test-scope" high when its fragility is considered. In any permanent workroom much may be done to ensure correct polarity of supply points and wiring. The kitchen table enthusiast will not usually be so fortunate, and in many cases will have only a lighting pendant as a power source. Fig. 1 outlines the author's answer to these difficulties. It will be seen that an earth connection is essential to the device, and practically any form of earth will do, as only the shunting current of one relay (a matter of milliamperes) must be dissipated, and a regulation "dead-earth" characteristic is therefore unnecessary. An earth rod or plate buried outside a convenient window or a twisted wire connection to a convenient waterpipe will suffice.

The Operating Principle

Since the neutral line of the orthodox 230/240 volt supply is earthed at its sub-station transformer, it is at earth potential. If, as indicated in Fig. 1, two similar relays are connected in series across a 230/240 volt A.C. supply A and B, and their common connection earthed, no potential can develop across that relay wired between neutral and earth. This relay will thus retain its former setting. The second relay will, however, be fully energised by the A.C. mains voltage across it from phase to earth, and will reset its switches from their former setting. The resulting current paths can be studied in Fig. 1, and the fact that the output terminals P and N retain their individual polarities irrespective of A and B polarities, will be apparent.

The Relays

In Fig. 1, A.C. type relays are shown, the windings of which must be rated at 230-240 volts. This is an undesirable limiting factor and may be overcome by utilising D.C. relays and rectifiers such as abound in Government surplus equipment and are thus inexpensive. If a "series" resistance be placed in the common earth lead, a wide range of voltage ratings is possible, bearing in mind that both relays chosen should be, at least, similar as to resistance and working voltage of the windings. The associated switching should be similar to that of Fig. 1, but any form of single-pole, two-way action will do, a good positive action being preferred. Relays rated lower than 100 volt working should not be considered unless of extremely low current rating, as the series resistances' "wattage" would become prohibitive. Even if such a resistance was available, its size would be rather too large for any compact unit to be considered. Many obtainable types of relays are provided with their own small rectifiers; where none such are obtainable, any small half-wave 240-volt type will be found adequate, though perhaps a little larger. Some surplus vibrator units provide up to four such rectifiers in a bridge assembly.

Further Improvements

Should low-current consumption relays be utilised, as in the author's model, a low-wattage lamp can replace the series resistance (Fig. 2). Such a lamp should be chosen carefully, so that it will at least glow under operating conditions, thus acting as a visual indicator that there is current in the earth line and that the device is functioning. It is obvious that should the earth connection fail, that apparatus being fed through the device will become "alive" at chassis. The lamp can, of course, do nothing to prevent this

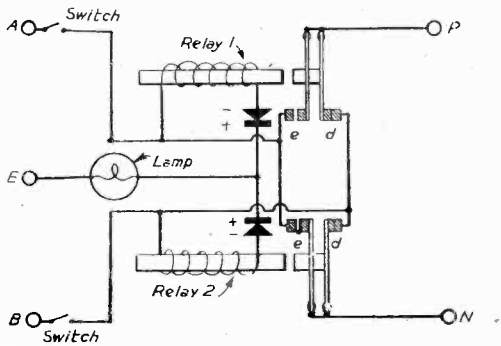


Fig. 2.—Modification for use with low-current relays.

condition, which might in certain circumstances be dangerous.

The Third Relay

The answer to the above problem was the inclusion in the earth line of a third relay, which would be energised under operating conditions by the D.C.

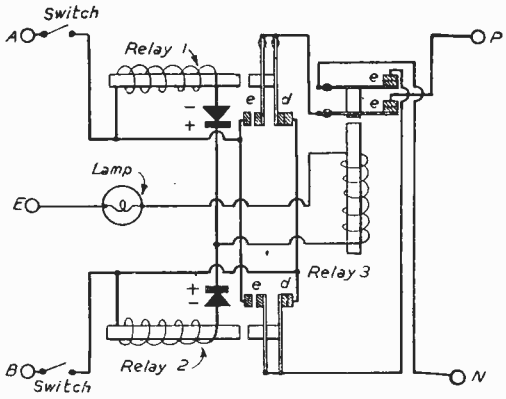


Fig. 3.—Inclusion of a third relay.

pulses in the earth line, and would thus require no extra rectifier. This relay would hold its switches closed when energised and isolate the terminals P and N from the device in the event of an earth line rupture or relay failure, etc. The wiring for the corrector utilising a third relay is shown in Fig. 3. If required, a small flashlamp bulb or low-wattage lamp may also be included as shown, serving the dual function of indicator and fuse. If the latter function is required of the lamp, a good "dead-earth" is essential. Since practically all relays possess more than one switch action, it is obvious that the single make-break action of the third relay would at least be duplicated on such types as those previously utilised. In fact, by far the easiest way in choosing a set of three relays is, if possible, to obtain three electrically similar in the 100-240 volt range, and choosing a suitable wattage lamp to drop the remaining voltage, if any, its filament resistance being the appropriate fraction of one relay coil resistance. Since the rectifiers are opposed, i.e., positive to positive, no appreciable current will flow directly between A and B should an earth rupture occur. A two-pole on/off switch should be incorporated as shown in Fig. 3, also fuses, if the supply is not fused at the supply point in the workroom. It must be observed that whilst an earth line fuse will clear a short to earth of the mains phase line, due to a possible relay failure, it will not fuse the supply circuits themselves.

The completed unit as shown in Fig. 3 will be found extremely useful, and the author suggests that as a compact bench unit its use will prevent many nasty experiences to the maker and user of A.C./D.C. type equipment.

News from the Clubs

IXWORTH RADIO CLUB

Hon. Sec. : P. G. Wright, Thurston Road, Gt. Barton, Bury St. Edmunds.

THE recent working station, G3CZY/A, at the Bury St. Edmunds Handicrafts Exhibition, proved a great attraction to visitors. In January began an intensive series of Technical and Morse classes. Local P.W. readers will be welcomed, should they wish to attend.

EDINBURGH AMATEUR RADIO CLUB

Hon. Sec. : D. B. R. Black, 16, Edina Place, Edinburgh.

THE club meets every Wednesday evening at 7.30 p.m. in Unity House, Hillside Crescent. December's programme included : Dec. 3rd. : Talk on Aerials. Dec. 10th. : Club TX. Dec. 17th. : Amplifiers Lecture. Dec. 24th : Club TX.

New members will be welcomed. Particulars obtainable from Secretary.

HASTINGS AND DISTRICT AMATEUR RADIO CLUB

Hon. Sec. : W. E. Thompson, 8, Coventry Road, St. Leonards-on-Sea.

THE Club Annual Dinner was held on December 2nd at the Regent Hotel. Most members attended and we were pleased to entertain ladies and friends. Everyone expressed complete satisfaction with the excellent repast, and the evening went all too rapidly. We were surprised to find out how much the XYL's knew about radio in their answers to the "20 Questions" quiz !

At the general meeting held on November 18th two lectures were given, one on the principles and circuitry of radar, by J. D. Heys (G3BDQ) and the other on mechanical and electrical design features of 3,000-type relays by W. E. Thompson.

The committee has drawn up a tentative programme for the early 1953 meetings, so for the next three months at least members can look forward to several interesting sessions. Meetings will be held on January 13th and 27th at the Saxon Cafe ; VHF aerials is the subject for the first meeting, and Tape Recorders for the second.

BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec. : R. T. Parsons, 14, Carlyle Avenue, Brighton, 7.

