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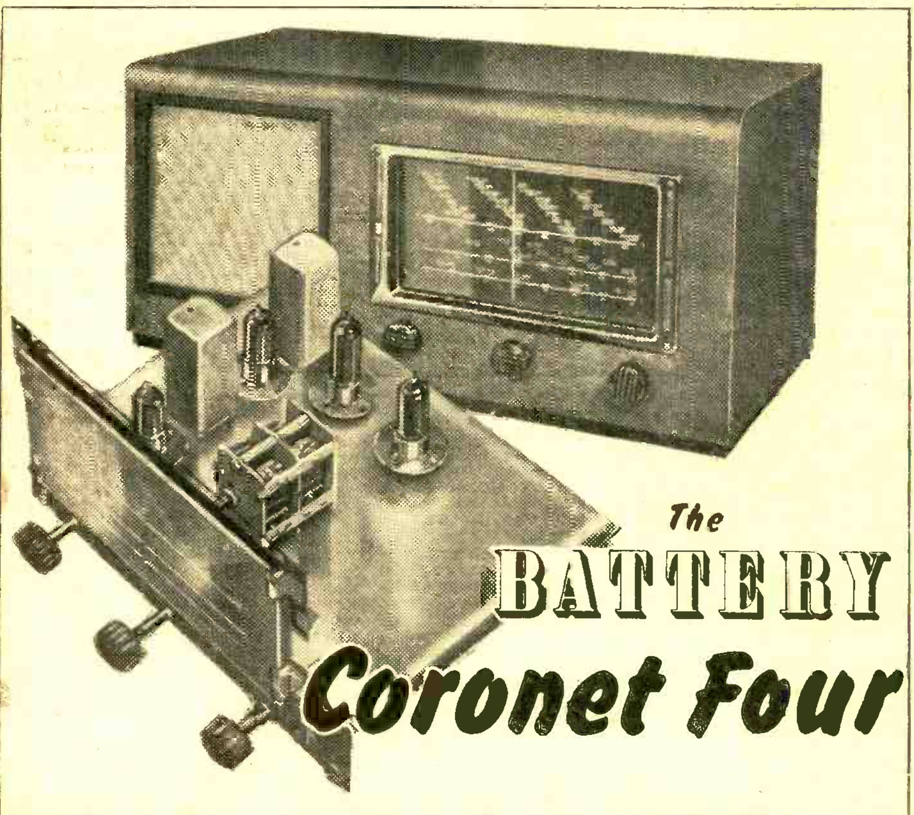
Vol. 30 No. 570

APRIL 1954

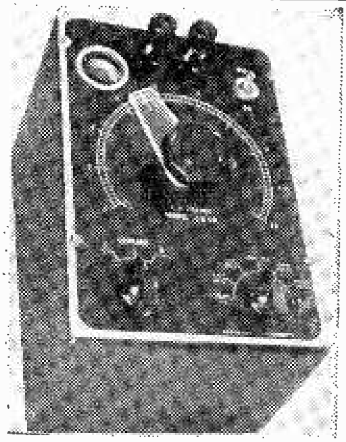
EDITOR: F.J.CAMM

PRACTICAL WIRELESS



The BATTERY Coronet Four

IN THIS ISSUE:



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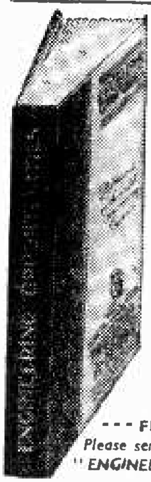

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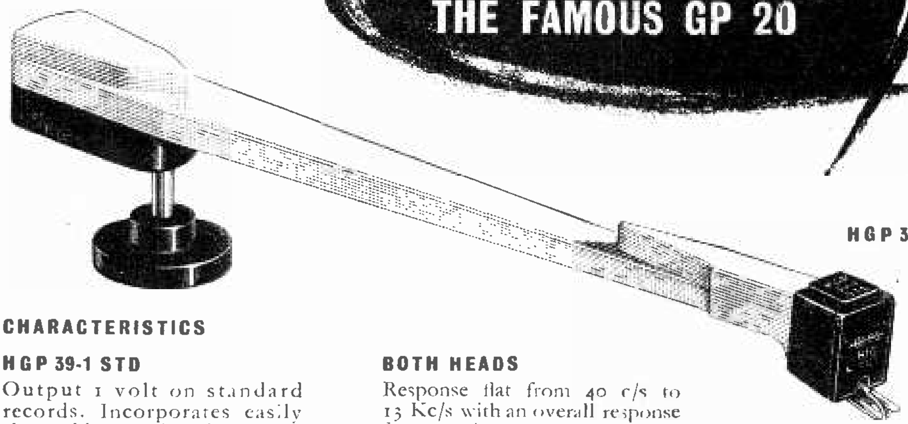

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Practical Wireless

EVERY MONTH
VOL. XXX, No. 570, APRIL, 1954

Editor: F. J. CAMM

22nd YEAR OF ISSUE

COMMENTS OF THE MONTH

By THE EDITOR

Mobile Radio

USERS of mobile radio systems are facing difficulties, as is clear from recent announcements in Parliament by the Postmaster-General. Mobile radio, of course, refers to two-way radio, developed during the war years by the police and fire services. It was so successful that when the war ended its importance in increasing the efficiency of all services using vehicles became apparent. There are over 10,000 radio equipped vehicles operating in Britain to-day, including radio equipped taxi cabs and ambulances. Tug-owners, electricity authorities, transport operators, the Automobile Association, industrial users and publishers (the publishers of this journal were the first in the trade to make use of two-way radio) are among those who make use of the system.

A struggle is now taking place to obtain wavelengths from the authorities for these services. The first frequencies granted for taxis and tugs in 1947 were somewhat grudgingly conceded after a long struggle and it took a further eighteen months to convince the G.P.O. that ambulance radio justified a further allocation of frequencies. During 1947-48 the mobile services were given operating frequencies in the 70-megacycle band, but then the G.P.O. decided to refuse further licences because, as they said, all future allocation would be in a new band—156-185 megacycles, —and this was promised as the permanent band for the services quoted above.

Manufacturers went to great expense to redesign apparatus for this band, causing installation to cease for about a year. Further, it was not made clear, either to manufacturers or users, that this new frequency allocation was contrary to an international agreement signed by the G.P.O. in 1947 on behalf of the Government, nor was it made clear that the BBC was claiming these frequencies for television. The manufacturers and users were committed to heavy expenditure over the past five years, and now the Postmaster-General blandly announces his intention to cede a large part of it to the new TV services! Naturally, manufacturers have protested that he should do this without consultation with representatives of the users. It must be pointed out that the use of the mobile frequencies for TV will be a further contravention of the international agreement. Worse than that, under the new arrangement the TV band will lie adjacent to the mobile frequency band, and it is obvious that they will seriously interfere with each other unless a sort of Utopia or guard band is left between the two services. It is clear that users are to lose a large part of their frequencies at some future unspecified date; that they may lose further frequencies: that they will be given no guarantee against recurring changes of frequency involving further expense, and that they will not receive compensation for the expense involved. No wonder that sales of two-way radio installations have reached a standstill and that the export of such apparatus has been harmed. We hope that the P.M.G. will give further consideration to this matter.

"THE PRACTICAL MOTORIST AND MOTOR CYCLIST"—OUR NEW MONTHLY

ON April 8th will be published an addition to our group of practical journals—THE PRACTICAL MOTORIST AND MOTOR CYCLIST, 1s. monthly, and in the same style and format as *Practical Mechanics*. It is designed to appeal to every motorist and motor cyclist who takes an intelligent interest in his car or motor cycle. It will show him how to tune up his engine so that the most economical performance is obtained, how to fit new pistons and rings, renew the bearings, adjust the steering, back-axle and gearbox, and in fact do all those repairs which do not need factory equipment. It will review the latest cars, motor cycles and accessories, and its readers will have the services, free, of a panel of automobile experts—all men of wide practical experience and practising automobile engineers who know the troubles usually encountered and methods for their speedy and economical repair. The magazine is lavishly illustrated by a staff of expert photographers and draughtsmen.

Repair, maintenance and overhaul is the theme of this new monthly of ours, an important mission in view of the rising costs of repairs, the high cost of new cars, and the large number of old cars which perforce must still be kept in good running order. If you are a motorist you should order this important new monthly journal to-day. *Remember the date—April 8th for the issue dated May.*—F. J. C.

ROUND the WORLD of WIRELESS

Largest Transmitter

A GIANT transmitter, the largest in the world, went into operation at Jim Creek Valley, Washington, towards the end of last year.

The transmitter has a power of 1,200,000 watts and was built for the U.S. Navy by R.C.A. It will enable the naval authorities to communicate with any of their units in any location using c.w. on any frequency from 14.5 to 35 kc/s.

Two identical units are operated in parallel in the transmitter, either of which can be worked independently should the other be put out of service.

Thimble-size Transistor

IT is learned that a transistor the size of a thimble and 100 times as powerful as commercially available types has been developed by the Minneapolis Honeywell Regulator Company.

Dr. Finn J. Larsen, research director, has stated that the new power unit, with an output of 20 watts, is capable of doing work not possible with the lower-output type.

Radio Exceeds Electricity

IT is reported that the number of homes in the United States with radio receivers exceeds the number powered by electricity.

According to the census bureau, 95.7 per cent. of all homes have wireless with only 94 per cent. having electricity. The difference indicates battery sets in use. The report shows that the number of radio homes increased from 40 per cent. in 1930 to 83 per cent. in 1940 to practically one or more in every home in 1950.

Mr. J. W. Barrow

RECENTLY appointed deputy general manager of the M.S.S. Recording Company, Limited, of Colnbrook, Bucks, is Mr. J. W. Barrow, A.M.I.P.E.

Educated at Prescot Grammar School and St. Helens Technical College, Lancs, Mr. Barrow served an apprenticeship with British Insulated Cables and was afterwards connected with the development of their Meter, Welding Machine and Moulding Machine Factories. In 1942 he was appointed works manager of their Cressex Works at High Wycombe, at that time manufacturing aircraft components, and at the end of the war became works manager of the United Insulator Company, Limited. Since 1949 until his present appointment, he has been connected with the development of the overseas factories of British Insulated Callender's Cables, Limited.

Politicians on the Air

IN a written reply, Mr. D. Gammans, Assistant Postmaster-General, has stated that, between January 1st, 1952, and November 30th, 1953, the number of members of the House of Commons to have broadcast includes 248 Conservatives, 247 Socialists, 15 Liberals and 3 Irish Nationalists.

British Standard for Magnetic Tape Sound Recording

THE British Standards Institution has recently issued a revision of B.S. 1568, the new standard being entitled "Magnetic tape sound recording and reproduction for programme interchange."

The standard specifies the requirements for recording on magnetic tape and of the associated recording and reproducing equipment which are necessary for the successful interchange of recordings for broadcasting or similar purposes.

Copies of the standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 2s. 6d.

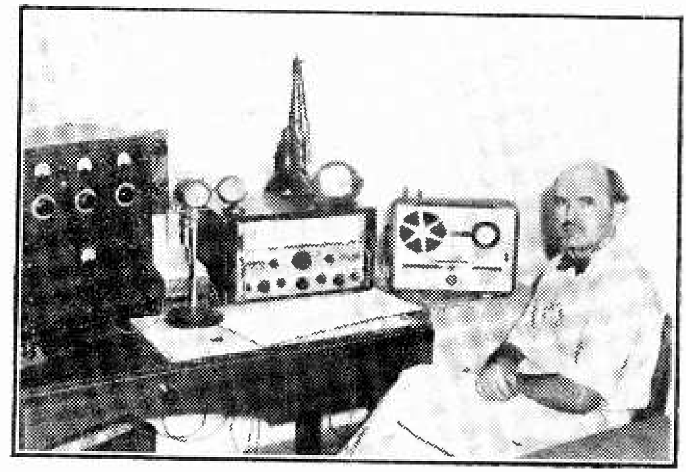
Confiscation of Receiver

WHEN a Hounslow man was convicted of operating a radio without a licence recently the G.P.O. applied for an order to confiscate his set. The man, William John Daniels, pleaded guilty and was fined £2 with 10 shillings costs.

It was alleged that Daniels denied that he possessed a radio receiver and refused officials permission to enter his home.

Drama Students' Prize

FOR the second year the BBC is to hold a competition for drama students at Broadcasting



S. A. Faulkner, of the Inland Revenue Department, Kuala Lumpur, Malaya, is seen with his transmitter VS2DB. His transmissions are regularly received in this country. Mr. Faulkner uses a Grundig "Reporter" Tape Recorder to record his contacts' transmissions, and plays them back immediately for their benefit.

House, London, at the end of June. The prizes, which are for proficiency and promise in the art of acting for the microphone, are open to not more than six final year students (three of each sex) from each of the Drama Schools which conduct regular instruction in microphone acting technique to an approved standard.

The two winners (one student of each sex) will each be offered a six months' engagement with the BBC Drama Repertory Company, starting within three months of the prize competition. The two runners-up (one of each sex) will receive a cash prize of £25 each.

Broadcast Receiving Licences

THE following statement shows the approximate number of sound receiving licences issued during the year ended December, 1953. The grand total of sound and television licences was 13,268,270.

Region	*Number*
London Postal ...	1,663,886
Home Counties ...	1,451,100
Midland	1,268,154
North Eastern ...	1,651,247
North Western ...	1,288,982
South Western ...	1,016,844
Wales and Border ...	644,451
Total England and Wales	8,984,664
Scotland	1,110,629
Northern Ireland ...	216,131
Grand Totals	10,311,424

B.I.R.E.

THE following meetings will be held during March, 1954:

London Section.—Wednesday, March 31st, 6.30 p.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1.—" Radio Astronomy." R. Hanbury Brown (University of Manchester—Jodrell Bank Experimental Station).

Scottish Section.—Friday, March 12th, 7 p.m., at the Department of Natural Philosophy, The University, Edinburgh.—" The Acoustic Design and Measurement of Buildings "—H. C. Watson (Newall's Insulation Co., Ltd.). Thursday, March 11th, 7 p.m., at the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow.—" The Acoustic Design and Measurement of Buildings," H. C. Watson (Newall's Insulation Co., Ltd.).

North-Western Section.—Thursday, March 11th, 7 p.m., at the College of Technology, Sackville Street, Manchester, 1.—" Colour Television," G. B. Townsend (Research Laboratory, General Electric Co.).

West Midlands Section.—Tuesday, March 23rd, 7.15 p.m., at Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.—" Industrial Application of Electronic Instruments," A. G. Wray, M.A. (Marconi Instruments, Ltd.).

British Radio Telephone for Turkish Police

A COMPLETE Pye Multi-carrier System has just been installed at Adana, in the south of Turkey, in an attempt to combat crime both there and at the port of Mersin.

The system consists of a 15-watt control station, controlling two 50-watt repeaters mounted at points where maximum coverage can be obtained. The whole system is duplex, and it is possible to connect telephone subscribers so that they can speak direct to any of the patrolling police vehicles.

Marconi Marine Appointments

THE Marconi International Marine Communication Co., Ltd., announces the appointment of Mr. J. W. Dalton as manager of its Grimsby depot. Mr. F. W. J. Grinter, who since July, 1953, has been in charge of the company's depots at both Hull and Grimsby, will continue to be responsible for contracts business in both areas for the time being.

Like most senior depot personnel, Mr. Dalton, who is a native of South Shields, commenced his service on the seagoing staff of the Marconi Marine Co., which he joined in 1928.

In 1946 he was appointed manager of the Cape Town depot of Marconi (South Africa), Ltd., where a considerable amount of his work was with the South African fishing fleets. He remained there until October, 1953.

Radio and Radar for Ship

A " RADIOLOCATOR IV " radar installation, other electronic aids to navigation, and radio communication equipment have been fitted on board the new motorship *Port Montreal* by members of the technical staff of the Glasgow depot of the Marconi International Marine Communication Co., Ltd. The *Port Montreal*, a vessel of 6,400 tons, has been built at Govan, by Harland and Wolff, Ltd., to the order of the Port Line, Ltd.

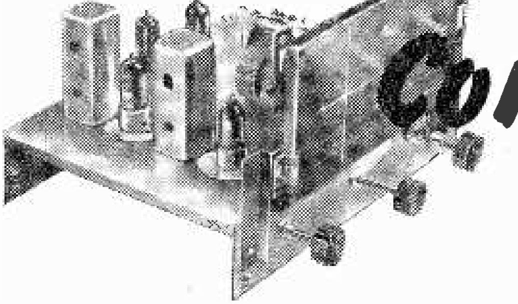
Home Service and Light programme listeners recently heard the last in the series of " Bedtime with Braden," featuring Bernard Braden and Barbara Kelly, pictured above. The show will be off the air for some months while Braden visits his native Canada.

Hungary Steps up Programmes

HUNGARY has increased its domestic radio programmes by six hours a day and transferred its foreign transmissions to a new station.

The Kossuth and Petöfi stations, which previously carried both home and foreign programmes, will in future broadcast only Hungarian-language items. Each will increase programme time by six hours. Kossuth will broadcast from 4.30 a.m. until midnight; Petöfi from 6 a.m. to 11 p.m.

The BATTERY Coronet Four



OUR POPULAR 4-VALVE SUPERHET IN SIMPLIFIED FORM FOR OPERATION FROM DRY BATTERIES

THE success of the Coronet Four in its original A.C. form resulted in many inquiries from readers who either had no mains facilities or who were on D.C. As a result of these inquiries we produced an A.C./D.C. version which has proved just as popular—although, in view of the limitation of H.T. supplies, the performance is not quite so good as that of the straight A.C. model. Many readers are, however, without any mains facilities and have asked for a battery version of the receiver, and to satisfy these requests we have modified the original model for battery operation. This is not a straightforward modification, however, as in both the previous mains models the actual circuit consisted of only three valves, the fourth in each model being a mains rectifier. Three valves would, however, give a very inferior performance with the limited power supplies which are available to the battery user, and accordingly we have added a further stage of L.F. amplification. In this way we have retained the original idea of using a single design which could be adapted with the minimum of changes in components—the most important of which are the coils, tuning arrangements and chassis. The photographic illustrations will show that the original layout has been retained, the output valve now being inserted in the valveholder position originally used for the rectifier, whilst the position of the original output valve is now used for the combined diode and pentode L.F. stage.

The mains transformer cut-out is not needed, and therefore if a new chassis is being made or purchased it need not contain either this rectangular cut-out or the two holes for the electrolytic condensers. Furthermore, the large clearance hole in the rear chassis used originally for the mains connector is not

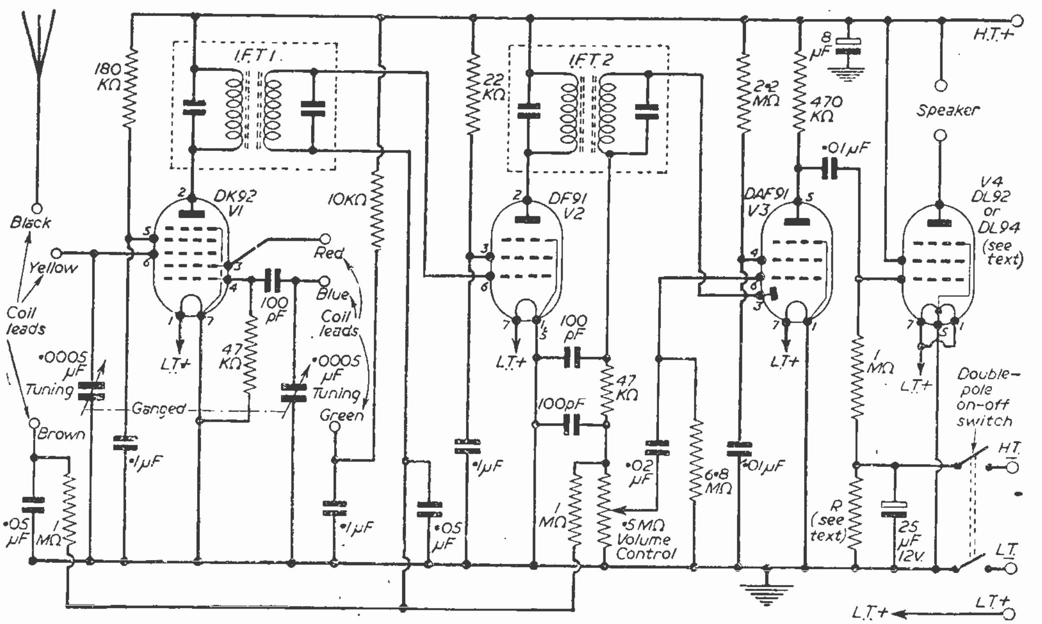


Fig. 1.—Theoretical circuit of the Battery Coronet.

now required and can be replaced, if a new chassis is employed, by a standard grommet through which the battery leads are taken. If a ready drilled chassis as used in the two previous models is employed, the leads may be simply taken through the larger hole without a grommet.

The Circuit

From the circuit given on page 202 it will be seen that basically the main arrangement has been retained, the frequency changer now being a heptode, as there is not available a triode-pentode or similar valve for all-dry operation. It was thought desirable that this receiver should be for all-dry working, rather than to use the obsolescent type of two-volt accumulator type valves, although it must be remembered that the batteries used for the filaments do not have an unduly long life. However, more about this later. After the heptode is a standard variable-mu R.F. pentode, all the tuning arrangements being retained as in the two previous models. Following the I.F. stage is the single diode pentode, the same idea and values being retained for the A.V.C. action and I.F. filtering. The pentode section of this stage is coupled to the output stage through the usual type of R.C. coupling, and the speaker is fed direct in the usual way, without any form of negative feedback. Auto-bias is provided in the H.T. negative lead, and it will be noted in the circuit that the bias resistor has not been given a value, and also that the output valve has two references, one in brackets. For the output stage of this type of receiver there are available two types of output pentode, the base connections being slightly different for the two types. The recommended valve is the DL92 and this has a slightly lower H.T. consumption than the DL94 and, therefore, the bias resistor will be different. If you decide to use the DL92, the resistor should have a value of 1,000 ohms, but if a DL94 is employed the resistor will have to be reduced to 470 ohms. The transformer ratio for the loudspeaker will also be different in the two cases, about 50 to 1 for the DL92 and greater—about 65 or 70 to 1—for the DL94. These figures are for a 2- or 3-ohm speaker. The DL94 will provide a larger signal output from the louder stations, but on very weak stations there may not be noticeable a great difference in the output.

The H.T., as well as the L.T., has been switched in the receiver to avoid risk of current drainage, whilst

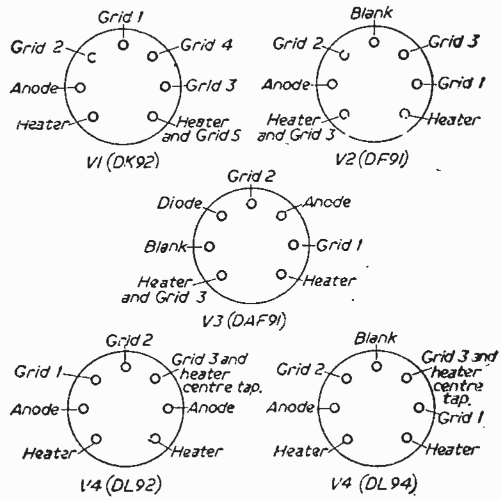


Fig. 2.—Details of valve base connections.

the receiver is not in use. It costs very little more to add this precaution and both batteries, or both sections of the battery, are thus isolated in the "off" position.

Batteries

The battery leads have not been shown with any form of termination, as here again there are two alternatives available to the constructor. The L.T. for the filaments must be a 1.5 volt cell(s), and the total filament current is .25A. The H.T. required is

LIST OF COMPONENTS

1—.5 MΩ volume control with D/P switch, type SG/1 with 1½in. spindle.—Reliance Manufacturing Co.

1—Coil pack, type R.L.30
2—I.F. transformers, type "U" } Roding Labs.

1—2-gang .0005 µF tuning condenser with type SL8 spin-wheel drive and dial—Jackson Bros.

1—Metal chassis, type CH.12 (12in. x 9in. x 2½in.).—Denco.

4—B7G valveholders. Ediswan Clix.

3—Control knobs, type K.365.—Bulgin.

1—8in. loudspeaker with transformer.—Whiteley Electrical.

Valves (Mullard)
1—DK91
1—DF91
1—DAF91
1—DL92 (or 94) see text.

Resistors (Erie Resistor Co. ½ w.)
1—22 KΩ
2—47 KΩ
1—180 KΩ
1—470 KΩ
3—1 MΩ
1—2.2 MΩ
1—6.8 MΩ
R—see text.

Condensers (T.C.C.)
1—8 µF (150 v), type CE18F
1—25 µF (12 v.), type CE31B
2—.1 µF, type 343 v.
2—.05 µF, type 346
1—.02 µF, type 346
2—.01 µF, type 246
3—100 pF SM, type 101 SMP

Sterns Radio:
1—Aerial/earth socket strip
1—5-way tag strip (centre E)
5—Rubber grommets
Two dozen 6B.A. × ⅜in. bolts and nuts: connecting wire and sleeving; 1 yd. screened single flex. Multicore solder.

One cabinet.—Tallon.

90 volts. Combined batteries are available from Vidor, Ever-Ready, etc., which include a 1.5-volt section, and these are provided with four-pin sockets. Separate 90 and 1.5-volt batteries are also available, and the L.T. batteries will give a much longer period of life than the combined units. Therefore, the constructor should decide whether he is going to use a combined or separate batteries, and having obtained them fit the battery leads with plugs to suit.

Construction

Actual construction is very simple and follows the lines already given. A very much smaller chassis could, of course, have been used, but the large full-vision dial takes up considerable space and has been found very desirable by all who have built the other models. Accordingly there is nothing much to be gained by using a smaller chassis as the dial is so easily fitted on the specified chassis, which also carries the volume control and wavechange switch. The beginner will also find the open layout and large amount of room which is available very useful for making connections, and as there are only a dozen or so resistors and condensers the wiring is very straightforward and easy. The 5-way socket strip is attached through one of the original transformer mounting holes, or if a new chassis is being constructed may be positioned at any point approximately where shown in the wiring diagram. The battery leads are soldered to the four tags in the order shown and are thus firmly anchored and not likely to move any components or introduce any short-circuits should they be inadvertently pulled. Note the coil connections, and again the constructor is warned not to cut these down or add lengths to them, or to the I.F. transformer leads, or the matching will be upset. The components are not, of course, drawn exactly to scale nor as to their exact position. To facilitate the wiring plan, the draughtsman has had to open out the components in certain positions, and also, to keep the drawing clear, the components are in some cases only approximate as to size. Remember to connect the resistors and condensers by the shortest route, clipping off the wire ends as needed for this purpose. The central earthing busbar has been retained and at various points the earthed components are taken to this direct. A length of ordinary twin flex is used from the two negative tags on the tag-strip to two contacts on the on-off switch on the volume control, and the return run of this switching is taken to the earthing busbar and the junction of the biasing resistor and gridleak of the output stage. Care is therefore necessary to make certain that these leads are kept separate, that is, the L.T. negative battery lead on the tag-strip is taken to one side of one of the switches, the other side of which is taken to the earthing busbar. By using black and red flex and checking the contacts on the switch before making the connections there should be no difficulty.