THE A.G.M. was held on January 6th. Officers for 1953. Chairman, Mr. C. T. Fairchild. Vice-Chairman, Mr. R. T. Henley. Hon. Sec., Mr. R. T. Parsons (re-elected for third year). Hon. Treasurer, Mr. W. G. Pitfield (re-elected). Mr. F. R. Jupp was elected to serve on the committee. The past year's activities were reviewed and the future discussed. It is hoped to continue the interesting programme of lectures and talks with more emphasis on elementary subjects in order to aid younger members.

Forthcoming events include :

Feb. 17th : Tape and Disc Recording, by Mr. G. Austin.

Mar. 3rd : Radio Autobiography, by Mr. R. T. Parsons.

This last programme follows upon the suggestion of a member and if successful it is hoped to invite other members to perform at later dates.

COVENTRY AMATEUR RADIO SOCIETY

Hon. Sec. : K. Lines, 142, Shorncliffe Road, Coventry.

WITH a varied programme recently, including a Sausage and Mash Supper, Junk Sale, M.C.C. Contest, lecture on "Workshop Practice," by "Monty," and the regular monthly Night-on-the-Air, the Society has had a successful month. New members are needed and will be welcomed at any of the regular fortnightly meetings held at the Y.W.C.A., Queen's Road, at 7.30 p.m.

STOKE-ON-TRENT AMATEUR RADIO SOCIETY QHT.

Rear of Cottage Inn, Oakhill, Stoke-on-Trent.

REGULAR weekly meetings have been held every Thursday at 7.30 p.m. and during the last few weeks much equipment has been completed, including several T.V. sets, hot supers, etc.

The routine of minutes, lectures, morse training, practical work and rag chew has once again been instituted, as although previous meetings excluding lectures for some time have been popular, the members thought that they were missing a definite advantage.

The club TXG3GBU is hors de combat awaiting the rebuild of a Marconi TX salvaged from beneath three tons of scrap for £3.0.0.

Any person wishing to join the Society should write in the first instance to the club Hon. Secretary.

LONG-PLAYING RECORDS

PRINCIPLES OF THE L.P.R. AND CIRCUIT REQUIREMENTS

By Gordon J. King

NOW that at least another four record manufacturers are producing long-playing records, enabling most musical tastes to be satisfied, many more constructors will, no doubt, start surveying the problem of converting their existing 78 r.p.m. record reproducing equipment to cater also for this current style of record reproduction. In the first place, therefore, let us get a brief glimpse of what the long-playing record has to offer over its older-style counterpart.

The degree of satisfaction derived from any recorded music is limited in part on the quality of reproduction, that is, the closeness of approach between the original and the reproduced, considering, of course, the disconcerting accompaniment of surface noise—or record hiss; and perhaps to a greater extent on the arbitrary intervals between a series of records which may comprise a complete concert performance. In these respects, at least, the long-playing record yields a great increase in musical satisfaction, particularly to those interested in the longer works, for apart from the much extended playing time per disc, the quality of reproduction, including the minimisation of record hiss, is much enhanced.

It is necessary, however, in order to gain the full advantages afforded by these new records, to know something about how they differ from ordinary 78 r.p.m. recordings, and how the amplifier circuits must be altered to cater for their modified frequency response.

General Characteristics

One of the salient features of these new recordings is, of course, the much extended playing time, brought about by a 2.35 : 1 reduction in turntable speed, coupled with an increase in record groove pitch. In this respect long-playing records have approximately 300 grooves to the inch, as compared with something less than 100 on 78 r.p.m. records. These two factors combined create an increase in duration of playing time of almost six times longer than that available from 78 r.p.m. records.

Because of the increase in record groove pitch it obviously follows that the actual groove width is reduced; which means that a considerably lower recording level is demanded to prevent the risk of breaking down the groove walls on heavy modulation peaks. This represents one of the reasons why the new records are quite unsuitable for use with the acoustic gramophone—although, needless to say, the recording engineer is at last able to concentrate solely on the quality aspect, instead of, as hitherto, having to compromise between quality and record magnitude. As opposed to a groove width of 0.007in. and a groove depth of 0.0029in. employed on 78 r.p.m. discs, the corresponding figures for a long-playing record are 0.003in. and 0.002in. respectively—and for this reason the new discs are frequently called *microgroove* long-playing records.

To combat the resulting increase in record hiss, due to the reduction in modulation amplitude, a new record material is adopted, entirely different from shellac used for 78 r.p.m. discs. This new material comprises a Vinyl compound, and though "unbreakable" is softer than shellac and consequently much more easily scratched. Great care is, therefore, necessary in handling the records, and in particular they should be at all times protected from contact with substances that may scratch or abrade their surface. Furthermore, they readily acquire a static charge and so are more difficult to keep free from dust and foreign particles. The most impressive feature of the material, however, is that it gives a very much lower surface noise than shellac base discs—an advantage which means a great deal to the high-fidelity enthusiast.

Stylus Pressure and Dimension

The new groove dimensions demand a reproducing needle having a tip radius of 0.001in., as opposed to

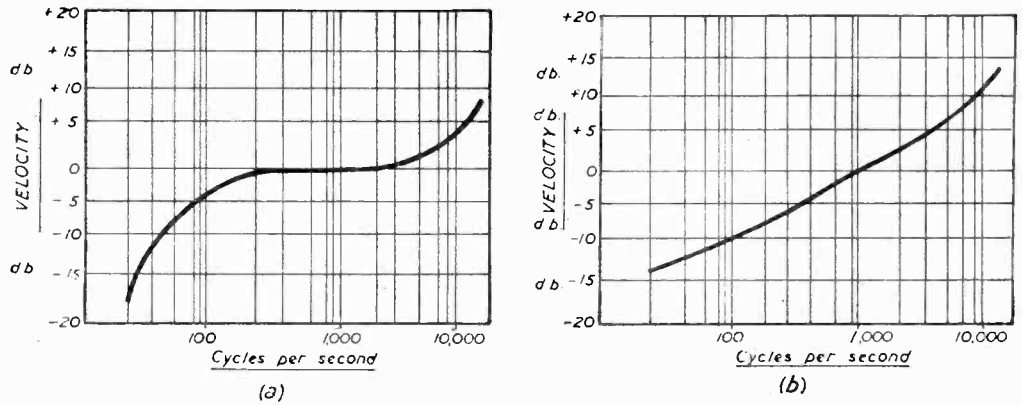
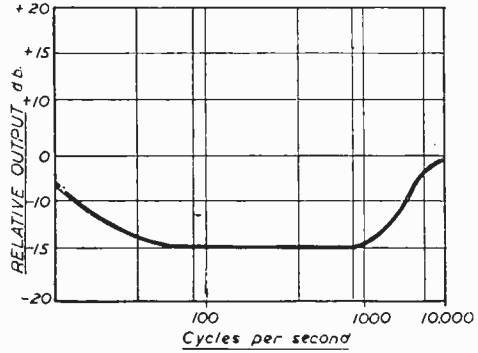


Fig. 1(a).—78 R.P.M. recording characteristic and (b).—Microgroove recording characteristic.

the 0.0025in. tip radius needed for 78 r.p.m. records. It should be emphasised here that to use a standard needle on microgroove recordings will, even on a single playing, ruin the record.

In addition to this, the needle pressure must be considerably less than that used on standard records, for excessive pressure will tend to damage the delicate walls of the groove. With this in mind, manufacturers have developed special light-weight pick-ups employing a stylus of " permanent " material, such as sapphire, and having a greatly reduced needle pressure. As it is virtually impossible to change this type of stylus without upsetting the tracking, and promoting consequent damage to the record, it is necessary to have two interchangeable pick-up heads, one for standard and the other for microgroove recordings. These, if necessary, should be counter-balanced so that the needle pressure on the micro-groove record does not exceed 10 grams, which is the *maximum* approved weight.



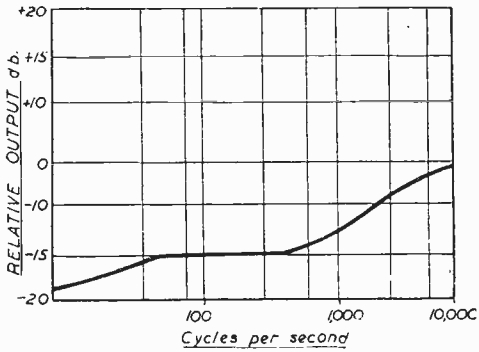


Fig. 2(a).—Approximate crystal pick-up response and (b).—Approximate magnetic pick-up response.

Pick-up Design

Pick-ups have been designed fitted with a stylus of each type, and so arranged that it is possible by turning the head over to bring the appropriate one into use. This arrangement, of course, has a distinct advantage from the user's point of view, but unless facilities which provide a change of tone-arm balance are also incorporated, the long-playing record may suffer undue wear, for it must be borne in mind that the weight requirements differ between the two types of records. An " all-purpose " stylus in a head of compromise design is sometimes used to reproduce alike standard and long-playing records. This method, however, is not considered the best practice, for both record and stylus wear are accelerated after the first few playings.

The curves of Fig. 1 illustrate the difference between standard and microgroove recording characteristics, and, as will be observed, the most striking difference is the reduced bass response of the long-playing records, for it shows an almost constant rise from the low to the high frequencies, as compared with the much more linear response of standard records.

This is made necessary by recording amplitude limitations governed by the spacing between the grooves, for it follows that if the recording amplitude were to take the more linear form adopted on standard records, the groove walls would break down on peak modulation. Nevertheless, the constant rise curve of Fig. 1b greatly improves the ratio of the high-frequency recorded amplitude to the surface noise; although, on the other hand, it does give rise to an extra large degree of tracking distortion. But owing to the fact that microgroove records are not modulated so near the centre of the disc as is usual with standard records, coupled with the reduction in the size of the stylus point, little difference in this respect is discerned between the two kinds of records.

Both crystal and magnetic types of pick-ups are employed for playing microgroove records. They differ in function in as much as the voltage generated by the crystal bears a relationship proportional to the *amplitude* of needle movement, whereas with the magnetic type it is the *velocity* of the needle movement that determines the generated output. In any case, the output from both types will, of course, be less with microgroove than with 78 r.p.m. recordings, owing to the enforced reduction in general recording level of the former, which amounts to about minus 8 db. at 1,000 c.p.s. On the other hand, however, a reduction in velocity of movement affects the magnetic pick-up to a greater extent than the reduction in

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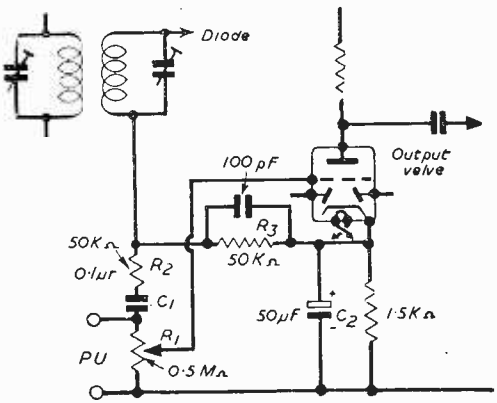


Fig. 3.—A typical pick-up input circuit of an average receiver.

Complete kit comprises Hi-craft 40 watt control unit, starter lamp, lamp holders, clips, and wiring diagram. Price 22/6 plus 1/6, or for callers only, complete with 40 watt daylight tube, 32/6.

FLUORESCENT LIGHTING BALLAST UNITS

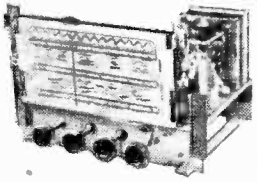
40-Watt Type. This is a combination condenser and choke unit for controlling fluorescent tubes. The only other item needed is a starter switch which can be an automatic type or an ordinary on/off manually operated type. We offer these well-made units at less than half price, namely 16/6 each.

STARTER LAMP

For fluorescent lighting 2-pin SBC, suits all types of tubes, 3/6 each. Lamp holder 2-pin SBC, 1/9.

OUTSTANDING VALUE OF NEW PRODUCTION

MODEL B. Six Wavebands, 11-15 metres continuous in 5 ranges (4 Bandspread) and M.W. 185-550 metres. Six position Tone Switch (3 Radio—3 Gram). Price £15/15/-, plus 7/6 carr. and insurance, or H.P. Terms £5/9/- deposit.



MODEL B3. Three Waveband, Long, Medium, Short, Gram. switching on wave change switch. 3 position Tone. Price £12/12/-, plus 7/6 carr. and insurance, or H.P. Terms £4/6/- deposit. Both chassis 11½in. x 7in. x 8in. high. Latest type valves: 6BE6, 6BA6, 6AT6, 6BW6, 6X4. A.C. mains operated, flywheel tuning, negative feedback over entire audio section, engraved knobs, fully guaranteed.

BUILT TO HIGHEST PERFORMANCE STANDARD AND SPECIFICATION

MAGNETIC TAPE RECORDER KIT—YOURS FOR £11/14/6

Total cost, £35.

Cabinet only, £4/17/6.

Tape Deck only, £16/10/-.

Tape Deck. Fitted with 3 motors giving fast rewind/forward run and no friction. High fidelity record/playback giving approximately 1 hour playing from standard 1,200ft. tape. Tape, 35/- per reel.

Amplifier. High gain enables recording to be made from microphone, pick-up, or loudspeaker. Separate bass and treble lift controls.

Cabinet. Portable, in rexine covered, table model is polished walnut.

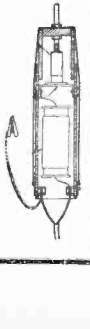
Instruction Booklet. Shows in close detail exactly how to assemble and operate the recorder, is free with kit or available separately at 5/- (credited if you buy kit or complete recorder). Complete kit of parts, including 6 B.V.A. valves, loudspeaker and cabinet (state whether portable or table model required). Price £35, or £11/14/6 deposit and 12 monthly payments of £2/6/3. Carriage/ins. 10/- extra.

RADIO STETHOSCOPE

A novel device aptly called a Radio Stethoscope is described in a recent edition of the "Radio Constructor," this is compact and can be slipped into the pocket rather like a fountain pen. With it in most districts a receiver can be checked from the grid of the first valve right through to the output without a signal generator, the stethoscope will operate in both L.F. and R.F. circuits without alteration. It is a complete fault finder.

The only parts needed to make the simple circuit tracer are a pair of crocodile clips, a germanium crystal, and a paper tubular condenser and we will supply whole outfit for 6/6, post free, and with each outfit we will give re-print of the article as it appeared in the "Radio Constructor."

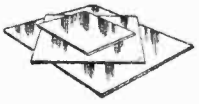
NOTE.—If you wish to make it up as a pocket unit then you will need a few other odds and ends, solder tags, etc., from your spares box.



T.V. SERVICING AID

Will enable service engineers to check video response, stage gain, etc., without removing the chassis from the cabinet.

Kit comprises B7G Plug, germanium crystal and indicator lamp together with making and operating instructions. Price only 6/6. Ditto, available for B9A, also 6/6.

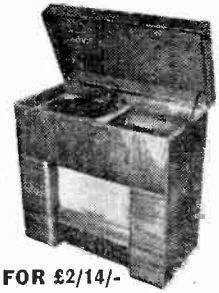


SHEET PAXOLIN

Invaluable for when you are experimenting. Size 12in. x 6in., 2/-. Size 12in. x 12in., 3/6. Size 24in. x 12in., 6/-.