Testing

No trouble should be experienced in using the receiver as there is no trimming or lining up to be carried out. Simply plug in the batteries and a good aerial and earth, and switch on. The number of stations which can be received will depend, of course, on the particular locality and no guide can be given here. It varies considerably from place to place, and also according to the efficiency of the aerial and earth. Remember that with a battery receiver there is little power in hand, and therefore the best possible aerial and earth connection should be used, the former a vertical type for preference and the latter a wire leading to a metal spike or plate buried in the ground.

Record Reproduction

Unlike the two mains models of this receiver there is adequate audio amplification to permit of the use of a gramophone pick-up if required. In the mains models there is only the output stage, the fourth valve in each case being used for the mains rectifier. As already mentioned, to retain the four-valve layout and general lines of the Coronet, however, in this model we have used an additional stage, the pentode section of the combined diode valve being used merely as a straightforward audio amplifier to feed an output

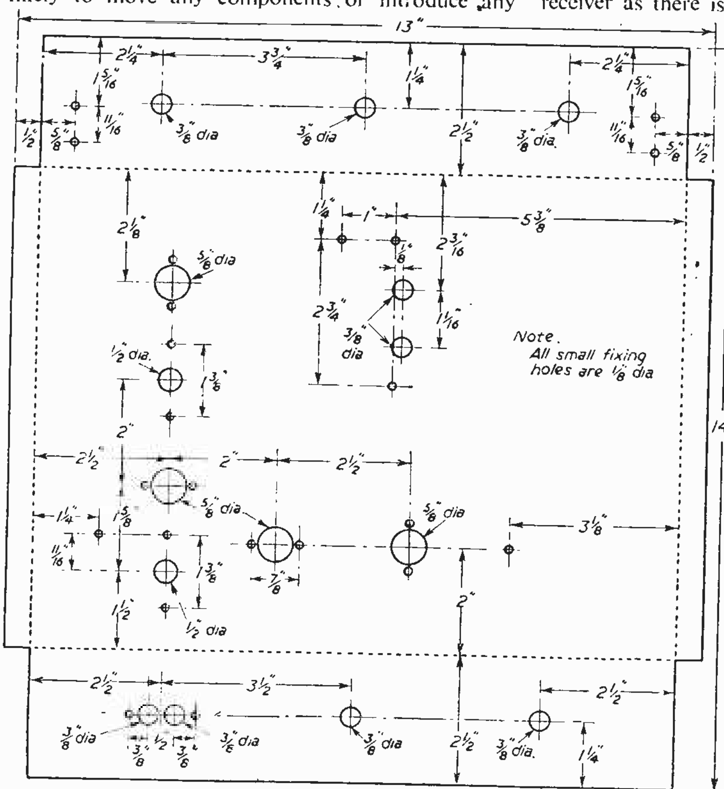


Fig. 3.—Details of chassis drilling.

stage utilising another pentode. The net effect of these two pentodes is that a pick-up feeding the first stage will be provided with sufficient amplification to give a reasonable output on normal records. In the case of the mains valve it is, of course, insufficient without adding a further stage.

The simplest connection for the use of a pick-up is to join it across the L.F. volume control, and it is quite in order to fit a two-socket strip on the rear runner, and to run a length of twin screened lead (or two short lengths of standard television coaxial lead) from these two sockets to each side of the volume control. The capacity effect of the pick-up across the control when receiving radio signals will, however, result in slight loss of brilliancy, depending upon the type of pick-up used. The provision of a simple on/off switch on the gramophone motor-board, by means of which one lead from the pick-up to the pick-up sockets may be broken, will remove this difficulty, but the leads from pick-up sockets right up to the pick-up itself should be screened to avoid hum. If it is found that the record reproduction is adequate then a permanent installation may be made by fitting a two-pole switch on the rear chassis runner, by means of which the top end of the volume control (that is, the junction of the 47 k., 1 m. and 100 pF. condenser) may be taken to one side of the switch so that when switched to radio the pick-up is disconnected, and when switched to gram the radio components are disconnected from the volume control. If this is not done, then when using the set for record reproduction the tuning dial will have to be adjusted to a point where no radio signals can be heard, as otherwise they will break through and be heard superimposed on the record.

Tone Control

As in the case of the two previous models, no feed-back or tone controlling devices have been included, but in this model, in view of the large audio gain which is available some volume could be sacrificed if desired, to introduce negative feedback, either from the anode to grid of the output stage, or even between the two audio stages. However, it is not felt worth while in the ordinary way to make such a circuit change, and the simple inclusion of a small fixed condenser across the speaker transformer primary is the simplest and cheapest way of modifying the tone to suit individual tastes. A value of .02 μF may be taken as a rough standard value.

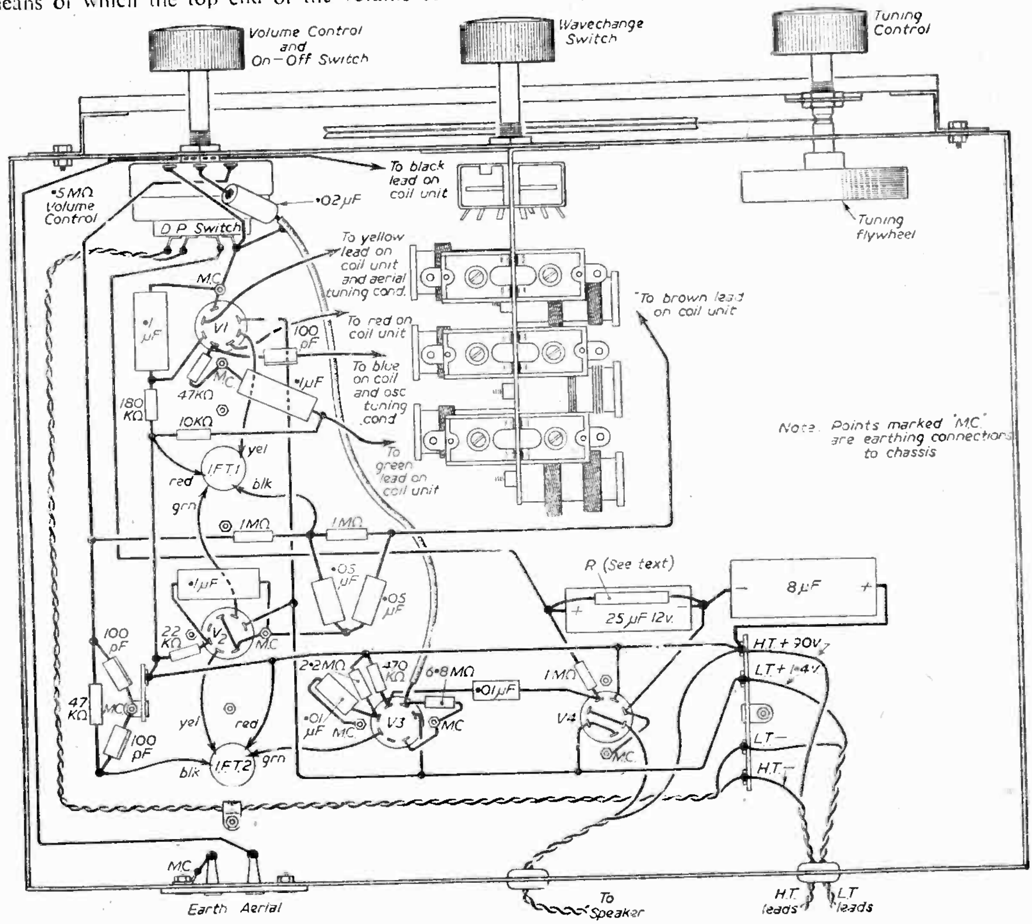
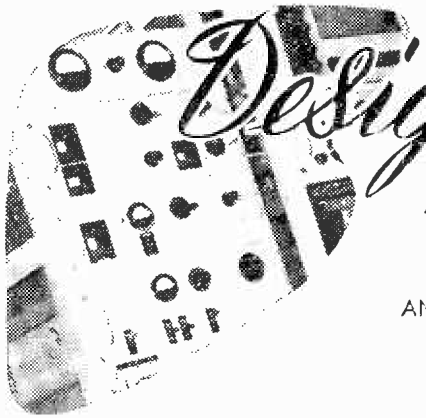


Fig. 4.—Wiring plan—drawn to scale.



Designing ELECTRONIC METERS

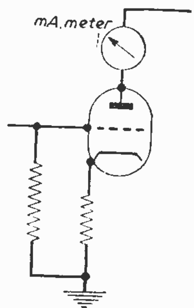
AN INFORMATIVE ARTICLE FOR THE EXPERIMENTER AND SERVICE ENGINEER

By J. S. Kendall

THE term electronic means the use of the radio valve in its widest sense. Whilst the valve voltmeter is probably the best known of the electronic meters, it incorporates the basic circuit. Again, in normal amplifier and radio circuits small changes of up to 10 per cent. do not greatly affect the performance, but with the electronic meter, very often special circuits and components have to be used that will hold the voltages applied to the actual electronic meter circuit to very close limits, often to better than 1 per cent., in order that the readings should be accurate. On other types the circuits used are such that the voltage variations are cancelled out by the circuit used.

The types of valve have to be chosen with the greatest of care; there is a limit to the grid resistance permissible with a valve. Under normal class "A" amplifier working the maximum grid resistance that can be used is $10/G^2M$, but as anode currents can be reduced by the use of a large cathode resistor larger values can be used. For example, if a valve normally has an anode current of 10 mA there seems to be no reason why it could not be cut down to half this. Look for a moment at the diagram in Fig. 1 and consider what happens if the cathode resistor is made larger. The bias on the valve is increased, cutting down the anode current; but there is a snag. In the cathode circuit the meter is to measure D.C. voltages, so that any change in anode current, caused by the change in grid voltage, will set up a voltage in opposition in the cathode circuit, reducing the sensitivity of the circuit. How then can this be overcome? Why not try introducing another valve in the circuit in such a way that as the cathode current of one valve rises the cathode current of another falls? Again, we have a circuit that is simple, as will be seen in Fig. 2. Here are two triodes, one connected up as in Fig. 1 and the other with the anode to the H.T. line, cathode joined to cathode and grid to earth. The operation is simple; as the anode current of the first valve rises so does the cathode voltage, but as the cathode voltage rises the current through the control valve falls as the grid is taken more negative with respect to cathode. If a negative voltage is applied to the meter valve the reverse will hold. The loss of sensitivity is one half by the use of the control valve, and the effect of the variations in H.T. volts are to a very large extent offset.

We have now obtained a circuit with which we can use high grid resistors, but have lost half of the sensitivity and, being "efficiency minded," we want that back and more besides. Again, with the circuit we have at the moment, there is no way of "zero-ing" the meter in use. This, of course, has its advantages as it allows either positive or negative voltage to be read without the meter being set in any way; also, the readings will vary as does the state of the valve, so that constant calibration will be required. The remedy is simple. Make a bridge circuit for the anode with a few resistors. It is a very well-known fact that if the resistors in the anode circuit are large, the anode current of the valves will be reduced. The writer has found that resistors between 5 KΩ and 10 KΩ are quite good. The circuit in Fig. 3 consists of an anode circuit of three resistors; two are fixed and the other



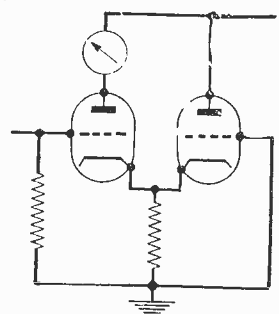
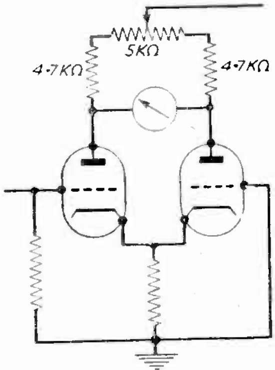


Fig. 1. (left)—Circuit to demonstrate the effect of variation in bias. Fig. 2.—Both valves are affected in this circuit.

is a potentiometer. The value of the resistors is 4.7KΩ (the actual value is not so critical as the ratio of one to the other); a balance of 5 per cent. is good enough. At points like this in the circuit it is a good idea to use one of the high stability resistors such as the Dubilier high stability type. These are readily available, although the price is a little higher than that of the normal types, but the extra reliability is well worth the additional cost. How many of us at one time or another have not wasted hours with an instrument that has developed a fault when it was most required and with time at a premium? It is not wise to use a carbon track potentiometer in the circuit as the current causes the behaviour to become very erratic; the writer has never been let down by wirewound types.

Here is a circuit that is in the form of a bridge, with the meter as the balance indicator. When the circuit is balanced there is no current through the meter, so that this indicator sets itself at zero. The 5,000Ω potentiometer is the balance control. The fact of the circuit being balanced has returned the sensitivity of the circuit in Fig. 2 to normal.

We have now a circuit that will give good service, but then how do we calculate the value of the cathode resistor? Look at the maker's graph of the valve to see how low a voltage can be applied to the grid and yet be on the straight portion of the valve curve. For example, a certain valve has a curve that is straight



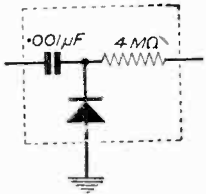


Fig. 3. (left)—A balancing circuit with common cathode resistor. Fig. 4.—Circuit for a typical probe.

until −10 volts, then starts to curve. This is just over the point at which we require to bias, so we calculate the bias resistor for −8 volts. If the curve is not too sharp the point where the bend starts is quite a good place; as the two valves will be operating in the opposite directions the distortion will cancel out and the scale will be linear.

Having developed our circuit we come to the point of choice of valve. Here there are many. Some people prefer the use of the double-triode, but this is beset with dangers. With the valve voltmeter the input resistance is very high, perhaps 10MΩ, so any leakage from other electrodes carrying a H.T. voltage will upset the working. For example, a valve-holder is being used that is not perfect—we tend to regard everything as perfect until proved otherwise—if the low insulation is only 1,000MΩ it will cause a deflection on the meter equal to 1 volt! The 10MΩ resistor forms a path to earth, and the current at 100 volts through 1,000MΩ is only 1/10th of a micro-ampere, but a tenth of a micro-ampere through a resistance of 10MΩ is 1 volt. Higher voltages give greater errors. This can, of course, be balanced out to some extent on the balance control. The remedy is very simple. The old double-ended types of valve, such as the EF37A, EBC33, SP41 and SP61, have a metallising, and if this is earthed to chassis any current to the grid is earthed and has no effect. It is for that reason that the major portion of the valve voltmeters of repute use this double-ended type of valve. If there is no metallising, as in the case of the 6J7G, there is a very long path along the surface of the glass. Here the resistance is very high, but a slight leak can occur. The first requirement, then, is that the valve shall be double-ended.

It is of no use trying to use a variable-mu type as it is not linear, but a linear type is. In these days, the number of types available is limited. Mullard, Ltd., make a triode—the EBC33 and a pentode—the EF37A. Mazda make the SP41 and SP61 H.F. pentodes. These pentodes, when strapped as triodes, are superior in that they have a larger slope of mutual conductance, i.e., the change in anode current is larger for the same change in grid volts.

The H.T. voltage can be lowered as the sensitivity of the valve rises. This seems the same as reducing the grid resistance, but as the H.T. voltage falls, the secondary emission from the control grid falls until, at 50 volts, it is almost non-existent, and then grid resistances as high as 100 MΩ can be used if obtainable. The writer usually designs around the 100-volt mark.

The input resistor so far has been dealt with as being one resistor for use on one volt, but what if 0-10 or 0-100 volt scales are required? Just tap the resistor and switch the tappings. For example, if the

LIST OF PARTS

Valves—Two EF37A.
One EZ40.
One B8A valveholder and two Octal.
Case : "9" } Kendall and
Chassis : "7" } Mousley, Tipton.
Mains transformer : Radio Experimental Products.
Plug : Bulgin type P38.
Jack : " " J6.
Meter : 0-1 mA meter.
Condenser : One type CT323235 (Dubilier).
Resistors :
One .9MΩ ½W HiStab 1% } Dubilier.
One 90KΩ ½W " 1% }
Two 5KΩ ½W " 1% }
One 100KΩ ½W normal 20% } Dubilier
Two 4.7KΩ 1W " 20% }
One 10KΩ 1W w-w 5W }
One 1KΩ 1W 20% }
One 500 ohm w-w pot. } Colvern
One 5KΩ w-w pot. }

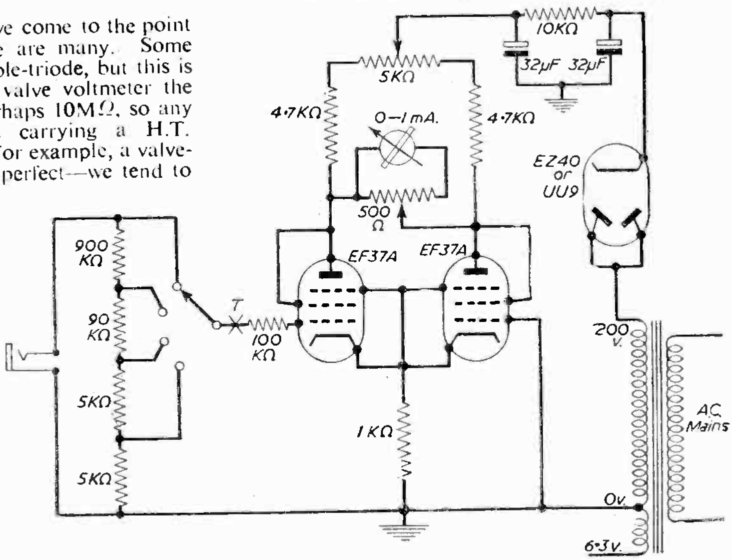


Fig. 5.—Circuit of a valve voltmeter incorporating the details and circuits described in this article.

total resistance is to be 10 MΩ, then 1 MΩ will be the 10-volt tap and 100 KΩ the 100-volt tap. We then require a good quality wafer switch of high insulation resistance and three resistors; one per cent. Dubilier high stability type are best. These resistors should be of ample wattage rating; remember that they may change value if they are overloaded. The sizes 100 K., 900 K., are available in one per cent., but not the 9MΩ; this is only available in five per cent. If the one per cent. accuracy is required for the meter, the input resistance will have to be kept down to 1MΩ. The valve voltmeter can be used for the measurement of E.H.T., but it is not advised as it is impossible to get resistors that are high enough to prevent the loading of the E.H.T. circuit.

We have now dealt with the design of the high-quality valve voltmeter for the measurement of D.C. For the measurement of A.C. and H.F. it is usual to use a diode probe. The valve type of probe will go up to 150 volts, but voltages as high as this can be measured with the conventional meter of the moving coil type. For meter applications at high frequencies there is, at the moment, nothing to beat the crystal probe. The circuit of a typical probe is shown in Fig. 4. The diode can well be the Mullard OA60 or OA61. Why a 4MΩ resistor? The peak voltage is the one that we get from the diode and it is the R.M.S. in which we are interested, so if the input resistance of the meter is 10MΩ, a series resistor of 4MΩ will convert the peak to the R.M.S.

A circuit of a complete valve voltmeter is given in Fig. 5. This circuit has all that we have so far discussed and also a device for the balancing out of excessive deflection. This is in the form of a potentiometer of 500Ω resistance in the 0-1 mA. meter circuit. As the valve wears, the sensitivity of the circuit can be increased here. The method of calibration is to set the range to 0-10 volts then join a nine-volt battery to the meter and set until the correct reading is obtained on the meter, which should, of course, be "zeroed" first. The balance control can be set so that there is either a right-hand or left-hand zero on the meter, thus allowing either positive or negative voltages to be measured.

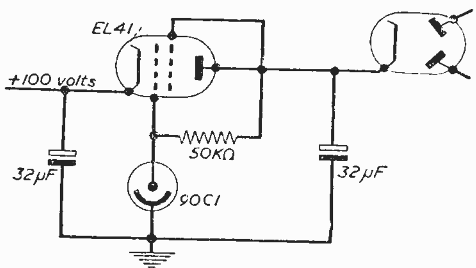


Fig. 6.—Here the voltage is stabilised.

There is nothing in the layout or the construction of the meter that requires comment.

How about the measurement of resistance or insulation with the meter? As soon as we try to get these measurements we must have a voltage that is constant no matter what changes in mains voltage occur. The smoothing circuit can be dispensed with but the circuit becomes rather unusual for the radio engineer. Fig. 6 is a typical circuit. It consists of a suitable gas stabiliser valve such as the 85A1, 90C1, 7475, 150B2 of Mullard, Ltd., depending on the voltage required. The 90C1 and the 7475 are the best as they give in the region of 100 volts for test. The circuit is very simple in operation and provides a reliable output at an impedance of under 100Ω, as good as a battery only far more reliable.

Fig. 7 is a typical meter for insulation; one volt is required for full scale deflection, but if a 100 micro-ampere meter were used only 1/10th of a volt would be required and the meter would be 10 times as sensitive as the one we are considering. With the 100Ω resistor switched in the grid circuit, 10 mA. will be required for a full-scale deflection. The resistance with 100 volts across it to give 10 mA. is 10,000Ω,

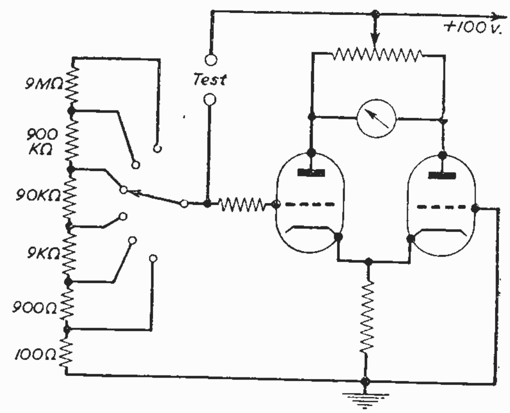


Fig. 7.—Circuit of an insulation tester.

and this forms the lowest value of insulation that can be measured. At the other end of the scale, on the top range with the 10MΩ resistor in circuit, a minimum resistance of 1,000MΩ will be measured and if the meter has a scale of 100 divisions, the highest value measurable with the instrument will be to the order of 100,000,000,000Ω! If the 100 micro-ampere movement were used, we would be able to rise to one million MΩ. The accuracy of the measurement would be within 10 per cent. These are figures that are well within the reach of the average constructor. If the items being tested are condensers it is best to start at the lowest range. There is far less chance of the meter being damaged through overload.

It is correct to measure insulation resistance but this is not required as often as low resistance. The shunt method is employed for this, i.e., on the 100Ω range a 10,000Ω, 10-watt resistor is joined between the H.T. line and the grid. This gives one volt here so that the meter swings over to the full scale and stays there. If a resistor is joined between grid and chassis, a certain amount of current will be shunted away from the grid resistor. A 10,000Ω resistor will shunt away one per cent. and the needle will drop one per cent. on the scale. A 100Ω resistor will take 50 per cent. and the needle will register half scale; a 1Ω resistor will shunt away enough to allow only one per cent. scale deflection. The constructor will have to work out the calibration chart for himself. The highest resistance range that can be made is governed by the resistors that are available. The Dubilier types are as hgh as 9MΩ at five per cent. tolerance, whilst the Erie types are up to 90MΩ, at −0 to plus 100 per cent. tolerance.

The Beginner's Guide to RADIO

The Twelfth Article of a Series Explaining the Fundamentals of Radio. This Month the Question of Transmission is Considered

By F. J. CAMM

The Superhet (Continued)

THE remaining H.F. circuits are fixed tuned, or pre-set to a particular frequency which is independent of the carrier frequency, and, as already mentioned, is known as the intermediate frequency.

In the case of an intermediate-frequency stage in a superhet receiver there is only one (converted) carrier frequency to be catered for, and the typical tuned primary, tuned secondary, I.F. transformer can be designed for some particular selectivity characteristic.

Radio Transmission

Up to the present we have dealt chiefly with radio reception and the functions of the various components which make up a wireless receiver. We have been able by means of simple receivers to illustrate most of the theoretical points which have been made.

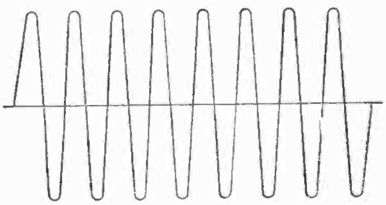


Fig. 51.—The waveform of an unmodulated carrier wave.

It is now necessary to explain what happens at the transmitting end, and how radio waves are radiated into the ether. We must first grasp how a signal voltage is developed in the receiving aerial by a broadcast transmission. We have already seen what happens to it as it passes through the receiver. First let us consider what happens during a pause in the programme, whilst the microphones are idle. The transmitter is still actively radiating, and the voltage generated in the receiving aerial has the simple *sine-wave form* shown in Fig. 51. These oscillations are of *unmodulated continuous wave*-form and have a frequency which represents the carrier frequency of the transmitter. The *amplitude* of these oscillations is the distance of their *peaks* or *nodes* above and below the neutral line, and the distance between each of these nodes is the wavelength. Different transmissions, as is well known, are allocated different wavelengths, hence the necessity for the variable tuning condenser in a receiver. Now the wavelength is equal to 300,000 divided by the frequency, the answer being in metres, and it follows that corresponding to every carrier frequency there is a particular wavelength. Frequency is always referred to in terms of kilocycles per second.

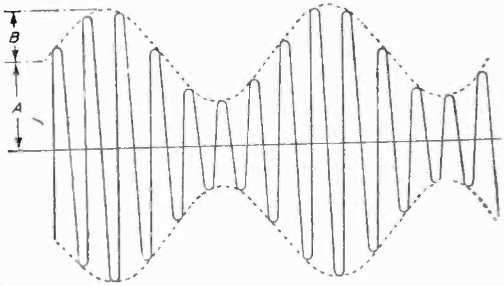


Fig. 52.—The form of the modulated carrier wave.

Now, as soon as the transmitter commences to radiate a programme the oscillations at the receiver take on a complicated character. Superimposed upon them are the sounds picked up by the microphone and this causes a variation of the amplitude

Figs. 53 and 54.—When a stone is thrown into a pond, waves are radiated, which eventually reach the shore.

(see Fig. 52). This variation is continually changing throughout the broadcast according to the volume of the sound, and the nature of the instrument or voice creating it. Fig. 52 is a case of modulated H.F. oscillations which is comparatively simple. It will be seen that the amplitude variation follows a simple sine-wave curve and this would be the kind of modulation produced if the sound controlling the transmitting microphone was of a single frequency. The dotted curves in Fig. 52 are known as the *modulation envelope*. If A in Fig. 52 represents the amplitude of the carrier oscillation when unmodulated, then the depth of modulation is given by the ratio B/A. If the unmodulated voltage amplitude in one of the receiver circuits is 1 volt, then with 50 per cent. modulation the amplitude would rise and fall at modulation frequency between the extreme of 1.5 volts and 0.5 volt, whilst at 100 per cent. modulation the extremes would be 2 volts and zero. There are reasons why modulation must not be permitted to reach such a limit.

Sideband Frequencies

Again referring to Fig. 52, suppose the carrier frequency is F cycles per second and the modulation frequency M cycles per second, it must not be assumed that the modulated oscillations are the result of these two components which one might at first suppose. An analysis shows that three unmodulated components together make up a resultant of the form shown in the illustration. The three components are all of high frequency and the relative frequency values are : F, F+M, and F−M. Whether we refer to the oscillation in terms of the graphical interpretation of Fig. 52, or whether we substitute the idea of the three unmodulated component oscillations, we are really dealing with the same thing. With modulation of the normal broadcast kind, there is not just a single modulation frequency to consider but a range of them. This means, in effect, that the radiation of a broadcast transmitter spreads over a band of frequencies from F+M to F+m, and from F−M to F−m, where M is the highest modulation frequency used and m is the lowest.