Special offer this month.—12 pieces, each 8in. x 5in. medium thickness for 6/-.

29 GNS. AUTO RADIO GRAM 29 GNS.



Console type Cabinet. With full grained walnut finish, will take standard type auto change gram. unit. Price £11/10/-. H.P. Terms, £3/17/- deposit and 12 monthly payments of 16/9, plus 15/- carriage. **Radio Chassis to suit, £8/19/6.** H.P. Terms, £3 deposit and 10 monthly payments of 13/-, plus 7/6 carriage.

Auto Change Units. For long playing and standard records with suitable pick-up head. £11/11/-. **SPECIAL OFFER.**—Cabinet, Radio chassis and Auto Changer, 29 gns. H.P. Terms, £10/14/- deposit and 12 monthly payments of £2/3/-. Non-callers add £1 carr. and ins.

R.1155 FOR £2/14/-

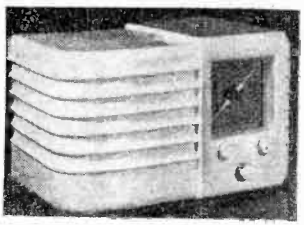
This set, as most will know, is considered to be one of the finest communications receivers available today. The frequency range is 7.5 kc/s to 18 Mc/s. It is complete with 10 valves and is fitted in a black metal case. Made for the R.A.F., so obviously a robust receiver which will give years of service. Slightly used but completely overhauled and guaranteed in perfect working order. **Price £7/19/6,** or will be sent against a deposit of £2/14/-, balance 12 monthly payments of 11/6. If you cannot call to collect please include an additional 10/- to cover cost of transit and carriage. This partly returnable to you if and when you return the transit case.

MAINS POWER PACK FOR R.1155

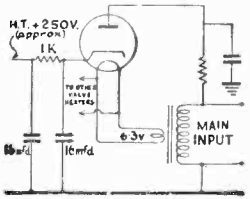
With pentode output stage. Plugs into socket on receiver so no internal modifications are required. Price £5/10/- complete with 5in. speaker ready to work, carriage 3/6.

PROFESSIONAL RADIOS YOU CAN MAKE

You will find that the building of our all-mains radio receivers is simplicity itself, and the more you make the less time each takes: everything down to the last nut and bolt is supplied and everything fits together in a professional manner. When finished the receiver looks and plays as well as those being offered in radio shops at anything between £10 and £14. The one illustrated above we call the "Occasional," in a choice of colours, Ivory or Walnut and the T.R.F. costs £6/1/6 plus 2/6 post and insurance (H.P. terms being £2/1/6 deposit and 10 monthly payments of 10/6), while the superhet costs approximately £9 (H.P. terms £3/2/- deposit and 12 monthly payments of 13/6).



The other radio illustrated we call the "White Lady." This is an extra fine cabinet of pure white. The complete T.R.F. receiver costs £6/5/-, H.P. terms being £2/3/- deposit and 10 monthly payments of 10/9. Constructional data for either set is available at 1/6, post free.



ADJUSTABLE THERMOSTATS

250 v. heavy silver contacts can be adjusted to operate between 70-300 deg. F. These are suitable for aquarium heaters, electric blankets, etc. 1 Amp. Model 3/6. 2 Amp. Model 5/6. 5 Amp. Model, 14/6. Post, etc., 6d. extra.

Don't be cold this winter, make an Electric Blanket, blueprint 1/6, post free.

A POWER PACK FOR 15/-

Efficient power supply, O.K. for operating a receiver, amplifier, instrument or other device requiring up to 60 mA. at approx. 250v. Parcel consists of filament transformer, rectifying valve, smoothing resistor and 16 x 16 mfd. 350v. electrolytic condenser. Note the filament transformer will supply enough current to operate 3 or 4 other valves.

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(*Continued from page* 158)

amplitude affects the crystal. Furthermore, the properties of the crystal provides an increase in output voltage at the lower frequencies (see Fig. 2a), but, although this does not wholly counteract the deficiency of bass in the recording, it does enable the crystal pick-up to be used, to a degree of satisfaction, on standard amplifiers and radios without extensive bass correction measures being necessary.

Owing to the reduction in needle velocity, coupled with the reduced response of long-playing records at the lower frequencies, it is easily realised that if we reproduce them via the medium of a magnetic head, the loss of bass will be more apparent than ever (see Fig. 2b), and will result in thin and reedy reproduction. Extensive measures are, therefore, necessary to give the desired bass-boost to an amplifier used in conjunction with a magnetic head to reproduce long-playing records—for usually the degree of compensation afforded by standard equipment is sufficient only to give the correct bass-boost to 78 r.p.m. records.

Another added advantage in favour of the crystal pick-up for general use is that it generates nearly three times as much voltage as the magnetic type

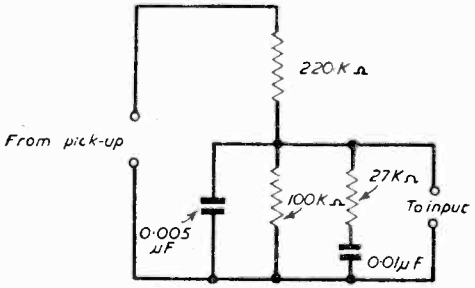

Fig. 4.—A bass-boost circuit for a magnetic long-playing pick-up.

operating under the same conditions. Therefore, apart from requiring extensive bass-boost, magnetic heads invariably require a pre-amplifier stage before they can be used successfully to drive a standard radio or amplifier.

The Motor

It is of paramount importance to the good reproduction of microgroove records that the motor speed be *constant*. With induction type motors, power-cuts obviously have some effect on their speed, but in this connection little can be done by the constructor. He should, however, ensure that the motor is free from drag, and that the moving parts are free-running and as near to being frictionless as mechanical ability will allow.

A motor which is running constantly a revolution or so fast or slow, will have little effect on performance; the trouble starts when the motor speed changes during an actual playing, for the effect is much more discernible on microgroove than on 78 r.p.m. discs.

The rim-drive motor is commonly employed nowadays, and is easily arranged to cater for the three speeds demanded of present-day records. These are much less expensive than their governor type counterparts, and are adequately suited for the needs of the home constructor. They should, of course, be well maintained; should a rumble or uneven motion suddenly develop, however, the rubber drive pulley will often be found to be worn, not perfectly even and smooth, but with a slight flat, which necessitates only the replacement of the worn pulley to bring the motor back to its normal smooth running condition.

Three-speed automatic record-changers have been developed using the rim-drive method, and follow closely the standard style of machine apart from, perhaps, the auto-trip mechanism. The old style of rotating striker would, of course, tend to jar the needle out of the groove each time it came into operation, so now a very light ratchet arrangement is employed which functions on the *outward* swing of the tone-arm from the centre of the eccentric play-out groove.

Pick-up Matching

In the main, the problems associated with changing over from 78 r.p.m. to long-playing records boil down to a poor bass response, coupled with inadequate volume. It matters not whether one is using an ordinary radio receiver or high-fidelity amplifier, the problems are there just the same, although, in certain cases, they may be more pronounced than in others.

Let us suppose, for instance, that we have a standard

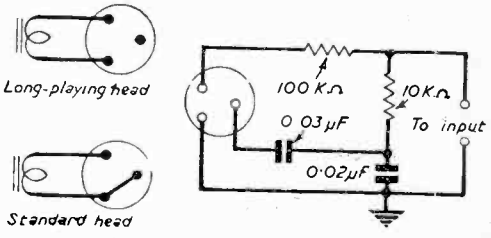

Fig. 5.—Automatic compensation system used in conjunction with Decca pick-ups.

radio receiver installed with pick-up terminals; and in conjunction with this we wish to use an add-on long-playing record unit which incorporates a crystal pick-up. As previously intimated, sufficient voltage is usually provided by this style of pick-up to feed straight into the pick-up terminals of an average receiver, therefore in this respect, at least, little trouble should be experienced. But from the quality point of view, the story might well be a little different.

It is most important to remember that when using a crystal pick-up its frequency response is critically dependent on the value of load impedance it works into. The correct figure is always given by the manufacturers, and should be strictly adhered to by the constructor. Too low a value has the effect of severely limiting the bass response of the pick-up, just the opposite to what we want for good reproduction.

Now to get back to our receiver. If we examine the input section we shall find quite probably that it closely follows the circuit of Fig. 3. Here R1 constitutes the volume-control, across which the pick-up terminals are connected. This style of receiver rarely employs a "gram/radio" change-over switch, for it is left to the operator either to de-tune the receiver or take out the aerial to prevent radio break-through whilst using a record-player. This means, then, that the pick-up is shunted not only with the ½ megohm volume-control, but also with the additional im-

pedance offered by the elements comprising C1, R2, R3 and C2. These, as will be seen, are fairly low in value, and result in an overall pick-up load impedance far too small for a desirable bass response.

The situation in this case may be eased by providing a " gram/radio " switch to disconnect C1 from the top end of R1 and the pick-up terminal. The total pick-up load impedance will then be governed solely by the value of the volume-control.

In older receivers a capacitor resistor combination was often employed across the pick-up terminals to damp the high resonant frequencies, which characterised the vintage type magnetic pick-ups. It follows, of course, that components of this nature must be removed from the circuit before satisfactory long-playing record reproduction can be attained.

If the inherent receiver design does not allow the necessary high value pick-up load impedance to be acquired, an additional resistor, to make up the stipulated value, should be included in series with the pick-up and the pick-up sockets. This arrangement not only facilitates the matching, but as it functions as a form of potential divider, it attenuates the voltage from the pick-up as fed to the grid of the valve by a ratio dependent on the value of the series resistance, and the impedance as measured at the pick-up sockets of the receiver.

If the constructor desires to play both kinds of records on an existing amplifier or receiver, it will be as well to fit a two-way switch arranged so that the long-playing position cuts out the existing compensation, and brings in the necessary matching components. In fact, some long-playing record units can be obtained already fitted with this kind of change-over switch.

Maintaining the bass response from a receiver used in conjunction with a magnetic pick-up demands different tactics. In this case it is usually found necessary to employ a tone-compensating network in series with the pick-up and input terminals. The component values used in the network will depend to a large extent on the design of the pick-up, and in this respect it is always advisable to seek assistance from the appropriate manufacturer.

For experimental purposes the simple circuit of Fig. 4 can be used, and if the indicated component values are employed the circuit will give a response very nearly equal to the reciprocal of the microgroove recording characteristic curve of Fig. 1b.

The Decca magnetic interchangeable head pick-up uses a similar circuit, which is automatically brought into operation by plugging in the long-playing head. This is facilitated by means of a three-pin plug on the head and a three-pin socket on the tone-arm. Fig. 5 illustrates this point, and it is clearly seen how the appropriate compensation is achieved. Furthermore, as the heads are of different weights, the problem of needle-pressure compensation is also solved.

No matter what method is adopted to provide bass-boost, however, the effective pick-up output voltage is bound to be attenuated, and very little is left to feed the receiver or amplifier—often little more than 20 milli-volts! When it is realised that a normal receiver needs at least a quarter of a volt to give satisfactory volume, it becomes obvious that additional features are demanded for the reproduction of long-playing records when using a magnetic pick-up. In certain receivers it will probably be necessary to add an extra valve, though it is sometimes possible to change one of the audio valves to a type giving a higher gain.

Hum troubles are likely to develop in the course of these modifications, and this point should be carefully considered, for the brilliant quality which long-playing records are capable of giving can be easily spoilt by a background of hum.

PHILIPS' ARTISTES DEPARTMENT

PHILIPS announce the acquisition of the Columbia American label, which means that they will periodically be issuing records of such famous celebrities as Frankie Laine, Jo Stafford, Guy Mitchell, Johnnie Ray, Doris Day, Rosemary Clooney, Mitch Miller, Paul Weston, Toni Arden, Frank Sinatra, etc.—names already established throughout Great Britain.

They also have under exclusive recording contracts the following British artistes, Gracie Fields, Flanagan and Allen, David Hughes (now starring in the London show, " Paris to Piccadilly "), Gary Miller, Jean Carson and Johnny Brandon (two latter names currently appearing in Emile Littler's " Love From Judy "), Hermione Gingold, Gilbert Harding and Geraldo.

They will be utilising various musical directors and arrangers and the first record issues contain the names Norman Warren, Geoff Love, Bruce Campbell, Geraldo and Peter Yorke. They are not exclusively employing any musical directors on Philips records as they intend to promote a policy of experimenting in the arranging field and building up names to world prominence.

It is also intended to build up as many new British personalities as possible for world exploitation by the Philips organisation, following the practice previously adopted by Leonard Smith and Norman Newell, late of Columbia records, and now responsible for the artistes side of the Philips organisation. Rita Williams will be responsible for vocal group commissions on Philips records.

As a temporary measure recording will be undertaken by Universal Programmes Corporation, 35, Portland Place, W.1, and until the acquisition of their own studios they are recording at Portland Place and Conway Hall.

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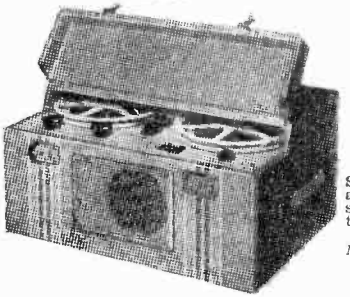

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- ★ Complete. Ready to switch on.

Supplied fully assembled and wired, with all valves, 1,200ft. spool of tape, take-up spool, crystal hand microphone, instruction book, and circuit diagram.

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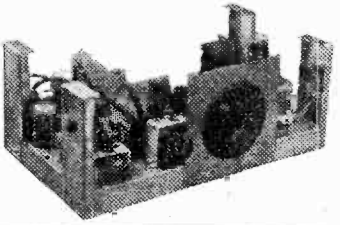

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Supplied in maker's original wood transit case. LASKY'S PRICE. **£11 19 6** Complete. Carriage 12/6 extra.

USED MODEL R1155 RECEIVERS. Aerial tested before despatch. Complete with 10 valves.
LASKY'S PRICE £7/19/6. Carriage 12/6 extra.

FULLY ASSEMBLED POWER PACK AND OUTPUT STAGE FOR R1155 RECEIVERS. For use on 200-250 volt A.C. mains. Wired and complete with valves.
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ROTHERMEL (DEAF AID) CRYSTAL MICROPHONES. Diaphragm driven. Extremely sensitive, can be used for tape recording, etc. Miniature 1¼in. diam., ¼in. thick. 7/6 POST FREE.

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3 Wavebands : 12-35 metres ; 35-100 metres ; 200-550 metres. Size : 4 x 4 x 3in. Price **16/-.**

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465 Kc/s Iron dust cores, in cans, midget type. Size : 1in. x 1in. x 2¼in. Price, **12/6** per pair.
Wearite Type 550. Permeability tuned. 445-520 Kc/s. In cans, size : 3in. high, 1½in. square. Price **12/6** per pair.
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4-station operation. For use on A.C./D.C. mains 200-250 volts. Supplied complete, with 3 new valves, ready for immediate installation.
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MASTER UNIT, £7/15/0. Carr. 5/- extra.