The Water Analogy

When a wave is radiated we can secure an almost exact analogy of what happens by considering the effect of a stone dropped into the centre of a pond. Suppose a piece of wood is floating on the surface of the pond. When the stone is dropped waves will spread out in ever-widening circles from the spot where it entered until they reach the boundaries of the pond. You will observe that as the first wave hits the piece of wood it tilts and rises above it, the piece of wood sinks as the wave passes, only to rise again to receive the next one, and it continues to rise and fall until the waves have ceased. The stone can be considered as the transmitting station, the water as the ether, the waves as the wireless waves, and the piece of wood as the receiver (see Figs. 53 and 54). We have seen above how the waves produced by the transmitter differ from those on the surface of the pond.

Wireless waves we have seen, on striking the aerial, cause an electric current to flow, or oscillate, upon its surface. The aerial is connected to the aerial coil and aerial condenser, the whole constituting what is known as the aerial circuit, and it is in this circuit that the electric currents oscillate or vibrate. If it is tuned correctly it will oscillate in sympathy with the incoming waves, but if it is out of tune it will not respond to anything like the same extent. Consider that something is producing a succession of waves in a steady procession from left to right on the surface of a pond, and imagine a pendulum to be suspended above the water ; the first wave is shown approaching (see Figs. 55, 56 and 57). The next instant the wave strikes the pendulum and sends it swinging to the right. The first wave passes on, and the pendulum swings back. Immediately it reaches its highest point at the left a second wave hits it and swings it over to

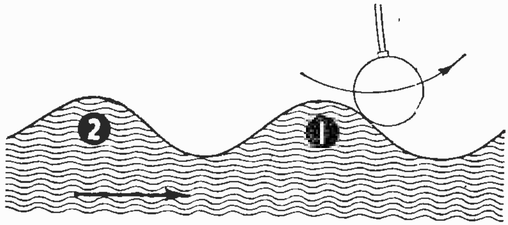


Fig. 55.—The first wave oscillating the pendulum.

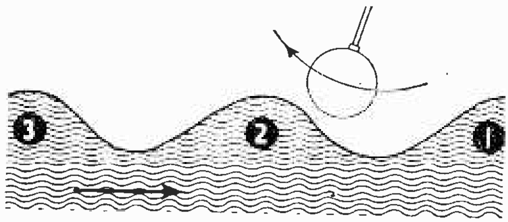


Fig. 56.—The pendulum returning to meet the second wave.

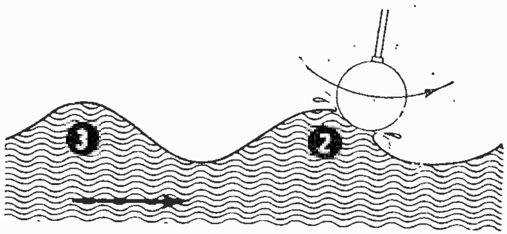


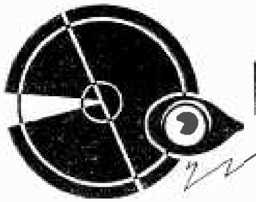
Fig. 57.—Further impetus is given by the succeeding wave.

the right again. This cycle of operations is repeated and the waves keep the pendulum swinging continuously.

Wavelength

This example is similar to the aerial when it is tuned to the oncoming waves. The swinging of the pendulum is dependent upon its being of a suitable length so that it swings back at just the right speed to be in the correct position when it receives the impact from the succeeding wave. In the case of a pendulum that was too long it would move slowly, and possibly be on the return swing to the left when the second wave reached it. The movement would then be arrested rather than assisted ; conversely, if it were a short pendulum, it would be much quicker in its movements and so get out of step with the waves.

(To be continued.)



FITTING A Magic Eye

HOW TO ADD THIS USEFUL DEVICE TO YOUR RECEIVER

By B. L. Morley

A DEVICE which enables a broadcast receiver to be accurately tuned is a very useful and necessary item: it is difficult to judge exactly by ear alone when the receiver is accurately tuned, and it is not until, perhaps, a passage of music of the "side-band splash" from an adjacent station is heard, that attention is drawn to the matter.

When aligning a receiver some indication that peaking is taking place is essential and here again the magic eye is found very useful.

There is available on the ex-Government market a number of these valves: they are known generally as the 6U5G or the Y63. They are the standard "magic eye" type, and the end of the tube gives a green glow when connected in the circuit. The tube is mounted end on so that the glow can be seen when tuning in.

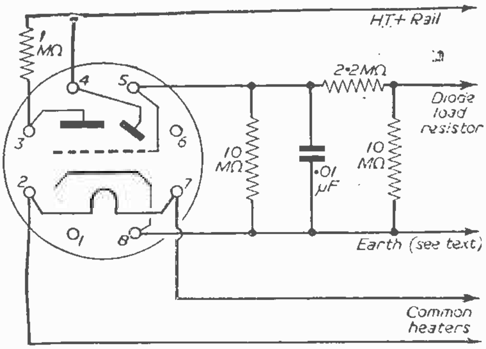


Fig. 1.—The required circuit.

A sharp shadow is seen and this varies in width when the tuning is varied, the shadow reaching its smallest dimensions when the set is accurately tuned.

It is not a difficult matter to equip an existing broadcast receiver with the device, or to adapt it to a home-constructed set.

The Circuit

In Fig. 1 is given the required circuit, together with the values of the components required. A standard octal valveholder is used and the components can be mounted across the tags on the holder.

The cathode is taken either to earth or the low potential side of the diode load resistor in the receiver while the grid (pin 5) is taken to the high potential end of the load resistor.

The anode which provides the "glow" effect is taken directly to the H.T. positive rail.

In Fig. 2 will be seen a portion of an actual detector stage in a broadcast receiver. "R" is the diode load resistor and the 2.2 megohm resistor connected to pin 5 of the magic eye is connected to this resistor at "A." The cathode of the magic eye is connected to "B" or earth.

Now, as the required station is tuned in the voltage produced across "R" by the signal will increase, becoming a maximum when the station is right on tune. The voltage is fed across the grid and cathode of the magic eye, and so the current through the magic eye will increase to a maximum when the station is right on tune. The anode of the triode section in the magic eye is connected to the grid of the control portion and so maximum current will flow to the control anode. The increased current causes the green glow on the control "anode" to become a maximum, hence the shadow line is at a minimum and an accurate visual indication is given that the station is on tune.

The circuit given is one of the simplest for adaptation purposes. The 10 megohm resistor forms the grid leak for the magic eye while the 2.2 megohm resistor ensures that the loading on the detector stage of the broadcast receiver is neglible.

Some audio impulses find their way to the magic eye and are inclined to cause the shadow to vary in sympathy with the music or speech. To offset this the 0.01 μF condenser is fitted to decouple the grid.

The magic eye takes a current of about 4 mA in the anode circuit, and 0.3A at 6.3 volts for the heater. This small current can be safely added to the receiver without overloading it.

There should be no difficulty in locating the H.T. common in the receiver for connection of pin 5.

Should the receiver be of the A.C./D.C. type then the heater chain can be broken for the insertion of the magic eye heater, provided the normal current through the heater chain is 0.3A.

There should be no difficulty in tracing the diode load resistor if the connections to the last I.F. coil are

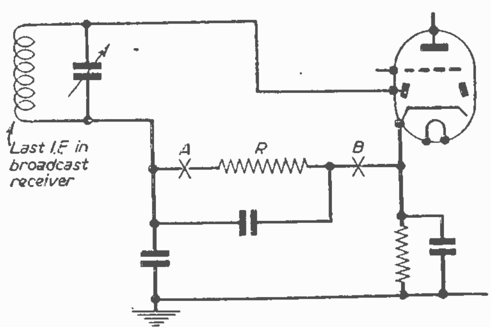


Fig. 2.—A portion of an actual detector stage in a broadcast receiver.

carefully followed. Note that the actual connection of the cathode circuit of the magic eye will depend upon the circuit of the receiver. Where the diode load is inserted in the cathode circuit it will be found that better results are obtained by making the connections as shown in Fig. 2, i.e., grid of magic eye to "A" and cathode of magic eye to "B."

In cases where the cathode of the detector valve is connected directly to earth then the cathode of the magic eye must also go direct to earth.

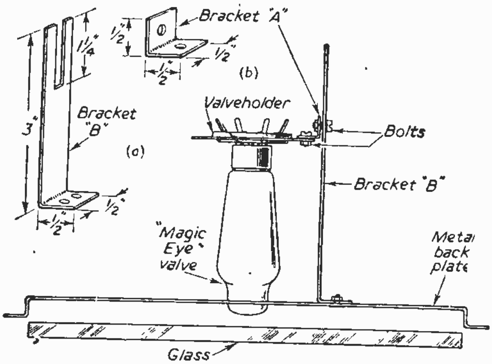


Fig. 3.—Details of the mounting of the magic eye tuning indicator.

Mounting

The position for mounting the magic eye will depend largely upon the layout of the receiver.

In order to assist the constructor some details of an actual case follow.

The receiver had a glass escutcheon engraved with station names, etc. A convenient point at the top of the glass was vacant and so the paint on the reverse side of the glass was scraped away to form a clear circle of glass of the same diameter as the end of the magic eye.

Behind the glass was mounted a metal back plate and this was drilled so that the end of the magic eye could protrude through it (see Fig 3). A short length of metal was then formed into the shape in Fig. 3(*a*), and another small bracket (*b*) was made to hold the valveholder. The slot in (B) was ¼ inch wide and was made so that the valveholder could be slid backwards and forwards and thus enable the magic eye to be fitted in the best position.

The whole assembly was mounted as shown in the illustration.

Once the mechanical details of mounting have been settled there should be no difficulty over the electrical side, and once in operation you may wonder however you possibly managed without it before!

Premiums for Technical Writing

THE Radio Industry Council announces the award of premiums of 25 guineas each for articles published in the public technical press during 1953 as follows:

"Spectrum Equalization," by G. G. Gouriet, A.M.I.E.E. (*Wireless Engineer*, May, 1953.)

"Triode Transformation Groups," by A. W. Keen, M.I.R.E., A.M.I.E.E. (*Wireless Engineer*, October, 1953.)

"A Cylindrical Magnetron Ionisation Gauge," by A. H. Beck, B.Sc. (Eng.), A.M.I.E.E., and A. D. Brisbane. (*Vacuum*, April, 1952—published April, 1953.)

"The Scanning Electron Microscope and the Electron-optical Examination of Surfaces," by D. McMullan, M.A., Ph.D. (*Electronic Engineering*, February, 1953.)

"A Linear Sweep Cathode-ray Polarograph," by H. M. Davis, B.Sc., A.R.I.C., and Miss J. E. Seaborn, B.Sc. (*Electronic Engineering*, August, 1953.)

"Selective Calling for Radio-telephone Systems," by J. R. Pollard, M.A., A.M.I.E.E., M.I.R.E. (*Electronic Engineering*, December, 1953.)

The presentation of the awards will take place at a luncheon to be held by the Public Relations Committee of the Radio Industry Council on Thursday, March 11th, at a time and place to be announced later.

Objects

The Radio Industry Council's premiums for technical writing were first awarded in respect of articles published during 1952. The council's object is to encourage the writing and publication of articles reporting technical progress and development of radio, television and electronics in Great Britain, and the awards are made by a panel of judges for articles which, in their opinion, deserve to be commended by the industry. Any writer is eligible who is not paid a salary wholly for writing and not earning 25 per cent. of his income from fees from articles or from book royalties. Where an article is by two or more authors each must be eligible under these terms, and the award of 25 guineas is made jointly. The awards are made for articles published at home and abroad in papers or periodicals which can be bought by the public on the bookstalls or by subscription.

The judges at present forming the panel are:

Professor Willis Jackson, D.Sc., D.Phil., M.I.E.E., F.Inst.P., Research Dept., Metropolitan-Vickers Electrical Co., Ltd., Manchester.

Mr. P. D. Canning, Chairman of the Technical Directive Board of the R.I.C.

Mr. W. M. York, F.I.A.M.A., Chairman of the Public Relations Committee of the R.I.C.

Mr. C. E. Strong, a member of the Technical Training Committee of the R.I.C.

Vice-Admiral J. W. S. Dorling, C.B., M.I.E.E., Director, R.I.C.

On Your Wavelength

BY THERMION

World Tape Pals

AN association new to me is World Tape Pals, which has its origin and headquarters in the United States, although its members are spread over the world. The object is the exchange of recorded tapes on any subject. It is an entirely independent organisation, and members pledge themselves not to raise internationally controversial issues. There is no membership fee outside the United States, and no rules apart from those of common courtesy. When I received details of this Association I naturally wrote for further particulars. I was anxious to know whether it has associations with any political organisation, such as those I have criticised in the past, which are secretly allied to the political parties of foreign powers. I am always naturally suspicious of world-wide organisations claiming world-wide membership but which are run, so to speak, from the corner of the kitchen table, without headquarters, and with a sort of proprietary secretary.

My inquiries elicited the fact that World Tape Pals is not associated with any political organisation whatever. The total membership to date is about 70 to 80, including 15 in England; there are at present no members in Scotland or Ireland. The way the scheme works is quite simple. After completing the necessary application form (giving particulars of the tape recorder in use and hobbies and interests of the applicant) and being recorded as a member, a membership roster is sent which gives full names and addresses of all members, together with brief details of their occupations and interests. From then on it is entirely up to the member to contact any other recordists he chooses. He makes a recording calculated to be of interest to his "victim" and posts it off, at the same time sending a brief note by post notifying his opposite number that the tape is on the way. The recipient of a tape follows the same procedure, except of course that if he does not intend to reply immediately he should acknowledge receipt of the tape as a matter of courtesy. There is absolutely no control by the organisation over the number of tapes sent by any member—he can send as few or as many as he likes. In actual fact, the only function of World Tape Pals is to make the introductions and leave it at that, except that a News Sheet is sent to all members periodically. The only expense to members is the cost of tape and postage.

For further details readers should write to World Tape Pals, 14, Hill Top Road, Northfield, Birmingham, 31.

M.O.T. Licence Regulations

MR. CHARLES FRANCIS, of Wroxham, does not like my criticism of the M.O.T. licence regulations. He thinks I am trying to exploit a mare's nest, and that what I am trying to say in effect is: "If the chap who uses a radio set in his car without a licence can get away with it, who is the M.O.T. to take on the job of helping the P.M.G. to catch him?"

I said nothing to suggest that I was in favour of motorists avoiding taking out licences for car radios. What I did imply was that we should be particularly careful not to become a police state where each department or each citizen acts as a snooper for the next.

He states the obvious when he says that critics are in a privileged position. Of course they are, otherwise they would not be critics. Where people disagree, as they are entitled to do, I do not hesitate to accord them right of reply. No one can be expected to agree with every view printed in this or any other periodical or newspaper. The dish is served, but you pass the course you do not like.

He goes on to say that he thinks I am deliberately controversial. Of course I am, and I shall go on being so. If I merely stated the obvious, hinting at a fault and hesitating dislike, being willing to wound and yet afraid to strike, there would be no need for my contribution at all. I should merely be expressing views with which everyone agreed and therefore views which need not be expressed.

Radio Show Comes of Age

THE Radio Show which takes place this year at Earls Court from August 24th (pre-view day) to September 4th will be the 21st, and so the Radio Show comes of age. The first Radio Show was, of course, held more than 21 years ago owing to the intervening war years when exhibitions were not held. There will be many new features, including an arena with seats for about 800 in which will be given demonstrations of the O.B. units of the BBC. This will be supplementary to the usual TV studio which this year will seat about 400. There will also be facilities for demonstrating TV sets suitable for alternative programmes.

Servicing "Rackets"

THE trade has done a great deal during the last five years to clean up the service racket, but the cancer has not been completely eradicated. I had a letter the other day from a reader who has himself become a service agent in his district in order to clean it up. His previous employer had no scruples about swindling his customers, and my reader quotes a case in which a charge of £4 was made "for replacement valves and condensers" when the only defect was a broken wire. When he remonstrated with the employer he was told that that was the general practice! On another occasion a set was "robbed" of certain components required to repair another set, and the circuit altered accordingly.

I do not believe that this is general practice. There are black sheep in all trades, and when I receive letters of this sort I only have the reader's word and have not the advantage of hearing the other side.

A Midget Top Lift Inductor

HOW TO MAKE A USEFUL ACCESSORY FOR TAPE RECORDERS AND OTHER EQUIPMENT

By A. C. R. Skynner

MOST circuits for tape recorder amplifiers include, in one of the earlier stages, a "top lift inductor." To obtain an even response at all frequencies great amplification of the lower and higher frequencies is needed. Usually several compensating devices are employed in both recording and reproducing circuits. One of the most common of these is shown in Fig. 1. A resistance, condenser and inductance are connected in series between the line carrying the signal (usually between the first and second amplifiers) and earth. The values of R1 and C1 are chosen to allow frequencies above a given value to pass through them, thereby providing "bass boost." By itself this arrangement would, however, diminish still further the already weakened signals at the upper end of the frequency range. The inductor, L, and capacitor, C2, are therefore inserted. They form a tuned circuit, and the values are so chosen that it will resonate at a frequency near the upper limit of the range the tape and head are capable of reproducing. The tuned circuit will still allow the middle frequencies to pass, while preventing loss of the upper frequencies. The whole arrangement will, therefore, diminish the amplification of the middle frequencies only, or, to put it another way, will provide "bass and top lift."

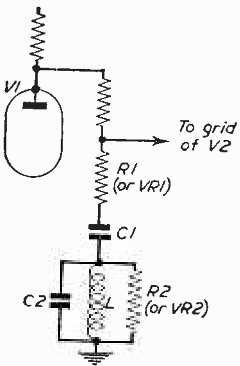


Fig. 1—One circuit of a tone compensating network.

Although special inductances are made for this purpose most amateurs will wish to make their own, or to adapt some item in the spares box for the purpose. When building my own tape recorder I tried out a large number of old transformers, chokes and odd coils without success. Either the inductance was nowhere near that required, or the component was so bulky that hum pickup, one of the main dangers in an amplifier of this kind, became noticeable. Finally I tried a pair of high-impedance headphone bobbins, and constructed the inductor described. It has the advantage of being only one 1in. square, saving space and eliminating hum pickup from this source, and of being infinitely variable.

Headphone Bobbins

The bobbins used were of 2,000Ω each, though lower or higher values could be used by altering the value of C2. They are mounted side by side in a box, about 1in. in height, breadth and width cut from a piece of tin plate and soldered together, as shown in the diagram. The simplest way to do this is to bind them together with a piece of cellulose tape. The piece of soft iron shown below the bobbins in the diagram is a strip of transformer lamination. It can be of any size provided it covers the holes in the bottom of each bobbin, and so makes a complete soft iron ring when the U-piece is lowered fully. It is applied to the bottom of the bobbins before they are inserted in the box and fixed in place with another piece of cellulose tape. The bobbins are now placed in the box, and a little melted candle-wax can be poured round the edge to hold them in place.

The bobbins will be mounted in the correct position, and connected correctly, if they are set up in the same way as they were found in the headphone, with the same connections. If there is any doubt they can be connected in series with a flash-lamp battery (with the wires joined in any way) and both slid over a straight piece of lamination. A needle suspended from a piece of cotton and held close to the lamination will move when the circuit is made and broken if the bobbins are magnetically orientated in the same direction. If the needle does not move, either reverse the position of one bobbin or reverse its connections. When the bobbins are correctly positioned in this way insert them in the box with the two ends which were touching at the bottom of the box.

The U-piece is cut from another lamination. The size is not at all critical, but it should be a little narrower than the width of the holes in the bobbins so that it will slide easily, and long enough to allow the ends to touch the strip of lamination mounted under the bobbins. A hole is drilled centrally, before bending, to take a long 6 B.A. bolt or piece of screwed rod, which is fastened to the U-piece as shown.

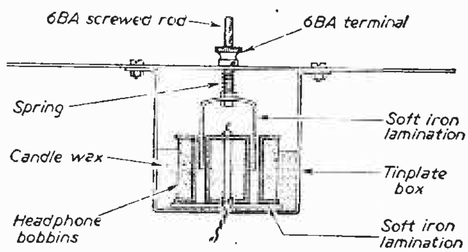


Fig. 2—Details of construction of the inductor.

Mounting

The bolt or screwed rod passes through a hole drilled centrally in the lid, with a light spring between the U-piece and lid. The U-piece is then raised or lowered by twisting a 6 B.A. terminal outside the lid. This arrangement is particularly convenient, since with the terminal fully unscrewed the U-piece can be rapidly lifted in and out of the bobbins, and the effect on reproduction at different positions immediately compared. Constructors may mount the component according to their own tastes.

Will the Superhet be Superseded?

A REVIEW OF STRAIGHT AND SUPERHET CIRCUIT DETAILS, AND A LOOK INTO THE FUTURE

By F. E. Apps

THE superheterodyne receiver has been with us now for about twenty years as the standard receiving circuit. It had had a short spell of popularity a few years before, but the tuned-radio-frequency (T.R.F.) receiver made a short comeback. The T.R.F. receiver was in its day a quite efficient job. There were many different circuits used (although all basically the same) and some even incorporated two separate reaction circuits. Some were rather difficult to tune, and nearly all were very critical on reaction setting. Owing to the fact that the valves used at that period were not extra efficient and the "Q" factor of most tuning coils was low, the overall gain of the T.R.F. was not high. On the other hand very good signals with little noise were receivable, and in the best jobs could compare more than favourably with any superheterodyne. Owing to the lack of technique that we have at the present day radio-frequency stages had to be confined to one stage only, as more than one stage rendered the set very unstable.

Now compare the superheterodyne, with or without an R.F. stage. It is, in a normal receiver, perfectly stable over all wavebands, has high overall gain, and controlled reaction is unnecessary, but owing to the manner of working of a superhet it suffers in nearly all cases with a poor signal-to-noise ratio. In most cases this is due to the frequency-changer circuit and valve, and even a separate oscillator valve and mixer valve does not improve the signal-noise ratio very much.

In brief, we have now the good and bad points of both types of receiver, so we will now proceed to try to find a method by which we can incorporate the good points of both and eliminate the bad.

Compromises

Since television, it has been found possible to have two, three or even four R.F. stages in a T.R.F. job, without instability and with a reasonable gain to each stage, using the present day valves, but the point must be noted that this is on a set frequency.

I do not consider it impossible to design a circuit in these circumstances which is variable tuned and still maintain stability. Then, with a good detector stage, plus efficient A.V.C. and distortionless output stage, a set could be designed having the necessary overall gain without a poor signal-noise ratio. There are a few snags to be overcome: one is that the gain in a T.R.F. varies from minimum gang condenser setting to maximum gang condenser setting; also, T.R.F.s are liable to unstable points at various settings. These, however, could be ironed out on research. I do not consider that more than two R.F. stages are necessary for the ordinary domestic receiver, and it would be better if one stage could be cut out for local reception. Special attention would have to be given to coils to ensure high "Q" with the maximum amount of selectivity. This latter is important, as this circuit would have fewer tuned circuits than a superheterodyne. As fewer components would be required this type of set should be much cheaper than the present-day superhet.

You may think that this is retrogression. Well, that may be, but I propose to retrogress still further in an endeavour to find something simpler but equally and perhaps more efficient than the superhet.

The Super Regen.

The super regenerative set had a vogue for a time a few years back. Now this circuit was simple, but had a marvellous gain. It had one great fault, that it was only controllable in skilled hands, otherwise it burst into violent oscillation. Now I consider that this "Armstrong" circuit is worthy of further research, as if it could be made automatically controllable a cheap, efficient and very high gain set would be the result.

Whether frequency modulation, if and when it became commonly available in this country, would result in new circuits is doubtful. The United States have used F.M. for a few years now, but all their receivers are superheterodynes except, of course, for the discriminator circuits. As there is only one F.M. experimental station in this country opportunities of trying out are very poor. Nevertheless, an opportunity does exist here for a completely new circuit.

Velocity modulation (a method by which the electron stream velocity is increased in bunches at a modulating frequency) is at present only at the research stage. Here again is a likely idea to employ new circuits.

The transitron, however, may be the final answer to this question. This, no doubt, is a great advance and I do not think it possible that the transitron will be merely a substitute for a valve. Although some of its characteristics are similar to a valve there are other types which differ considerably. This, I think, will be bound to lead to new methods, new circuits and new conceptions of radio reception. Although the R.C.A. laboratories have made quite a number of sets using only transitrons and no valves, they have been using, up till my last information, only standard circuits. This, however, does not rule out the idea that the transitron will be the cause of a complete change.

Well, readers, there are probably many more ideas about this subject that this article may bring to your minds. Science must not remain still: it must progress. The superhet has now reigned for about 20 years. Surely it is time we moved forward again!

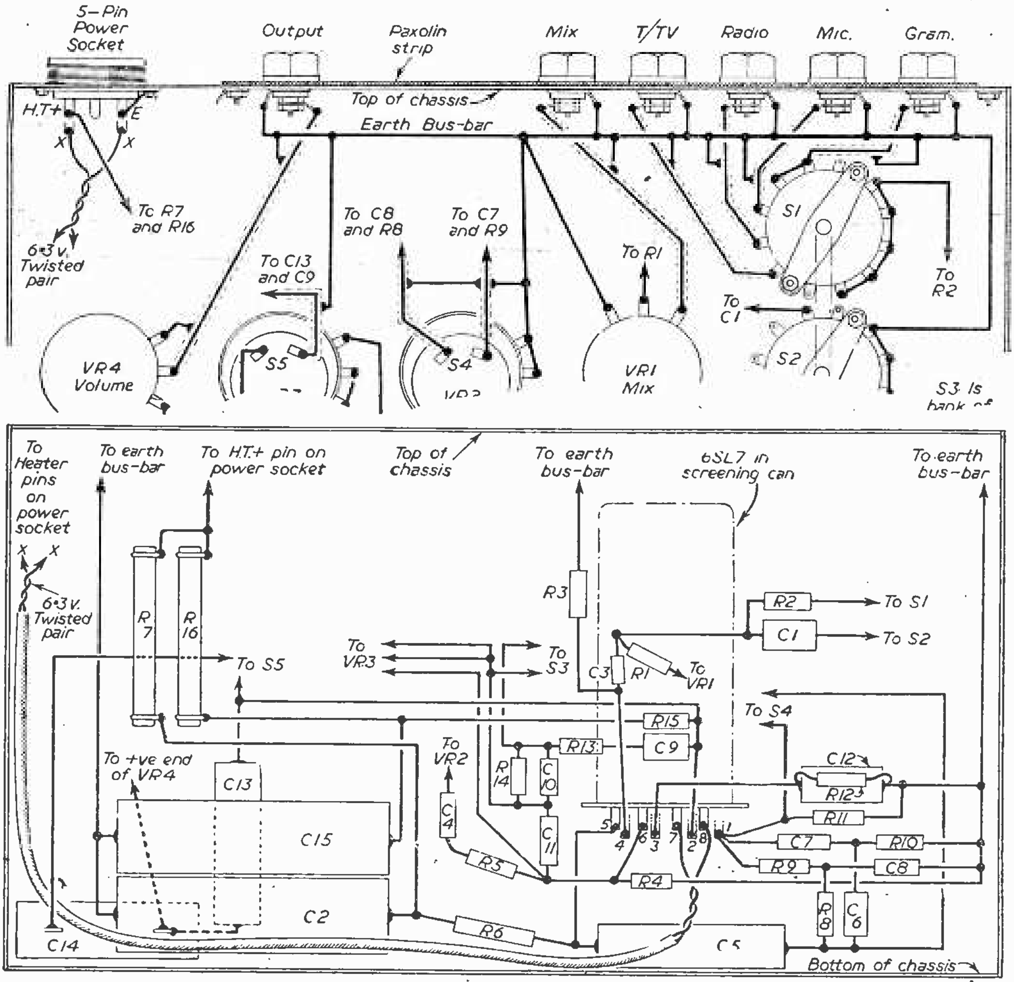
An Economy Quality Amplifier

HINTS ON THE USE OF PICK-UPS AND SOME WIRING MODIFICATIONS

ONE or two readers have asked for details of the type of correction which is provided in the design of this particular amplifier. The L.P. correction will suit any type of *uncorrected* pick-up crystal, balanced armature or moving-coil. The only proviso (see first paragraph on page 101 of the February issue) is that for full amplifier output the pick-up must have an output on average recordings of more than .06 volts RMS, and if more than .5 volt must be suitably attenuated to below that figure. If the pick-up is already corrected for L.P. (see the maker's literature), then it is permissible to omit C10, R14, C1, S2 and S3 from Fig. 3 of the February issue, or leave them in against future requirements and use the 78 switch position for both 78 and L.P.