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LASKY'S PRICE, **8/6.**

No. 3. Midget. Less trimmers. Size : 2in. x 1¼in. x 1¼in., ¼in. spindle.
LASKY'S PRICE, **6/6.**

No. 4. Standard type. Size : 2¼in. x 2¼in. x 1¼in., ¼in. spindle.
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SPECIAL PARCEL OF MAINS DROPPING RESISTANCES. Wire wound, .1, .2, .3 amp. 12 Assorted. **15/-** POST FREE.

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All 200-250 volts c.p.s. primary. Finest quality, fully guaranteed.
MBA/3. 350-0-350 v. 80 mA, 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. Price, **18/-.**
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MBA/6. 350-0-350 v. 100 mA, 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price, **22/6.**
MBA/7. 250-0-250 v. 80 mA, 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. Price, **18/-.**
AT/3. Auto transformer. 0-10-120, 200-230-240 volts, 100 watt. Price, **17/6.**

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Special transformers. 2 amps, with the following tappings : 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts. PRICE, **17/6.**

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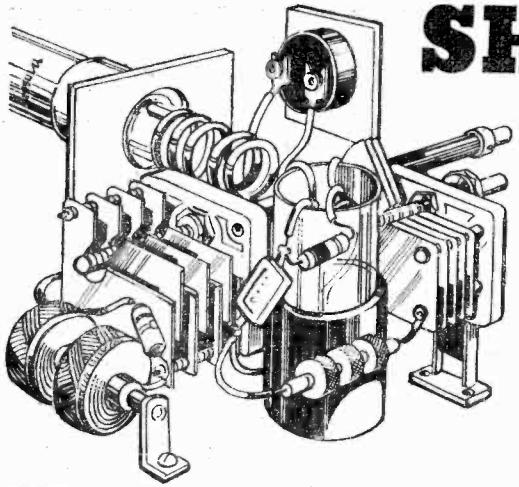


SHORT-WAVE SECTION

Modern American Amateur Communication Receivers

2.—THE NATIONAL H.R.O. "SIXTY"

By A. W. Mann

The latest models designed and produced by the company are the H.R.O. "Sixty" and the N.C. 183D. In this article we are concerned with the former.

THE senior model National H.R.O. amateur communications type receiver as available in this country previous to the war, was listed at £49 15s. complete with four plug-in coil units. The power pack and matched loudspeaker being available as separate items.

So far as the average amateur station receiving equipment was concerned, an H.R.O. senior model was the exception rather than the rule. Due to government disposal of surplus radio equipment, however, a considerable number of British amateur transmitting stations now include a senior H.R.O. among their receiving equipment.

Data

The valve line-up of this pre-war model was as follows: 1st R.F., 2nd R.F. and two I.F. valves were type 58. Mixer, 57. Second Det. 2B7, R.F. oscillator and B.F.O. respectively were type 57. Output valve, 2A5. The I.F. transformers being tuned to 456 kc/s.

The outstanding features of this model were the precision tuning dial, very efficient drawer type plug-in coil units, and band-spread facilities. The ranges covered being 1.7 to 4 Mc/s, 3.5 to 7.3 Mc/s, 7.0 to 14.4 Mc/s and 14.0 to 30 Mc/s. Additional coils were available if required.

The Senior H.R.O. is undoubtedly a very good receiver and still meets the requirements of many amateurs. So far as the 100 per cent. DX amateur is concerned, however, the rapidly increasing congestion on the amateur bands clearly demonstrates that even better amateur communications receivers will be required in order to guarantee a reasonable measure of consistent QSOs.

Post-war Models

The National Company, being fully aware of the situation, planned accordingly and produced the H.R.O. 50, followed by the H.R.O. 51, as well as other models.

The H.R.O. "Sixty"

This design retains the well-known drawer type plug-in coil units, together with the National precision type tuning dial, but, in addition, an edge lighting, direct reading frequency scale is included. The range in use only being shown at one time.

Dual Conversion

In keeping with modern practice, dual conversion is used, the H.R.O. "Sixty" being what we term here a double superheterodyne.

There are three 456 kc/s I.F. stages employing 12 permeability tuned circuits on all bands and in addition one 2,010 kc/s I.F. stage on all frequencies above 7 Mc/s.

National Company practice in the past has been to build the heavy-duty power supply as a separate unit. In the present instance the power supply is built in, but very effectively isolated from the receiver section.

H.R.O. "Sixty" Coverage

The coverage of this receiver as supplied is as follows: 50 to 430 kc/s, 480 to 35 Mc/s, 50 to 54

The H.R.O. "Sixty." Photo by courtesy of the National Co., Inc.

Mc/s. 'Phone, C.W. and N.F.M. being available with an adaptor.

Valve Complement

6BA6, 1st R.F.; same for 2nd R.F.; 6BE6, mixer; 6C4, H.F. osc.; 6BE6, 2nd H.F. converter; 6SG7, 1st I.F.; same for 2nd and 3rd I.Fs., 6H6, det. and A.V.C.; 6H6 auto noise limiter; 6SJ7, 1st audio; 6SN7 phase splitter and S meter amplifier; 6V6GT (two) PP audio; 5V4G, rectifier, 6SJ7, B.F.O.; OB2, voltage regulator; 4H4, osc. filament current regulator.

Sensitivity, 1Mv or better at 6 db signal-to-noise; selectivity being variable from 8 kc/s overall to approximately 1,200 cps at 40 db.

Power output 8 watts undistorted push-pull audio amplifier; fidelity plus or minus 2 db, 50-15,000 cycles at gramo input.

Image ratio: better than 65 db at any frequency up to 35 Mc/s. The makers claim that after warming up receiver frequency drift is negligible.

Other New Features

It is worthy of note that in the H.R.O. "Sixty," the H.F. oscillator and 6BE6 mixer heaters are current-regulated, and the H.F. oscillator and S meter amplifier are voltage-regulated.

Readers who were interested in the Select-O-Ject as described in Q.S.T., November, 1949, issue, will remember that this device will reject an unwanted signal, or on the other hand, boost a wanted signal above interference and background noise. A special accessory socket is fitted for the use of this unit, of which the National Company produce a commercial version.

Panel Controls

If readers will refer to the illustration accompanying this article they will gain a good idea as to the panel control layout. Top, centre: edge-lighted frequency scale; in centre, micrometer dial for logging. Bottom, centre: plug in coil unit A shown in place. At extreme left, top limiter control. Centre A.F. gain; next, calibration switch, bottom C.W.O., and 'phone jack. Centre panel, smaller control knobs are, top left, band switch, centre tone, and antenna trimmer respectively. Right of centre panel: top oscillator, dimmer, A.V.C. switch.

Extreme right: top selectivity, centre phasing, H.T. switch; bottom right: R.F. gain; left: combined Am-NFM-Phono switch.

The dimensions of the table model are 19¾in. × 10⅝in. × 16½in. The shipping weight, complete with speaker and four coils, is 100lb. Rack models are also available.

Precision Engineering

The H.R.O. "Sixty" specification and high-class workmanship, places it in the precision radio instrument class. Like its predecessors, it is somewhat higher-priced than the types which fall within the province of the average transmitting amateur and short-wave listener. There are several outstanding short-wave receivers in the lower-priced classes, it is admitted, but those who can afford the necessary outlay will enjoy short-wave amateur band listening at its best.

Extra Coil Units

Additional coil units are available should they be required. These are listed as: H.R.O. 60AA, 27-30 Mc/s; 60AB, 25-35 Mc/s; 60AC, 21-21.5 Mc/s; 60AD, 50-54 Mc/s; 60A, 14-30 Mc/s, bandspread, 27-30 Mc/s; H.R.O. 60B, 7-14.4 Mc/s, bandspread, 14.0-14.4 Mc/s; 60C, 3.5-7.3 Mc/s, bandspread, 7.0-7.3 Mc/s; 60D, 1.7-4.0 Mc/s, bandspread, 3.5-4.0 Mc/s. The A, B, C, D being supplied with the receiver as standard equipment.

For the lower frequency bands, the following are available: H.R.O. 60E, 900-2,050 kc/s; 60F, 480-960 kc/s; 60G, 180-430 kc/s; 60H, 100-200 kc/s; 60J, 50-100 kc/s.

Barnstaple Transmitting Station

ON December 11, 1952, the new permanent transmitting station, at Fremington, between Barnstaple and Bideford, took over the West of England Home Service on 285 metres (1,052 kc/s) from the temporary transmitter which has been operating from a caravan on the site. This is one of a number of low-power stations being built by the BBC to improve reception of the Home Service in certain areas.

The new transmitter, which is of higher power than the caravan transmitter, will extend the area of improved reception beyond the immediate surroundings of Barnstaple and Bideford to include outlying districts such as Northam, Great Torrington, and South Molton.

The equipment, housed in a building some 14ft. square, is designed for completely automatic operation without the attendance of staff. It comprises two Marconi transmitter units working in parallel to give an output of 1¼ kW. Later a third transmitter unit will be added, increasing the total power to 2 kW.

Main and reserve crystal controlled drives are provided, and automatic frequency control equipment will shortly be installed which, using the Droitwich 200 kc/s carrier as a reference, will maintain the transmitter drive frequency within very close limits of accuracy.

Automatic monitoring equipment supervises the performance of the transmitting equipment itself by comparing the programme fed to the transmitter with that being radiated. Each transmitter unit is fitted with a monitor which checks the input against the output before the latter reaches the combining circuit, and in the event of a fault in one of the transmitter units it would be automatically disconnected, leaving the station running on reduced power. Should further faults occur, the affected transmitter units would be closed down by their respective monitors.

In order that the engineering staff at the parent centre at Bristol may obtain information regarding the condition of the equipment at Barnstaple a telephone indicator device has been installed. A telephone call to the station will cause this equipment to send to line a series of coded tone-pulses—similar to those used on an automatic telephone system for indicating "dialling," "ringing" or "number engaged." From the particular tone code heard the engineers can determine the state of the various items of equipment at the station. Such calls are made as a matter of routine during programme hours so that, if necessary, an engineer can be sent out.

News from the Trade

New EKCO Export Table Autoradiogram

ANNOUNCED a short time ago by E. K. Cole, Ltd., and now in full production, is a new export three-speed table autoradiogram, the TRG189, which possesses several outstanding features.

Playing automatically all sizes of standard and long-playing records, the TRG189 covers medium and short waves in three ranges and is fed from A.C. mains of 100/150 volts or 200/250 volts, 50 or 60 cycles. These features make it particularly suitable for overseas purchasers, including visiting forces, who wish to use the set in this country and later take it overseas.

The radio unit incorporates a two-speed tuning control and the 5-valve circuit gives excellent reception on short-waves, including the 11-metre band. The set is fully tropicalised.

E. K. Cole, Ltd., Southend-on-Sea, Essex.

Windsor Capacity and Resistance Bridge (Model 110c)

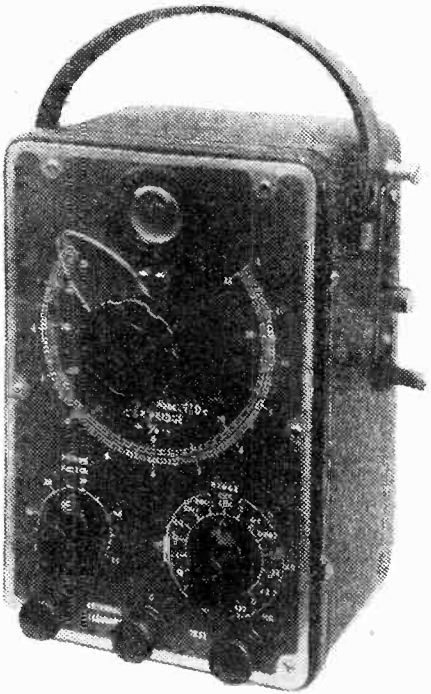
THIS new bridge from Taylor Electrical Instruments, Ltd., operates from A.C. mains and is designed to give accurate measurements of capacity and resistance at 50 cycles.

Eight capacity ranges enable measurement to be made from 5 pF to 1,200μF, and eight resistance ranges are available covering from 0.1 ohm to 120 megohms.

Special comparator scale marked in percentage is incorporated for checking components against external standard.

Power factor measurements up to 50 per cent. are available on all capacity ranges.

A conventional bridge circuit is used and when measuring capacity an internal standard capacity with a variable series resistance constitutes one arm of the bridge. The other arms comprise a variable resistance calibrated 0—12 and a fixed resistor. The condenser under test makes the fourth arm of the bridge. A.C. volts from a low-voltage screened secondary winding of the mains transformer are applied to the bridge and the out-of-balance voltage is amplified by a 6J5 valve which is resistance coupled



The new Model 110c Windsor Bridge.

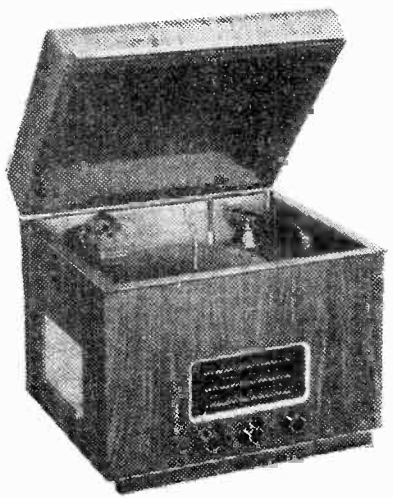
to a "Magic-eye" valve. This combination is very sensitive and small out-of-balance voltages are indicated by a blurring of the "X" shaped shadow of the "Magic-eye" valve. The variable resistance in series with the condenser is calibrated 0—50 and measures the power factor. On resistance ranges the internal resistance standard is switched into the bridge in place of the condenser and the power factor control.

The outer scale marked 0—12 is used on all capacity and resistance ranges and has a length of 9in., giving a total scale length of 72in. on both capacity and resistance measurements.

The inner scale is marked in percentage giving plus 50 per cent. and minus 25 per cent. for comparison purposes when components are checked against external standard.

The complete instrument is 8in. x 5¼in. x 5in. deep and weighs 6 lbs. Mains consumption is 15 watts, and the price £14 10s.

Taylor Electrical Instruments, Ltd., 419/424, Montrose Avenue, Slough, Bucks.



The Ekco Model TRG189.

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).

"Safe" Universal Circuits

SIR,—With reference to the article in the October issue on this subject, I would like to point out a consideration when using an A.C./D.C. circuit off a D.C. supply.

Correct polarity is necessary, of course, before the circuit will operate, the chassis usually being negative. On examining a D.C. supply it may be found that the positive line is approximately at earth potential, i.e., the positive line is the neutral. It would obviously be useless to connect the neutral to the chassis in this instance, and there is no simple alternative but to operate the circuit with the chassis "line" to earth.

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 with the coupon from page iii of cover.