Wiring Corrections

The author regrets that two or three slips occurred in the wiring diagrams Figs. 10 and 11, and to avoid any difficulty corrected copies of these are reproduced below. In the case of Fig. 11 which was one side of the tone-control pre-amplifier the "earth bus-bar" was shown connected to a tag in contact with the chassis. As mentioned in the text, however, this bus-bar must not be in contact with the chassis and the extension of the connection should therefore be omitted. In the case of the other view, Fig. 10, the position of C3 has been changed to conform with the theoretical circuit. The valveholder for the 6SL7 is spaced from the bottom of the chassis by 1¼in., and this is done by using 1½in. 4B.A. bolts and nuts.



Revised diagrams for the tone-control pre-amplifier chassis.

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TELEKING. Constructor's Envelope, 6/-; Coilsets, 44/6; Chassis kit, 50/-; T.C.C. kit, £7/4/3; RM4 rectifier, 21/-; Allen Components, LO308, 40/-; FO305, 21/-; DC300, 39/6; FC302, 31/-; GL16 and GL18, 7/6 each; BT314, 15/-; SC312, 21/-; AT310, 30/-; OP117, 9/-; Dubilier Resistor pot. kit, 81/6.

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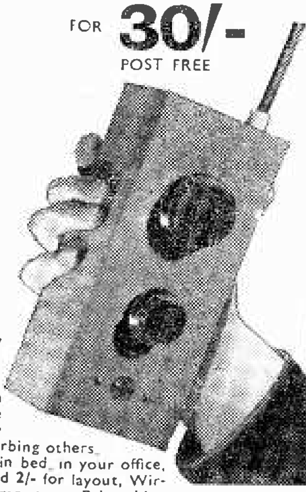

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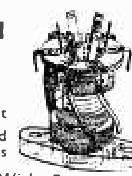

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TRANSMITTING TOPICS

MORE ON MAINS TRANSFORMER MODULATION

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

PREVIOUSLY, a paralleled 6L6 arrangement was described for obtaining enough audio for modulating up to nearly 100 watts of carrier input. The matching being arranged by using a centre-tapped choke or the centre-tapped secondary winding of a power transformer as a 2 : 1 step-up audio transformer. As was pointed out, however, there are snags to such an arrangement. One snag is that normally one must use a heavy by-passed dropper resistance to drop the H.T. supply to the 6L6 modulator valves. One possible way out is drastically to lower the screen voltage of the 6L6 audio valves, so that 500 volts can be used on the anodes without the anode currents becoming excessive. Each 6L6 will then only take about 40 mA. and fair results may be obtained. As one is in any case handicapped in matching, the input to the P.A. stage can be adjusted to give the best matching feasible.

However, more flexibility would be very desirable, especially as one power pack has to supply some 200 mA for the modulator tubes, as well as 150 mA to 200 mA for the P.A. stage. A single, very large power pack is thus required, and likewise the choke or transformer used as the modulation transformer must be hefty. However, a tip here may be of value. If the inductance is not well maintained under the high D.C. flowing in these circuits, the modulation transformer or centre-tapped choke may be given an air gap. The laminations can be removed, and reassembled with a thin separator such as a piece of paper. Where an air-gap already exists, it is quite permissible for speech of communication quality to make the air gap a little larger still.

Some suggested other arrangements may be of interest, however, as they offer greater flexibility and scope for ingenuity. They offer the possibility of getting a 'phone signal of reasonable power without having to purchase a modulation transformer. Naturally a proper modulation transformer is the best technical solution, but in these hard times it is often rewarding to experiment with material and equipment on hand ! Accordingly, the circuit shown in Fig. 1 may be of interest. By using an additional choke and a coupling condenser of, say, 2μF. capacity, individual power packs may be used for modulator and P.A. Even if one pack is used for both stages, the current passing through the chokes is split, so that their operating conditions may be more favourable.

While a single choke is used for the P.A. anode circuit, one may use the primary winding of a mains transformer. This enables matching to be adjusted within limits, as shown in the circuit of Fig. 2.

Push-pull

Push-pull circuits are much favoured and, by adopting load splitting in this way, the centre-tapped secondary of a power transformer may be utilised, as shown in Fig. 3. Each half of the secondary is tightly coupled together, so that a fair push-pull balance is obtained, even when the signal is taken off one side of the winding only. In fact, the objection to this arrangement that is really serious is that the transformer forms a 2 : 1 step-down to the stage being modulated. As previously discussed, a step-down of this order is seldom required, and is usually a very bad mis-match to the average P.A. stage. However, a centre-tapped choke, or a centre-tapped secondary of a power transformer, enables us to obtain

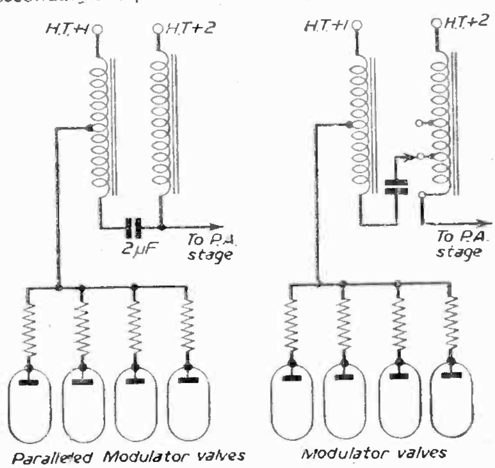
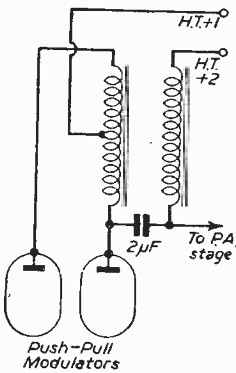


Fig. 1 (left).—An additional choke enables separate feeds to be used with the paralleled modulator valve arrangement previously described in these pages. Fig. 2 (right).—A tapped primary winding enables a measure of load matching to be effected, thus giving greater flexibility.

a 2 : 1 step-up auto transformer. By combining the two ideas, as in Fig. 4, the overall result is a 1 : 1 transformation between the push-pull modulator valves and the P.A. stage. This will enable a feasible match to be obtained between modulator and P.A. stage. Moreover, if negative feedback is applied to the modulator, the effects of a mis-match can be overcome, as with negative feedback the effects of mis-matching become far less serious.

Further combinations could be suggested to provide for "mains transformer modulation" to meet various possibilities, but it is considered that the ideas produced will be enough to show that a little ingenuity may be very effective in overcoming various snags. In fact, the writer has on various occasions employed mains transformers in modulators, both in emergency and for normal 'phone operating. Many other amateurs have been encountered using mains transformers as modulators, and some really excellent signals have been noted. In this connection, for top band and similar use, where only a one-valve modulator is required for powers of some 20 watts R.F. stage input, a small mains transformer can be utilised as a genuine transformer. Thus, if say a transformer



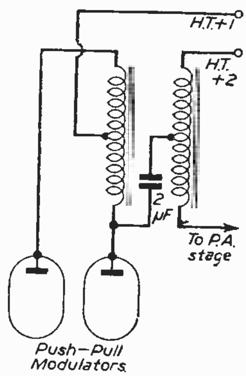


Fig. 3 (left).—A push-pull modulator using a centre-tapped winding. Fig. 4 (right).—The poor matching of Fig. 3 is overcome by using a second centre-tapped winding as a step-up transformer.

with a normal 250-volt tapped primary and a 300-0-300 secondary is available, it can be used as a straight modulation transformer by using one half of the secondary and the whole of the primary. The primary voltage taps again give a selection of tapping points for adjusting matching. Usually the requirement would be for a slight step-up from, say, a 6L6 modulator to a P.A. stage, so that the P.A. would take its audio signal from one half of the 300-0-300 secondary. Thus, if the primary is tapped from 200 volts to 250 volts, we have a range of step-up ratios. In this case we have the 200 volts tap stepping up to 300 volts, or a step-up ratio of 1 : 1.5. The 230-volt tap would give 1 : 1.3, and the 250-volt tap 1 : 1.2. This is quite a reasonable range of taps, and would, in fact, be very useful for the low-power applications suggested. The circuit of Fig. 5 shows this arrangement.

While schemes of this sort are often extremely effective, it must be clearly understood that they depend very largely upon the mains transformers available. The value of good husky components has previously been stressed. However, certain compensating factors should be noted. First, a mains transformer operates normally at 50 cycles, so that adequate inductance for speech purposes is generally available, even when carrying plenty of D.C. feed current. Moreover, nowadays the tendency is to restrict the higher frequencies of a telephony transmitter. The capacity of a mains transformer winding, however, usually gives the top cut automatically, without attenuating vital speech frequencies unduly. If necessary a little judicious top peaking or tone control can be employed. The great attraction of these systems is that they offer the possibility of obtaining

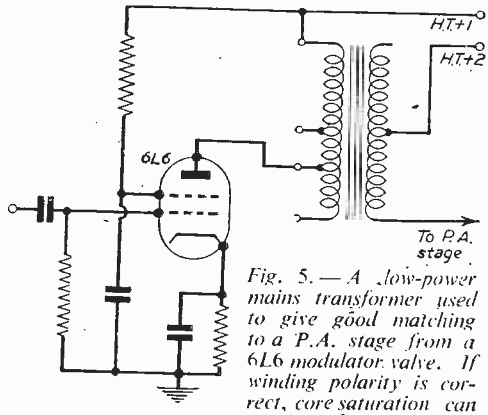


Fig. 5.—A low-power mains transformer used to give good matching to a P.A. stage from a 6L6 modulator valve. If winding polarity is correct, core saturation can be made small.

speech modulation at the cost of a little trial and error, plus ingenuity; that is, of course, if one has a few odd chokes and mains transformers on hand. No amateur would *buy* a mains transformer (unless at bargain rates), just as a modulation transformer!

Multicore at R.E.C.M.F. Show

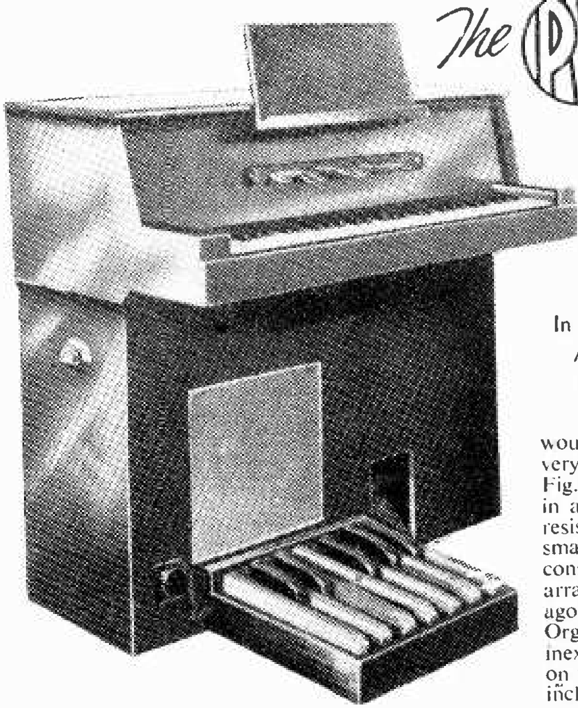
NEW ideas in solder and soldering will be featured on the Multicore Solder Stand at the 1954 Radio Components Show which opens at Grosvenor House on April 6th.

The main exhibit is, of course, devoted to the well-known Ersin Multicore Solder containing three cores of non-corrosive flux which has, during the last 15 years, become established as the most reliable solder for all purposes in the electronic and allied industries. This product is approved by A.I.D., A.R.B., and G.P.O., and as it is widely used in the U.S.A., it complies with Federal specification.

Besides the usual tin/lead alloys Ersin Multicore Solder is also shown in extra high and low melting point solders and one containing silver for use on silver plated ceramics. Standard gauges available range from 10 to 34 S.W.G.

A new type of Ersin Multicore Solder which will be shown, contains five cores of a new Pentacol derivative non-corrosive flux which has been specially formulated for extreme soldering speed. This product will be found particularly efficacious for jointing of extremely oxidised components and at present is being supplied only to manufacturers at home and overseas.

Among the few working exhibits at the Exhibition will be a solder ring-making machine from Multicore Solders Ltd. Hemel Hempstead factory.



The (PW) FULL-COMPASS Electronic ORGAN

In This Concluding Article of the Series the Amplifier and Power Pack are Described

By W. J. Delaney (G2FMY)

ALL that is now needed to complete the instrument is the amplifier and power pack, and there are various alternatives available in this connection. In the prototype, the power pack and amplifier were combined in one unit, a photographic illustration of which may be seen on page 225. There are two or three essentials which must be dealt with here before discussing the amplifier. First, as will have been seen from the previous articles, a stabilised supply at 300 volts is required for the oscillators. The standard VR150/30 stabiliser is available quite cheaply, and is intended for 150 volts, so that two in series are needed, and to drop the output from the main H.T. line a series resistor is required. The output stages of a suitable amplifier, to handle the bass range and to enable suitable volume to be obtained, should consist at the very least of two 6V6's in push-pull. These, driven in Class AB1, will give a reasonable output for normal domestic or home use, but if the instrument is to be used in a church or hall it would be better to use 6L6's or KT66's with higher H.T. The circuit on the next page shows the prototype arrangement, for which 6V6's were used with a mains transformer delivering 325 volts at 100 mA. This was an Elstone product, type MT/3, but if the 6L6's are to be used, the Elstone MT/A150 should be used. This delivers 350 volts at 150 mA in addition to the rectifier and heater supplies.

Expression Control

To perform the function of an expression control various ideas are possible, but ordinary variable grid-leaks as used in standard volume control practice have not been found satisfactory. As these would have to be of high resistance, they would not be wire-wound, and after only a short period of use become very noisy. The arrangement depicted in the circuit, Fig. 27, has, however, proved absolutely foolproof in action, and easy to install. It consists of a low-resistance potentiometer, wire-wound, mounted on a small bracket between two wooden boards, the construction being indicated in Fig. 26. This basic arrangement was suggested by a reader some time ago for use with his version of the original P.W. Organ, and is not only simple to make up, but also inexpensive. It should be mounted on a cross strip on the floor of the organ so that the upper portion is inclined only a few degrees from the vertical. If mounted flat, it will be found difficult to obtain sufficient ankle movement to obtain maximum volume. To remove noise and enable the low value to be used, a cathode follower is employed, and to overcome the slight loss which this type of stage gives, a 6SL7 is employed, the first half acting as a straightforward R.C. amplifier, followed by a standard 6SN7 as a paraphase splitter for the output valves. Some unusual values may be noted in the circuit, and on no account should the SL and SN valves be changed round, as this will result in considerably reduced output. It will be noted that negative feedback has been included, but this is not on the ground of quality of reproduction. It will be appreciated that where one is amplifying the entire range of an organ any slight unevenness of response or distortion of this type is masked in the general overall output, but trouble has been experienced from certain forms of inter-modulation. This is corrected by the feedback arrangement used, but the constructor may, if he prefers, omit this and see how his particular speaker and cabinet performs. There is, of course, greater volume when the feedback is cut out, but unless the screening at the points mentioned, together with the heater wiring, has been efficiently carried out, there will be a background of hum and noise. Feedback with the values given completely removes this. As a further point of interest it was found preferable to use the centre-tap on the heater winding, running all the heater supplies in twin twisted (plastic) flex. Earthing one side of the heater winding, and taking one pin on each valve to chassis, resulted in quite a fair hum background which was cured by adopting the centre-tap scheme. If desired, a hum-dinger (low-value wire-wound potentiometer) may be included across the heater winding and adjusted for minimum hum. The high wattage ratings of certain resistors is to ensure reliability and noiseless operation and although it is possible to reduce these ratings, it may be found that in time the background will become noisy. The

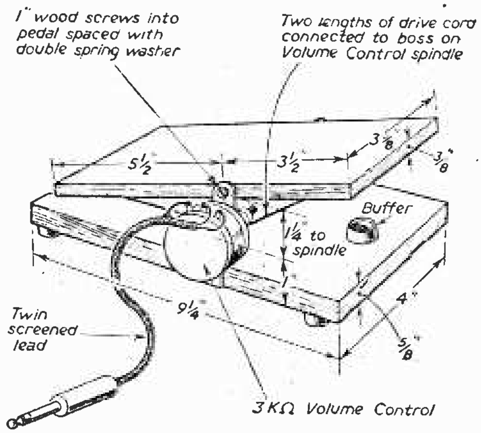


Fig. 26.—Details of a suitable expression pedal control.

slight additional expense here, in view of the overall cost of the instrument, is well worth while.

Amplifier Layout

The only problem remaining is the alternative housing of speaker and amplifier. The output from the pre-amplifier is at high impedance, and therefore an unduly long lead should not be employed. The output from the expression pedal, however, is at low impedance, and therefore may be of practically any length. If the particular installation is to include a separate speaker cabinet, therefore, there are again two alternatives. The power pack and amplifier may be built as in the prototype, and the leads from the transformer secondary to the loudspeaker may be extended as desired, or the phase-splitter and output stage may be housed with the speaker, and the power pack separated for inclusion in the organ cabinet. This would, however, call for the use of relays to switch on the heater supplies. An alternative idea would be to use separate cabinets housing loudspeakers, each having its own amplifier, again relying upon relays operating from a low-voltage source to switch on the essential high powers. 6L6's run fairly hot, but the size of a normal organ body is sufficient to dissipate the heat, and to assist in this the bottom of the cabinet may be provided with corner feet only, a number of 1in. diameter holes being drilled in the bottom through which the air will be drawn and keep the interior cool.

Connections and Operating Notes

The amplifier and/or power pack should be provided with an octal socket as shown in Fig. 27 and a socket should be joined direct across the mains transformer primary. Into this is inserted the two-pin plug shown in Fig. 19, connected to the primary of the special heater transformer feeding the tone generator units. A length of 8-way cable, or separate leads suitably bound together should be provided at each end with an octal plug (Bulgin type P.448), and when this is inserted with one end in the octal socket on the power pack and the other in the socket on the small unit on the tone generator shelf, the switch on the volume control will automatically control the mains input to both transformers, in addition to feeding the various H.T. or L.T. supplies to the separate sections. To accommodate the expression pedal a standard plug and pack arrangement is suggested, and permits the power pack to be removed easily for servicing. Twin screened leads were actually used, but are not essential.

A standard Bulgin mains connector was fitted and fuses may be included if desired. To use the instrument, plug in the mains and make certain all the relative plugs and sockets are soundly joined, and switch on at the pre-set point. Advance this just a short distance, and make certain that the expression pedal is "up"—the position of minimum volume.

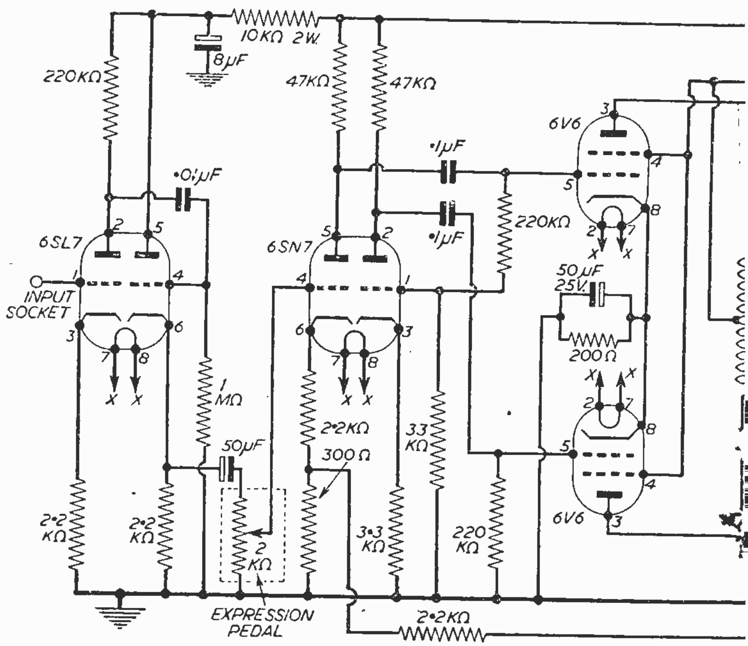


Fig. 27.—Theoretical circuit of

After a short lapse of time for warming up, set all the stop keys up ("off" position), depress the 8ft. stop and then press any key and it should sound in the speaker. As the expression pedal is depressed the volume should increase, and the pre-set control may then be set to give the desired maximum level for the output. In the home, for instance, it may be found that it is not needed more than about a quarter of the way on, whilst in a small hall it may have to be turned full on. When the note is heard, depress the 4ft. stop and the octave of the note should then be heard, together with the one already depressed. Depressing the 16ft. stop will add the octave below, so that with only one note down, three notes at octave intervals will sound. Depressing the vibrato stop will cause the note to waver in the usual tremulant manner, and the speed of this may be adjusted by the constructor to individual requirements. The small pre-set control on the pre-amplifier will not affect the actual speed—merely the strength of the vibrato. To modify the speed the condenser C22 should be changed. There is a wide range available here, from the slow tremulant of the standard pipe organ to the fast vibrato of the cinema organ, and as mentioned in earlier pages, if desired two or three switches of the stop-key type may be added to select different capacities for C22 to give differing speeds of vibrato. The pedal stop-keys if both up will result in an almost inaudible bass from the pedals, whilst depressing one or both will vary the "weight" of the pedals. The centre stop-key, which I call "couple," has the effect of opening the 4ft. and 16ft. stops in addition to the pedals. If, therefore, only the 8ft. stop is depressed and a note is played with the foot on one of the pedals a single note with faint background of bass will be heard. Depressing the "couple" switch will bring in both the 4ft. and 16ft. notes plus the pedal, and with this particular design each added note is added to the volume. Thus the effect of throwing the "couple" switch is also to increase the volume in sympathy with the additional notes. The remaining stop keys may be labelled by the constructor according to preference, and there is no hard and fast rule which may be given here. The one immediately next to the centre, which opens the short-circuit across R14, gives an increase in volume and is more or less an Open Diapason. When this stop is up the tone-control stage is out of circuit and the 22 kΩ resistor cuts down the volume giving a softer tone. The next stop is suitable to be named "Closed Diapason," the the next "Melodia," next "Viola" or "Dulciana," next "Trumpet," next "Flute," and the last "String." This brings in the other half of the tone-control stage and hardens the tone mainly in the upper register.

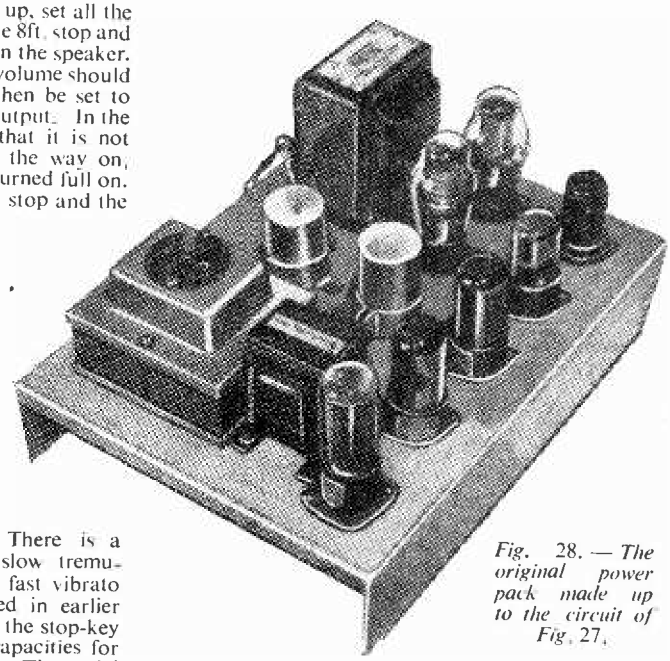
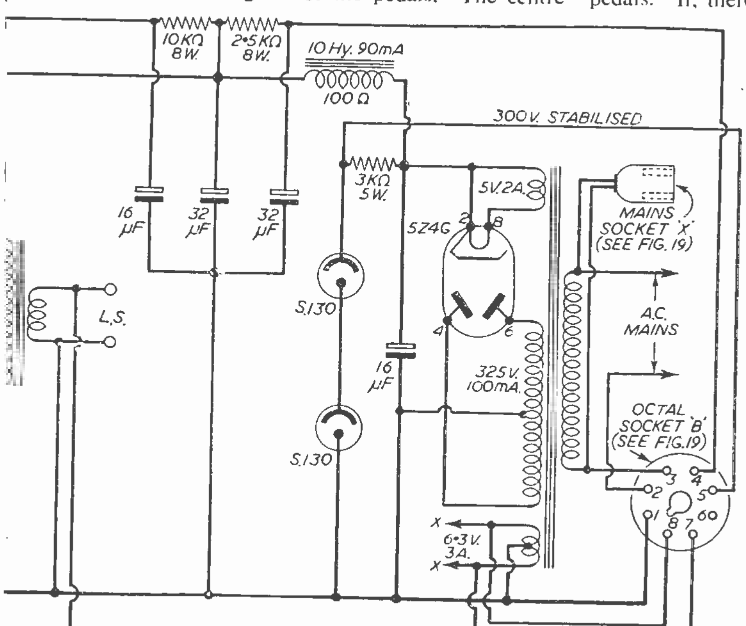
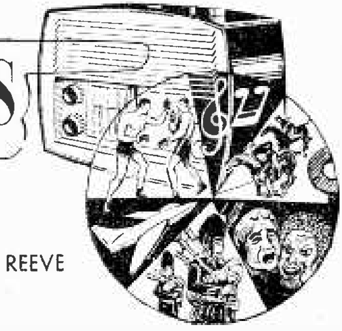


Fig. 28. — The original power pack made up to the circuit of Fig. 27.



nain amplifier and power pack.

Programme Pointers



By MAURICE REEVE

New Year Programmes

CHRISTMAS and New Year programmes were on much the same lines as in previous years, A good variety and a wide choice could be had by all. "We Beg to Differ" made it the occasion for a welcome return, and now that Gilbert Harding is back in the team, is one of the most scintillating programmes. It can hold its own with "Any Questions," which can be guaranteed to amuse as well as instruct us at all times. Dickens was there, too, and who could contemplate a Christmas without him?

There were the customary bits of gaucherie and lack of liaison between programmes, an example of which was the repetition of the Grieg Concerto on the 25th at 3.15 and the 26th at 9.30 a.m. On New Year's Eve I heard "Ray's a Laugh" at 8.30, "Life With the Lyons" at 9 and "Take It From Here" at 9.30, each of which built up to a climax with "Auld Lang Syne"—quite a pain in the sum total of its effect. Probably many others did the same. I felt more than sure at the end that I should ne'er, ne'er, ne'er be forgot. It is a tune, and a sentiment, that I am not over fond of, anyway.

The Late Chester Wilmot

In common with all, if later than most, I must express my regret at the tragic death of Chester Wilmot, who narrated the Commonwealth Tour on Christmas Day.

"Variety Playhouse"

No talent so small, and no script so poverty-stricken of all except vulgarity, should be allowed to find a place as Mr. Peter Butterworth's, in "Variety Playhouse" on Saturdays. This programme has fallen off greatly in recent weeks. Announcers and commentators, too, do not make good variety items. But Mr. Butterworth touched an all-time low. Neither should Clementi Sonatinas be permitted in a programme "styled a piano recital." They are grade 3 and 4 child's stuff and of no musical value or interest whatever. Op. 36 No. 4 found its way into Mr. Lionel Bowman's programme.

Music

The new series of talks by Antony Hopkins, "Talking About Music," promises to be as good as the last. A very stimulating and instructive entertainer. In the second talk, "One Against All," he certainly put the Tschaikowsky concerto in its rightful place in the musical dustbin. Andar Foldes played brilliantly in a Friday piano recital, especially in a dazzling transcription of his own of Kodalys "Hary Janos" suite, which concert pianists should welcome. But he showed his limitations as an artist by adding a musical carbuncle, or cyst, at the end of the Bach-Busoni Toccatta in C which was truly and regally abominable.

There is an exasperating, irritating and vulgar little tune, of the Harry Lime and Litolff Scherzo brand, which is cropping up with unwanted frequency these days, called a "Swedish Rhapsodie," arranged by one Faith. My dictionary defines a rhapsody as "any wild, unconnected composition . . . a jumble (mus) composition irregular in form." That was certainly how Liszt handled it. But this wretched example plugs one inane tune again and again and yet again. Can't someone call a halt to it?

The historical "whodunnit" series proved very interesting and were capably handled. I heard the first, "Who Killed the King?" or the story of Mary Queen of Scots, the murder of her husband Darnley and the Casket Letters. Hugh Ross Williamson is to be complimented.

Sport

"Sports Report" and "Sports Parade" are two very well-produced and run programmes, usually under that much alive and wide awake young man, Eammon Andrews.

The new "At Home and Abroad" arrangement, on Tuesdays and Fridays, from 9.15 till 9.45 p.m., is a great improvement. It should render that funny little snippet, "Topic for To-night," on the Light, superfluous.

Plays

A wide variety of plays included Archer's "The Green Goddess" (a notable Christmas attraction), Somerset Maugham's "The Noble Spaniard," Eugene O'Neill's "Marco Millions," Chiarelli's "The Mask and the Face" (this in the "Twentieth Century Theatre" series), Priestley's "Jenny Villars" and Emlyn Williams's "Night Must Fall."

"The Green Goddess" is always welcome and makes capital entertainment. The Rajah's valet, if not quite a Sam Weller, is a minor classic rôle in its class. Abraham Sofaer, if not quite so suave as the late George Arliss, was none the less excellent, whilst Watkins was right up Charles Leno's street. "Night Must Fall" is a powerful psychological glimpse into a murderer's mind—how accurate I wouldn't know—and some of the things in men women fall for—again the accuracy of which I wouldn't vouch for. Richard Burton chose it and made the most of a star rôle. I shouldn't think "The Noble Spaniard" is vintage Maugham, and "The Mask and the Face" seemed to take too long to say too little. But "Marco Millions," which makes of the famous journey a modern capitalist enterprise and of Polo a twentieth-century "merchant adventurer," is a most brilliant allegory, and the most likely to live of these examples.

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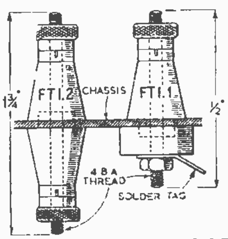

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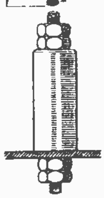

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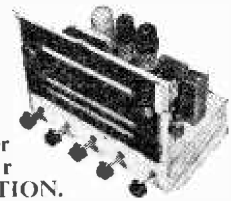

which still further substantiates their name for PERFECTION.

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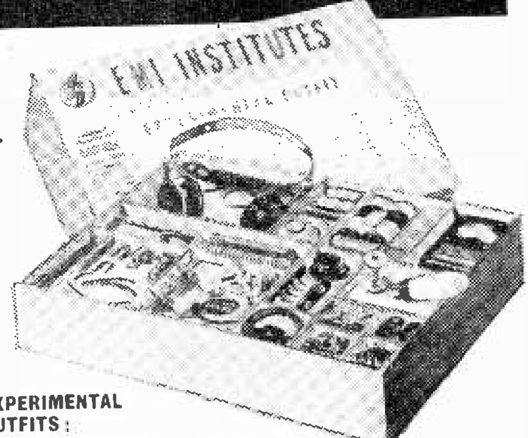

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AMPLIFIER DESIGN

1.—BASIC CONSIDERATIONS

By R. Hindle

A short series of articles dealing with the theoretical considerations of amplifier design, and containing at a later stage constructional features of various types of amplifier.

BASICALLY, the valve is not an amplifying device but is rather in the nature of a converter. Consider an indirectly heated triode depicted in Fig. 1, supplied with the necessary heater and H.T. voltages. The H.T. is a steady and unchanging voltage source ; at least it is always assumed to be so in elementary theory, and such an assumption is reasonable and justifiable for the present purpose. The anode of the valve, however, is tied directly to this source of steady voltage and so clearly the anode voltage cannot fluctuate because there cannot be a difference in voltage between two ends of a piece of wire (again reasonably assumed to be resistanceless for our present purpose). A signal, i.e., a fluctuating voltage, at the grid cannot produce an amplified voltage fluctuation at the anode : indeed, it cannot produce a voltage fluctuation at all !

What the valve is doing, in actual fact, is to convert a fluctuating voltage applied to its grid into a fluctuating current, the variations of which take the form, more or less faithfully, of the grid fluctuations. When the grid goes more positive (or, more likely, less negative), for instance, more electrons are attracted from the electron cloud gathered around the cathode and pass through to the anode, so increasing the current. A more negative grid reduces the number of electrons flowing to the anode.

Mutual Conductance

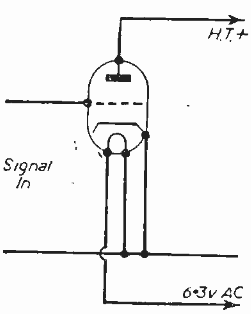
The relationship between grid volts and anode current can be represented graphically. If the words "more or less faithfully" could have been omitted from the previous paragraph and the anode current could be made to reproduce absolutely faithfully the grid fluctuations, the graph would be a straight line set at an angle to the baseline, as indicated in Fig. 2, and extending away to infinity in both directions. The greater the change in anode current for a given change in grid voltage, the steeper will be the slope. Thus the characteristics of an imaginary valve designated V1 are represented in Fig. 2 by the full line, and a second imaginary valve V2, having the characteristic shown in the illustration by the dotted line, which is steeper, is more sensitive to grid-voltage changes and so produces a greater anode current change for a given grid-voltage change. The slope of this characteristic curve can be specified by dividing the anode current change by the change in grid voltage producing it, the answer in mA/V being called the mutual conductance of the valve, or commonly the "slope." Expressed mathematically,

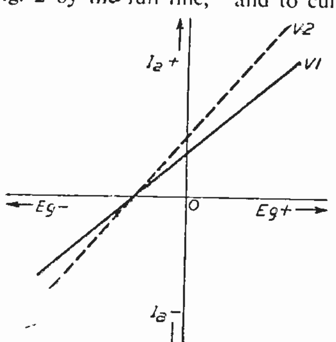
$$gm = \frac{\text{change in Ia}}{\text{change in Eg}}$$

where gm is the mutual conductance or slope
Ia is the anode current in mA
Eg is the grid voltage.

Thus it will be seen that gm is a measure of the quality (from the point of view of sensitivity) of the valve.

There is, of course, in practice an upper and a lower limit to the variation of Ia determined by the valve itself. The number of electrons available from the cathode is limited by the nature of the cathode and its temperature. The idea of the anode current varying in sympathy with a grid-voltage change is developed for "space charge" conditions, i.e., assuming that there is a reservoir of electrons in the form of a cloud round and about the cathode waiting to be impelled on a path towards the anode. When all the electrons are being dragged across to the anode as quickly as the cathode can give them up, and consequently no space charge can form, a state of saturation is reached and a further increase of grid voltage towards positive has no effect on the anode current. This condition is indicated on the practicable Ia/Eg characteristic curve by a flattening out at the upper end as seen in Fig. 3. At the other end of the characteristic a negative current is impossible in a valve. This would imply a flow of electrons from anode to cathode, which in a normal valve cannot occur. So the characteristic is ended at the zero Ia baseline and is seen on approaching this baseline to lose its linearity and to curve more slowly to zero.





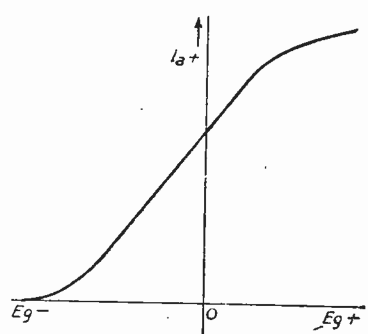


Fig. 1 (left).—Basic valve circuit. Fig. 2 (centre).—"Curve" for imaginary ideal valve. Fig. 3 (right).—Practical valve-curve.

A.C. Resistance

The situation now visualised, then, is a valve with a voltage across it from cathode to anode (the H.T.) and a finite current flowing. Now if the valve had no resistance to the flow of current, the current would be infinitely large, but we know it to be only a few milliamps. The valve thus exhibits a D.C. resistance which can be calculated by the usual Ohm's Law formula, dividing Ea by the Ia that it causes to flow. This resistance will vary, however, according to the conditions of working of the valve, and the more useful figure is the effective resistance exhibited when the anode voltage is changed slightly. For instance, a reduction in applied H.T. will cause a reduction in the current flowing, and the ratio is called the A.C. resistance. Thus:

$$\text{A.C. resistance (ra)} = \frac{\text{change in Ea}}{\text{change in Ia}}$$

Amplification Factor

There are two different ways of influencing the anode current, therefore. Either the grid voltage or the anode voltage can be changed, a reduction in Ea or a movement of Eg towards negative reducing the anode current flowing. In practice, however, it is found that for a given change in Ia a smaller change in Eg than in Ea will be required. This is to be expected because the grid is nearer to the cathode and consequently its effect would be expected to be greater, and also, the anode effect is to some degree mitigated by the interposed grid. The ratio of the change in anode voltage required to effect a certain small change in anode current to the change in grid voltage to make the same small change in anode current (it being assumed that in each case the electrode not being directly considered holds an unchanged voltage) is called the amplification factor. Thus:

$$\text{Amplification Factor } (\mu) = \frac{\text{Change in Ea}}{\text{Change in Eg}} \text{ for same change in Ia.}$$

It will be seen that the three valve constants are derived from the permutations and combinations of only three basic factors and that these basic factors are all differences rather than absolute figures. If any two of these constants are known, the third can be derived. For instance:

Amplification Factor

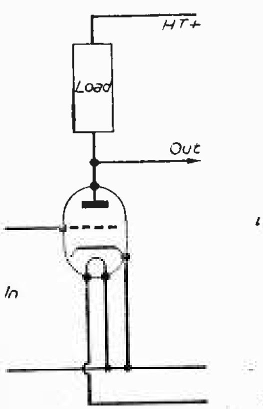
$$= \frac{\text{Change in Ea}}{\text{Change in Eg}}$$

$$= \frac{\text{Change in Ea}}{\text{Change in Ia}} \times \frac{\text{Change in Ia}}{\text{Change in Eg}}$$

thus $\mu = \text{ra} \times \text{gm}$ ....(1)

The really important thing to notice is, however, that all these three valve constants have been derived simply by connecting supply voltages direct to the valve and under circumstances that prevent amplification or, in fact, any output at all. Even μ is not really concerned with amplification! These constants and the characteristic curves that demonstrate them are referred to as static characteristics. They have their uses, but in practice they are not so simple as they had seemed to be. It is these static figures that are quoted in the usual abbreviated valve data lists and they must not be applied too literally in design work, particularly as they are derived for one particular set of circumstances which may not (indeed, they almost certainly will not) be matched in a practicable design.

The reason why the valve in Fig. 1 does not amplify was seen to be because the anode is connected directly to H.T. and the way to give it the chance of amplifying is to interpose between anode and H.T. positive a load of some sort across which the alternating currents can generate a signal. The load can be anything that presents opposition to alternating currents passed by the valves whilst at the same time maintaining a D.C. path for the H.T. supply. Thus the load can be resistive or reactive or a combination of the two, and so may take the form of either a resistor or an inductance. The need for a D.C. path debars a capacitance by itself, but a capacitor in conjunction with other components that provide a D.C. path can be and is used. Fig. 4 shows the circuit as it now stands. The alternating currents passing through the load will develop a voltage across it which, by Ohm's Law, will be proportional to the current fluctuations and to the value of the impedance in its path. Thus to increase the output of the valve two measures are practicable. Either the fluctuating currents must be increased (by choosing a more sensitive valve, that is, one with a higher gm) or by increasing the ohmic value of the load. It is possible by correct choice of valve and load to obtain a larger voltage across the load than is applied to the grid, and this is voltage amplification. Note that amplification does not automatically follow from the introduction of a load; it will follow only if the circuit constants chosen permit it. Note also that it does not matter what frequency of signal is applied to the grid, the conditions for amplification remain the same.



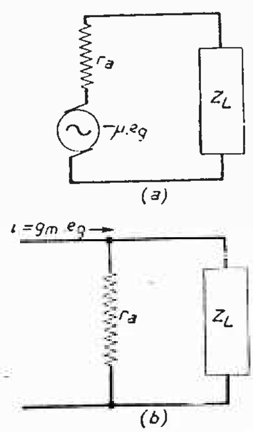


Fig 4 (left).—Basic amplifying circuit. Fig. 5 (right).—Alternative equivalent circuit.

Equivalent Circuit

It is convenient, when considering amplifiers of fluctuating voltages, to eliminate the purely D.C. side of the picture, which has merely to do with the provision of H.T. and any necessary bias, and to ignore the heater or filament supply, which has no task except that of ensuring that there is a supply of electrons to carry out the work, and the valve can then be considered as a generator of alternating voltage in series with a resistance. The generator produces a

(Continued on page 233)

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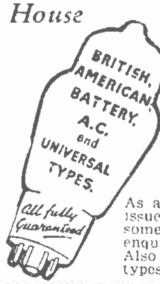

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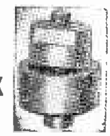

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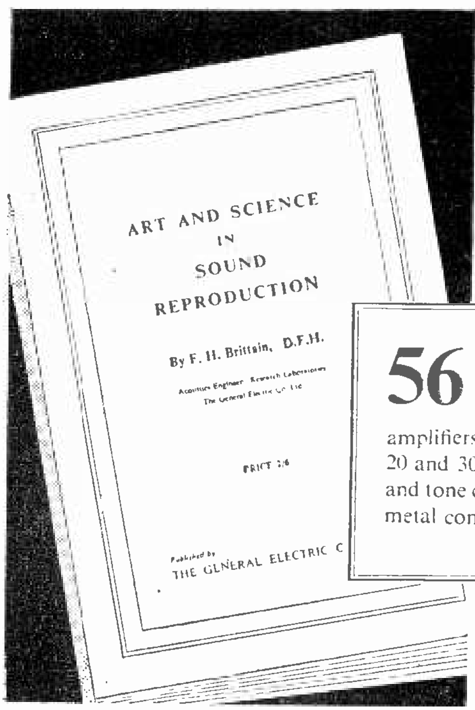

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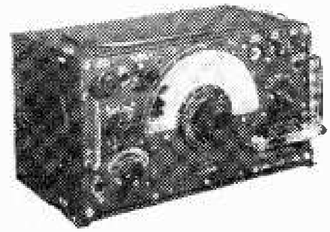

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voltage fluctuating with the signal applied to the grid and of an amplitude equal to the amplification factor (μ) × the voltage applied to the grid, and the resistance is equal to the A.C. resistance (ra) of the valve for the particular voltages applied to the valve. The load impedance (ZL) appears across the valve equivalent circuit as shown in Fig. 5a. The voltage shown in Fig. 5a as being produced by the equivalent generator has a minus sign in front of it. This is because, in effect, the signal at the anode of the valve is reversed in phase compared with the input voltage. For instance, when the grid signal is going negative it reduces the flow of electrons. This in turn reduces the voltage drop across the load, and so the voltage actually at the anode moves towards

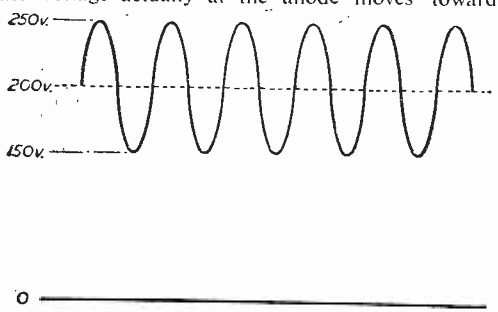


Fig. 6.—Combination of direct and alternating voltages.

the H.T. positive voltage, i.e., it goes positive. Thus the signal out from the anode goes positive when the grid goes negative.

This form of equivalent circuit for a valve is that most usually seen and, as shown, introduces two of the three basic valve parameters, i.e., μ and ra. It is applicable to any sort of amplifying valve such as triode, tetrode, pentode, etc., the type of valve merely determining the arithmetical size of the parameters. The third parameter, gm, is introduced in an alternative form of equivalent circuit given in Fig. 5b, where the valve is shown as equivalent to a device producing a current equal to gm . eg passing through a resistance equal to ra and the load ZL appears in parallel across ra. Both these conceptions are different ways of looking at the same thing, and whichever is used will lead to the same result, though the voltage generator form of Fig. 5a is the more convenient for basic theory and particularly for triodes, whilst the current generator form of Fig. 5b is rather handier for the case of pentode amplifiers.

It will be seen that the generated voltage in the voltage generator version is in effect across ra and the load in series, and so it is clear that some of the voltage is lost across ra, which is the valve itself, and only that part of the signal appearing across the load is available as an output from the valve. If, for instance, ZL was a resistance equal to ra, exactly a half of the generated voltage μ . eg would be lost across the internal resistance and the other half is available as an output. Similarly, in the case of the current generator version, assuming that the load is a resistance equal to ra, the current divides between the two arms, a half going through the internal resistance and only a half passing through the load to produce the output signal, so again a half the possible signal output is available.

Now, returning to the voltage generator version with a resistive load it is a simple matter to derive from first principles the formula for the actual amplification of the valve. The equivalent generator drives a current through ra and the resistive load which, because it is resistive, will now be designated RL. The voltage driving current through ra and RL is $-\mu$. eg and so, by Ohm's Law,

the current flowing (I) $= \dfrac{\mu \cdot eg}{ra + RL}$ ....(2)

The output signal (e out) = I . RL or substituting (2) above

$= \dfrac{\mu \cdot eg \cdot RL}{ra + RL}$ and (dividing by eg, the input voltage)

the actual amplification

$$M = \mu . \frac{RL}{ra + RL} \quad \text{...........................(3)}$$

To show again that the current generator equivalent circuit gives the same results, consider Fig. 5b, assuming that the load is resistive and therefore designated RL. RL and ra are in parallel so their effective resistance, from the well-known formula for resistances in parallel, is

$$\frac{ra \cdot RL}{ra + RL}$$

The voltage existing across both ra and RL is given by Ohm's Law

$$e = i . \frac{ra \cdot RL}{ra + RL}$$

$$= \frac{gm \cdot eg \cdot ra \cdot RL}{ra + RL}$$

(by substituting for I . the current shown in Fig. 5b)

But gm . ra $= \mu$ (I above)

so e $= \dfrac{\mu \cdot eg \cdot RL}{ra + RL}$ as before.

The negative sign that appears in the equivalent circuit diagrams has been quite justifiably ignored because at the moment only the amplitudes of signals are being considered and not their relative phases. In practice, of course, the phase is not of general interest in sound reproduction theory, but it will be

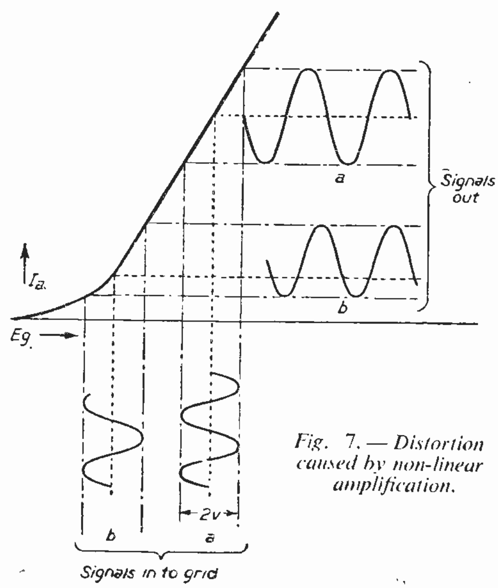


Fig. 7.—Distortion caused by non-linear amplification.

taken into consideration when looking at practical considerations and is of vital interest, for instance, in television video amplification.

It must be emphasised that the picture presented by the equivalent circuit diagram for a valve is purely the A.C. state of affairs divorced from the D.C. situation. In other words, the information given by the equivalent circuit has to be added to static conditions of working, i.e., the conditions applying without the application of a signal, to see what exactly is going on. To take an example, supposing that it is decided to operate a valve with 200 volts applied as H.T. and with a resistive load of 50 KΩ. The H.T. voltage at the anode under these conditions is found to be 100 volts and the valve has, say, a μ of 12 and an ra of 10,000 ohms under these conditions. These figures represent the static situation and do not presuppose any input signal. By Ohm's Law the actual anode current flowing under these static conditions can be derived. Thus, 100 volts is being dropped across the load resistor of 50 KΩ and so

$$Ia = \frac{100}{50000}\left(\times 1000 \text{ to give the result in mA}\right)$$
$$= 2 \text{ mA}$$

Also, gm can be derived by means of the formula already given if desired

$$\mu = ra \times gm$$
$$gm = \frac{12}{10000}\left(\times 1000 \text{ to give result in mA/V}\right)$$
$$= 1.2 \text{ at the working conditions specified.}$$

What we are really interested in is the actual gain from the arrangement and by the formula previously derived

$$M = \mu . \frac{RL}{ra + RL}$$
$$= 12 . \frac{50000}{10000 + 50000}$$
$$= 10$$

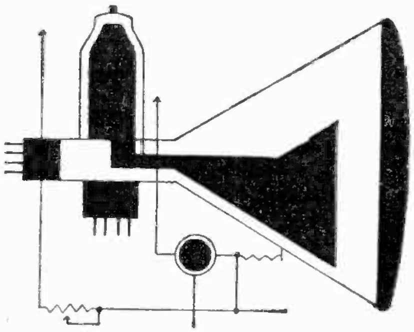
Now suppose that a signal is applied to the grid to be amplified, and further to simplify matters assume that it is a simple sine wave. The frequency is of no material importance so far as our theory has yet been developed. This signal is, say, 2 volts peak to peak and so the amplitude of signal available at the anode of the valve is $2 \times 10 = 20$ volts peak to peak. This has to be added to the static state in such a way that the anode voltage still averages that existing before the signal was applied, i.e., 100 volts. So the anode must fluctuate above and below this static voltage and will actually move between 110 volts and 90 volts to give the stipulated 20 volts signal. This is shown in Fig. 6.

Distortion Due to Non-linearity

Distortionless amplification has been assumed in the above and that may not necessarily be the case. A graph helps to create a visual impression of what is going on in practice. In Fig. 7 is drawn the grid volts anode current curve of a triode for negative grid volts and at (a) is shown a sine wave of two volts amplitude. Lines are now drawn from various points of the sine wave vertically to the curve and then horizontally to the right and the resulting current fluctuations are reproduced by constructing a wave connecting the points thus projected. Now it is found that if the part of the valve characteristic curve over which the input signal moves is perfectly straight the reproduced wave takes on exactly the same shape as that input wave; in the present example the input is a sine wave and, therefore, the wave projected to the right of the curve is also a sine wave—hence the common reference to "linear" amplification. But supposing the input sine wave instead of oscillating about the straight part of the curve is situated towards the curved knee of the characteristic. By the same method of construction it is found (as at Fig. 7b) that the current waveform has lost the perfect sine waveform and is now distorted. Obviously, for distortionless amplification steps have to be taken to ensure that the input keeps to the straight part of the characteristic, and this requires two measures. First, the straight and, therefore, usable part of the characteristic has to be measured along the grid bias baseline and the applied signal has to be kept below the maximum swing thus determined. Secondly, the swing has to be brought fairly and squarely into the straight portion as at 7a and this requires a fixed negative grid bias to the valve equal to the voltage indicated on the characteristic as coinciding with the middle point of the straight section.

Before proceeding any further with theory it will be as well to have a look at this practical approach to this matter. Fortunately, the valve manufacturers make the matter easier for the designer by publishing curves taking account of the actual conditions of working. These are known as the dynamic characteristics. The first thing to note from a curve allowing for the effects of having a load resistor is that the slope of the curve is reduced as compared with that of the same valve under static conditions without a load. The reason for this will be clear after a little thought. If the grid of a valve is made more negative and the anode is held at a steady potential (as is assumed in the static characteristic) the anode current will decrease. If the same valve has a resistive anode load, however, the effect of the decrease in current through the load is to reduce the voltage drop across the load and so increasing the H.T. voltage actually at the valve anode. This increase in voltage will tend to increase the anode current of course, and so will counteract to a degree the effect of the grid signal. The valve appears then to be less sensitive than the static curve indicated, which is equivalent to a lower slope (gm). The dynamic curves will also generally show only the part of the characteristic actually usable and will not be extended to the saturation point. The method is to lay a straight-edge along the curve to pick out a straight portion the length of which, projected on to the grid voltage scale, is sufficient to cover a grid swing equal to the maximum signal that it is expected to apply for amplification. In considering the length of grid swing required one has to bear in mind the method of specifying the signal input. This may be peak to peak, which indicates the actual grid voltage excursion or it may be just peak voltage, indicating the height of the peak from the zero baseline, or in other words half the peak-to-peak voltage. Thirdly, the signal may be specified as R.M.S. (which is the more common way of specifying a sine wave amplitude). To convert the R.M.S. value to the peak value it must be multiplied by $\sqrt{2}$ and to convert R.M.S. to peak to peak (as required for the present purpose) it must be multiplied by $2\sqrt{2}$, or approximately 2.8.

(To be continued.)