The reason for this somewhat peculiar state of affairs is the "three-wire" system of distribution often used in the case of D.C. supplies. The voltage originates at twice the value at which it is used by a normal domestic consumer and the centre point is earthed. The result is that one line is at, say, 240 volts above earth potential and the other at 240 volts below earth potential.

Briefly, it must not be assumed that the negative line is at approximately earth potential.—E. C. COX (Chesterfield).

High Fidelity Record Reproduction

SIR,—In the search for better listening, I have worked through the usual apprenticeship—building quality amplifier, good speaker in bass reflex cabinet, etc.—studying, reading and researching at each step, and I now find myself back at the beginning of things, the place where the noise comes from—the point of contact between stylus and record. I am driven to conclude that the greatest obstacle today to good listening is surface hiss. The more one strives after distortionless output and extended frequency range, the more obtrusive becomes that hiss and the more pressing the question of what can be done about it.

Assuming that the practice has ceased of incorporating abrasives with the material from which the record is pressed in order to grind the needle quickly to the shape of the groove, and that a modern resonance-free pickup has made scratch-filter circuits superfluous, the answer seems to be nothing but top cut. The latest oscillograph investigations show the hiss evenly distributed over the whole of the range of audibility. Having striven for extended frequency response, to cut that top is not encouraging.

It has occurred to me that perhaps a lubrication of the stylus point might help. I have been trying the old idea of using a record polish, a mixture of one third linseed oil and two thirds white spirit (turps substitute). The record is first cleaned with a velvet pad, oiled as sparingly as possible, polished with a soft cloth and played through with a sapphire needle. It is then polished again and set aside to dry. Judging by ear alone, I fancy the results are encouraging. Could any fellow sufferer suggest another mixture that I could try on my worn shellac discs? Being only an impecunious schoolmaster, I can't afford to throw them all away because I see no hope of ever replacing them, on my salary.

Finally, how much extra would it actually cost the customer to buy 78 r.p.m. records pressed in noise-free plastic instead of slate-filled shellac?—R. E. THOMAS (Tolworth).

Battery-Mains Portable

SIR,—I have just successfully completed the Battery-Mains Attaché Case Portable, described in the January, 1953, publication of PRACTICAL WIRELESS, and there are one or two points which I feel may be of interest to future constructors.

The only "snag" I met with was acute distortion on maximum volume, and I found this to be due to bias trouble in the second detector and output stage.

The reproduction was 100 per cent. improved by replacing R4 (10 MΩ) with a 470 KΩ, similarly one 470 KΩ replacing R7 (2.2 MΩ) and R8 (680 MΩ), entirely eliminated the distortion with a very slight drop in volume.

The second point which may be of interest is that a slightly larger frame aerial did improve sensitivity quite appreciably. This was wound with 12 turns of 30 s.w.g. enamelled wire on a former having dimensions of 10½in. × 9½in. I also found that this increase in size also affected the overall gain of the set, thereby increasing the number of foreign stations received at a comfortable "listening" volume.—I. S. R. HAYNES (Croydon).

Accurate Diagnosis

SIR,—My belated thanks for your assistance in solving my valve-voltmeter problem.

By pin-pointing the possibility of the trouble being in the earth leads I was led directly to the fault. I had too readily assumed the trouble in the home-

(*Continued on page* 173)

(*Continued from page* 170)

built unit—in fact, the earth lead of the Avo oscillator was sheared clean through inside the insulation.

You feel silly when one like that beats you. —P. BURGESS (Paisley).

TV Harmonic

SIR,—I noted with interest the letter by Mr. J. Law, under the heading "TV Harmonic," as some time ago I experienced a similar instance.

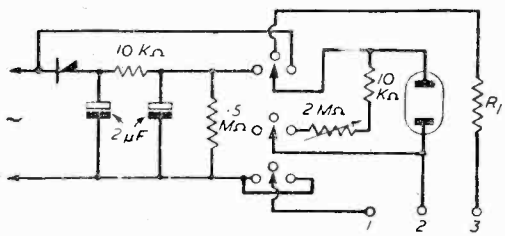
I was servicing a Cossor 916 TV receiver and after completing the repair work I left it, still out of its cabinet, on soak test. At a distance of about 3 yards away, on another bench, I was checking a four-valve battery superhet for S.W. performance when I came across the TV sound transmission on approximately 30 metres. Upon switching the TV on and off the transmission on the radio went on and off in sympathy.

As the frequency of the sound I.F. of the TV is 9.5 M/cs, it would appear that some form of I.F. radiation (complete with modulation) was taking place.

If Mr. Law has a TV set himself (or his immediate neighbours), it would account for his experience. —W. J. BLANCHARD (Ulceby, Lincs).

Quick Capacitor Tester

SIR,—I would like to suggest that the "Quick Capacitor Tester," as described in the January, 1953, issue, could be made more useful if a third terminal was added, and connected via a resistor R1 to the centre ("off") contact of the upper switch wafer. Then the neon tube could be used as a voltmeter, using the right-hand test terminal and the extra terminal (2 and 3 in the diagram). Also, by



Circuit referred to by Mr. Reakes.

connecting a resistor between terminals 1 and 2 (marked "Test" in the original article) and a capacitor between 2 and HT+, and setting the switch to the D.C. position, the circuit would become an oscillator whose frequency is given by the formula

$$f = \frac{1}{CR \log_e \frac{V_3 - V_1}{V_3 - V_2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where f = frequency c/s

C = Capacity across 2 and HT+ μF

R = Resistance across 1 and 2 MΩ

V_1 = Extinction voltage of neon tube

V_2 = Striking voltage of neon tube

V_3 = H.T. voltage

and for a given neon tube and H.T. voltage is

$f = \frac{K}{CR}$ where K is a constant whose value depends on V_1, V_2 and V_3 as in equation (1).

Most small neon tubes will oscillate from very low frequencies up to low radio frequencies.

The amplitude of the oscillation is approximately $V_2 - V_1$ volts peak-to-peak.

The output is taken from across terminals 1 and 2, via a capacitor to block the D.C. component.

In the diagram the circuit component values are as given in the article referred to. The series resistor R_1 is merely to limit the current through the neon tube and a value of 10-100 KΩ should prove satisfactory. A little experiment will soon satisfy this point.

The use of such a voltmeter for checking which side of the mains the chassis of an A.C./D.C. set is connected, if switches are connected in the "live" leads or not, the presence (or absence) of screen and anode voltages of valves are a few of the more obvious uses of this device.

Because the waveform of the oscillator contains a large number of harmonics, it can be used to calibrate other oscillators if the fundamental frequency (f in equation (1)) can be set accurately—say, by beating with the 50 c/s mains.—E. R. REAKES (Worthing).

Contact Operation and Maintenance

(*Concluded from page* 138)

across the contacts. This capacitor should be of mica construction and 1μF to 4μF in value. In order that the capacitor should not immediately discharge across the contacts during the opening time, a resistor of value 25Ω to 100Ω should be inserted in series with the capacitor. Higher values of resistor should not be used, as this will reduce the effectiveness of the capacitor during its primary charging cycle.

Summarising, the following points should therefore be noted for the operation of contacts in electrical equipment:

The contacts should be aligned so that the maximum surface area is used.

Where possible a dust-cover and flame barriers should be used.

Contacts carrying high values of current should be oil-immersed, have a fast release movement and, if possible, be assisted by a magnetic blow-out.

Contacts carrying low values of current should have a degree of self-cleaning action, and in all cases a dust-cover should be fitted.

Maintenance tools should be capable of adjusting operating travel, tension and rest position. Carbon tetrachloride should be used in conjunction with a dead-smooth contact file to ensure cleanliness of contacts.

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