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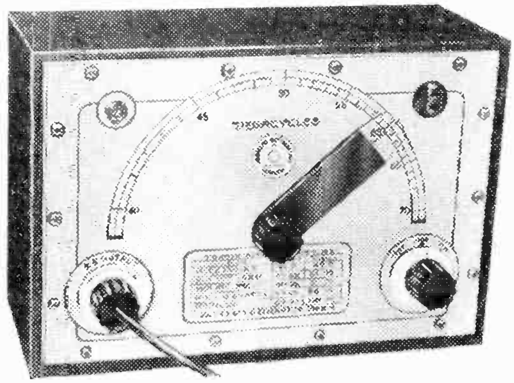

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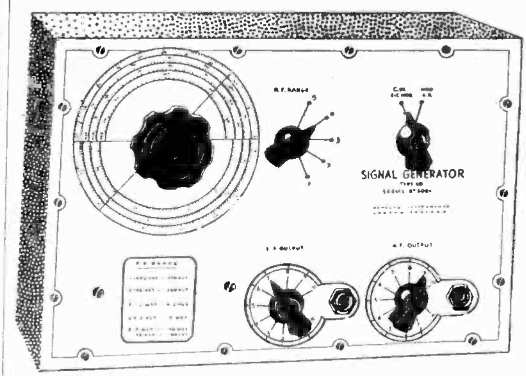

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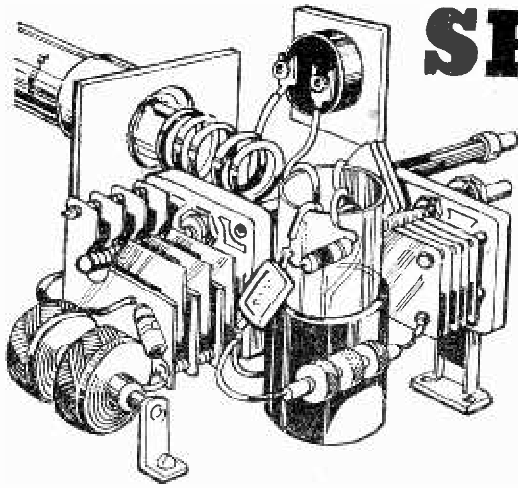


SHORT-WAVE SECTION

PARASITIC OSCILLATION IN S.W. CONVERTERS

By Wm. Nimmons

MUCH disappointment and frustration can result when, as sometimes happens, parasitic oscillation occurs in a short-wave converter. This very seldom happens after the converter has been in use satisfactorily for some time; more often it is an inherent defect of a newly built converter, and as such has to be "ironed out."

Parasitic oscillation is an unwanted oscillation; it usually occurs at a frequency different from that wanted—invariably at a higher frequency. It takes the form of a continuous hissing sound in the loudspeaker of such intensity as to drown all but the most powerful signals. It is not tunable but may vary in intensity at different points in the tuning range, usually disappearing as the condenser vanes approach their maximum setting. Thus normal operation may be possible over at least part of the range of tuning.

For some reason it is more prone to attack the triode-hexode and triode-heptode type of frequency-changer valve; the older pentagrid type is not nearly so liable to this form of trouble. At the same time the pentagrid is much less efficient at the higher frequencies, and this alone often rules it out as an efficient converter.

The elementary rules of short wiring and the return of all associated wires to a common earthing point are indicated, but in spite of these precautions parasitic oscillation may occur. It is worth while, before making any drastic alteration to the circuit or layout, to try the effect of altering the earthing points. Remember that although there may be a solid metal chassis there may be circulatory currents in it, and an endeavour should be made to reduce these currents to a minimum. Try earthing the tuning condenser at several different points, taking the points not to the chassis but to the lower end of the tuning coil. This applies even if the condenser is already connected to chassis but not if grid-bias is applied as in Fig. 3, because this would short the condenser.

Attention to these points may effect a cure. If not, it would be advisable to alter the oscillator section of the valve from tuned grid to tuned anode, or vice versa. This alteration can be carried out without extensive modifications of the layout. Fig. 1 shows the tuned grid type of circuit, while Fig. 2 illustrates the tuned anode. It will be seen that there is very little difference to the actual valveholder connections, although the effect of the alteration is to cause the oscillator to perform in a different manner. In one case the "reaction" coil is in the anode circuit and in the other it is in the grid circuit. The complementary tuning coil is similarly in the grid circuit in one case, and in the anode circuit in the other.

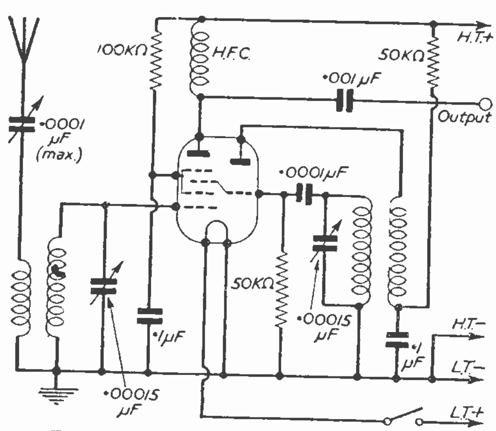


Fig. 1.—The tuned-grid frequency changer.

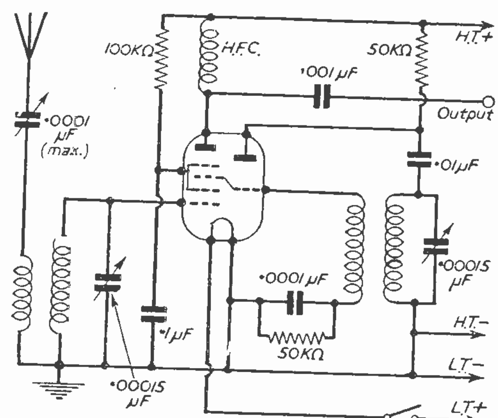


Fig. 2.—A variation of Fig. 1—The tuned-anode oscillator.

This will affect the constants of the circuit and may effect a cure.

Parasitic Oscillation Causes

It is useful at this point to indicate some of the chief causes of parasitic oscillation. Either the triode or heptode section of the valve may be responsible, or both. The triode section may be oscillating too vigorously, setting up a "squegging" action in the same manner as the ordinary reaction condenser of a T.R.F. receiver, which if pushed too far will result in a squegging sound. The condition may be the result of a combination of obscure effects resulting in the setting up of an oscillatory state at a different frequency from that at which the tuning condensers are set.

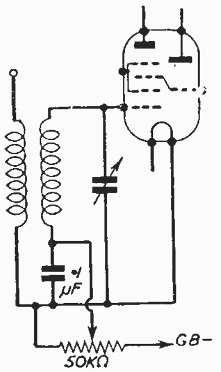


Fig. 3.—Parasitic oscillation in the hexode section of the valve may be stopped by the application of grid-bias.

If there is a whistle at each station, or a number of whistles, it is likely to be the heptode section that is at fault. Most converters work with the heptode at zero bias, and this is when the valve is most sensitive. It may "spill over," particularly at high anode and primer grid potentials. In this condition the valve is unsuited to the reception of signals, the remedy being to either (a) reduce the primer grid voltage until the self-oscillation ceases, or (b) apply grid-bias either in the form of a potentiometer and a nine-volt battery, or one or two dry cells. The latter method is simple but may reduce the sensitivity so much that weak signals will be lost. The former has the advantage of the bias being fully controllable but it adds another control to the converter. To insert the potentiometer break the coil wiring at the bottom, as indicated in Fig. 3, by-passing the bottom of the coil to chassis with a .1 mfd. condenser.

When squegging is the cause in the triode section it may be due to too much H.T., or to a too big or too closely coupled reaction winding. The "squegging" will probably be much in evidence on the higher wavelength coil (25-50 metres), and will probably fall off on the lower wavelength coils (13-26 metres) as the efficiency of the valve decreases at the higher frequencies.

A resistance of 100-5,000Ω can be inserted in the position shown in Fig. 4. This will cut down the energy of oscillation, and it is necessary to try different values of resistor until one is found which stops the "squegging" but does not reduce the amplitude of the oscillation too much. A variable resistance may be used as in Fig. 4. This enables the control to be accurately set, but again it adds a further control which may be undesirable and in unskilled hands result in the return of the "squegging."

It will be seen that a solution of the trouble should rather be found by a fixed resistance or by a reduction in the H.T., or in the provision of a smaller reaction coil.

The difficulty here is that what suits the higher wavelength coil will not necessarily suit the lower. Having found a fixed resistor that stops "squegging" on the higher the oscillation may be too damped on the lower wavelength coil, or having found one that stops it on the lower it may break out again on the higher wavelength coil. This is because the efficiency falls off at lower wavelengths. Therefore if one wants maximum efficiency on all bands it would be as well to incorporate a variable component in this connection.

Another method which may be used with or in place of the stopper resistance is to wind the reaction coil with resistance wire. A fairly fine wire should be used, about No. 30, and this alone may be sufficient to stop parasitic oscillation in the oscillator. When this is done it should be possible to use a stopper of lower resistance than if the winding were made of copper wire.

In Fig. 4 the tuned grid type of oscillator is shown; in the tuned anode (as in Fig. 2) the stopper resistance should be placed between the top of the coil and the grid of the triode section.

As previously mentioned parasitic oscillation may also occur in the signal-frequency section of the valve. The remedy is then to insert a resistance of about 50-100 Ω in the lead to the control grid. The wires leading out of the resistor should be cut off short, leaving not more than ½in. projecting, and the resistor then soldered into place.

The best instrumental method of detecting parasitic oscillation is to insert a low reading milliameter in the oscillator anode circuit, and to tune over the band. With this type of grid leak oscillator the anode current falls when the valve is oscillating, and there should be a gradual variation in the reading over the band as the valve goes into deeper oscillation at the high frequency end. Any sudden movements of the needle are a sure sign that parasitic oscillation is present. This is useful when one wishes to know whether it is the signal-frequency section or the oscillator section of the valve that is responsible.

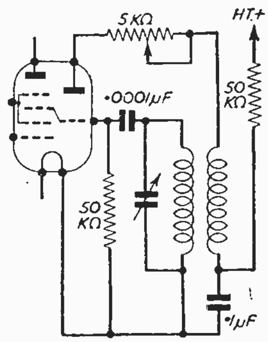
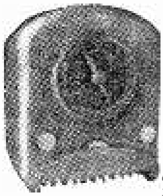


Fig. 4.—*A stopper resistance (5,000 ohms variable) is often effective when the oscillation is in the triode section.*

MAINS MIDGET RADIO



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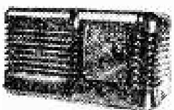

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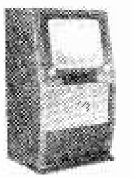

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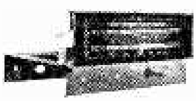

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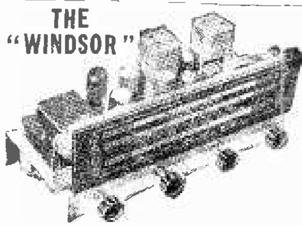

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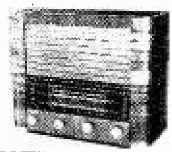

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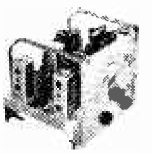

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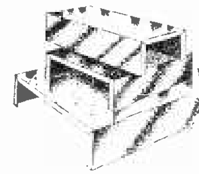

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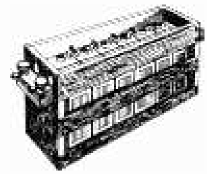

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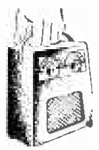

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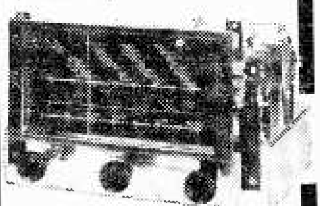

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1912 The FIRST TWELVE YEARS 1925

A RADIO EXPERT DESCRIBES THE FUN OF THE EARLY PIONEERING DAYS BETWEEN 1912 AND 1925

By C. H. Gardner

IN recent issues the Editor has emphasised the number of amateur wireless enthusiasts engaged in their hobby to-day, and it may come as a surprise to many readers to know that over 40 years ago there was quite a strong amateur radio movement in this country.

A fact sometimes forgotten is the part that these amateurs played in the advance of radio. In those days there was no question of helpful journals to provide background knowledge for the amateur, who had to discover facts for himself. But how much more fun it all really was, and for most of us, the only technical knowledge we had at our disposal was of a very general nature of the fundamentals of electricity and magnetism gained in the school classroom and from text books eagerly read.

But for any boy whose hobby was "messing about with electricity" the advent of wireless proved an irresistible draw, and every conceivable source of information was sought in order to obtain some sort of a basis on which to start experimenting. For most of us of that era our experimental work started by an attempt to pass a signal across two or three feet of space. This required two basic pieces of apparatus. A coil capable of giving a good, hefty spark and a thing called a "coherer."

Problem number one was how to obtain a suitable "spark coil" from limited pocket money, but instructions for making this piece of apparatus appeared in various journals from time to time and most of us made an attempt to construct it. The attempts were not always successful as construction involved the winding of a large quantity of wire over a core consisting of a bundle of soft iron wires. It was also necessary to make a condenser to go across the contact points, and this, in turn, had to be made by pasting sheets of tinfoil on to old photographic plates stripped of their negatives. This method of manufacturing a condenser usually resulted in something about six inches square and three inches thick, having a capacity of something less than we get in a thumbnail condenser to-day.

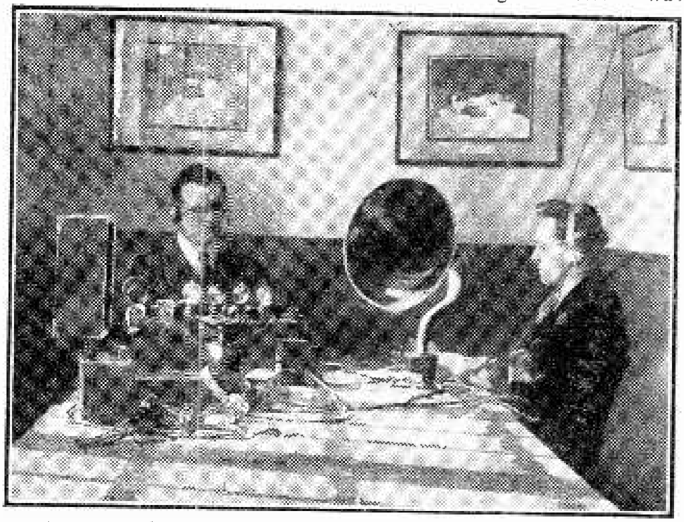
The coherer was usually described in the text books as a small piece of glass tube containing silver filings. As it required a considerable number of filed down sixpences to make a minute coherer, the tendency on the part of the impecunious amateur was to experiment with less expensive metals.

The idea was that if one produced a large enough spark between a couple of brass spheres, wireless waves would be set up. To each of these brass spheres was attached a short rod along which oscillations were alleged to occur, with the resultant formation of the required wave.

The receiving end consisted of a couple of similar rods poked into each end of the coherer. The theory then was that the wireless wave would set up oscillations in these rods and the resulting oscillations would cause the filings to fuse together. Attached to this coherer was also a battery and a bell. When the filings fused together the circuit was completed and the bell rang. A refinement was to arrange for the hammer of the bell to hit the coherer and thus break away the fused part of the filings making the whole apparatus ready for another signal.

If any amateur has become bored with the present-day forms of home construction, I can recommend that he has a crack at making this piece of apparatus work. Frankly, although a modified form of this equipment was made to work by experts, none of my own circle of acquaintances ever achieved much success with it, and it was a great relief to hear that other forms of detectors had been evolved.

It is rather difficult at this length of time to remember which of three forms of detectors really came into being first. The three forms of detector were known as the electrolytic detector, the magnetic detector, and the crystal. Of these the magnetic detector was



A very early radio installation by the author at Brooklands for establishing contact with a racing car.

quite outside amateur possibilities, although it was extremely reliable if rather insensitive and for a considerable period was the standard equipment on board ship. The electrolytic detector was another piece of equipment which I never heard that any amateur made work successfully, and the crystal detector became the standard job in so far as the amateur was concerned.

Concurrently with the coming into being for the amateur of the crystal detector, information became available regarding tuning systems, and the reception of morse transmissions from ships and commercial stations became for the amateur an established fact.

It would be appreciated that no signal amplification was possible, and therefore in order to obtain any range at all the detector must be of the utmost sensitivity and the apparatus have the maximum of efficiency, and this was where the fun really started. A theory was widely held amongst amateurs that in order to get the maximum voltage across the crystal tuning should consist of the greatest possible amount of inductance and the minimum amount of capacity. Tuners therefore tended to consist of inductance only, and in order to obtain fine tuning it was necessary to be able to make contact with each individual turn of the inductance coil. These were usually wound with enamelled wire along one side of which a strip about half an inch wide was bared by sandpapering. A sliding contact then allowed for the necessary turn-by-turn tuning.

The next theory was that in order to avoid loss, the gauge of the wire should be as heavy as possible. Considerable competition existed between local amateurs to produce the most " efficient " tuning coil of this type. I well remember stripping one pole of a large scrap generator and winding an inductance with wire approximately 1/8 of an inch in diameter. This resulted in a coil about three feet high and 18 in. wide. So far as I know none of my friends ever beat this effort which certainly had a most imposing appearance.

Crystals

But if tuning coils provided a considerable field for experiment, they in no way competed with the crystal in this respect.

The information available at the time always suggested that a carborundum crystal should be used. This was supposed to be an extremely stable though somewhat insensitive form of crystal, but it was in fact rarely used by the amateur owing to its lack of sensitivity. The search for crystal combinations of extreme sensitivity provided a great deal of fun, and trade circles having by now appreciated the growing market made available by amateur enthusiasts, entered into the spirit of crystal research with considerable gusto. The claims that were made for some forms of crystal and some combinations of these reflected considerable credit on the inventiveness of the publicity experts. It was also usual, in order to impress the amateur with the value and beauty of these crystals, to send them carefully packed in cotton wool and contained in little pill boxes. No doubt the profit on the sale of some of these crystals provided the original capital for much bigger things. They provided an irresistible bait to the amateur and the try-out of a new type of crystal was often the occasion for a gathering of one's friends. Needless to say, a good many of the " better results " obtained were psychological rather than factual.

Undoubtedly one of the most sensitive crystal combinations was a crystal of zincite with a tellorium point making contact, but in order to obtain its maximum sensitivity it was necessary to apply a small potential of about a quarter of a volt across it. This required the use of a dry cell and a potentiometer. As the potentiometer had to be across the dry cell it was essential that it should have a high resistance, and as no suitable potentiometer was available on the market, something had to be evolved.

It was found that a suitable potentiometer could be made by boiling a lead pencil until the wood split open allowing the graphite core to fall out. This was then fixed between two terminals screwed into a baseboard and a third terminal sliding along it provided the necessary adjustment.

A further essential was a pair of really sensitive high resistance telephones, and luckily these were obtainable at a price. As in my own case the price was out of reach for a considerable period, an ordinary telephone earpiece had to be used.

Imagine then the amateur of that day sitting down to receive signals. The adjustment of the crystal was very fine indeed, and many ingenious holders were evolved to provide a very fine adjustment of pressure. When a suitably sensitive spot on the crystal had been found, it was then necessary to adjust the potentiometer to attain maximum sensitivity. At the same time tuning search had to be made in the hope that some station or other within range might be transmitting.

Usually, just as a faint signal was being heard, somebody slammed a door in the house or another occupant of the room trod on a loose board. This was quite sufficient to throw the whole apparatus our of gear, whereupon one started the whole process afresh. A curious feature of this crystal combination was that it always seemed that the glittering red part of the zincite crystal was most sensitive, and I well remember spending many hours with a small crucible furnace trying to produce pure zincite crystals which would be sensitive all over—needless to say without attaining this highly desirable end.

The loose-coupled tuner came into existence for the amateur about this time. This consisted of a coil former as previously described, but inside this former was a smaller coil which could be slid in and out to a varying degree of coupling. As no slider could be arranged on this, the coil usually had tappings taken to a rotary switch on its end. Professionally manufactured, this looked a most attractive piece of apparatus though somewhat costly, and much fun became available to those who tried to construct this piece of apparatus themselves. The fundamentals were usually the cardboard rolls on which linoleum was supplied and some old brass stair rods.

Little has been said about aerials—the general idea being to get as much wire as possible as high as possible. Fortunate indeed were those of us with tall trees available and a friend with a good head for heights who had no objection to climbing on to the topmost boughs.

(To be continued.)

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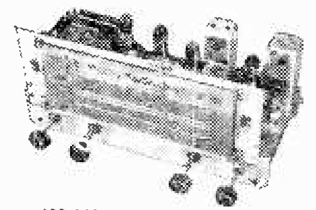

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E.H.T. TRANSF.—4 Kv. A.C., 2 v. 2 a., 45 -.
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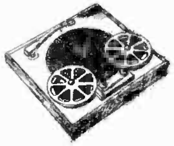

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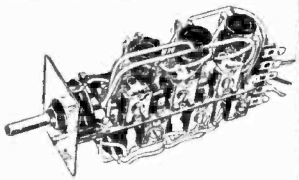

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23	1/7	2/7	1/7	2/7
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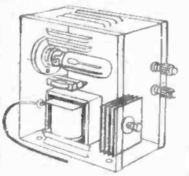

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TUB. PAPER.—500 v. wkg. up to .0005, **8d.**; to .006, **9d.**; to .01, **11d.**; .05 and .1, **1/1**; .2 and .25, **1/6**; .5, **2/3**.
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BRIDGE RECTIFIERS suitable for use with the above transformers, 2 amp., **11/3**; 3 amp., **12/6**; 4 amp., **15/-**; 6 amp., **23/6**. Post 1/4.
HALF WAVE. 125 volts A.C. input. RM1, 60 mA., **3/9**; RM2, 120 mA., **4/3**; RM3, 125 mA., **5/3**; RM4, 250 v. 275 mA. for T.V., **15/6**. Post 6d.
E.H.T. PENCIL RECTIFIERS.—K3/40 3.2 kV., **7/6**; K3/45 3.6 kV., **8/2**; K3/50 4 kV., **8/8**; K3/100 8 kV., **14/8**; K3/160 12.8 kV., **21/6**.
VALVES.—6AM6, 6CH6, 6BA6, 6BH6, 6BE6, 12BE6, 6C6, 6BW6, 3A4, 1U5, 6AL5, W77, N18, 6BJ6, 50C5, 1S5, **7/6** each; 6K8gt, 12K8gt, 1R5, VR150/30, 6BH7, **9/6** each.

35, Tenison Way London, S.E.1.

Faults in Home-made Eliminators

SOME USEFUL ADVICE FOR THE USERS OF BATTERY RECEIVERS

By "Experimenter"

A SURPRISINGLY large number of battery sets, intended by the makers to be run from a dry battery, derive their H.T. supply from eliminators, either A.C. or D.C.

With the present high prices of H.T. batteries, even with the purchase tax taken off, many wireless enthusiasts have made, or are about to make, battery eliminators. For the price of one 120-volt dry battery, or at most two, it is possible to make an eliminator that will last for years; not only is the first payment the only payment, but the current obtained is to all intents and purposes free, as in many cases the current drawn is not sufficient to actuate the meter installed by the electricity undertakings.

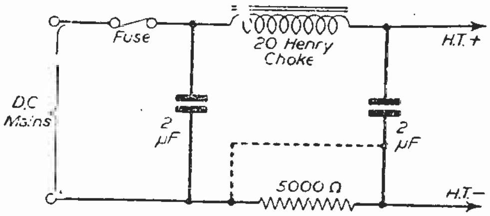


Fig. 1.—A fault in this circuit (shown by the dotted line) led to instability in the receiver.

For the benefit of those whose theoretical knowledge exceeds their practical experience, the following hints may prove useful, not only in the matter of personal safety but also to secure freedom from breakdowns—and what is perhaps more important, freedom from erratic operation.

This last is by far the commonest fault met with in home-constructed eliminators. As an example of what is meant by erratic operation, take the case of a straight receiver with reaction. A station is tuned in to a comfortable volume, only to fall away to nothing a few minutes later; or what is equally irritating, to burst into oscillation. Anyone with the necessary theoretical knowledge will deduce from this that the H.T. voltage is fluctuating in an erratic manner, but to pin down the cause of such a fluctuation is another matter.

Besides this fault there are others equally elusive which may very well occur. Among these is the fault of excessive hum. But before blaming the eliminator for causing the hum it is as well to determine whether or not the cause is in the set itself. The best method to do this is to try the eliminator on another receiver.

One peculiar case of hum which came to my notice took over six months to locate and pin down. It took the peculiar form of (a) a normal amount of hum with the reaction condenser at zero; (b) a gradual build-up of the hum as the reaction condenser was increased; and finally (c) an overpowering hum—sufficient to drown all signals—if the receiver was allowed to oscillate. The cause of this lamentable state of affairs proved to be nothing more or less than a broken pig-tail on a variable condenser! The consequent poor contact between the moving vanes and the frame of the condenser had, in some peculiar manner, found a resonance with the frequency of the mains hum, the strength of the resonance depending upon the amount of H.F. energy circulating in the condenser. Fortunately for the home constructor this fault is not likely to be met with very often!

Components

One of the snags in eliminator construction is that the constructor may be tempted to use parts he has on hand, without reference to their suitability. It cannot be too strongly emphasised that all condensers, chokes, etc., used in an eliminator should be sound and worthy. The condensers should be tested to twice, and preferably thrice, their working voltage. The choke should be a proper choke.

I mention this latter because I have come across several cases where L.F. transformers have been used as chokes. The L.F. transformer is totally unsuited to this position, except possibly in an eliminator drawing only a very small current—a matter of a few milliamps. Even then only the primary should be used as a choke. The secondary, with its fine wire, extremely high inductance, and liability to saturate the core, is unsuited. A good choke will have a resistance of around 400 ohms and an inductance of about 20 henries at a reasonable current—say 20 milliamps. The primary of a transformer may have a similar inductance when a few milliamps are flowing, but this will drop sharply when the current is increased. The secondary may have an inductance as high as 3,000 henries, but at a very low current. It may saturate the core with as little as one milliamp flowing. To use it is only to invite hum, and perhaps other troubles as well.

One particularly annoying fault was characterised by a sharp click in the loudspeaker after the set had

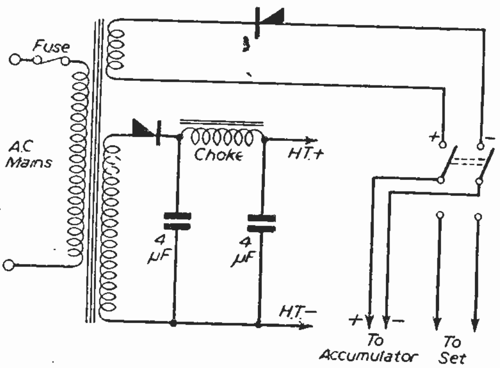


Fig. 2.—In this A.C. version, a double-pole, double-throw switch is used to isolate the receiver from the trickle-charger.

been in operation for a short time, when the volume would either fall away or increase and be accompanied by hum. The cause was found to be ruined insulation in an L.F. transformer which had been used as a choke.

Another drawback of a transformer is that it limits the current which can be drawn. The primary will have a resistance of around 2,000 ohms, and the secondary a resistance of around 10,000 ohms. This, added to the resistance already incorporated in the eliminator, will cut down the voltage and current which the unit can supply.

It may seem axiomatic that the condensers used should be sound, yet one comes across cases where leaky or open-circuited condensers are incorporated in the construction of eliminators, incredible though it may sound. The leaky condenser will absorb a great deal of the power, if it does not go on fire or explode; the open-circuited condenser will not smooth the hum. Moral: use sound condensers.

The resistance, which is used to break down the mains voltage to a value suitable for battery valves, should be at least of the 2-watt rating, and preferably of the 5-watt rating, if freedom from breakdown is desired. A 1-watt resistor will do the job, and may hold out for a time, particularly when low in value—around 5,000 ohms—but it may overheat and alter its resistance.

A D.C. eliminator which gave trouble was found on examination to have a faulty connection. This is shown in Fig. 1. The condenser between the positive and negative sides of the supply on one side of the choke was wrongly connected. The wrong connection is shown in dotted lines. This is a mistake in connecting up rather than a fault, but it proves that one cannot be too careful. The mistake caused instability in the receiver.

Trickle Charger

Turning to the A.C. mains eliminator, this usually incorporates a trickle charger. All the foregoing applies here, too; but the added complication of the trickle-charger is liable to add increased hum. Just how much hum must one tolerate? It is impossible to eradicate it entirely, but it must never be intrusive. One fault of the trickle-charger type of eliminator in which the accumulator is kept permanently on charge is excessive hum; this is doubtless due to the fact that the trickle-charger side of the transformer is unsmoothed.

It should be possible to smooth this side, but it would be very difficult because the commercial transformer has very little excess voltage over and above the 2 volts necessary to keep the accumulator charged.

One way out of the difficulty is as shown in Fig. 2. Here there is a double-pole, double-throw switch incorporated in the trickle-charger section; the accumulator goes to the centre poles, the trickle-charger to the upper outer, and the set to the lower outer poles.

News from the Clubs

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: N. Miller, 10, Rom Crescent, Romford.

AT the recent A.G.M., society officers were elected for the coming year. Healthy progress was reported with membership on the 30 mark, but new members will be warmly welcomed every Tuesday evening at 8.15 p.m. at R.A.F.A. House, 18, Carlton Road, Romford.

The club transmitter (G4KF) is on the air from this address and morse classes for beginners are being held. Plans are ahead for participation in N.F.D., and equipment is being assembled.

On March 30th, Louis Varney, A.M.I.E.E. (G5RV), will give a talk on "TV and Transmitter Design," and visitors will be welcomed.

MIDLAND AMATEUR RADIO SOCIETY
Hon. Sec.: D. Hall, 144, Hill Village Road, Sutton Coldfield.

AT a recent meeting a lecture was given by a member of the society, Geoff Nicholson (G3HKC), on "Receiver Design," which was well received.

The society holds its meetings on the third Tuesday in the month at the Imperial Hotel, Temple Street, Birmingham, commencing at 7 p.m. Visitors are cordially invited to attend.

IXWORTH RADIO CLUB
Hon. Sec.: Mr. P. G. Wright, Thurston Road, Great Barton, Bury St. Edmunds.

AT the January meeting, Mr. G. D. W. Ross gave a very interesting talk and demonstration on electronic organs, based on recent PRACTICAL WIRELESS details.

The next meeting is on March 20th, 7.30, at Church Institute, Great Barton.

WARRINGTON AND DISTRICT RADIO SOCIETY
Hon. Sec.: Mr. G. H. Flood, 32, Capesthorne Road, Orford, Warrington, Lancs.

AT the recent A.G.M., Mr. A. Ferguson was elected chairman, Mr. G. Flood secretary, and Mr. B. Webster re-elected treasurer.

The annual dinner was held on January 29th. Due to the indisposition of the president, Mr. A. Monk, the vice-president, Mr. G. Richards, officiated.

Visitors are welcome to meetings, held at the Kings Head Hotel, Winwick Street, at 7.30 p.m., on the first and third Tuesdays in the month.

THE WEST LANCASHIRE RADIO SOCIETY (CROSBY)
Hon. Sec.: S. Turner, 5, Balfe Street, Seaforth, Liverpool, 21.

THE meetings of the society are held every Tuesday evening at 8 p.m. over Gordon's sweetshop at the corner of St. John's Road, Waterloo. Recent events have included a talk and film-strip on "Valve Characteristics," a talk on "Early Transmitters," and a very successful junk sale.

New members and visitors are warmly welcomed.

NEWARK AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: J. R. Clayton, 160, Wolsey Road, Newark.

FORTNIGHTLY meetings at 7 p.m. in the Northern Hotel continue to be held. At recent meetings the club has enjoyed technical talks and demonstrations, quizzes and a junk sale. Meetings in March are on the 7th and 21st, to which newcomers and visitors are cordially invited.

CLIFTON AMATEUR RADIO SOCIETY
Hon. Sec.: C. H. Bullivant (G3DIC), 25, St. Fillans Road, London, S.E.6.

DURING recent weeks club members have been busy in the newly formed workshop engaged on the many tasks which have to be performed before more serious work can be tackled. There is now 40 square feet of bench space available.

The club station (G3GHN) has been active on top band and numerous contacts made with stations up and down the country. Other club stations active on top band on Friday evenings are invited to give G3GHN a call.

The Clifton A.R.S. meet at 225, New Cross Road, S.E.14, every Friday at 7.30 p.m., visitors and new members being assured of a warm welcome.

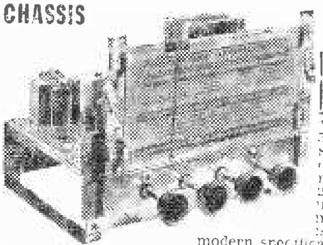
GRAVESEND AMATEUR RADIO SOCIETY
Hon. Sec.: Bob Appleton, 23, Laurel Avenue, Gravesend, Kent.

THE club-room has moved to Scout's Den, London Road, Rosherville, and meetings are now held every Thursday evening, at 7.30 p.m.

At last Annual General Meeting, held on January 14th, 1954, J. Irlam (G3JBT) and E. Woods (G3FST), were elected chairman and president, respectively.

New committee being elected, the club's past activities and financial status were discussed.

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 7½in. x 8½in. high. Dial size, 7½in. x 4½in. Price, complete and READY FOR USE, excluding speaker, **£12/12/-.** (Carr. and Pkg. 7/6 extra.)

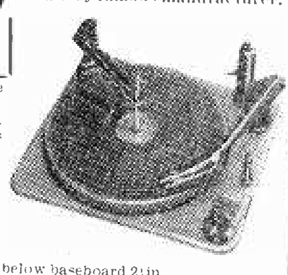
MODEL B.3. P.P.—This model is the B.3. Receiver but incorporates two 6BW6 VALVES in PUSH PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price **£15/15/-.** (Plus 7/6 carr. and ins.)

MODERNISE YOUR OLD RADIOGRAM FOR £25

We offer this Autochanger complete with Model B.3.-waveband as advertised together with 10in. p.m. Speaker for **£23** plus 10/- carr. and ins., or with B/PP Model for **£26** plus 10/- carr. and ins.

A GENUINE SPECIAL OFFER!

A 3-Speed Autochange Unit by a very famous manufacturer.



£11/14/6 (Normal Price is £16 10 -.)

- These units will auto-change on all three speeds 7in., 10in., and 12in.
- They play MIXED 7in. 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.
- Minimum base-board size required 13½in. x 12½in. with height above 5½in. and height below baseboard 2½in.

A bulk purchase enables us to offer these BRAND-NEW UNITS, including mounting instructions, at this exceptional price. Please include 7/6 packing and insurance.

In addition to the Record Players advertised we have

A FEW ONLY—NEW MANUFACTURER'S SURPLUS

3-SPEED AUTOCHANGER. Plays MIXED 10in. and 12in. Records and incorporates the ORTHODYNAMIC H.F. MAGNETIC HEAD fitted with Twin Alloy Stylus and Matching Transformer.

£10/19/6 (Plus 7/6 tax and ins.)

LATEST COLLARO 3-SPEED AUTOCHANGER

Incorporating the new STUDIO "O" PICK-UP. This is a NON-MIXER TYPE and is attractively finished CREAM.

£11/19/6 (Plus 7/6 carr. and ins.)

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.

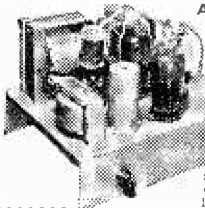
The Unit measures only 7in. x 4in. x 2in., including self-contained Power Supply, and can be accommodated either on or away from the main Amplifier, i.e., in the front panel of a Cabinet or any other position. Price, including drilled chassis, valves (6SN7 and 6J5), **£3/16/9.** Complete assembly data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

The PLESSEY Single Speed Record Player

£3/19/6 (Plus 5/- Carr. and insurance.)

RIM DRIVE 78 RPM, complete with Magnetic Pick-up and incorporating AUTOSTOP. These are complete BRAND NEW UNITS for A.C. mains 200/250 volts.

A 4-VALVE QUALITY "PUSH-PULL" 6-8 watt AMPLIFIER for A.C. mains

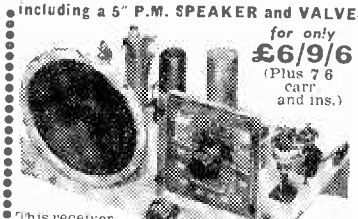


Incorporating Negative Feedback, Filter Input, Circuit and employing 6V6s in Push-Pull. A simple arrangement is provided to enable either a magnetic, crystal or lightweight pick-up to be used, and is suitable for use with Standard or long-playing records. A tone control is incorporated, and the 10-watt output transformer is designed to match 2 to 15 ohm speakers. The overall size of the assembled chassis is 10in. x 8in. x 7½in. high, and full practical diagrams are supplied. Price, including drilled chassis and valves, of complete kit, **£6 17 6.** Price of assembled chassis, supplied ready for use, **£8 12/6.** Full descriptive leaflets are available separately for **1/-.**

A COMPLETE 4 VALVE T.R.F. CHASSIS

including a 5" P.M. SPEAKER and VALVES

for only **£6/9/6** (Plus 7/6 carr. and ins.)



This receiver is the very latest design covering both L. and M.W.-bands, and includes modern BVA miniature valves, line up being 12BA6—12AT6—12A6—35W4. It incorporates Permeability Tuned Coils, ensuring excellent selectivity and sensitivity. Overall size of complete chassis including Speaker 10½in. x 4½in. x 6½in. An attractive Bakelite Ivory finished Cabinet, size 11½in. x 5½in. x 6½in. is available for 16/6. (Plus 2/6 carriage and insurance).

COMPLETE KIT for 12 WATT HIGH FIDELITY "Push-Pull" AMPLIFIER

Designed for A.C. mains 200 to 250 volts, employs 6 valves plus rectifier, with negative feed-back, and comprises a main amplifier chassis and a remote controlled Pre-amplifier and Tone Control Unit, incorporating four controls—bass, treble, main volume or mixing control, and a radio, gram, microphone selector switch. This control unit measures only 7 x 4 x 2in. The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore, that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV. 6.3 volts at 2 amps. and 30 mA. H.T. is provided for tuning unit etc. Price of complete kit, Amplifier and Control Unit, including drilled chassis and valves, **£14.** Complete specification and layout, **2/-.** We can also supply completely assembled and ready for use at **£17.** Please add 7/6 carr. and insurance.

THIS AMPLIFIER COMPARES WELL WITH THE WILLIAMSON AND SIMILAR DESIGNS AT A FRACTION OF THE COST.

"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 4½in. x 1½in. x 3½in. Price of complete kit with easy-to-follow assembly instructions, **42/6.** In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled Unit 7in. x 2½in. x 1½in. Price **47/6.** (Plus 1/- carr. and ins.)

STERN RADIO Ltd.

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

TELEPHONE: CENtral 5812/3/4

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).

Correspondent Wanted

SIR,—I would like, through your excellent journal, to get in touch with a boy of my own age (17 years) who is interested in the technique of radio, and who would like to correspond with someone.

I have a fair knowledge of magnetism and radio and have built several sets.

I am also studying to become a " ham " with a full licence.—RALPH SAMLAL (Electrical Dept., Pointe-à-Pierre, Trinidad).

Request for Valve Tester

SIR,—I have constructed many of the test equipment circuits described in PRACTICAL WIRELESS. I have found them all very useful, but one piece of equipment which seems to have been sadly neglected is a valve tester.

Could you please, in the near future, include an article on valve testing with a circuit and constructional details?

Re A.C./D.C., please do not make all your circuits " universal."—J. DIMMICK (Sheerness).

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 receivers described 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.

Officialdom?

SIR,—I was glad to read that you feel so strongly about the new clause in the road fund application form. I, too, have decided opinions upon this type of petty bureaucracy, but you are in a better position to make yourself heard. I firmly believe that only by creating a great deal of commotion over a long period is it possible to obtain action from officialdom, and I hope that you and your journal will make it your business to do so.

If a test case is brought in the near future to decide this matter, I hope you will report it prominently.—JAMES HEATON (Stockport).

Contact Wanted

SIR,—Through the medium of your excellent magazine I would like to contact any reader who has operated the type 18 Mk. III Army set or the aircraft receiver type 46151.—PHILIP COLE (Stonewall, Co. Cavan, Ireland).

Radio Control of Models

SIR,—I read Mr. G. Paish's letter in the February edition with interest as I encountered the same experience some years ago, only my speciality was model aircraft, where weight had to be the first consideration.

I tried a number of methods before I came across the tuned reed principle, which I found by far the best. For the receiver I used a self-quench regenerative type with A.F. amplifier and output stage which had a chassis of perspex 4in. long by 1½in. wide. The anode load of the output consisted of a headphone coil mounted under the required number of tuned reeds which in turn operated a solenoid, contactor electric motor, etc. The transmitter consisted of a variable audio oscillator, driver and two single triodes. I found that better results were obtained if the modulation wave-form was square—this was achieved by saturating a specially wound transformer.

The same control has since been fitted in a model diesel-driven racing car with complete success.

As far as I know there are no books on the tuned reed principle. I spent a long time experimenting before I achieved success.

I hope that the above will give Mr. Paish a base on which to start his experiments.—F. M. GIBBS (Olton).

SIR,—I have just seen the letter by Mr. G. Paish in your February edition of " Open to Discussion," and I, too, agree that a section in PRACTICAL WIRELESS dealing with Radio-controlled Models would be very welcome indeed. One reason is that once the transmitter, etc., has been built it could be made to work not only models, but whatever electrical apparatus the builder wished and from far off—also another reason is that there is so little literature about dealing with this subject, and try as I might I have been so far unable to get any circuit data which has been of any value.—N. WHITE (Camborne).

Radio Construction Society

SIR,—Recent articles in PRACTICAL WIRELESS have described power packs suitable for all dry battery portables. A member of our society constructed such a pack, using a 5KΩ dropping resistor on the H.T. side to reduce to 90 volts, as his secondary winding gave 210 volts. Most transformers taken from the spares box have been designed to give outputs well above 100 volts. On using the pack with a commercial receiver which functioned well on batteries the only audible response consisted of self-oscillations caused by feed-back via the common H.T. leads. The trouble was cured by decoupling all stages but the last, using 0.1 μF with 2K for the R.F. and 8μF with 20k for the A.F. In addition we would like to endorse the necessity of a thorough voltage check before connecting up the L.T. This account of our experiences may well save some reader a headache.

With regard to the A.C. versus A.C./D.C. controversy raised in the February issue, we are wholly in favour of the former on account of the mains isolation provided by the transformer. We hold this view on the grounds of safety, both personal and in respect of any auxiliary apparatus to which the set may be coupled.

In conclusion, may we through your columns invite any radio enthusiast in this area who would be prepared to address the boys in our society on any aspect of electronics, kindly to contact us.—N. GREEN, K. S. TETLOW (Belle Vue Grammar School, Bradford).

A.C./D.C. or A.C. Only?

SIR,—I am writing in reply to your editorial concerning A.C./D.C. designs.

My verdict after building and repairing many pieces of this type of apparatus during the last 20 years is emphatically "no!"

A.C./D.C. gear should only be tolerated by those who have no choice in the matter, i.e., those who are on D.C. mains. Were I myself in that unfortunate plight I would, I think, prefer to go to the trouble and expense of building myself a D.C./A.C. converter.

The arguments against A.C./D.C. gear are:—

(1) The hum nuisance. True, it can be reduced to negligible proportions by good design and workmanship—but it is always ready to intrude itself upon the least provocation.

(2) The "live" chassis. This is another real nuisance. Apart from the potential danger of shock it also limits one in the use of pickups, microphones, etc.

(3) Restricted range of suitable valve types. Fancy trying to design, for instance, a communications receiver, a 144 meg. converter or a Williamson type amplifier, around A.C./D.C.!

No, sir, A.C. only, every time!—W. MACKINTOSH (Putney, S.W.).

Wrotham Transmissions

SIR,—The increasing interest in V.H.F. reception suggests some readers may be interested in the transmissions by the BBC of Home, Light and Third programmes from Wrotham, on a wavelength of approximately 3.1 metres. A present schedule shows these as taking place at hourly periods from 11 a.m. and 1 p.m., with a two-hour period beginning at 2.30 p.m., and a further transmission beginning at 6 p.m. on Monday, Tuesday, Wednesday and Thursday of each week. No particular difficulty arises in winding coils for this wavelength. It is not possible to give exact details, but 3 turns about $\frac{3}{8}$in. in diameter forming a coil $\frac{3}{8}$in. long, self-supporting, will frequently be suitable. With really efficient U.S.W. design one or more turns will be required. If, however, the design is poor, with considerable stray capacity and long leads, it may be necessary to remove half a turn, though results are likely to become poor. The range is limited. As a guide to the correct tuning point in areas where the signal is weak some form of frequency-meter or signal generator is highly desirable, especially when experimenting with home-wound coils in converted apparatus.—F. G. RAYER (Upton-on-Severn).

Amateur Transmission

SIR,—I hope I may be privileged to reply to G3FYY on this question of the amateur transmitter. His answers are interesting and we can draw the following conclusions from them.

It is possible to devise a way to limit the range of a transmitter (4). That hams do cause interference (5).

I think he misunderstood my question about being off the band while using a C.O. Apparently, however, the ham can achieve this in spite of the crystal—Well! well! (3).

That all British hams are experts is rather a tall one. I've listened to plenty seeking advice from each other—some of it quite elementary. Come off it, G3FYY (5, 6 & 7).

This bogy of the 1932 Telecommunications Convention is the ace of the oppositions argument. After all this time it needs revising on this question of morse on V.H.F. And how is it that the Americans get away with this—quote: . . . the creation of two new classes of licence sometime during 1951. One would be a Novice Class, requiring the passing of an exam. including a code test at only 5 w.p.m. and a very simple written test in theory and regulation . . . Maximum input power probably would be 75 watts and crystal control would be required . . . code or voice in 145-147Mc/s.

. . . A Technician Class licence, with 5 w.p.m. code test but the same written test as for Class B licence. Privileges would be all those in bands above 220 Mc/s—unquote.—From the 1951 ARRL handbook.

I have also an American mag which describes a V.H.F. Citizen's band—no morse, no exam!

Seems the Americans can do the impossible!

But what is the use of arguing about whether a novice band is practical—it is obvious by now that the hams will do all in their power to oppose it. Of course, all hams aren't so fanatical. To quote the words of a well-known amateur: "I mugged up enough morse to pass the test and then with a sigh forgot it all."

I wonder how many turn away because of the discouraging attitude the British adopt to the novice.—HECTOR COLE (Workington).

Editorial and Advertisement Offices:
"Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. 'Phone: Temple Bar 4363.
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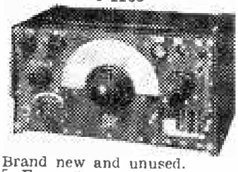
Registered at the G.P.O. for transmission by Canadian Magazine Post.

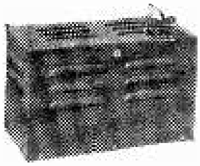
The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Wireless." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

EX-A.M. RECEIVER TYPE R1155



Brand new and unused.
5 Frequency ranges : 18.5-7.5 Mc's ; 7.5-3.0 Mc s ; 1,500-600 Kc s ; 500-200 Kc's ; 200-75 Kc/s Supplied in maker's original wood transit case. LASKY'S PRICE, £11/19/6 Complete. R.1155 Receivers. Second hand aerial tested, £7/19/6.
Carriage and packing 12/6 per unit extra, including 10/-, which will be refunded on return of packing case.

FULLY ASSEMBLED POWER PACK AND OUTPUT STAGE FOR R1155 RECEIVERS



For use on 200-250 volt A.C. mains. Wired and complete with valves. In steel case, black crackle finished, size : 12 x 5½ x 7 in. LASKY'S PRICE, 79/6. Carriage 5/- extra.
Power pack as above, complete with 6½in. loudspeaker. PRICE £5 5/0. Carriage 5/- extra.

METAL RECTIFIERS

6 and 12 volt F.W./H.W.

2 a.	9/-	RM.1 ...	3/10
3 a.	9/11	RM.2 ...	4/3
4 a.	12/-	RM.3 ...	5/-
6 a.	19/6	RM.4 ...	18/-

6 Volt		12 Volt	
½ amp.	2/6	½ amp.	3/11
1 amp.	4/6	1 amp.	6/6

TELEVISION SELENIUM RECTIFIERS

The very latest " Sentercell " S.T.C. range.

K3/40, 3.2 kV	6/-
K3/45, 3.6 kV	8/2
K3/50, 4.0 kV	8/8
K3/100, 8.0 kV	14/8
K3/160, 12.8 kV	21/6

MAINS TRANSFORMERS

All 200-250 v. 50 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/-.
MBA 6. 325-0-325 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/-.
MBA 8. SPECIAL OFFER. Drop through type. 235-0-235 v. 60 mA. 6.3 v. 3 a., 12/6.
AT'3. Auto transformer. 0-10-120, 200-230-240 volts 100 watts. Price 17/6.

COLLARO 3-SPEED CHANGERS

Studio xtal. turnover p.u. £9/19/6.

AERIAL RODS. 12in. long. Steel, copper plated. 2/6 dozen. POST FREE.

CRYSTAL DIODES

Glass type. Wire ends. 1/6 each.

LINE FLYBACK E.H.T. TRANSFORMER

Output 7-9 kV. E.H.T. with heater winding for EY51. 19/6.

P.M. FOCUS MAGNETS

35mm. With vernier adjuster. Tetrode 15/-. Triode 17/6. Less vernier. All types 12/6. 38mm. Wide angle, with vernier and picture shift control. 25/-.

VALVES. 10,000 IN STOCK AT THE LOWEST POSSIBLE PRICES.

SOME EXAMPLES

6V6 ... 7/6
35Z4 ... 9/-
6AM6 ... 7/6
6H6 ... 2/6
EF50, Red New Sylvania 10/-

SPECIAL OFFER. 4 Valves : 1 each 1R5, 1T4, 1S5 and 3S4.
LASKY'S PRICE 30/-
POST FREE.

1S4	7/6	1A5	9/-	6J7	6/6	EF39	7/6
3S4	9/-	12K8	8/6	0Z4	6/-	12K7	10/6
1T4	7/6	12Q7	8/6	KT2	3/6	6L6	10/6
1R5	7/6	6AL5	9/-	6K8	8/6	EA50	2/6
1S5	7/6	6K7	4/6	U50	7/6	EBC33	7/6
1C5	7/6	1D5	8/6	ECH35	13/6	35L6	10/-

J/RA/3 AMPLIFIER

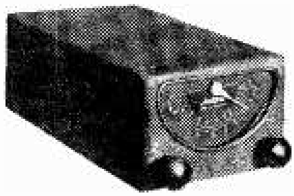
6 VALVES. 12-15 WATTS OUTPUT. Originally made for talkie film projectors. In carrying case. Chassis size : 14½ x 10 x 4 ins. For use in 100-110 volts A.C. mains. Grey crackle finish. Fitted with volume and tone controls. Resistance capacity coupled circuit. Output 2 KT66 in push-pull. High quality components used throughout. In black rexine covered wood case, size 15½ x 13½ x 9½ ins. giving plenty of room for speaker, etc. Circuit diagram available. Complete with 6 valves, fully assembled and wired.

LASKY'S PRICE £8.19.6 COMPLETE
Carriage 15/- extra.

Suitable 150 watt auto-trans. for 200/250v. 18/6

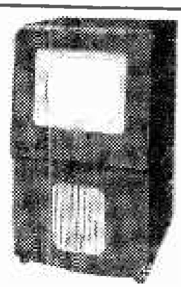
CAR RADIO SPECIAL

Partly Assembled Car Radios



Small size case, only 12 x 6 x 4in. Will fit most cars. For either 6 or 12 volts, depending on vibrator. Chassis supplied with 5 octal valveholders, medium wave aerial and oscillator coils. Output transformer, volume control, sundry resistances and condensers, dial and knobs. Case finished in pleasing shade of brown crackle. Dial calibrated 150-550 metres.
LASKY'S PRICE, 69/6. Carriage 5/- extra.
WRITE FOR FULLER DETAILS. Other chassis in various conditions of completion are available for personal callers only.
CIRCUIT for 5-valve car radio, using above chassis. PRICE 1/6.
We can supply a set of valves that will suit this car radio. All either GT. or metal. One each as follows : 6SA7 ; 6R7 ; 6V6 ; OZ4 ; 6K7. PRICE 32/6 THE SET.

DE LUXE T.V. CABINETS



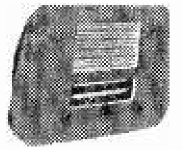
Our new 1954 Mark II model. For 12in. c.r. tubes. Finished in beautiful figured walnut veneer, with either light, medium or dark polish. Supplied complete with mask, glass, back, speaker baffle and fret, castors and c.r.t. neck protector. Inside dimensions : 16½in. deep, 17½in. wide, 28in. high. Overall height 32in. and width 18½in.
LASKY'S PRICE, £8 10/0.
Carriage 12/6 extra.
This cabinet can be supplied with aperture for 16in. or 17in. c.r.t. at no extra charge, but the mask and glass will be omitted.

LASKY'S RADIO

Lasky's (Harrow Road), Ltd.,
370, Harrow Road, Paddington, London, W.9
Telephones : CUNningham 1979-7214. All Depts.
MAIL ORDER AND DESPATCH DEPARTMENTS : 485-487, HARROW ROAD, PADDINGTON, LONDON, W.10.
Hours : Mon. to Sat. 9.30 a.m. to 6 p.m. ; Thurs., half day, 1 p.m.
Postage and packing charges (unless otherwise stated) : on orders value £1—1s. 0d. extra ; £5—2s. 0d. extra ; £10—3s. 0d. extra ; over £10 carriage free unless specifically stated otherwise. All goods fully insured in transit.

LASKY'S RADIO

BAFFLE RADIO CABINETS



Pleasing design, complete with drilled chassis, dial, drum drive and back. Finished in satin mahogany veneer, natural polish. Outside dimensions : 17½in. wide, 11½in. high, 5in. deep.
LASKY'S PRICE, 36/-.
Carriage 2/- extra.
Circuit and component list for 4 valve T.R.F. set available.

R.1132 RECEIVERS.

With all valves. In metal case.
Grade 1. Brand new 79/6
Grade 2. Soiled 49/6
Grade 3. Secondhand 39/6
Carriage 10/- each extra.

HEARING AIDS

By well-known manufacturer. In metal case, size 2½ x 1½ x 1 in. Complete with batteries and 3 sub-miniature valves. Two controls : volume and on/off. Fitted with internal crystal microphone.
LASKY'S PRICE 49/6
Carriage 2/6 extra.
Perfect working order, but slightly soiled.

SPECIAL APRIL OFFER

Magnetic recording tape, on Cyldon metal spools. By famous British manufacturer.
600 feet. 6/11 Post 1/6.
1,200 feet 14/11 Post 1/6.
LIMITED QUANTITY. BUY NOW AND SAVE CASH.

PLASTIC ESCUTCHEON MASKS

With dark screen filter.
12in. ... 12/6
16in. ... 25/-

WIRE MESH DINGHY AERIALS 5/-.

SHADED POLE GRAM MOTORS

Rim Drive. 9/6.

I.F. TRANSFORMERS

465 Kc/s Iron dust cores in cans, midget type. Size : 1in. x1½in.x2½in. Price 8/6 per pair.
WEARITE TYPE 550. 445-520 Kc/s. 8/6 per pair.
WEARITE TYPE 500. 450-470 Kc/s. 8/6 per pair.

LOUDSPEAKERS

First Quality. All 3 ohm speech coil. Less output trans.

3in.	14/6	6½in.	15/-
4in.	10/6	8in.	15/-
5in.	13/6	10in.	17/6

Now available. 12in. Goodmans heavy duty. 15 watts, 15 ohms.
LASKY'S PRICE. £5 19 6.
Carriage 3/6 extra.

SPECIAL PURCHASE STAINLESS STEEL RECORDING WIRE

¼hr. Reels 6/11
½hr. Reels 12/6
1hr. Reels 25/-

BOOKLETS: "How to Use Ex-Gov. Lenses and Prisms." Nos. 1 and 2, price **2/6** ea. Ex-Gov. Optical lists free for s.a.e. H. ENGLISH, Rayleigh Rd., Hutton, Brentwood, Essex.

ALTHAM RADIO CO. pay highest prices in the trade for all American equipment, including Test Sets, Transmitters, Receivers, etc. JERSEY HOUSE, Jersey Street, Manchester, 4. (Tel.: Central 7834-5-6.)

VALVES

6V6G AND GT, matched in pairs, new, boxed, **17/-** per pair; p. and p. 1/-. R. J. COOPER, 32, South End, Croydon, Surrey.

45/- PAID for 813 Valves, **60/-** 723A Bs; also required, type 808, 832, 836, 250th, etc. Details to PYPE-HAYES RADIO, 606, Kingsbury Road, Erdington, Birmingham, 24. (Erdington 4942.)

NEW VALVES WANTED, small or large quantities, 3Q4, 6V6, 5Z4, ECL80, EF80, EY51, PL81, PY82, KT61, 6L6G, VR150, 30, 5R4, 80, etc., etc. Prompt cash. WM. CARVIS, 103, North Street, Leeds, 7.

VALVE BARGAINS: KT66, VT25, **10/6**; 6BW6, 12AX7, **9/-**; 6L6, **8/6**; X66, **7/6**; EF50 Syl, 25L6, 6V6, DL92, **7/-**; 12SC7, 12SL7, 6SL7, 6J7, **6/-**; EF50, 6AC7, KT44, **5/6**; CV73, 6SS7, VR150 30, VR105 30, **4/-**; SP61, SP41, 6H6, **3/-**; 954, D1, **1/6**. H. & W., 16, South Drive, Chaddesden, Derby.

VALVES, PT.15, **5/-**; ML6, **4/-**. Meters, 3.5 A. (TC), 100ma (MC), **4/-**. Oil Thermometers 0-100°C, 6A/683, **9/-**. Oil Pressure Gauges, 150lb./sq.in., **6/-**. RF Chokes, 8.8 MH, **1/6**; 1.5 MH, **6d.**; post extra; free lists. ANNAKIN, 25, Ashfield Place, Otley, Yorks.

VALVES

NEW AND BOXED—ALL GUARANTEED

6V6GT	7/-	6BR7	12/6	6AG5	5/6
6X5	6/6	EL91	6/6	EAC91	6/-
6K7G	5/-	6AK5	7/6	6BW6	8/6
EF91	6/6	6J6	7/-	12AT6	8/9
6AL5	6/-	6CH6	6/6	EL32	5/6
EC91	7/-	6F33	9/6	EF92	6/-
12AU7	8/-	EY91	6/6	QS150/30	10/6
6BA6	8/9	12AX7	6/-	6K8	9/6
6BE6	8/9	6C4	6/-	6AT6	8/9

CONSTRUCTORS PARCELS, 10/- and **£1.** Guaranteed four times normal value: limited quantity.
HEAVY DUTY KNIFE SWITCHES. D.P.D.T.—Two on panel for **5/-**. Post 1/6.
MULTI-PLUGS & SOCKETS.—7-pin or 10-pin 2/3 pair.
MIKE TRANSFORMERS.—Approx. 100-1, 3/- ea.
VOLUME CONTROLS.—5 K., 20 K. and 25 K., **1/6** ea.
ALADDIN COIL FORMERS.—Less cores, 1/9 doz.
6/12 v. RECTIFIERS.—Small, full-wave **1/6** ea.
Post 9d. under £2.
Special bargain lists available (3d. stamp).

ELECTRAD RADIO & TV.,
5, DONEGALL STREET, BELFAST, N.I.

SPECIAL OFFERS

ROTARY CONVERTORS.—Input 24 volts D.C., output 230 volts A.C. 50 cycles 100 watt, **92/6** each. Also available with 12 volt input, **102/6**, carr. 5/-.
AMPLIFIERS.—A high fidelity unit with separate Bass and Treble controls, and constant impedance attenuator for setting volume level. In metal case with handles —15 watt output—for 200/250 v. A.C. Mains operation. Although intended for use with the Gaumont British Projector, this fine amplifier is ideal for P.A. work, Dances, etc. LESS VALVES **£12-10-0** or complete with all valves, **£15-12-6.** Carriage 10/-.
SPEAKERS P.A.—Goodmans PM 12in. 15 ohms Type T.2. A high class speaker at a low price. Ideal for above amplifier. **£5-10-0.**
SPEAKER CASE suitable for above. 19in. x 17in. x 13in. With lock, carrying handle, compartment for cable. **£3-10-0.** Worth Double.

WILCO ELECTRONICS Dept. P.W.
204, Lower Addiscombe Rd., Croydon.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64, inclusive, or a woman aged 18-59, inclusive, unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

CITY AND GUILDS (Electrical, etc.) on "no pass—no fee" terms. Over 95% successes. For full details of modern courses in all branches of Electrical Technology send for our 144-page handbook—free and post free. B.I.E.T., (Dept. 242A), 29, Wright's Lane, London, W.8.

T/V AND RADIO.—A.M.Brit.I.R.E., City and Guilds, R.T.E.B. Cert., etc., on "no pass—no fee" terms. Over 95% successes. Details of exams. and home training courses in all branches of radio and T/V; write for 144-page handbook—free. B.I.E.T. (Dept. 242G), 29, Wright's Lane, London, W.8.

ADMIRALTY SERVICE, H.M. Dockyard, Chatham. — Vacancies for Electrical Fitters for training in Electronics. A number of vacancies exist in the Electrical Engineering Department of H.M. Dockyard, Chatham, for Electrical Fitters and Electricians for employment on Radio work. A minimum of 5 years' experience as a craftsman in the electrical trade is necessary in the absence of indentures.—2. Opportunities for joining training courses covering the whole field of Naval electronics are available to candidates who satisfy the Departmental requirements.—3. The rate of pay is 139/4 per week, with an additional merit range of 32/- per week. An initial assessment of merit is carried out within 3 months of entry, when the first 16/- of the merit range is available, the amount awarded being retrospective to date of entry, further progress through the range being determined at subsequent periodical assessments.—4. Applications (in own handwriting) with full name, address, age, experience and examination qualifications (if any) should be addressed forthwith to:—THE PERSONNEL OFFICER, Electrical Engineering Department, H.M. Dockyard, Chatham.

THE POCKET LOUDSPEAKER SET

Using our clear drawings and instructions you can build a midget loudspeaker receiver small enough to fit in the jacket pocket. This receiver is fully self-contained—no aerial, earth, or external power supply being required. The midget batteries used are of the new layer type specially produced by a famous British maker for this class of receiver. Only one single-gang midget variable condenser is used for tuning, and the receiver requires no alignment. The midget components chosen are current British production, not surplus or foreign. Instructions and Drawings, including Theoretical Circuit and Point-to-Point Wiring Diagram.

PRICE 3/6 POST FREE

This offer applies only to Gt. Britain, Irish Republic and Northern Ireland.

SWIFT RADIO (W),
137 COTHAM BROW, BRISTOL, 6
Orders by Post Only.

SERVICE SHEETS for hire, reasonable terms. S.A.E. for particulars to W. J. HERBERT, 118, Gelli Rd., Gelli Pentre, Rhondda, Glam.

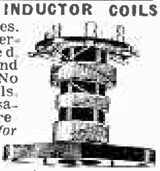
VARIOUS UNUSED Tag Boards of condensers, resistors, rectifiers; 7 components **1/3** (post 4d.); 13 compts. **1/9** (post 6d.); 15 compts. **2/9** (p. 6d.); 26 compts. **2/9** (p. 9d.); 43 compts. **5/3** (p. 9d.); strip of 24 Ceramic Trimmers, Yaxley switch and coil former, **3/9** (p. 1/-). Discontinued lines of famous manufacturer. Cabinets: New mahogany Cabinet, 19in. x 12in., with new 6½in. Rola closed field 3 ohm P.M. speaker; cut out for 9in. T.V. tube, but suitable for radio cabinet; price **20/-** (3/6 p. and p.); speaker is worth this! Beautiful new Radio Cabinet (walnut), 21in. x 14in. high x 9in. width, cut-out for dial 7¾in. x 7¼in., with new 10in. Plessey closed field 3 ohm P.M. speaker; price **25/-** (3/6 p. and p.); dial obtainable. New 3-speed Collaro Changer RC 3/531, cream finish, **£11** (7/6 carr.). 3-gang Condenser **3/6** (post 9d.); 2-gang **6/-** (p. 9d.). Ex-Gov. R1124D Set, with valves, **17/6** (2/6 carriage). Your satisfaction guaranteed. GLADSTONE RADIO, Gladstone Place, Newton Abbot, Devon.

MORSE CODE Training

Send for the Candler
BOOK OF FACTS
It gives details of all Courses which include a Special one for securing Amateur Licence.
CANDLER SYSTEM CO. Dept. 5LO
52b, Abingdon Road, London, W.8.
Candler System Co., Denver, Colorado, U.S.A.

SOUND MASTER
and
P.W. CORONET FOUR
COMPONENTS ALWAYS IN STOCK
Separate price lists for these and constructor televisors available on request
J. T. FILMER,
MAYPOLE ESTATE, BEXLEY, KENT
Tel.: Bexleyheath 7267

TELETRON SUPER INDUCTOR COILS



with miniature dust cores. Reception tested. Performance unequalled. Type HAX. Triple wound for Xtal diodes, Q100. No overlap. 3/- ea. TRF Coils. Ae/H.F. with compensated Ae. windings, pre aligned, 7/- pr. *Stamp for full list and circuits.*
THE TELETRON CO.,
266, Nightingale Rd., London, N.9.

Television, Radio, Record CABINETS MADE TO ORDER

ANY SIZE OR FINISH

CALL OR SEND DRAWINGS FOR QUOTATION

B. KOSKIE
(DEPT. C.)
72-76 Leather Lane, Holborn, E.C.1
Phone: CHAncery 6791/2

Practical Wireless BLUEPRINT SERVICE

PRACTICAL WIRELESS

No. of Blueprint

CRYSTAL SETS

1/6d. each

1937 Crystal Receiver ... PW71*
The "Junior" Crystal Set PW94*

2s. each

Dual - Wave "Crystal Diode" PW95*

STRAIGHT SETS

Battery Operated

One-valve : 2s. each.

The "Pyramid" One-valver (HF Pen) ... PW93*
The Modern One-valver PW96*

Two-valve : 2s. each.

The Signet Two (D & LF) PW76*

3s. each.

Modern Two-valver (two band receiver) ... PW98*

Three-valve : 2s. each.

Summit Three (HF Pen, D, Pen) PW37*
The "Rapide" Straight 3 (D, 2 LF (RC & Trans)) PW82*
F. J. Camm's "Sprite" Three (HF, Pen, D, Tet) PW87*

3s. each.

The All-dry Three ... PW97*

Four-valve : 2s. each.

Fury Four Super (SG, SG, D, Pen) PW34C*

Mains Operated

Two-valve : 2s. each.

Selectone A.C. Radiogram Two (D, Pow) ... PW19*

Three-valve : 3s. 6d. each.

A.C. Band-Pass 3 ... PW99*

Four-valve : 2s. each.

A.C. Fury Four (SG, SG, D, Pen) PW20*
A.C. Hall-Mark (HF Pen, D, Push Pull) ... PW45*

SUPERHETS

Battery Sets : 2s. each.

F. J. Camm's 2-valve Superhet PW52*

Mains Operated : 3s. 6d. each.

"Coronet" A.C.4 ... PW100*
AC/DC "Coronet" Four PW101*

No. of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve : 2s. each.

Simple S.W. One-valver PW88*

Two-valve : 2s. each.

Midget Short-wave Two (D, Pen) PW38A*

Three-valve : 2s. each.

Experimenter's Short-wave Three (SG, D, Pow) PW30A*
The Prefect 3 (D, 2 LF (RC and Trans)) ... PW63*
The Band-spread S.W. Three (HF Pen, D (Pen), Pen) PW68*

PORTABLES

1s. 6d.

The "Mini-Four" All-dry (4 valve superhet) *

MISCELLANEOUS

2s. each.

S.W. Convertor-Adapter (1 valve) PW48A*

(2 sheets), 7s. 6d.

The P.W. 3-speed Autogram ... ... *
The P.W. Electronic Organ * (2 sheets), 7s. 6d.

TELEVISION

The Practical Television Receiver, (3 sheets), 10/6
The "Argus" (6in. C.R. Tube), 2/6*
The "Super-Visor" (3 Sheets) 7/6*

All the following blueprints, as well as the PRACTICAL WIRELESS numbers below 94 are pre-war designs, kept in circulation for those amateurs who wish to utilise old components which they may have in their spares box. The majority of the components for these receivers are no longer stocked by retailers.

AMATEUR WIRELESS AND WIRELESS MAGAZINE

STRAIGHT SETS

Battery Operated

One-valve : 2s.

B.B.C. Special One-valver AW387*

Mains Operated

Two-valve : 2s. each.

Consoelectric Two (D, Pen), A.C. AW403

SPECIAL NOTE

THESE blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an asterisk denotes that constructional details are available, free with the blueprint.

The index letters which precede the Blueprint Number indicate the periodical in which the description appears. Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

No. of Blueprint

SHORT-WAVE SETS

Battery Operated

One-valve : 2s. each.

S.W. One-valver for American AW429*

Two-valve : 2s. each.

Ultra-short Battery Two (SG, det Pen) ... WM402*

Four-valve : 3s. each.

A.W. Short Wave World-beater (HF Pen, D, RC Trans) AW436*
Standard Four - valver Short-waver (SG, D, LF, P) WM383*

Mains Operated

Four-valve : 3s.

Standard Four-valve A.C. Short-waver (SG, D, RC, Trans) WM391*

MISCELLANEOUS

Enthusiast's Power Amplifier (10 Watts) (3/-) WM387*
Listener's 5-watt A.C. Amplifier (3/-) ... WM392*
De Luxe Concert A.C. Electrogram (2/-) ... WM403*

QUERY COUPON

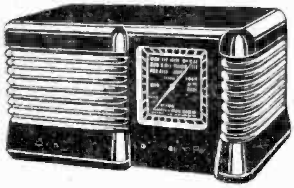
This coupon is available until April 4th, 1954, and must accompany all Queries, sent in accord with the notice on page 249.
PRACTICAL WIRELESS, April, 1954.

Published on the 7th of each month by GEORGE NEWNES, LIMITED, Tower House, Southampton Street, Strand, London, W.C.2, and printed in England by W. SPEAIGHT & SONS, Exmoor Street, London, W.10. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A sia), LTD. South Africa: CENTRAL NEWS AGENCY, LTD. Subscription rate including postage, for one year: Inland and Abroad 13s. 6d. (Canada 13s.) Registered at the General Post Office for the Canadian Magazine Post.

CABINET as illustrated. 11½ x 6½ x 5¼in. in walnut or cream, complete with T.R.F. chassis, 2 wave-band scale, station names, new waveband, backplate, drum, pointer, spring, drive spindle, 3 knobs and back. **22/6.** P. & P. 3/6.

As above with Superhet Chassis, **23/6.** P. & P. 3/6.

As above complete with new speaker to fit and O.P. trans., **35/-.** P. & P. 3/6, with Superhet Chassis, **36/-.** P. & P. 3/6.



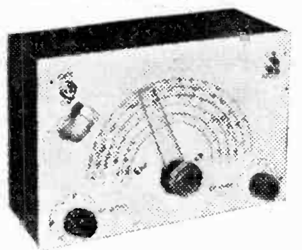
Used metal rectifier, 230 v. 50mA., **4/6** ; gang with trimmers, **6/6** ; M. & L. T.R.F. coils, **5/-** ; 3 obsolete Ex Govt. valves, 3 v/h and circuit, **6/6** ; heater trans., **6/-** ; volume control with switch, **3/6** ; wave-change switch, **2/-** ; 32 x 32 mfd., **4/-** ; bias condenser, **1/-** ; resistor kit, **2/-** ; condenser kit, **4/-.**

M. & L. Superhet Coils with circuit, **6/6** ; iron cored 465 IF's, **7/6** ; min. gang, **5/6** ; volume control with switch, **4/-** ; wave-change switch, **2/6** ; heater trans., **7/6** ; 4 v/h, **1/6** ; 4 obsolete Ex Govt. valves, metal rectifier and Xtal diode with circuit, **14/6** ; 25 x 25 mfd., **1/-** ; 16 x 16 mfd., **3/3** ; condenser kit (17), **7/6** ; resistor kit (14), **3/6.**

Used 5 valve A.C. mains 200/250 3-waveband superhet. Complete in outstanding walnut cabinet, size 22 x 14 x 10½in. Valve line up, 6K8, 6K7, 6B8G, 6F6 and U50 rec., 8in. P.M. speaker. In first-class working order. **£7/19/6.** P. & P. 12/6. We have a few of these in A.C./D.C., price as above.

All dry A.C. mains battery unit. 200/250 v. Metal case size 8 x 5 x 3in., by famous manufacturer incorporating Westinghouse metal rectifiers, 3,500 mfd., 16+24 mfd., mains trans., 3 smoothing chokes, output 90 v. 10 mA., 1.4 v., .25 amp. P. & P. 2/6. **39/6.**

COMPLETELY BUILT SIGNAL GENERATOR. Coverage 110 Kc/s-320 Kc/s., 300 Kc/s-900 Kc/s., 900 Kc/s-2.75 Mc/s., 2.75 Mc/s-8.5 Mc/s., 8.5 Mc/s-25 Mc/s., 17 Mc/s.-50 Mc/s., 25.5 Mc/s.-75 Mc/s. Metal



case 10 x 6½ x 4½in., size of scale 6½ x 3½in., 2 valves and rectifier. A.C. mains 230/250 v. Internal modulation 400 c.p.s. to a depth of 30%. Frequency calibration accuracy plus or minus 1%. Modulated or unmodulated R.F. output continuously variable 100 milli-volts. Post and packing 4/-. **£4/5/0. 34/-** deposit, three monthly payments of £1.

High impedance plastic recording tape by famous manufacturer. 1,200 feet complete on spool, **17/6.** P. & P. 1/6. 600 feet **8/-.** P. & P. 1/-.

Amplifier Case. black rexine covered, leather carrying handle, chrome plated corners, rubber feet, felt lined, detachable lid. External dimensions 13½ x 13½ x 9½in. **£1.** P. & P. 2/6.

Pri. 200/250 v., secondary 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volt at 2 amps., **13/-.**

Drop thro' 280-0-280, 200 mA., 6 v. 5 amps., 5 v. 3 amps., **27/6.**

Heater Transformer. Pri. 230-250 v., 6 v. 1½ amp., **6/-** ; 2 v. 2½ amp., **5/-**. 2 v. 2½ amp. and 6 v. 0.6 amp. E.H.T. insulated, **8/6.** P. & P. each 1/-.

R.I. MAINS TRANSFORMERS. chassis mounting, feet and voltage panel. Primaries 200/250.

300-0-300 60 mA. 6.3 v. 1 a., tapped at 4 v. 6.3 v. 2 a. tap 4 v., **13/6.**

350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., **13/6.**

350-0-350 70 mA. 4 v. 5 a. 4 v. 2.5 a., C.T., **18/6.** P. & P. on the above transformers 2/-.

500-0-500 125 mA. 6.3 v. C.T. 4 a. 6.3 v. C.T. 2 a. 5 v. C.T. 2 a., **27/6.**

500-0-500 120 mA. 4 v. C.T. 4 a. 4 v. C.T. 4 a. 4 v. C.T. 2.5 a., **27/6.**

500-0-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., **39/6.**

P. & P. on the above transformers 3/-.

32 mfd., 350 wkg.	2/-
16 x 24 350 wkg.	4/-
4 mfd., 200 wkg.	1/3
40 mfd., 450 wkg.	3/6
16 x 8 mfd., 500 wkg.	4/6
16 x 16 mfd., 500 wkg.	5/9
8 x 16 mfd., 450 wkg.	3/9
32 x 32 mfd., 350 wkg.	4/-
32 x 32 mfd., 350 wkg. and 25 mfd., 25 wkg.	6/6
25 mfd., 25 wkg.	11d.
250 mfd., 12 v. wkg.	1/-
16 mfd., 500 wkg., wire ends	3/3
8 mfd., 500 v. wkg., wire ends	2/6
8 mfd., 350 v. wkg., tag ends	1/6
50 mfd., 25 v., wkg., wire ends	1/9
100 mfd. 350 wkg.	4/-
100+200 mfd., 350 wkg.	9/6
16+16 mfd., 350 wkg.	3/3
Ex Govt. 8 mfd. 500 v. wkg., size 3½ x 1¼, 2 for	2/6
60+100 mfd., 280 v. wkg.	7/-
16+32 mfd., 350 wkg.	6/-
50 mfd., 180 wkg.	1/9
65 mfd., 220 wkg.	1/6
8 mfd., 150 wkg.	1/6
60+100 mfd., 280 wkg.	8/6
50 mfd., 12 wkg.	11d.
32+32 mfd., min., 275 wkg.	4/-
50 mfd., 50 wkg. 8 mfd., wkg., wire ends	1/9
Miniature wire ends moulded 100 pf., 500 pf., and .001 ea.	7d.

Fully shrouded mains transformer, input 200/250 secondary 350-0-350 175 mA. 6.3 v. 7 amp., 5 v. 3 amp. p/p 3/-, **35/-.**

Fully shrouded pushpull transformer, PRI 6,000 ohms, SEC 15 ohms, p/p 2/-, **20/-.**

Fully shrouded choke, 15 Hen. 180 mA., p/p 2/-, **15/-.**

Fully shrouded choke, 5 Hen. 120 mA., p/p 2/-, **8/6.**

We regret that in error we advertised the above in the February and March issues of "Practical Wireless" as Partridge Transformers. This is not correct and we offer our apologies for this unfortunate misrepresentation and any inconvenience this statement may have caused Messrs. Partridge.

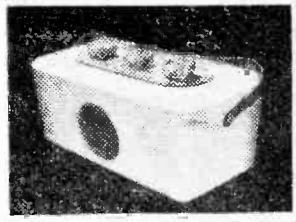
CONSTRUCTOR'S PARCEL, comprising chassis 12½ x 8 x 2in., cad. plated 18 gauge, v/h., IF and trans. cut-outs, backplate, 2 supporting brackets, 3 waveband scale, new wavelength station names. Size of scale 11½ x 4½in., drive spindle, drum, 2 pulleys, pointer, 2 bulb holders, 5 paxolin international octal valve holders, 4 knobs, and pair of 465 IF's, **16/6.** P. & P. 1/9.

AS ABOVE, but complete with 16+16 mfd. 350 wkg. and semi-shrouded drop thro' 250-0-250 60 m.a., 6 v. 3 amp. Pri. 200-250, and twin-gang **31/6.** P. & P. 3/-.

5in. M.E. field coil 750 ohms with O.P. trans., **17/6.** P. & P. 1/-.

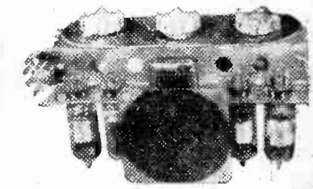
Germanium crystal diode, 2/3, post paid.

BATTERY CHARGER KIT, comprising metal case 5 x 4½ x 4½ trans. 230/250 v. and metal rec. Will charge 6 or 12 v. battery at 1½ amp., **19/6.** P. & P. 2/6.



PERSONAL PORTABLE CABINET in cream-coloured plastic, size 7 x 4½ x 3 in. Complete 4-valve chassis. Scale and 3 knobs. Takes miniature 90 v. and 7½ v. batteries. **9/-.** P. & P. 1/6.

3in. P.M. SPEAKER to fit above, **10/-.** Miniature output transformer, **5/-.** Miniature wave-change switch, **1/6.** Miniature 1-pole 4-way used as Volume and Off, **1/6.** 4 B7G valveholders, **2/4.** Midget twin gang ⅞in. dia., ⅞in. long and pair medium and long-wave T.R.F. coils ⅞in. long x ⅝in. wide : complete with 4-valve all-dry mains and battery circuit, **8/6.** Condenser Kit, comprising 11 miniature condensers, **3/6.** Resistor Kit, comprising 15 miniature resistors, **4/6.** The above receiver (less valves and batteries) could be built for approximately **51/-.** P. & P. 2/6. Valves to suit above **10/-** ea. Point to Point Wiring Diagram 1/-.



View of chassis as it would look when assembled with valves inserted.

Extension speaker cabinet, in contrasting walnut veneers, size 15 x 10½in. Will take 6½ or 8in. speaker, **17/6.** P. & P. 2/-.

Volume Controls. Long spindle less switch, 50 K, 500K, 1 meg., **2/6** each. P. & P. 3d. each.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., **4/-** each ; 10 K. and 50 K., **3/6** each. ½ and 1 meg., long spindle, double pole switch, miniature, **5/-.** P. & P. 3d. each.

Standard Wave-change Switches. 4-pole 3-way, **1/9** ; 5-pole 3-way, **1/9.** Miniature 3-pole 4-way, 4-pole 3-way, **2/6.**

Valveholders. Paxolin octal, **4d.** Moulded octal, **7d.** EF50, **7d.** Moulded B7G, **7d.** Loctal amphenol, **7d.** Loctal pax., **4d.** Mazda Amph., **7d.** Mazda pax., **4d.** B8A, B9A amphenol, **7d.** B7G with screening can, **1/6.** Duodecal paxolin, **9d.**

Trimmers. 5-40 pf., **5d.** ; 10-110, 10-250, 10-450 pf., **10d.**

Twin-gang .0005 Tuning Condensers. 5/-. With trimmers, **7/6.**

Midget .00037 dust cover and trimmers, **8/6.**

P.M. SPEAKERS

	with trans.	less trans.
3½in.		13/6
5in.	16/6	12/6
6½in.	16/6	12/6
8in.	18/6	15/-
10in.		19/6

Post and packing on each of the above 1/6 extra.

Truvox BX11 12 in. P.M. 3 ohm speech coil, **45/-.** P. & P. 3/6.

Crystal pick-up with Sapphire Trailer Needle, with volume control, **23/-.** P. and P. 1/-.

Terms of business : Cash with order. Dispatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/- up to 10/-, 1/6 up to £1, and 2/- up to £2. All enquiries and list, stamped addressed envelope.

D. COHEN, RADIO AND TELEVISION COMPONENTS

23, HIGH STREET, ACTON, W.3. (Opposite Granada Cinema)

Hours of Business : Saturdays 9-6 p.m. Wednesdays 9-1 p.m. Other days 9-4.30 p.m.